Technical Report on the Preliminary Economic Assessment of the Battery Hill Manganese Project Woodstock, New Brunswick, Canada

Prepared for: Manganese X Energy Corp.

Prepared by:
Mr. Paul Baluch, P.Eng., P.E., Wood
Mr. Alan Drake, P.L.Eng., Wood
Dr. Greg Gosson, P.Geo., Wood
Mr. Matthew Harrington, P.Geo., Mercator Geological Services Limited
Mr. Paul Ténière, P.Geo., Mercator Geological Services Limited
Mr. Gil Violette, P.Eng., Wood
Mr. Piers Wendlandt, P.E., Wood

Effective Date: 12 May 2022
Project No.: 248489

Important Notice

CERTIFICATE OF QUALIFIED PERSON

Paul Baluch, P.Eng.
Wood Canada Limited
400-111 Dunsmuir Street
Vancouver, British Columbia, Canada V6B 5W3
Tel: (604) 664-4668

I, Paul Baluch, P.Eng., am employed as a Technical Director, Civil/Structural/Architectural with Wood Canada Limited.

This certificate applies to the technical report entitled titled "NI 43-101 Technical Report on the Preliminary Economic Assessment of the Battery Hill Manganese Project, Woodstock, New Brunswick, Canada" with an effective date of May 12, 2022 (the "Technical Report").

I am a member of Engineers & Geoscientists British Columbia, Association of Professional Engineers and Geoscientists of Alberta, Association of Professional Engineers and Geoscientists of Saskatchewan, Professional Engineers Ontario and member of Idaho Board of Professional Engineers and Professional Land Surveyors. I graduated from the Slovak Technical University in Bratislava, Slovakia with Diploma in Civil Engineering in 1980.

I have practiced my profession for 38 years. I have been directly involved in site investigations, site development, infrastructure and civil works scoping studies, prefeasibility and feasibility studies, and detailed engineering on mining, infrastructure, and other industry projects.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101), for those portions of the Technical Report that I take responsibility.

I am responsible for Sections 1.1, 1.2, 1.14, 1.17, 1.20, 1.21; Section 2.1, 2.2, 2.4, 2.5; Section 3.1; Section 18, Sections 21.2.1, 21.2.5; Sections 25.8, 25.10; and Section 27 of the Technical Report.

I am independent of Manganese X Energy Corp. as independence is described by Section 1.5 of NI 43–101.

I have had no previous involvement with the Battery Hill property.

I have read NI 43–101, and the parts of the Technical Report that I am responsible for have been prepared in compliance with that Instrument.

As of the date of this certificate, to the best of my knowledge, information and belief, the parts of the Technical Report that I am responsible for preparing contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

"signed and stamped"

Paul Baluch, P.Eng.

Dated: June 24, 2022

CERTIFICATE OF QUALIFIED PERSON

Alan Drake, P.L.Eng.
Wood Canada Limited
111 Dunsmuir St, Suite 400
Vancouver, British Columbia, Canada V6B 5W3

I, Alan Drake, P.L.Eng., am employed as a Manager, Process Engineering with Wood Canada Limited.

This certificate applies to the technical report entitled "NI 43-101 Technical Report on the Preliminary Economic Assessment of the Battery Hill Manganese Project, Woodstock, New Brunswick, Canada" with an effective date of May 12, 2022 (the "Technical Report").

I am a Professional Licensee Engineering with Engineers and Geoscientists British Columbia. I graduated from the Technicon Witwatersrand with a National Higher Diploma in Extraction Metallurgy in 1993.

I have practiced my profession for 28 years. I have been directly involved in metallurgical plant operations, process design, construction and commissioning of minerals processing and hydrometallurgical facilities for base and precious metals.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101), for those portions of the Technical Report that I take responsibility.

I am responsible for Sections 1.1, 1.2, 1.10, 1.13, 1.17, 1.18, 1.20, 1.21; Sections 2.1, 2.2, 2.4, 2.5; Section 3.1; Section 13; Section 17; Sections 21.1, 21.2.1, 21.2.3, 21.2.6-21.2.9, 21.3.1, 21.3.3; Sections 25.6, 25.10, 25.13, 25.14; Sections 26.1, 26.5, 26.11; and Section 27 of the Technical Report.

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Alan Drake, P.L.Eng.

Dated: June 24, 2022

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CERTIFICATE OF QUALIFIED PERSON

Gregory Gosson, Ph.D., P.Geo.
Wood Canada Limited
111 Dunsmuir St, Suite 400
Vancouver, British Columbia, Canada V6B 5W3

I, Greg Gosson, Ph.D., P.Geo., am employed as Technical Director (Geology & Compliance) with Wood Canada Limited.

This certificate applies to the technical report entitled "NI 43-101 Technical Report on the Preliminary Economic Assessment of the Battery Hill Manganese Project, Woodstock, New Brunswick, Canada" with an effective date of May 12, 2022 (the "Technical Report").

I am registered as a Professional Geoscientist in the Province of Ontario, (Membership #3003), and as a Professional Geoscientist with Engineers and Geoscientists British Columbia (Registration #27367). I graduated from Queen's University, Kingston, Ontario in 1979, with a B.Sc. Honours, Geological Sciences, and a Ph.D. in Geology, from Victoria University, Wellington, New Zealand in 1986.

I have practiced my profession for 20 years as an exploration geologist, mine geologist, and senior management positions for several different public mining companies, where I was involved in due diligence studies and property negotiations, advanced mining studies, and discussions with process engineers on marketability of various mine products. More recently, my relevant experience includes 15 years as a Technical Director of Wood Canada Limited and its predecessor companies AMEC and Amec Foster Wheeler, where I provided technical oversight, including peer review of the preparation of numerous preliminary economic assessment, prefeasibility and feasibility studies, including their property descriptions, and marketing studies and contracts.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101), for those portions of the Technical Report that I take responsibility.

I am responsible for Sections 1.1, 1.2, 1.4, 1.5, 1.15, 1.20, 1.21; Sections 2.1, 2.2, 2.4, 2.5; Sections 3.1-3.3; Section 4; Section 19; Section 23; Sections 25.2, 25.9, 25.14; Sections 26.1, 26.2, 26.11; and Section 27 of the Technical Report.

I am independent of Manganese X Energy Corp. as independence is described by Section 1.5 of NI 43–101.

I have had no previous involvement with the Battery Hill property.

I have read NI 43–101, and the parts of the Technical Report that I am responsible for have been prepared in compliance with that Instrument.

As of the date of this certificate, to the best of my knowledge, information and belief, the parts of the Technical Report that I am responsible for preparing contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

"signed and stamped"

Greg Gosson, Ph.D., P.Geo.

Dated: June 24, 2022

CERTIFICATE OF QUALIFIED PERSON

Matthew D. Harrington, P. Geo.
Mercator Geological Services Limited
65 Queen Street
Dartmouth, Nova Scotia, Canada B2Y 1GA

I, Matthew D. Harrington, P. Geo., am employed as President and Senior Resource Geologist with Mercator Geological Services Limited.

This certificate applies to the technical report entitled titled "NI 43-101 Technical Report on the Preliminary Economic Assessment of the Battery Hill Manganese Project, Woodstock, New Brunswick, Canada" with an effective date of May 12, 2022 (the "Technical Report").

I am a member in good standing with the Association of Professional Geoscientists of Nova Scotia (Registration Number 0254) and the Association of Professional Engineers and Geoscientists of Newfoundland and Labrador (Member Number 09541). I graduated with a Bachelor of Science degree (Honours, Geology) in 2004 from Dalhousie University.

I have practiced my profession for 18 years. My relevant experience with respect to the Battery Hill property includes extensive professional experience with respect to geology, mineral deposits and exploration activities in the Northern Appalachians and elsewhere. I have specific experience in assessment of manganese-iron deposits in the Woodstock area and contributed to the June 2021 Mineral Resource estimate for the Battery Hill deposit. I also contributed to the 2013 Mineral Resource estimate and 2014 PEA prepared for the nearby Plymouth deposit on behalf of Canadian Manganese Company Inc.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101), for those portions of the Technical Report that I take responsibility.

I am responsible for Sections 1.1, 1.2, 1.11, 1.20, 1.21; Sections 2.1, 2.2, 2.4, 2.5; Sections 3.1-3.3; Section 12.4; Sections 14.1-14.4, 14.6, 14.7; Sections 25.5, 25.14; Sections 26.1, 26.3, 26.11; Section 27 of the Technical Report.

I am independent of Manganese X Energy Corp as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Battery Hill property as a consultant with Mercator Geological Services Limited since 2017. I am a co-author on a prior technical report titled "NI 43-101 Technical Report, Battery Hill Project Mineral Resource Estimate, Woodstock Area, New Brunswick, Canada" with an effective date of June 18th, 2021.

I have read NI 43–101, and the parts of the Technical Report that I am responsible for have been prepared in compliance with that Instrument.

As of the date of this certificate, to the best of my knowledge, information and belief, the parts of the Technical Report that I am responsible for preparing contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

"signed and stamped"

Matthew D. Harrington, P. Geo.

Dated: June 24, 2022

CERTIFICATE OF QUALIFIED PERSON

Paul J. Ténière, P. Geo.
Mercator Geological Services Limited
65 Queen Street
Dartmouth, Nova Scotia, Canada B2Y 1GA

I, Paul J. Ténière, P. Geo., am employed as a Senior Associate Geologist with Mercator Geological Services Limited.

This certificate applies to the technical report entitled titled "NI 43-101 Technical Report on the Preliminary Economic Assessment of the Battery Hill Manganese Project, Woodstock, New Brunswick, Canada" with an effective date of May 12, 2022 (the "Technical Report").

I am a member in good standing with the Association of Professional Geoscientists of Ontario (Registration Number 2493), the Association of Professional Engineers and Geoscientists of Newfoundland and Labrador (Registration Number 06620), and the Association of Professional Engineers and Geoscientists of New Brunswick (Registration Number M8502). I have been a registered Professional Geologist (P.Geo.) continuously since 2006. I graduated with a M.Sc in Geology from Acadia University (2002) and a B.Sc. (Honours) degree in Earth Sciences (1998) from Dalhousie University.

I have practiced my profession for 24 years. I have worked as a geologist in Canada, USA, and internationally since my graduation 24 years ago. My relevant experience with respect to the Battery Hill property includes extensive professional experience with respect to geology, mineral deposit styles, and exploration activities in the Northern Appalachians including the Silurian sedimentary succession that is the focus of this Technical Report.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101), for those portions of the Technical Report that I take responsibility.

I visited the Battery Hill property on February 24, 2021.

I am responsible for Sections 1.1, 1.2, 1.6, 1.7, 1.20, 1.21; Sections 2.1, 2.2, 2.3.1, 2.4, 2.5; Sections 6-12; Sections 25.3, 25.4; Section 27 of the Technical Report.

I am independent of Manganese X Energy Corp as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Battery Hill property since 2020 including being a co-author on a prior NI 43-101 technical report titled "NI 43-101 Technical Report, Battery Hill Project Mineral Resource Estimate, Woodstock Area, New Brunswick, Canada" with an effective date of June 18th, 2021.

I have read NI 43–101, and the parts of the Technical Report that I am responsible for have been prepared in compliance with that Instrument.

As of the date of this certificate, to the best of my knowledge, information and belief, the parts of the Technical Report that I am responsible for preparing contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

"signed and stamped"

Paul J. Ténière, P. Geo.

Dated: June 24, 2022

CERTIFICATE OF QUALIFIED PERSON

Gil Violette, P.Eng.
Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited
495 Prospect Street, Suite 1
Fredericton, New Brunswick, Canada E3B 9M4

I, Gilman G (Gil) Violette, M.Sc.E., P.Eng., am employed as a Principal Hydrogeologist / Interim Geotechnical and Mining Group Lead, Atlantic Canada with Wood Environment & Infrastructure Solutions Canada Limited.

This certificate applies to the technical report entitled titled "NI 43-101 Technical Report on the Preliminary Economic Assessment of the Battery Hill Manganese Project, Woodstock, New Brunswick, Canada" with an effective date of May 12, 2022 (the "Technical Report").

I am a member of the Association of Professional Engineers and Geoscientist of New Brunswick (APEGNB). I graduated from the University of New Brunswick with a Bachelor of Science in Engineering degree in 1980 and a Master of Science in Engineering degree in 1990.

I have practiced my profession for 42 years. I have been directly involved in civil, mining, environmental and hydrogeological engineering projects including slope stability, dewatering of open pits, water supply for municipalities and industry and various subsurface investigations supporting those works.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101), for those sections of the Technical Report that I am responsible for preparing.

I visited the Battery Hill property on September 21, 2021.

I am responsible for Sections 1.1, 1.2, 1.16, 1.20, 1.21; Sections 2.1, 2.2, 2.3.2, 2.4, 2.5; Section 3.1; Section 5; Section 16.3.1; Section 20; Sections 25.12, 25.14; Sections 26.1; 26.6, 26.7, 26.9-26.11; and Section 27 of the Technical Report.

I am independent of Manganese X Energy Corp as independence is described by Section 1.5 of NI 43–101.

I have had no previous involvement with the Battery Hill property.

I have read NI 43–101, and the parts of the Technical Report that I am responsible for have been prepared in compliance with that Instrument.

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"signed and stamped"

Gil Violette, P.Eng.

Dated: June 24, 2022

CERTIFICATE OF QUALIFIED PERSON

Piers Wendlandt P.E.
Wood USA Mining Consulting
2000 S Colorado Blvd # 2-1000
Denver, CO, United States of America, 80222

I, Piers Wendlandt P.E., am employed as a Principal Mining Engineer with Wood USA Mining Consulting.

This certificate applies to the technical report entitled ""NI 43-101 Technical Report on the Preliminary Economic Assessment of the Battery Hill Manganese Project, Woodstock, New Brunswick, Canada" with an effective date of May 12, 2022 (the "Technical Report").

I am registered as a Professional Engineer in the State of Colorado (PE. 0047235). I graduated with a BSc. in Mining Engineering from the Colorado School of Mines in 2005, with a Master's of Public Affairs from the University of Texas at Austin in 2009, and with a Master's in Business Administration from the University of Colorado at Denver in 2019.

I have practiced my profession for 15 years. I have been employed in both site-based operations and consulting roles during my career and have extensive experience with all aspects of the mine planning process. I have been directly involved in numerous scoping, pre-feasibility, and feasibility studies in a leading capacity. As a consultant, I have supervised the inputs and coordination of specialist disciplines into the mine planning and Mineral Reserves estimation process for open pit metals projects around the world. I have completed open pit mine plans and schedules, estimated equipment and personnel requirements, and estimated capital and operating costs. After earning an MBA, I have undertaken financial modeling in support of technical studies.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101), for those portions of the Technical Report that I take responsibility.

I am responsible for Sections 1.1-1.3, 1.12, 1.17-1.21; Sections 2.1, 2.2, 2.4, 2.5; Section 3; Section 14.5; Section 15; Sections 16.1, 16.2, 16.3.2, 16.3.3, 16.4-16.9; Sections 21.1, 21.2.1, 21.2.2, 21.2.4, 21.2.6-21.2.9, 21.3.1, 21.3.2, 21.3.4, 21.3.5; Section 22; Section 24; Sections 25.7, 25.10, 25.11, 25.13, 25.14; Sections 26.1, 26.4, 26.8, 26.11; and Section 27 of the Technical Report.

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"signed and stamped"

Piers Wendlandt P.E.

Dated: June 24, 2022

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TABLES

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1.0 SUMMARY

1.1 Introduction

At the request of Manganese X Energy Corp. (Manganese X), Wood Canada Limited (Wood) and Mercator Geological Services Limited (Mercator) have prepared an independent National Instrument 43-101 (NI 43-101) Technical Report (Report) disclosing the results of a preliminary economic assessment (PEA or Project) of their Battery Hill Manganese property (Property) located near the town of Woodstock in New Brunswick, Canada. Manganese X is a publicly traded mining company based in Quebec, Canada and listed on the TSX Venture Exchange under the "MN" stock ticker.

1.2 Terms of Reference

Manganese X is using this Report as a conceptual analysis of a development option to assess the economic viability of the Project and identify work required to complete more advanced mining studies.

Mineral Resource estimates were completed in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines, November 29, 2019 (CIM MRMR Best Practice Guidelines) and reported in accordance with the CIM Definition Standards for Mineral Resources and Mineral Reserves, May 10, 2014 (CIM Definition Standards).

The final product from the Project is expected to be a high purity manganese sulphate monohydrate (HPMSM) of suitable quality for use in the production of lithium-ion batteries.

Measurement units used in this Report are in metric and the currency is expressed in Canadian dollars unless otherwise noted.

1.3 Key Outcomes

Key Project outcomes are presented in Table 1-1.

Readers are cautioned that the PEA is preliminary in nature. It includes Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the PEA will be realized. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.

Table 1-1: Key Project Outcomes

Metric	Unit	Outcome
NPV_{10} (after tax)	US$M	486
IRR (after tax)	%	25
LOM	years	40 years mine production 7 years stockpile reclaim
Operating Cost	US$/t processed	122
Capital Cost	US$M	350
Average Annual Production HPMSM	t	68,000
Average Daily Mine Production Rate (mill feed)	t/d	1,000
LOM Production	Mt	Measured and Indicated Mineral Resource: 12.2 Mt @ 7.45% Mn
	Mt	Inferred Mineral Resource: 4.7 Mt @ 8.26% Mn
HPMSM Market Price used in PEA Study	US$/t	2,900
Average Strip Ratio (Waste:Mill feed)	-	1.35
Pay Back Period (after tax)	years	2.8
Average LOM Annual Gross Revenue	US$M	177

1.4 Location, Mineral Tenure and Surface Rights

The Battery Hill property is located in western New Brunswick, Canada, and consists of two discontinuous mineral claims with a combined area of 1,407 hectares (the Property). Manganese X owns a 100% interest in the claims.

1.5 Royalties

The claims are subject to a 3% gross metal royalty on production.

1.6 History

The manganese-iron occurrences in the Woodstock area were first discovered in 1836 with interests focused on the recovery of iron. Historical mining activities in the early 1860s were primarily in the Iron Ore Hill area. No further activity was done until exploration work commenced in the early 1950s by way of ground geophysical exploration and diamond drilling of the Plymouth deposit several kilometres to the southwest of Mineral Claim 5816. During this exploration period the South Hartford, North Hartford, Plymouth, Moody Hill, and Sharpe Farm deposits were identified. Several diamond drill holes tested these areas but only a summary of the drilling results remains.

In 2010, Globex Mining Enterprises Inc (Globex) took ownership and commenced exploration activities by collecting rock samples near the Iron Ore Hill historical workings, followed by a magnetometer survey over Mineral Claim 5816, and the drilling of two holes on Mineral Claim 5816 and one hole on Mineral Claim 5745 in 2011.

1.7 Geology and Mineralization

The sedimentary units that host the manganese-iron mineralization in the Project area occur within the Smyrna Mills Formation of the Silurian Perham Group. These sedimentary units are in contact with the Carboniferous Mabou Group strata several kilometers to the east, and with argillaceous limestone and calcareous shale units of the Late Ordovician to Silurian White Head Formation in the immediate area to the east (Smith and Fyffe, 2006).

Development of upright, tight, local folds that trend generally northeast in the Project area is attributed to the mid-Devonian Acadian Orogeny. A weaker, subsequent system of cross folds is present in the southeastern part of the area and may be attributed to later stages of the same orogeny. These folds have affected strata of economic interest and resulted in substantial thickening of mineralized units in fold hinge zones. This locally produced broad zones of near-surface mineralization that may be particularly amenable to open pit development. Faulting has also contributed to structural thickening of the mineralized beds with folding and faulting together locally creating widths in excess of 200 m.

The manganese-iron mineralization in this district is stratiform and sedimentary in origin and related to redox condition fluctuations in the offshore zone of a Silurian continental shelf environment developed adjacent to a stable cratonic margin. The constituent folded deposits are all classified for present purposes as being of the stratiform, manganiferous subset of the Clinton iron-formation deposit type described by Gross (1996).

Most of the manganese-iron mineralization occurs near the base of the Smyrna Mills Formation. This formation is comprised of non-calcareous silty shale and associated ferro-manganiferous siltstone, and calcareous shale interbedded with calcareous quartzose sandstone. It also includes calcareous sandstone, crystalline limestone, nodular limestone, polymictic conglomerate, and minor non-manganiferous shale and laminated, graptolitic siltstone. The underlying Whitehead Formation is Silurian to Ordovician in age and forms part of the Matapedia Group consisting of argillaceous limestone interbedded with calcareous shale (Smith and Fyffe, 2006).

Based on previous drilling on the Iron Ore Hill occurrence, the main intervals of manganese-iron interest within the Smyrna Mills Formation consist of brick red and maroon hematite rich siltstones and weakly magnetic green siltstones. The highest manganese results are encountered in the brick red to maroon, hematite bearing units containing the manganese carbonate mineral rhodochrosite. Manganese occurs predominantly in the form of rhodochrosite and iron occurs in both oxide (hematite, magnetite, and ilmenite) and carbonate minerals (predominantly siderite).

1.8 Exploration and Drilling

Manganese X acquired a 100% interest in the Property in December 2018 and since that time has completed gravity and magnetometer ground geophysical surveys, three programs of core drilling totalling 53 holes (9,697 m), and a metallurgical investigation program.

In 2016, Eastern Geophysics Ltd. (Eastern Geophysics) completed ground gravity and magnetometer surveys that covered Mineral Claim 5816 on behalf of Manganese X. The surveys were planned over the same area as a 2011 Globex magnetometer survey with the purpose of providing follow up testing and enhancement of the data collected during 2011. Gravity survey highs closely coincide with positive anomalies identified by the earlier magnetometer survey but provide better definition of potential drilling targets.

Iron Ore Hill was identified as containing five of the six best targets with weakly anomalous areas occurring throughout the Sharpe Farm and Moody Hill areas.

In 2016, Manganese X completed a diamond drill program consisting of 16 drill holes for a total of 3,572 m of NQ-sized core. Drilling activities focused on the southern area of Mineral Claim 5816 where the strongest anomalies of the 2016 magnetometer survey occur. In 2017, Manganese X completed 9 diamond drill holes totalling 1,598 m of NQ-sized core on the Sharpe Farm and Moody Hill target areas. This drilling program was designed to further delineate, expand, and improve the structural understanding of the significant manganese mineralization identified during the 2016 drilling program. In 2020, Manganese X completed 28 additional diamond drill holes totalling 4,509 m of NQ-sized core on the Moody Hill target areas. This drilling program was designed to further delineate, expand, and improve the structural understanding of the manganese-iron mineralization on the property, and had the specific purpose of providing a sufficient technical basis to support a Mineral Resource estimation program in accordance with the CIM Definition Standards. Drilling confirmed significant widths of continuous mineralization from surface to a maximum vertical depth of approximately 150 m over a strike length of 500 m.

In 2022, Manganese X completed a total of four diamond drill holes totalling 589 m of NQ-sized core. The objective of the 2022 drilling program was to test known manganese occurrences in areas nearby but separate from the Battery Hill Mineral Resource estimate to determine if there may be other manganese occurrences in the area that Manganese X should be focusing on. As of the effective date of this Report none of these drill holes have been sampled and sent for assay analyses and only three of the drill holes have been logged by Manganese X. Therefore, assay results from these four drill holes are still pending. These four drill holes do not have any material impact on the current Battery Hill Mineral Resource estimate as they were completed outside of the current Mineral Resource estimate area.

1.9 Sampling and Data Verification

Core was logged for lithology, structure, alteration and mineralization, photographed then split at the Manganese X core shed near Woodstock with one half of the core labelled, bagged and shipped to the Activation Laboratory Ltd (Actlabs) preparation laboratory in Fredericton, New Brunswick or shipped directly to their main laboratory in Ancaster, Ontario. Actlabs is an international, Canadian Association for Laboratory Accreditation (CALA) accredited, analytical services firm registered to the ISO 17025 ISO 9001:2008 standards and is independent of Manganese X.

Samples averaged 2 m in width with core recovery and rock quality designation (RQD) determined for the 2017 and 2020 drill core. The analytical method chosen for all Manganese X drilling programs was XRF-Fusion (Actlabs Code 4C).

Manganese X employed a Quality Assurance and Quality Control (QAQC) program of certified reference materials (CRMs), blanks, duplicate pulp split samples and quarter-core duplicate samples. CRMs, blanks and quarter core duplicates were generally inserted after every 20th sample. Six check samples of pulp material from the 2016 drill program along with the two CRMs were sent to SGS Canada Ltd (SGS). The QP author is of the opinion that the quality of the analytical results from the 2016, 2017 and 2020 diamond drilling programs are sufficiently reliable to support their use in the Mineral Resource estimate for the Project.

Data verification by the QP author included review of public records and internal source documents reporting geological interpretations, geochemical or geophysical anomalies and historical and current exploration and drilling results. During their site visit the QP author collected independent witness samples from all drilling campaigns and submitted them to the ALS Global (ALS) laboratory in Moncton, New Brunswick along with a blank sample and CRM for preparation and subsequent analysis using XRF methods. ALS is a commercial analytical firm that is accredited by the CALA and also holds ISO 9001 and ISO/IEC 17025 registrations and is independent of Manganese X. From the data verification performed, the QP author believes that industry standard levels of technical documentation and detail are evident in all drilling programs and that the drill hole database is acceptable for Mineral Resource estimation.

1.10 Metallurgical Testwork

Between 2017 and 2019, Manganese X has carried out testwork on the Battery Hill property. Testwork included mineralogical, diagnostic leach and purification, beneficiation and pre-concentration testing. In 2020, Manganese X commenced with a flowsheet development test program that included the investigation of leaching parameters, solid-liquid separation methodology, and primary and secondary purification processes. A summary of the results of this work were previously reported in the NI 43-101 Technical Report Battery Hill Project Mineral Resource Estimate, Woodstock Area, New Brunswick, Canada with an effective date of June 18, 2021, Ténière et al., 2021 (2021 Technical Report).

A phase 2 testwork program was initiated in 2020 to further investigate the purification process and was expanded to include flowsheet development testing. The testwork was able to demonstrate a higher product purity of >99.9% and defined the unit operations for leach extraction, solid-liquid separation and primary purification stages.

A phase 3 metallurgical program was initiated in 2021 to support the PEA. The work was aimed at refining the process flowsheet, establishing major equipment requirements, reagent consumptions, metallurgical recovery and evaluating alternative process options for potential cost savings.

Comminution testing returned results indicating a Bond crusher work index of 3.3 kWh/t and a Bond ball mill work index of 18.1 kWh/t.

Leach and neutralization testing established an optimum grind size of 150 µm P_{80} and demonstrated that leach conditions could be further optimized to return acceptable leach extractions with lower acid consumption. Under these locked-cycle conditions, leach extractions of 84% with an acid consumption of 250 kg/t were achieved.

Calcium and magnesium removal was up to 90%, but with indications that removal could improve to 95% and 99% with optimization. Crystallization of manganese sulphate from evaporated and purified liquor was readily achieved. High entrainment of impurities in fine crystals was identified as an issue, but reprocessing with effective washing, removal of fine insoluble material and improved solid-liquid separation could upgrade the crystals to meet target specifications.

Samples of neutralized leach residues were submitted for acid rock drainage (ARD) and toxicity characteristic leaching procedures (TCLP) testing. TCLP tests were negative for all elements of concern.

Metallurgical testwork and associated analytical procedures were performed by recognized testing facilities, and the tests performed were appropriate to the mineralization type. Samples selected for testing were representative of the mineralization at the Battery Hill and were selected from within the planned mine area.

The overall manganese metallurgical recovery assumption for the projected life of mine is estimated at 78%.

1.11 Mineral Resource Estimates

The definition of Mineral Resource and associated Mineral Resource categories used in this Report are those recognized under NI 43-101 and set out in CIM Definition Standards.

The Mineral Resource estimate was prepared under the supervision of QP author Mr. Matthew Harrington, P. Geo., with an effective date of May 12, 2022. A summary of the Battery Hill Mineral Resource constrained within a conceptual open pit shell is presented in Table 1-2. Assumptions, metal threshold parameters and deposit modelling methodologies associated with the Mineral Resource are summarized in notes underneath Table 1-2.

Factors that may materially impact the Mineral Resource include, but are not limited to, the following:

- Changes to the long-term HPMSM price assumptions including unforeseen long term negative market pricing trends, and changes to the CA$:US$ exchange rate
- Changes to the deposit scale interpretations of mineralization geometry and continuity
- Variance associated with density assignment assumptions and/or changes to the density values applied
- Inaccuracies of deposit modelling and grade estimation programs with respect to actual metal grades and tonnages contained within the deposit
- Changes to the input values for mining, processing, and general and administrative (G&A) costs to constrain the Mineral Resource
- Changes to metallurgical recovery assumptions including metallurgical recoveries that fall outside economically acceptable ranges
- Variations in geotechnical, hydrological, and mining assumptions
- Changes in the assumptions of marketability of the final product
- Changes with respect to mineral tenure, land access, land ownership, environmental conditions, permitting, and social license.

Table 1-2: Battery Hill Mineral Resource Estimate – Effective Date: May 12, 2022

Cut-off (Mn %)	Category	Tonnes (Mt)	Mn (%)	Fe (%)
1.5	Measured	11.32	6.72	10.94
	Indicated	23.82	6.24	10.50
	Measured Plus Indicated	35.14	6.39	10.64
	Inferred	27.72	6.46	10.73

Note: (1) The QP for the Mineral Resource statement is Mr. Matthew Harrington P. Geo. who is an employee of Mercator.

(2) Mineral Resources were prepared in accordance with the CIM Definition Standards (May 10, 2014) and CIM MRMR Best Practice Guidelines (November 2019).

(3) Mineral Resources are constrained within an optimized pit shell with average pit slope angles of 45° and a 2.9:1 strip ratio (waste: mineralized material).

(4) Pit optimization parameters include pricing of US$2,900 ($3,625)/t for HPMSM (100% HPMSM = 32% Mn; $1.25 to US$1.00 exchange rate), mining at $7.43/t, a 3% gross metal royalty on the HPMSM produced, combined processing and G&A (1,000 t/d process rate) at $126.31/t processed, an overall Mn recovery to HPMSM of 78%, and a selling cost of US$65.00 ($81.25)/t HPMSM. Fe content did not contribute to the pit optimization process but was applied for bulk density determination purposes (see note 7).

(5) Mineral Resources are reported at a cut-off grade of 1.5 % Mn within the optimized pit shell. The cut-off grade reflects the marginal cut-off grade used in pit optimization to define reasonable prospects for eventual economic extraction by open pit mining methods.

(6) Mineral Resources were estimated using Ordinary Kriging methods applied to 3 m downhole assay composites. No grade capping was applied. Model block size is 5 m x 5 m x 5 m.

(7) Bulk density was applied using a regression curve based on Mn % and Fe % block grades. Average bulk density for Mineral Resources is 3.01 g/cm^3. Only manganese is considered having reasonable prospects for economic extraction; iron is reported for quality and density determination purposes.

(8) Mineral Resources may be materially affected by environmental, permitting, legal, title, taxation, social, political, marketing, or other relevant issues. See paragraph above Table 1-2.

(9) Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.

(10) Figures may not sum due to rounding.

1.12 Mine Plan

The open pit mine designs are based on pit shells obtained using the Lerchs-Grossman (LG) algorithm considering the information stored in the resource model, pit slope angles, a HPMSM sales price, mining and processing operating costs, stockpile reclaim costs, G&A costs, closure and shipping costs, royalty, and process recovery. The ultimate pit selected for mine planning utilizes an elevated cut-off grade strategy in order to drive Project economics and corresponds to a US$676/t HPMSM price. The Mineral Resource model was used without adjustments for mine planning. Mining loss and dilution are accounted for in the block size (5 m x 5 m x 5 m), and no additional dilution or losses were applied.

The open pit has been designed as a conventional truck-shovel operation with the pit design considering a total of 19 pit phases from six pits. The mine plan assumes conventional open pit mining using a contract mining equipment fleet at a total mining rate of 1.0 Mt/a to provide a mill feed of 365 kt/a, or 1,000 t/d. The mine plan will utilize a stockpile for mineralized material to enhance Project economics and to sustain mill operations 24 h/d, 7 d/wk at a single, central processing facility. The mining operations will have a 40-year mine production life, with a two-year pre-production period, and seven years of stockpile reclaim feed at the end of the mine life. A subset of the Mineral Resources within the PEA mine plan is summarized in Table 1-3.

Table 1-3: Subset of the Battery Hill Mineral Resource Estimate within the Mine Plan

Classification	Cut-off (Mn %)	Tonnage (Mt)	Grade (Mn %)	Contained Mn (kt)
Measured	3.3	5.90	7.65	451
Indicated	3.3	6.37	7.26	462
Total Measured and Indicated		**12.26**	**7.45**	**913**
Inferred	3.3	4.73	8.26	391
Total Inferred		**4.73**	**8.26**	**391**

Note: (1) Mineral Resources within the mine plan were estimated using open pit mining methods and include Inferred Mineral Resources that are too speculative geologically to have economic considerations applied to them that would enable them to be categorized as Mineral Reserves.

(2) Input assumptions to the pit shells that constrain the Mineral Resource estimate include an HPMSM price of US$2,900/t, mine operating cost of $7.43/t, process operating cost of $110/t, G&A cost of $7.60/t, stockpile reclaim cost of $1.46/t, closure cost of $3.00/t, selling cost of US$65/t, process recovery of 78%, a gross metal royalty of 3% applied to the HPMSM produced, and a pit slope of 45°.

(3) Tonnes, grades and contained metal may not sum due to rounding.

1.13 Process Design

The proposed process for treating Battery Hill manganese resources is a whole ore sulphuric acid slurry leach performed under conditions which result in formation of a filterable residue from leaching of the largely manganese carbonate mineralization. Leach solution is neutralized with limestone, concentrated by evaporation, purified through a proprietary process then further evaporated to produce a crystallized manganese product. The bulk of the contained manganese is recovered as crystalline manganese sulphate monohydrate meeting all specifications for sale as a battery grade product.

Current test results indicate that the mineralization is soft with respect to crushing (Bond crusher work index of 3.3 kWh/t). Two stages of crushing and a single screening stage prepares the material for a single stage of ball milling to achieve the required target grind P_{80} of 150 µm. Milled slurry is thickened before advancing to leach.

Leach takes place in mechanically agitated tanks with sulphuric acid addition at elevated temperature. These conditions provide a satisfactory combination of filterability and extraction.

Neutralization with fine limestone and with aeration, provides substantially complete iron and aluminum precipitation. The resulting slurry is thickened and filtered. The filter cake is the principal waste product for disposal to a filtered residue storage area. The filtrate is the pregnant leach solution that advances through an evaporation stage for concentration, and then through a proprietary purification process to remove calcium and magnesium.

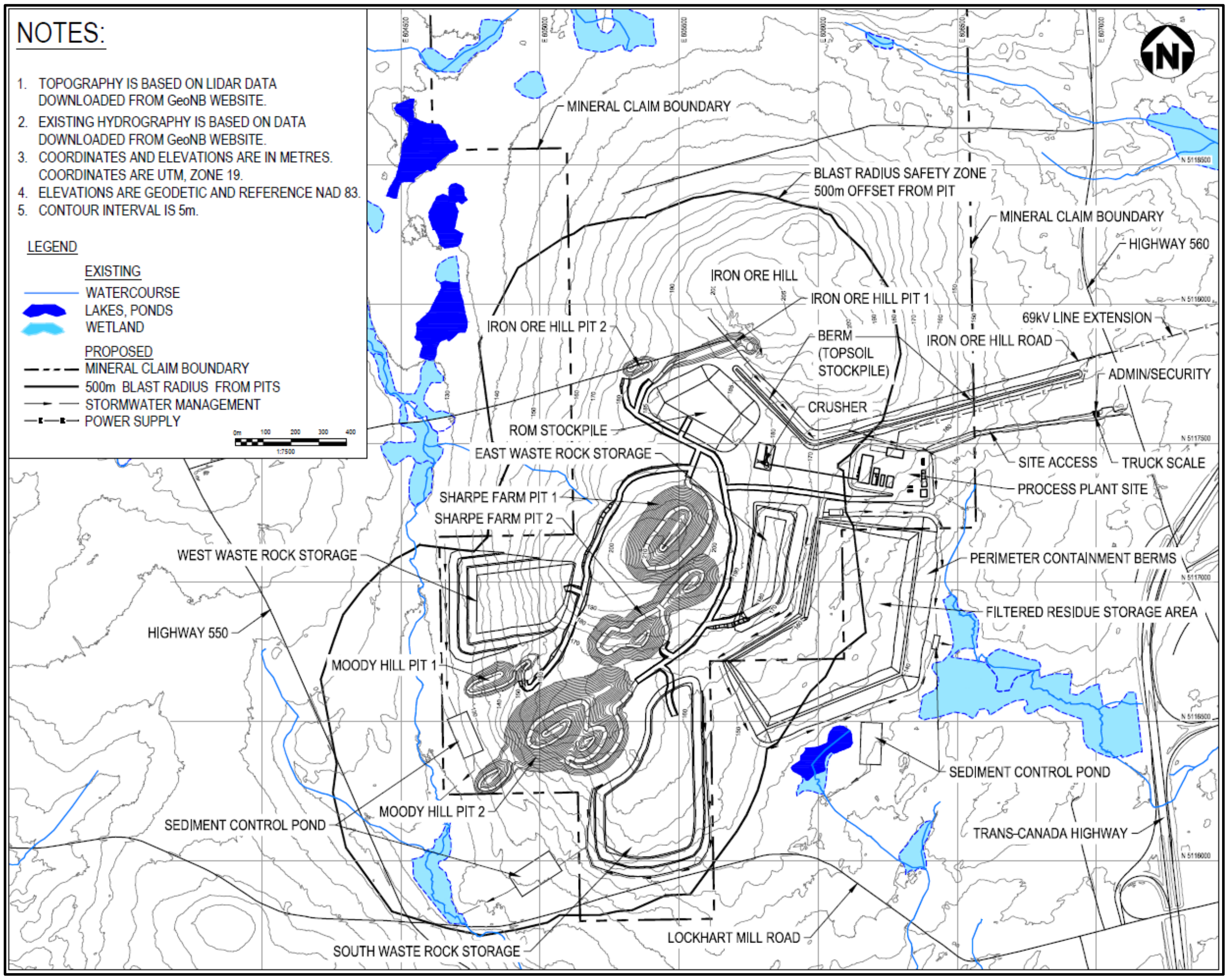
An initial manganese sulphate product is crystallized from the purified solution through heating and additional evaporation in a first stage crystallization. The crystal product is separated from a saturated bleed solution by centrifuging, with contaminants present primarily through solution entrainment in the separated crystals. This primary product is selectively redissolved in fresh water and filtered to remove minor insoluble impurities. The filtered solute is then sent to a second stage of evaporation and crystallization to generate a high-purity crystal product, which is separated from the saturated bleed solution by centrifuge, dried and packaged. The final product is battery grade manganese sulphate monohydrate.

A bleed stream from the manganese sulphate crystallization controls concentrations of minor impurities. The bleed stream is pumped to a manganese precipitation process where a reagent is added to the liquor to precipitate manganese and minor amounts of calcium and magnesium. The resulting precipitate is filtered from the liquor and returned to the calcium and magnesium removal stage. The filtrate advances through a crystallizer where an impure by-product is produced.

1.14 Planned Project Infrastructure

Onsite infrastructure and services required to support the Project include a crushing facility, process plant and ancillaries, sulphuric acid plant, mining facilities, waste rock storage facilities (WRSFs), Run-of-Mine (ROM) stockpile, filtered residue storage area (FRSA) runoff ditches and sedimentation ponds, administration and security facilities, and power, water and fuel supply and distribution (Figure 1-1). Where appropriate tensioned fabric structures (prefabricated, modular design) and containerized buildings will be used. No camp or onsite accommodation is required given the site’s proximity to the nearby down of Woodstock.

Figure 1-1: Site Plan Layout



Source: prepared by Wood, dated 2022

Access to the Project site will be to the east via a new road constructed off Highway 560. This road will lead to the main supporting infrastructure including the process plant with its ancillary facilities, sulphuric acid plant, mine truck shop, tire shop, warehouse, office trailers for both owner and contractor staff and fueling station.

Three WRSFs with a combined capacity of 24.4 Mt is sufficient for storing waste over the life-of-mine (LOM). Mineralized material from the ROM stockpile will be reclaimed by loader to the crushing facility and has a maximum capacity of 3.5 Mt.

Filtered residue from the process plant will be trucked to the FRSA which will accommodate 8.69 Mt of residue for the first 24 years of mine operation after which residue will be trucked to the Moody Hill Pit 2.

Runoff from the WRSFs and FRSA will be collected and routed through one of five sedimentation ponds prior to discharge into natural receiving water courses.

An extension off NB Power's 69 kV transmission line 0020 just east of the Trans-Canada Highway to the main substation located at process plant site area is estimated to be 2 km. Power will be distributed via two 12.47 kV overhead lines to the step-down transformers at the process plant and to yard lighting and ancillary buildings.

1.15 Markets

A series of commodity market research reports on high purity manganese products including HPMSM were prepared by CPM Group (CPM) in March 2022.

As part of their analysis, CPM provided guidance on HPMSM pricing in the form of a long-term forecast price and a "risk managed" base case price. Pricing considered the projected supply-demand gap, the transport cost advantage the Project has over China when supplying North American and European markets, and the exemption from import duties that a Canadian producer has when supplying these markets. CPM generated a single weighted average forecast price of HPMSM (80% North America/20% Europe) for the 2029 to 2035 period of US$4,200/t. A risk managed base case scenario for the long-term period covering the LOM for the Project was provided at US$2,900/t HPMSM. This risk managed base case price was used as input for determining reasonable prospects for eventual economic extraction for establishing Mineral Resources, as input to the engineered pit and cut-off determination for the mine plan, and as the base-case commodity price in the economic analysis.

CPM determined a world supply-demand deficit for high purity manganese beginning in 2023 and increasing to 900 kt/a by 2035. With an expected production rate of approximately 80 kt/a of HPMSM or 25.6 kt/a of manganese metal, CPM determined that it is a reasonable assumption that the market will have capacity to absorb the planned HPMSM production from Battery Hill.

There are no current contract or sales agreements in place for mining, concentrating, smelting, refining, transportation handling, sales or hedging.

1.16 Environment, Permitting Social Considerations

Recent (2021) environmental baseline studies have been conducted for surface water monitoring which provide supplementary data on surface water quantity and quality needed to characterize seasonal changes in baseline conditions and seasonally restricted vegetation and bird observations.

As part of the Environmental Baseline Assessment, information obtained from the Atlantic Canada Conservation Data Centre (ACCDC) showed several species at risk (SAR), both provincially and federally have been observed within the Property, including Butternut tree (Juglans cinerea) and various bird species. During the Spring 2021 bird monitoring, two such species including Canada Warbler (*Cardellina canadensis*) and Bobolink (*Dolichonyx oryzivorus*) were confirmed in the general area; however, neither were observed within the Project footprint. Although both Black Ash (*Fraxinus nigra*) and Butternut have been noted in the general area by the ACCDC, neither was observed during the Spring 2021 survey.

Around six provincial/municipal permits will be required prior to the mine development including an environmental impact assessment (EIA), mining lease, approval to operate, development permit, water withdrawal permit and a watercourse and wetland alteration permit. Other federal and/or provincial regulations may require compliance.

Most of the land for the mine site is privately owned and will need to be purchased or a written agreement from the landowner will be required to obtain the mining lease. Adjacent landowners and residences will be affected by the Project whether from direct impacts from mining activity, altered view-scape and/or mine related travel; however, the socio-economic benefits will include opportunities for high-wage employment, local spending and taxation. As part of the required EIA, a public consultation process will be conducted with a 30-day public review and comment period.

The site is located within traditional unceded territories of both indigenous peoples of New Brunswick, including the Mi'Kmaq and Wolastoqay (Maliseet) First Nations. First Nations Communities must be informed about the Project and have an opportunity to express their concerns. The proponent must show that a robust engagement has taken place and that stakeholder concerns have been taken into consideration and a response has been provided.

A reclamation plan will be required describing the proposed closure and restoration as well as a detailed cost estimate. A financial security is also required by the New Brunswick Department of Energy and Resource Development (NBNRED) as a condition of the mining lease approval and is based on engineering costs for protection, reclamation, and rehabilitation of the environment.

1.17 Capital Costs

The Project's initial capital cost, as summarized in Table 1-4 is $438 million, including indirect costs of $80.4 million and contingency of $97.4 million.

This estimate was prepared in accordance with the Association for the Advancement of Cost Engineering (AACE) Class 5 study definitions with an expected accuracy of -30%/+40%. Costs are expressed in fourth-quarter 2021 Canadian dollars.

Sustaining capital relates to mobile equipment and building replacement and totals $27.2 million over the LOM. The total Project capital inclusive of initial and sustaining costs is estimated at $465.2 million.

Table 1-4: Capital Cost Estimate Summary

Cost Area	Cost ($M)
Open pit mine	4.0
Process facilities	220.4
FRSA	2.0
Infrastructure	19.1
Subtotal	245.5
Indirect cost	80.4
Owner's cost	14.7
Contingency	97.4
Total	**438.0**

1.18 Operating Costs

Total operating costs over the LOM have been estimated at $2,597.1 million with an average operating cost estimated at $152.86/t of material processed as summarized in Table 1-5.

Table 1-5: Average Operating Costs over LOM

Cost Area	$/t Processed	Total ($M)
Mining	23.03	391.3
Process	116.81	1,984.6
G&A	7.68	130.4
Filtered residue storage	5.35	90.9
Total	**152.86**	**2,597.1**

Note: Figures may not sum due to rounding.

1.19 Economic Analysis

The PEA study represents forward-looking information, including the Mineral Resource estimates in the PEA mine plan and the cash flows derived from them, forecast HPMSM prices used, capital and operating cost estimates, estimated HPMSM production, and payback period. Actual results may vary from the forward-looking information with the Mineral Resource estimates, costs, HPMSM prices, metallurgical recoveries, and taxes being different from what was assumed for the PEA.

The PEA was evaluated using a discounted cashflow analysis. Cash inflow consists of annual revenue projections for the mine. Cash outflows such as capital costs, operating costs, taxes, and royalties are subtracted from the inflows to arrive at the annual cash flow projections. Cash flows are taken at the end of each period.

The financial evaluation of the Project generates positive before and after-tax results. The after-tax internal rate of return (IRR) is 25% and the after-tax net present value at a 10% discount rate (NPV_{10}), is $486 million. After-tax payback of the initial capital is achieved 2.8 years following the start of production.

The Project is most sensitive to changes in manganese feed grade and HPMSM selling price, followed by changes to total capital costs and operating costs.

1.20 Conclusions

The supporting testwork and mine design are at a PEA level of study. Under the assumptions used in this Report, the Project shows a positive economic return.

1.21 Recommendations

The QPs have identified recommendations to support a two-phased approach where drilling, testwork and engineering studies (Phase 1) should be completed ahead of a pre-feasibility study (Phase 2). Phase 1 has been estimated at $3.7 million and Phase 2 has been estimated at $1.7 million for a total cost of $5.4 million.

2.0 INTRODUCTION

At the request of Manganese X, Wood and Mercator prepared an independent Report disclosing the results of a PEA on their Battery Hill property.

2.1 Terms of Reference

Manganese X is using this Report as a conceptual analysis of a development option to assess the economic viability of the Project and to identify work required to complete more advanced mining studies. Manganese X announced the results of the PEA in their news release of May 12, 2022, triggering an independent NI 43-101 technical report. This Report supports the PEA disclosure.

Mineral Resource estimates were completed in accordance with CIM MRMR Best Practice Guidelines and reported in accordance with the CIM Definition Standards.

Measurement units used in this Report are in metric and the currency is expressed in Canadian dollars unless otherwise noted.

2.2 Qualified Persons

The following Report authors are Qualified Persons (QPs) for the sections of the Report they are responsible for preparing:

- Mr. Paul Baluch, P.Eng., P.E., Technical Director Civil/Structural/Architectural, Wood
- Mr. Alan Drake, P.L.Eng., Manager Process Engineering, Wood
- Dr. Greg Gosson, P.Geo., Technical Director Geology and Compliance, Wood
- Mr. Matthew Harrington, P.Geo., Senior Resource Geologist, Mercator
- Mr. Paul Ténière, P.Geo., Senior Associate Geologist, Mercator
- Mr. Gil Violette, P.Eng., Principal Hydrogeologist, Wood
- Mr. Piers Wendlandt, P.E., Principal Mining Engineer, Wood

2.3 Site Visits

2.3.1 QP author P. Ténière Site Visit

QP author P. Ténière visited the Property on February 24, 2021, and the New Brunswick Department of Natural Resources and Energy Development (NBDNR) core storage facility in Sussex, New Brunswick on December 17, 2020, to complete an independent witness (IW) check sampling program of drill core from the Property. During his site visits P. Ténière completed the following tasks and inspections:

- Review and inspection of the Manganese X core storage facility in Woodstock and compared select core intervals with original drill logs and sampled intervals.
- Collected three IW quarter core samples from the 2020 Manganese X drill program on the Battery Hill Project (Moody Hill target) for check assay analyses. Also collected 11 quarter core IW samples from the 2016 and 2017 Manganese X drilling programs for check assay analyses.
- Reviewed the data collection and QAQC procedures for the drilling and sampling programs.
- Completed a field inspection in the northern part of the Project area including the northern part of the Moody Hill target. Drill sites were not accessible due to deep snow conditions at the time.

The personal inspection (site visit) completed by QP author P. Ténière on December 17, 2020, and February 24, 2021, confirmed the following:

- The Manganese X core facility at the Project was well organized and there was evidence of proper QAQC procedures in place for core logging and sampling.
- Manganese mineralization was evident in the core samples reviewed and sample intervals were properly documented in core boxes and in the core logging database.
- Access to the Project area is excellent through secondary roads and well-maintained trails owned by private landowners with agreements in place. Access for exploration and drilling activities is practical.

2.3.2 QP Author G. Violette Site Visit

Mr. Violette visited the Project site on September 21, 2021. During his visit he viewed drill core located at the Iron Ore Hill core shack building for the purpose of understanding the geotechnical/hydrogeological characteristics, completed a field inspection of the Moody Hill target and surrounding areas to assess the local physiography, soil depth, culture, and assessed local infrastructure for access to the property and proposed location of mine facilities and distance to local services.

2.4 Effective Dates

The Mineral Resources and this Report have an effective date of May 12, 2022. The effective date of the Report is May 12, 2022.

2.5 Sources of Information

All sources of information include expert reports referenced in Section 3 and documents listed in Section 27.

The following technical reports have been previously filed on the Property:

- Ténière, P., Harrington, M., Warkentin, D., and Elgert, L., 2021. NI 43-101 Technical Report Battery Hill Project Mineral Resource Estimate, Woodstock Area, New Brunswick, Canada; report prepared by Mercator Geological Services Ltd. for Manganese X Energy Corp., effective date June 18, 2021, 143 p.
- MacKinnon, P., 2020. NI 43-101 Technical Report on the Woodstock Manganese Occurrence Exploration Licenses 5816 and 5745 Near Jacksonville and Irish Settlement Carlton County New Brunswick, report prepared for Manganese X Energy Corp., effective date June 30, 2020, 94 p.

3.0 RELIANCE ON OTHER EXPERTS

The QPs have relied upon other expert reports that provided information regarding mineral rights, property agreements, royalties, taxation, and marketing and commodity price information contained within this Report.

3.1 Legal Status

The QPs have not independently reviewed the ownership of the mineral rights of the property. The QPs have fully relied upon, and disclaim responsibility for, information supplied by Manganese X's external legal counsel, Stewart McKelvey for the property mineral tenure information through the following document:

- Manganese X Energy Corp – Status of Mineral Claims: letter prepared by Stewart McKelvey for Wood Canada Limited and Manganese X Energy Corp, dated May 13, 2022, 12 pgs.

This information is used in Section 4.1 for property description, in Section 14 to support reasonable prospects for eventual economic extraction, including inputs to the cut-off applied to the Mineral Resource estimates, in Section 16 for the mine plan, and in Section 22 to support various inputs to the financial model of the Report.

3.2 Royalties

The QPs have not independently reviewed the royalties any underlying property agreements. The QPs have fully relied upon, and disclaim responsibility for, information supplied by Manganese X for the property legal ownership information through the following document:

- Guidance Regarding the Gross Metal Royalty on Production from the Battery Hill Property: letter prepared by Manganese X for Wood Canada Limited, dated June 1, 2022, 5 pgs.

This information is used in Section 4.3 for property description, in Section 14 to support reasonable prospects for eventual economic extraction, including inputs to the cut-off applied to the Mineral Resource estimates, in Section 22 to support various inputs to the financial model of the Report and Section 26.2 to support recommendations. Manganese X obtained advice from separate external legal counsel when preparing the information on royalties and underlying property agreements.

3.3 Marketing and Commodity Pricing

The QPs have not independently reviewed the marketing and commodity pricing information for HPMSM. The Wood QPs have fully relied upon, and disclaim responsibility for, information supplied by CPM Group (CPM) for information related to marketing, including market entry strategy, and for HPMSM pricing information through the following documents:

- Market Outlook for High-Purity Manganese Products, report prepared by CPM Group for Manganese X Corporation, March 27, 2022, 110 pgs.
- High Purity Manganese Market in North America, Market Balance and Price Forecast, report prepared by CPM Group for Manganese X Energy Corporation, March 27, 2022; 21 pgs.
- HPMSM Single-Price Calculation for Manganese X PEA Study, letter report prepared by CPM Group for Manganese X Energy Corporation, April 8, 2022, 4 pgs.
- HPMSM Market Update, letter report prepared by CPM Group for Manganese X Energy Corporation, April 20, 2022, 6 pgs.

This market research information is used in:

- Section 14 as support for the commodity price input and marketability of the HPMSM when establishing reasonable prospects of eventual economic extraction for the Battery Hill Mineral Resources
- Section 16 for support for the assumptions used in the mine planning – HPMSM commodity price and market for the HPMSM production rate
- Section 22 to support the base-case HPMSM price and the upside HPMSM price used in the sensitivity analysis.

CPM is an independent research and consultancy company based in New York. It has a track record of advising its clients on precious and specialty metals markets, including manganese that extends back to before it was organized as an independent company in 1986. The analysts that were CPM at the time of its formation had constituted the Commodities Research Group at J. Aron and Goldman Sachs back into the 1970s, and the founder had analyzed and written extensively about EVs and other alternative energy technologies beginning in 1978.

The lead author of these expert reports is Andrew Zemek of CPM, with inputs from other members of the CPM team and selected external consultants.

One of the points made in the comprehensive CPM market research report was that the HMPSM market is relatively small and dominated by China with many aspects of the market considered sensitive corporate information and confidential. This makes market analysis and predictions difficult when compared to traditional freely traded metals where market information is more readily available. Accurate forecasts are difficult with the rapid changes in battery chemistries, and the drive by developed countries to replace internal combustion engine driven vehicles with battery electric vehicles. There can be any number of choke points in the supply chain for battery or vehicle manufacturers that can limit the projected growth rate of the demand curve for HPMSM. The risks to market forecasts are in part mitigated by the use of a "risk managed", base case HPMSM price of US$2,900/t versus the market analysis showing a US$4,200/t price being a realistic possibility.

The Wood QP submitted a list of written questions to the lead author of the CPM reports, who responded with his written answers. Two follow-up video conference calls with Wood's QP and other Wood senior technical staff, to assist Wood in understanding the basis of CPM's research, market forecasts, and the conclusions relevant to the Project. Wood's QP has confidence in the expertise of CPM and that the research reports provide a reasonable basis for a PEA level study of the market assessment, commodity price projections, and market entry strategies for HPMSM production from the Project.

3.4 Taxation

The Wood QPs have not independently reviewed the taxation information. The Wood QPs have fully relied upon, and disclaim responsibility for tax information, derived from experts retained by Manganese X contained in the following document:

- Reliance on Other Experts for Tax Information: NI 43-101 Technical Report Prepared for Manganese X Energy Corp – Taxation Narrative, letter from Wasserman Ramsay CA's prepared for Wood Group USA, dated June 6, 2022, 3 pgs.

This expert information is used in support of the sub-section on tax information and the tax inputs to the financial model that provides the after-tax financial analysis in Section 22 of the Report.

4.0 PROPERTY DESCRIPTION AND LOCATION

4.1 Property Location and Description

The Property is in western New Brunswick, Canada, approximately 6 km northwest of the town of Woodstock, approximately 15 km east of the town of Houlton, Maine, USA (population 6,123), and approximately 105 km north of the city of Fredericton (population 58,220).

The following information on property location and description was provided by Stewart McKelvey, external legal counsel for Manganese X (see Section 3).

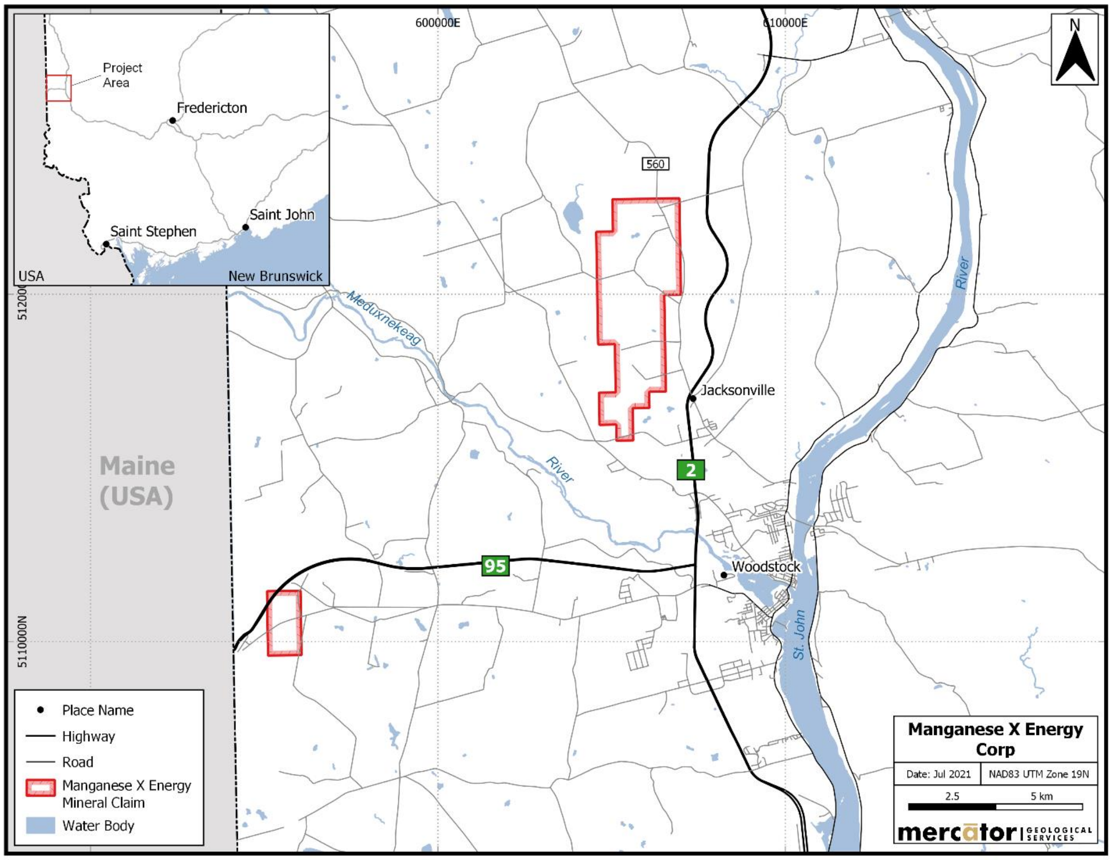
Manganese X holds 100% interest in Mineral Claim 5816 and Mineral Claim 5745 that are not contiguous with each other (Figure 4-1). Both Mineral Claims are located in Carleton County, New Brunswick, approximately 6 km west-northwest of the town of Woodstock. The Property is centred at map coordinates 605639 m Easting and 5119588 m Northing (UTM NAD83 Zone 19N) within NTS Map Sheet 21J/04 (h).

No claims, liens or encumbrances, granting to any other person, firm or corporation any right to acquire the Claims are registered with the New Brunswick Department of Energy and Resource Development electronic database of mineral titles.

Table 4-1: Mineral Claims Table for Battery Hill Project

Mineral Claim No.	Mineral Claim Name	Registered Right Holder Name	No. of Claim Units	Issue Date	Expiry Date	Area (ha)
5816	Jacksonville	Manganese X Energy Corp. (100%)	55	2010-07-21	2024-07-21	1,228
5745	Irish Settlement	Manganese X Energy Corp. (100%)	8	2010-03-25	2024-03-25	179
Total			63			1,407

Figure 4-1: Location Map for Battery Hill Property



Source: Ténière et al., 2021

4.2 Option Agreements and Royalties

The following information has been extracted from new releases and annual information forms filed on SEDAR by Globex and Electric Royalties Limited (Electric Royalties).

The Property is subject to a 3% gross metal royalty (GMR) on production payable to Globex. On July 13, 2020, Globex sold two thirds of the 3% GMR to Electric Royalties. Under the terms of the original option agreement with Globex, if the Project is not in commercial production by the sixth anniversary of the effective date of the agreement (April 22, 2016), Manganese X will pay the royalty holders an advance royalty payment of $20,000 annually. The agreement includes all claim units in Mineral Claim 5816 and Mineral Claim 5745.

4.3 Royalty Obligations

The following information has been provided by Manganese X (see Section 3).

On April 22, 2016, Sunset Cove Mining (a predecessor to Manganese X) entered into an Option Agreement with Globex. The Option Agreement contains a GMR that is payable to Globex related to the future production of the Battery Hill Property mine that Manganese X plans to build and operate at the mineral property known as Battery Hill in New Brunswick, Canada (the Property). Manganese X has or will file a copy of the Option Agreement on SEDAR at www.sedar.com at the same time as this PEA Report is filed on SEDAR.

The terms of the GMR are described in section 5.4 of the Option Agreement as reproduced below:

> *5.4.1 A Gross Metal Royalty ("GMR") calculated in accordance with section 5.4.2 shall be payable to Globex on all metals produced from the Property in the following percentages: (a) 3% GMR shall be payable in cash or in kind at the Venders sole discretion upon the date of delivery of the metals by a processing facility in US dollars.*
>
> *5.4.2 For the purposes of this Option Agreement, "Gross Metal Royalty" shall be defined as the agreed upon percentage (as determined in accordance with section 5.4.1) of the value of all metals including but not limited to manganese iron, precious metals, base-metals, industrial minerals, compounds, etc. produced from the Property as delivered by an arms length or wholly owned or partially owned processing facility. No costs of any kind whatsoever, including transportation, smelter or treatment charges, shall be deducted from the value of the metals, minerals compounds, etc. produced from the Property in the calculation of the GMR.*
>
> *5.4.3 The GMR shall be paid, at Globex's exclusive option, in cash or in kind at the processing facility immediately upon delivery of the metals, minerals or compounds, provided that Globex will be required to elect on an annual basis at the end of Sunset's fiscal year which form Globex wishes to receive payment in and payment shall be in the form so elected for the balance of the fiscal year.*
>
> *5.4.4 Sunset and Globex shall instruct the processing facility which produces the metals, minerals or compounds that are derived from the Property to deposit Globex's GMR in a separate account in the name of Globex. Sunset shall have no control over or interest in such account. The form and content of the instructions contemplated by this section shall be at the discretion of Globex, subject to the requirement to make an election as to form of payment on an annual basis as set out in section 5.4.3. The GMR shall be separate as to ownership; this is to say that Globex's GMR and metals, minerals or compounds shall be, immediately upon production, the exclusive property of Globex.*

5.4.5 Sunset shall have the right to commingle ores and minerals from the Property with ores and minerals from other properties. Where commingling occurs, Sunset shall calculate from representative samples the average grade of the ore and shall weigh (or calculate by volume) the ore before commingling. If concentrates are produced from the commingled ores by Sunset, Sunset shall also calculate from representative samples the average recovery percentage for all concentrates produced during the calendar quarter. Prior to commingling ores, minerals or concentrates, Sunset shall provide to Globex written procedures to be used in commingling, which written procedures shall be based on practices common in the industry.

5.4.6 Sunset, in its sole discretion, shall be entitled to determine whether to commence commercial production on the Property and to choose the processing facility or facilities to be used to process the ore derived from the Property.

5.4.7 Sunset shall have the right to hedge its share of production.

Wood has relied on Manganese X for the assumptions used in the PEA regarding the GMR. Manganese X obtained external legal advice on the GMR when providing guidance and related risk disclosure to the QPs as described in Section 4.3.1.

4.3.1 Gross Metal Royalty Assumptions

For the purpose of the application of the GMR to the inputs of the cut-off for the Mineral Resource estimate, mine plan and economic analysis, the following assumptions have been made:

- 3% GMR
- The GMR is applied to the HPMSM product from the processing facility.
- Base case assumed price of the HPMSM for the GMR is US$2,900/t (HPMSM price source: CPM Group, April 20, 2022, "HPMSM Market Update" letter report to Manganese X).

In determining the GMR amount, no costs of any kind shall be deducted from the value of the product produced.

When providing the GMR guidance Manganese X identified the following risk factors:

- The Option Agreement contains significant ambiguity and vagueness with respect to certain terms of the GMR, including (i) the determination of the references prices that are to be used to value the metals and products that are produced from the Property; and (ii) the stage of production in the processing and value chain of deliverable metals within a production facility whereby the GMR becomes payable. The GMR is also silent or missing several terms typically found in a royalty agreement, such as: (a) terms addressing the transferability or assignability of the royalty by the royalty holder; (b) whether the consent of the property owner/miner is required for any such transfer or assignment of the royalty by the royalty holder; (c) whether the property owner/miner has a right of first refusal on any sale of the royalty by the royalty holder; and (d) whether the property owner/miner has a right or option to redeem or repurchase the royalty from the royalty holder.

- The Option Agreement has not been the subject of any litigation, arbitration, or interpretation proceedings and accordingly no findings or decisions have been made by any court, arbitrator, or independent expert regarding the specific interpretation of the Option Agreement. Alternate interpretations of the terms of the Option Agreement and the GMR that are reasonable may exist that may be legally enforceable.
- The guidance provided by Manganese X to Wood regarding the application of the GMR for the purpose of this 2022 Battery Hill NI 43-101 Technical Report should not be relied upon as a legal opinion regarding the interpretation of the Option Agreement and its legal enforceability.
- Manganese X does not currently have a committed customer or offtake purchaser for any HPMSM and there is no assurance that Manganese X will be able to market and sell any HPMSM at the price indicated in the report by CPM.

4.4 Surface Rights and Permitting

The following information was obtained from the Natural Resources and Energy Development (https://www2.gnb.ca/content/gnb/en/departments/erd/energy/content/minerals/content/Minerals_exploration/LandAccessAndUse.html)

As defined under the New Brunswick Mining Act (Mining Act), minerals are generally owned by the Crown.

Crown-owned minerals are property separate from the soil; that is, a landowner owns the surface rights but does not own mineral rights. By means of the Mining Act, the province makes Crown-owned minerals available for exploration and development. Prospectors (persons or companies that hold prospecting licences), holders of claims, and holders of mining leases have the right to prospect, explore, mine, and produce those minerals, whether they are on Crown-owned or privately-owned lands. They also have the right of access to the minerals; however, they are liable for any damage they cause.

Land access permission is required from surface rights holders in New Brunswick before mineral exploration activities can be undertaken. Surface titles to lands covered by the Property are held by various private landowners or the Province of New Brunswick. For both Crown land and private land, mineral exploration licence holders must come to an agreement with the landholder in order to gain the right to access and be able to conduct exploration work on the land.

For work on Crown land, it is necessary to submit a Notice of Planned Work on Crown Land. A Notice of Planned Work on Private Land must be delivered to the landowner if intrusive work of any kind is planned. The claim holder must attempt to reach an agreement with the landowner regarding any surface disturbance such as damage and/or interference with use and enjoyment of the land, including plans for reclamation. The claim holder is required to notify landowners prior to each year of work.

4.5 Permits or Agreements Required for Exploration Activities

The Project is located on private lands. Manganese X has executed land access agreements with private landowners to complete the exploration work on its mineral claims (diamond drilling). Amendments to these land access agreements will be required to conduct prospecting, geochemical surveys, ground geophysical surveys requiring line cutting, trenching, and all drilling activities. These land access agreements will cover any land disturbance or other damage associated with the intended exploration work and need to be renewed on a regular basis.

Refer to Section 20 with regards to required permits.

4.6 Environmental Liabilities

The Moody Hill, Maple Hill and Iron Ore Hill historical mine workings contain open trenches, pits, and possibly one inclined shaft at Iron Ore Hill. These can be considered minor environmental disturbances since they are over 150 years old in an area of current agricultural disturbances.

4.7 Significant Risk Factors

The QP has identified the following risk factors that may affect access, title, or the right or ability to perform work on the Property:

- The footprint for establishing the Project infrastructure will require agreements from local landowners and adjacent mineral title holder, which is at an early stage of assessment.
- See also the significant risk factors identified regarding the GMR in Section 4.3.1.

5.0 ACCESSIBILITY, CLIMATE, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 Accessibility

The region can be accessed via the Trans-Canada Highway or Route 95 which joins the I-95 Interstate highway at the USA border. Mineral Claim 5816 can easily be accessed via Route 560 from which the claim units are transected in an east-west direction by Lockhart Mill Road, Iron Ore Hill Road, Burtt Road, Hopkins Road and Kirk Road, all just west of the village of Jacksonville. For Mineral Claim 5745, access is from Route 95, approximately 10 km west of Woodstock.

The closest international airport is the Greater Moncton Roméo LeBlanc International Airport (YQM) located approximately 270 km southeast of the Project. Regional airline service (Air Canada and Porter Airlines) is also available from Saint John Airport (YSJ) and Fredericton Airport (YFC) with daily direct flights from Montréal and Toronto.

5.2 Climate and Physiography

The Project is in the temperate zone of North America, and although the property is within 157 km of the ocean (Bay of Fundy), climatic conditions are more humid continental, governed by the eastward flow of continental weather patterns. The average annual temperature is approximately 10°C, with an average summer maximum of 30°C and an average winter minimum of -30°C. Winter conditions are prevalent at the site from late November until early April. Frost depth is approximately 2.0 m. Annual precipitation is approximately 1,000 mm with 60% of this occurring as rain and the remainder as snow. Mineral exploration field programs can efficiently be undertaken from May through to late November in all areas. Programs such as drilling and geophysical surveys can also be implemented year-round but delays due to poor winter weather conditions such as heavy snow fall should be expected.

The Project is located within the Saint John River watershed and is primarily agricultural land with forested sections. Overburden thickness can reach 10 m in depth. Topographic elevations on the Mineral Claims range between 120 and 180 m above sea level (masl). Surface drainage systems consist of abundant small lakes, rivers, and streams.

5.3 Local Resources and Infrastructure

The Project is well positioned with respect to infrastructure. The town of Woodstock (population approximately 5,200), which includes full-service accommodations, gas stations, grocery stores and restaurants, tool rentals and hardware stores, plus hospital, police, and fire services. Agriculture is the predominant land use in the Project area. Railway transportation is accessible in Houlton, Maine (population approximately 6,100), approximately 15 km west of the Project and also in McAdam, New Brunswick, approximately 75 km to the south. Access to the provincial electrical grid system is available approximately 2 km east of the site.

The surface drainage systems present in the Saint John River watershed provide readily accessible potential water sources for incidental exploration use such as diamond drilling. They also provide good potential as higher volume sources of water such as those potentially required for future mining and milling operations. Groundwater resources are typically used for household and commercial water supply in the region and are considered a good potential for water supply for the Project.

Exploration staff and consultants, as well as forestry, heavy equipment and drilling contractors can be sourced from within New Brunswick and surrounding provinces such as Nova Scotia and Quebec. The agriculture and forestry sectors are the major employers in the region, with J.D. Irving Ltd. being dominant in western New Brunswick. The local, rural and urban communities of the region provide a large base of skilled trades, professional, and service sector support that can be accessed for exploration and resource development purposes.

Additional information on surface land requirements, availability and sources of power, water, mining personnel, potential tailings storage, waste disposal areas, and potential processing plant sites relevant to the Project is provided in Section 18.

6.0 HISTORY

6.1 Historical Assessment Work

Past exploration work on the Property consists of surface exploration activities such as ground geophysics, drilling, and geological mapping. The historical work on the Property has mainly focused on Mineral Claim 5816 which contains the Moody Hill, Iron Ore Hill, Maple Hill, Wakefield, and Sharpe Farm manganese-iron mineral occurrences.

The manganese-iron occurrences in the Woodstock area were first discovered by Dr. C.T. Jackson in conjunction with a geological study of the State of Maine in 1836. Initial development interests were focused on the recovery of iron. In 1848, the Woodstock Charcoal and Iron Co. was formed, and two small blast furnaces operated between then and the early 1860's. Most of the mining activity during this time was primarily in the Iron Ore Hill area. No further work was undertaken after the close of the mine in the 1860s until Strategic Materials Corporation (Stratmat) commenced exploration efforts in the area in the early 1950s.

Between 1953 and 1960, Stratmat conducted various metallurgical investigations and field work consisting of ground geophysical exploration followed by diamond drilling (Sidwell, 1957). Reconnaissance gravity surveys were conducted southwest from the Iron Ore Hill area to the Maine border. During this time Stratmat completed a total of 10,370 m of drilling, of which 5,300 m was completed on the Plymouth deposit, located several kilometres southwest of Mineral Claim 5816. This deposit is not held by Manganese X. Historical drill logs from this program are no longer available, but drilling results are reported in Sidwell (1957). As a result of this work, Stratmat identified the South Hartford, North Hartford, Plymouth, Moody Hill, and Sharpe Farm deposits. Sidwell (1957) reported approximate tonnages and grades for each of these deposits, but the estimates are considered historical in nature and do not comply with the CIM Definition Standards. In 1986, Mineral Resource Research Limited (MRSL), on behalf of the New Brunswick Department of Natural Resources, completed limited drilling, minor bulk sampling, and a magnetometer survey on the Plymouth deposit (Roberts and Prince, 1990).

In 2010, Globex took ownership of the Property and commenced exploration activities by collecting rock samples near the Iron Ore Hill historical workings. A total of seven rock samples were tested and confirmed the presence of higher grades of manganese than had been reported in the historical testing, as well as abundant quantities of lower grade material (MacKinnon, 2011). As a result of this initial sampling, a follow up sampling program was completed and consisted of 59 rock samples taken along intermittent outcrops in a ditch adjacent to the historical workings. The results of this program returned manganese values from 1% to 26.15% MnO (26.15% MnO contains 20.25 weight percent elemental Mn). Higher grade results were obtained from black, sub-metallic layers in the mixed, predominantly brick red and maroon alternating bands within the mineralized horizon. Maroon layers provided the next highest grades (MacKinnon, 2011).

In 2011, Globex completed a diamond drilling program and a 64 km magnetometer survey over Mineral Claim 5816. The 2011 drilling program consisted of a single diamond drill hole on Mineral Claim 5745 for a total of 175 m, and two drill holes on Mineral Claim 5816 for a total of 377 m. The holes drilled on Mineral Claim 5816 were drilled to intersect mineralization in area of the historical workings at the Iron Ore Hill mineral occurrence. The highest-grade manganese mineralization was observed in both the maroon and green siltstone units.

6.2 Regional and Government Survey Work

In 1952, the New Brunswick Resources Development Board completed a review of New Brunswick manganese occurrences (Sidwell, 1952), and in 1954 the Geological Survey of Canada (GSC) completed a preliminary review of the Woodstock area manganese occurrences. The United States Bureau of Mines and Maine Geological Survey also initiated studies of similar manganese deposits, across the US border in Aroostook County, Maine in 1952.

In 1968, the Geological Survey of Canada published a Memoir on the Woodstock area that included a regional geological map showing locations of the various manganese-iron prospects (Anderson, 1968). This report provided detailed descriptions of the main Woodstock area manganese deposits and documented the location of several manganese-iron occurrences located southwest of the Plymouth Deposit and extending south to the Maine border.

6.3 Past Production

Small-scale production from the Woodstock area iron-manganese occurrences occurred shortly after their discovery in 1848 with a reported 63,502 t mined from the Iron Ore Hill occurrence with a lesser amount from the Moody Hill occurrence (Sidwell, 1957). Gross (1967) reported that the manganese-iron produced from the Woodstock area during this period was found to have exceptionally good physical qualities and was shipped to England for use by the Royal Navy for armour plating gunboats.

7.0 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

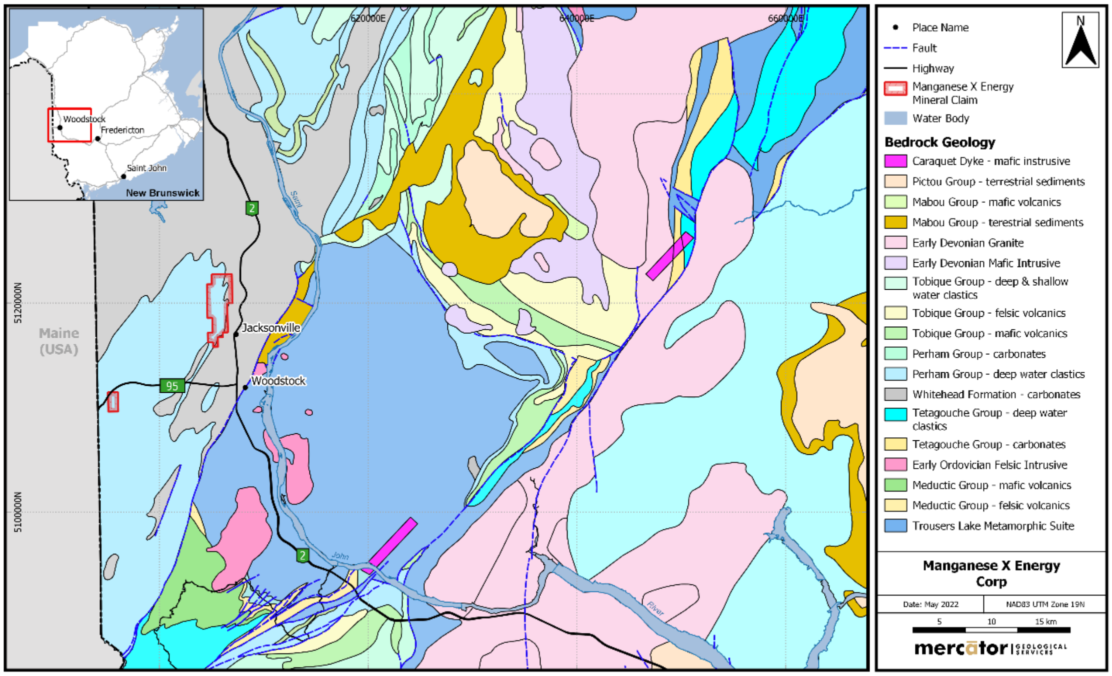
The sedimentary units that host the manganese-iron mineralization in the Woodstock area occur within the Smyrna Mills Formation of the Silurian Perham Group (Figure 7-1). These sedimentary units are in contact with the Carboniferous Mabou Group several kilometres to the east, and the argillaceous limestone and calcareous shale units of the Late Ordovician to Silurian White Head Formation immediately to the east (Smith and Fyffe, 2006).

Hamilton-Smith (1972) reported a large syncline passing through the area of the Property, but Potter (1983) described an anticline through the same area. From drill sections it appears the latter would be accurate. This folding event is attributed to the Acadian Orogeny. A weaker, later system of cross folds occurring in the southeastern area of the mineralized strata may be attributed to the later stages of the same orogeny but do not appear to have significantly affected the structure in the Property. Large- and small-scale faulting has also been described in geological studies of the area (Hamilton-Smith, 1972 and Potter, 1983) with northeast-southwest orientations similar to the main axis of folding noted.

Caley (1936) proposed the Woodstock manganese-iron mineralization deposition environment as one of offshore hydrothermal conditions resulting in a chemical precipitate accompanied by volcanic activity. Miller (1947) suggested similar deposits in Maine were derived from subaerial weathering and erosion of volcanic rocks. Sidwell (1957) concurred with the latter explanation and stated that the second stage of remobilization and mineralization was likely hydrothermal and restricted to those occurrences of the manganese-iron assemblage in zones of intense structural deformation.

More recent work from investigations resulting from a Master of Science thesis by Way (2012) indicates the mineral bearing strata were initially derived from hydrogenous-detrital sources without any indication of an hydrothermal input as a source of manganese-iron. This conclusion was based on the observation that sodium/magnesium ratios, chondrite normalized rare earth element (REE) patterns, and mineralogical evidence of rapid changes in ocean redox conditions suggest the mineralized lithofacies were formed in an offshore zone of a continental shelf on a stable cratonic margin.

Figure 7-1: Regional Geological Map of Woodstock Area

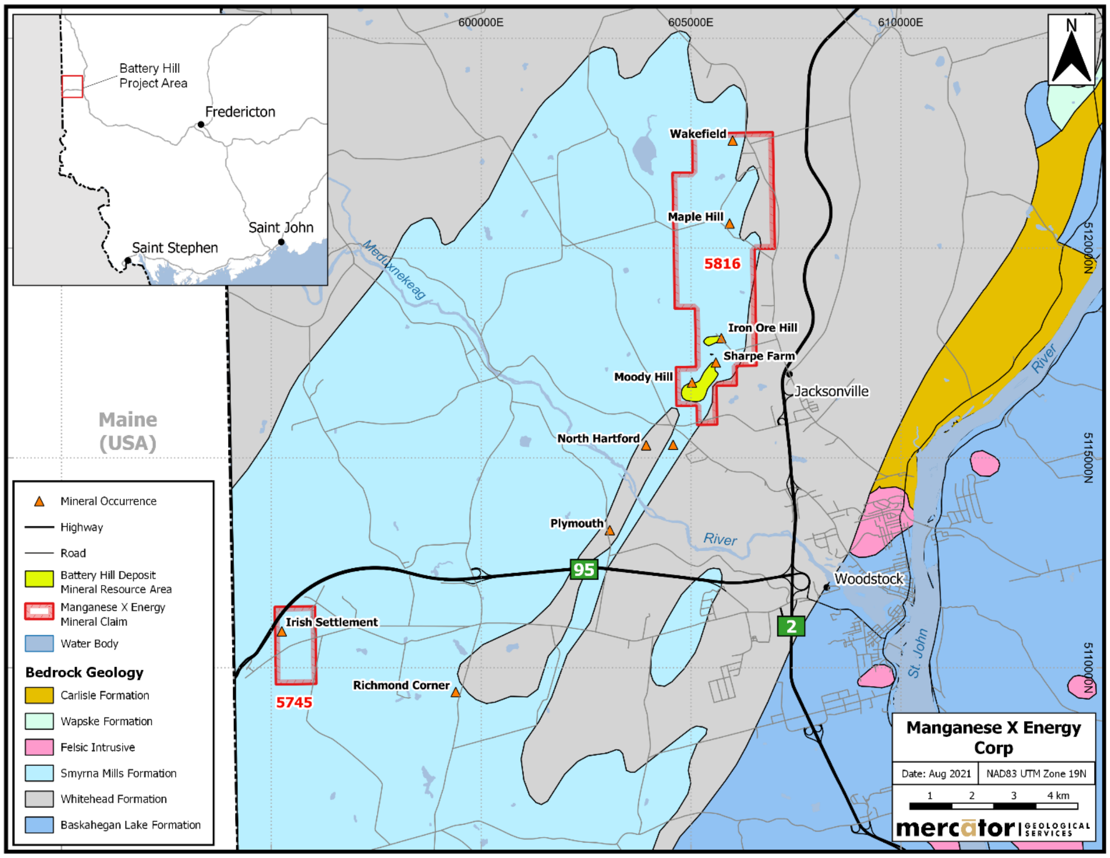


Source: prepared by Mercator, dated 2021

7.2 Property Geology

The sedimentary units that host the manganese-iron mineralization in the Woodstock area occur near the base of the Smyrna Mills Formation of the Silurian Perham Group (Figure 7-2). Smith and Fyffe (2006) describe the Smyrna Mills Formation as comprised of dark grey, non-calcareous silty shale and associated ferro-manganiferous siltstone, and dark grey calcareous shale interbedded with medium grey calcareous quartzose sandstone. It also includes green calcareous sandstone, light grey, crystalline limestone, green nodular limestone, grey polymictic conglomerate, and minor red shale and dark grey laminated, graptolitic siltstone. The underlying Whitehead Formation is Silurian to Ordovician in age and forms part of the Matapedia Group. It consists of dark grey to bluish grey, massive to abundantly laminated, very fine-grained argillaceous limestone interbedded with calcareous shale.

Figure 7-2: Geology of the Battery Hill Manganese Property



Source: prepared by Mercator, dated 2021

Based on previous drilling on the Iron Ore Hill occurrence, the main intervals of manganese-iron interest within the Smyrna Mills Formation consist of brick red and maroon hematite-rich siltstones and weakly magnetic green siltstones. The highest manganese results are encountered in the brick red to maroon, hematite-bearing units containing the manganese carbonate mineral rhodochrosite. Iron oxides such as magnetite and ilmenite are also present at lower levels. The slightly magnetic, altered green siltstones commonly include the iron carbonate mineral siderite. Non-magnetic green and black siltstone beds present in the stratigraphic section do not carry iron and manganese grades of potential economic interest.

The manganese and iron mineralization of potential economic interest within the Property is bedded and stratiform in nature and is recognized as being of primary sedimentary origin. Manganese occurs predominantly in the form of the carbonate mineral rhodochrosite, and iron occurs in both oxide (hematite, magnetite, and ilmenite) and carbonate minerals (predominantly siderite) (Figure 7-3 and Figure 7-4).

Figure 7-3: Core Photo (122 m depth) of Moody Hill Central Drill Hole SF16-08 (High Grade Manganese Zone)

Figure 7-4: Core Photo of Moody Hill Central Drill Hole SF16-08 (120 to 132 m) with Green Grey Lithologies and Manganese-Iron Mineralization

Manganese X drill sections show that an anticlinal structure showing upright, tight folding style trends northeast across the Property. As noted above, the related folding event is attributed to the mid-Devonian Acadian Orogeny and a weaker set of cross folds present in the southeastern part of the Property is similarly assigned. These folds have not significantly affected strata of potential economic interest in the Property. Folding has resulted in substantial thickening of mineralized units in fold hinge zones, and this locally produced broad zones of near-surface mineralization that may be particularly amenable to open-pit mining techniques. Faulting has also contributed to structural thickening of the mineralized beds with folding and faulting together locally creating widths of more than 200 m.

Large- and small-scale northeast-southwest trending faults have been mapped in the area and are broadly similar in orientation to the axial surface trends of the dominant fold set that affects the manganese-iron mineralization (Hamilton-Smith, 1972). An east-west trending, sinistral fault offsets the main mineralized sequence by approximately 650 m north of the area hosting the North and South Hartford occurrences, near the southern end of Mineral Claim 5816.

Other than in the areas of historical excavation such as at Moody Hill, very few bedrock outcrops occur in the Project area. However, it is reported that poor exposures can locally be viewed in some of the cultivated fields prior to planting or after harvest season. The average depth of overburden ranges from 2 to 4 m.

7.3 Manganese-Iron Mineralization and Mineral Occurrences

The manganese-iron mineralization encountered in the Battery Hill Property tends to be lenticular, stratiform and generally steeply dipping in form, having been shaped and thickened by tight folding and possible faulting. In the Iron Ore Hill area, tight folds with steep northwest plunges have been noted. In the Moody Hill historical open-cut workings, several folds showing shallow southerly plunges are present. Further detailed structural mapping is required to improve the structural interpretation of the area.

To date, five main areas of mineralization (mineral occurrences) have been defined within the Property, these being Wakefield, Maple Hill, Iron Ore Hill, Sharpe Farm and Moody Hill. Figure 7-2 identifies the occurrence locations within Mineral Claim 5816.

7.3.1 Wakefield Occurrence

The Wakefield mineral occurrence occurs on the far northern extent of Mineral Claim 5816. This occurrence was one the of the original discoveries identified by C.T. Jackson during an 1836 geological mapping program (MacKinnon, 2020). Detailed work has not been completed for this mineral occurrence to date by Manganese X because it is located in a cultivated area near residential homes.

7.3.2 Maple Hill Occurrence

The Maple Hill mineral occurrence is located 2 km south-southwest of the Wakefield occurrence in a wooded patch that measures approximately 175 to 200 m^2 in area. Historical trenching on this occurrence exhibited less manganese-iron mineralization than seen at the Moody Hill or Iron Ore Hill occurrences, though higher grade material has been reported (MacKinnon, 2011). In comparing the known location of the occurrence to the geophysical response of the 2011 Globex magnetometer survey, the deposit is located on the extreme western edge of the magnetic field anomaly where response is weak to moderate compared to much of the rest of the anomaly. The large area of strongest response located on the eastern edge of the survey in the Maple Hill area has not yet been ground checked by Manganese X.

7.3.3 Iron Ore Hill Occurrence

The Iron Ore Hill historical workings are located approximately 3 km south of the Maple Hill occurrence. In the early 1950's, Stratmat identified a strong gravity anomaly measuring approximately 762 m in strike length. Globex's 2011 magnetometer survey confirmed a similar sized anomaly centered on the Iron Ore Hill area. The historical workings are still visible at the site which produced approximately 63,502 t of iron (MacKinnon, 2020).

Sampling on and near the historical workings by Globex in 2010 confirmed the presence of higher grades of manganese than had been reported in previous testing, and also identified an abundance of lower grade material. As a result of this sampling, an additional 59 samples were collected, mainly along intermittent outcroppings in a ditch adjacent to the historical workings. Higher grade results were obtained from black, sub-metallic layers in the mixed, predominantly brick red and maroon alternating beds within the mineralized horizon. Maroon layers provided the next highest manganese grades.

7.3.4 Sharpe Farm Occurrence

The Sharpe Farm occurrence is located southwest of the Iron Ore Hill occurrence. Sidwell (1957) described it as coinciding with a 792 m long gravity anomaly that is substantially weaker than the anomaly associated with the Iron Ore Hill occurrence. Two holes drilled at that time were reported to have intersected silicified slates showing an average width of 45.7 m with an average grade of 9% Mn.

The 2011 Globex magnetometer survey identified a moderate to strong circular anomaly with two smaller responses extending in a semi-continuous manner northeastward toward the Iron Ore Hill occurrence. This anomaly is the second strongest in the survey, after the Iron Ore Hill occurrence, and is over 400 m in diameter. Including the area between this and the Iron Ore Hill occurrence, the total length of the northeast-southwest trending anomaly is 700 m. Ground checking by Manganese X resulted in the discovery of a few historical trenches as the only evidence of historical workings (MacKinnon, 2012).

7.3.5 Moody Hill Occurrence

Sidwell (1957) describes the Moody Hill occurrence as a 518 m long weak to moderate magnetometer survey anomaly compared to the Iron Ore Hill occurrence, with historical drilling results indicating a width of 251 m. Ground checking of the occurrence by Manganese X revealed several 1 to 5 m deep and up to 30 m long trenches. No samples collected at that time were analyzed but many of the rocks viewed appeared to be similar to units present at the Iron Ore Hill occurrence (MacKinnon, 2011).

Diamond drilling by Manganese X on the Moody Hill occurrence defined the spatial aspects of this significant manganese-iron deposit.

8.0 DEPOSIT TYPES

New Brunswick's manganese-iron occurrences have been divided into two broad types according to whether manganese mineralization is primary or secondary (Webb, 2008). The two divisions are further categorized on the basis of regional and localized geological setting. The Battery Hill deposits are considered to be of primary, sedimentary origin.

Manganese mineralization in primary manganese deposits develops syngenetically with deposition of the host rocks. Significant deposits of this type in New Brunswick occur in two geological settings:

- Silurian sedimentary rocks: manganese and iron mineralization resulting from oxidization of manganese and iron in ambient seawater during the deposition of sediments in marine basins
- Ordovician volcanogenic–sedimentary rocks: manganese and iron mineralization derived largely from hydrothermal fluids associated with submarine volcanism.

New Brunswick's largest and most extensive known manganese deposits occur within the Silurian sedimentary sequence near Woodstock, which hosts the Battery Hill deposits as well as the adjacent Plymouth deposit owned by Canadian Manganese Company Inc. (Kesavanathan et al., 2014). These stratified manganese-iron deposits are associated with red and grey, siliciclastic to calcareous siltstone and shale of the Smyrna Mills Formation (Perham Group). Manganese content in the rocks is interpreted to have been deposited from seawater in an oxygen-rich environment. Following deposition and lithification, the manganese-bearing horizons underwent structural thickening due to repeated folding and faulting.

Manganese is predominantly present at the Property in the form of the carbonate mineral rhodochrosite and iron occurs in both oxide (hematite, magnetite, and ilmenite) and carbonate minerals (predominantly siderite). The mineralization comprising the current Mineral Resource estimate has been classified by some past workers as being of the Algoma Type banded iron-formation (BIF) group. More recent research reported by Way (2012) indicates that the Battery Hill Deposit and others within this stratigraphic setting can be most accurately classified as Clinton Type sedimentary iron deposits as defined by Gross (1996).

9.0 EXPLORATION

9.1 Overview

Exploration work completed by Manganese X on the Property prior to the current Mineral Resource estimate includes ground gravity and magnetometer surveys, three programs of core drilling, and a preliminary deposit modelling program designed to facilitate drill program planning. The geophysical and drilling programs are described below.

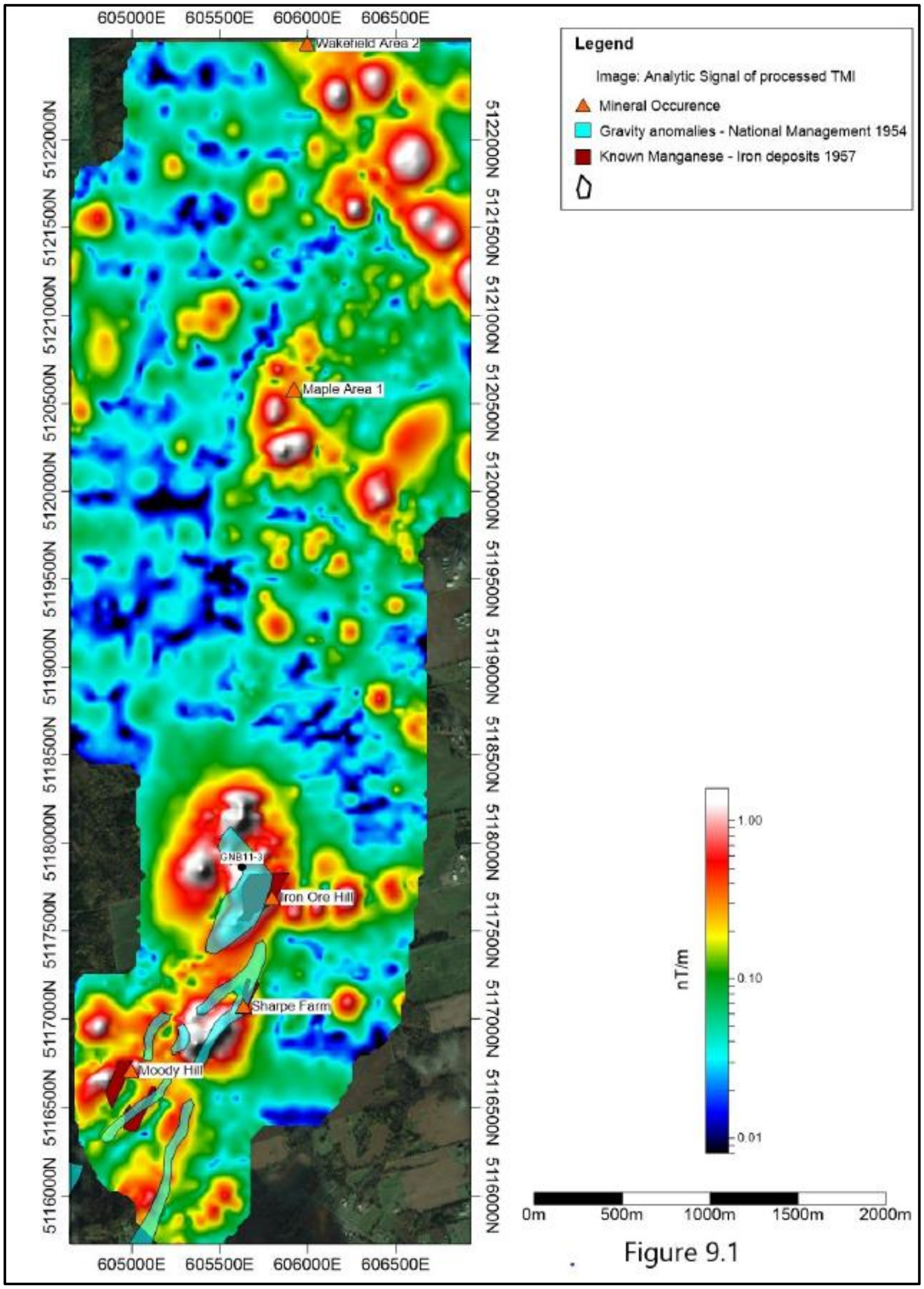
9.2 Ground Gravity and Magnetometer Surveys

In 2016, Eastern Geophysics completed ground gravity and magnetometer surveys that covered all of Mineral Claim 5816. The surveys were planned over the same area as the 2011 Globex magnetometer survey with the purpose of providing follow-up testing and enhancement of the data collected by Manganese X in 2011. The 2016 ground gravity survey consisted of 164 stations along 4 km lines at 100 m line separation. The anomalous gravity survey results closely coincide with the 2011 Globex magnetometer survey positive anomalies and provide better definition of potential drilling target areas.

The gravity survey was followed later in 2016 by a 124-line km ground magnetometer survey (Figure 9-1). This survey was planned with a 50-m offset north-south from the 2011 Globex survey to provide an effective line spacing. Data for both the 2011 and 2016 surveys were collected using GEM GSM-19W (Overhauser Effect) magnetometers. One was deployed as a base station and the other as the rover. For the 2016 survey, data was acquired in continuous acquisition mode using a sample rate of one reading per second. The 2016 survey provided better definition of anomalies with a sample interval of 1 m compared to the 2011 survey which had a line sample interval of approximately 12.5 m.

AusieCan Geoscience Inc. (AusieCan) was contracted by Manganese X to process the 2016 ground magnetic data and merge it with the geophysical data collected in 2011. Several modelling methods were used, and a 3D magnetic susceptibility model was developed. AusieCan observed that the 3D model is in reasonable agreement with the geological model of the area in that it depicts steeply dipping and tightly folded structures. In overlaying the 1950s historical gravity results with the 2016 gravity and magnetometer results, AusieCan noted reasonable correlation, with some exceptions.

Figure 9-1: 2016 Ground Magnetometer Survey Results



Source: MacKinnon, 2020

The 2016 magnetometer survey expanded on the existing coverage area mainly in the northern regions of the grid and doubled the coverage density of the previous survey by surveying between the previous survey lines. In addition, permission was received to survey a small, but important, area near the Iron Ore Hill occurrence that was not covered in the 2011 Globex survey. The 2011 Globex survey identified well-defined anomalies from Iron Ore Hill, southwest to Moody Hill and off Mineral Claim 5816 to the south.

The strongest anomaly in the north coincides with a line of houses along Route 560 in the north of Jacksonville, which may reflect cultural influence. Several smaller anomalies west of this area appear to be away from any cultural effects but are smaller compared to the Moody Hill and Iron Ore Hill anomalies (see Figure 9-1).

The AusieCan interpretation of the 2016 geophysical survey identified Iron Ore Hill as containing five of the six best targets on the grid, with weakly anomalous areas occurring throughout the Sharpe Farm and Moody Hill areas. The Sharpe Farm and Iron Ore Hill anomalies are interpreted to be connected, as the magnetometer results show some separation between the individual occurrences, possibly due to faulting or as a result of an interference folding pattern (see Figure 9-1). AusieCan cautioned that in areas of tight folding, results and therefore the interpretation may be misleading, as there can be cancelling magnetic effects due to close repeating of magnetic horizons leading to apparent magnetic lows where in fact strongly magnetic material may be present.

9.3 Preliminary Deposit Modelling to Support Drill Planning

In 2017, Manganese X contracted Mercator to complete preliminary solid models and a grade and tonnage block model assessment to facilitate further internal drill program planning and also to support a future Mineral Resource estimate. The work completed focused on the three main mineralized zones on Mineral Claim 5816 (Moody Hill, Sharpe Farm, and Iron Ore Hill) and examined results from the confirmation drilling programs carried out by Manganese X that consisted of 25 holes totalling 5,188 m completed in 2016 and 2017. Mercator received digital project data from Manganese X, including drill logs, drill core assay results, drill hole collar and downhole survey results, core specific gravity measurements, core photos and associated reports. A project drill hole database was created by Mercator and imported into GEOVIA Surpac ver. 6.8 modelling software. A full data review and validation of the database was not completed by Mercator during this study.

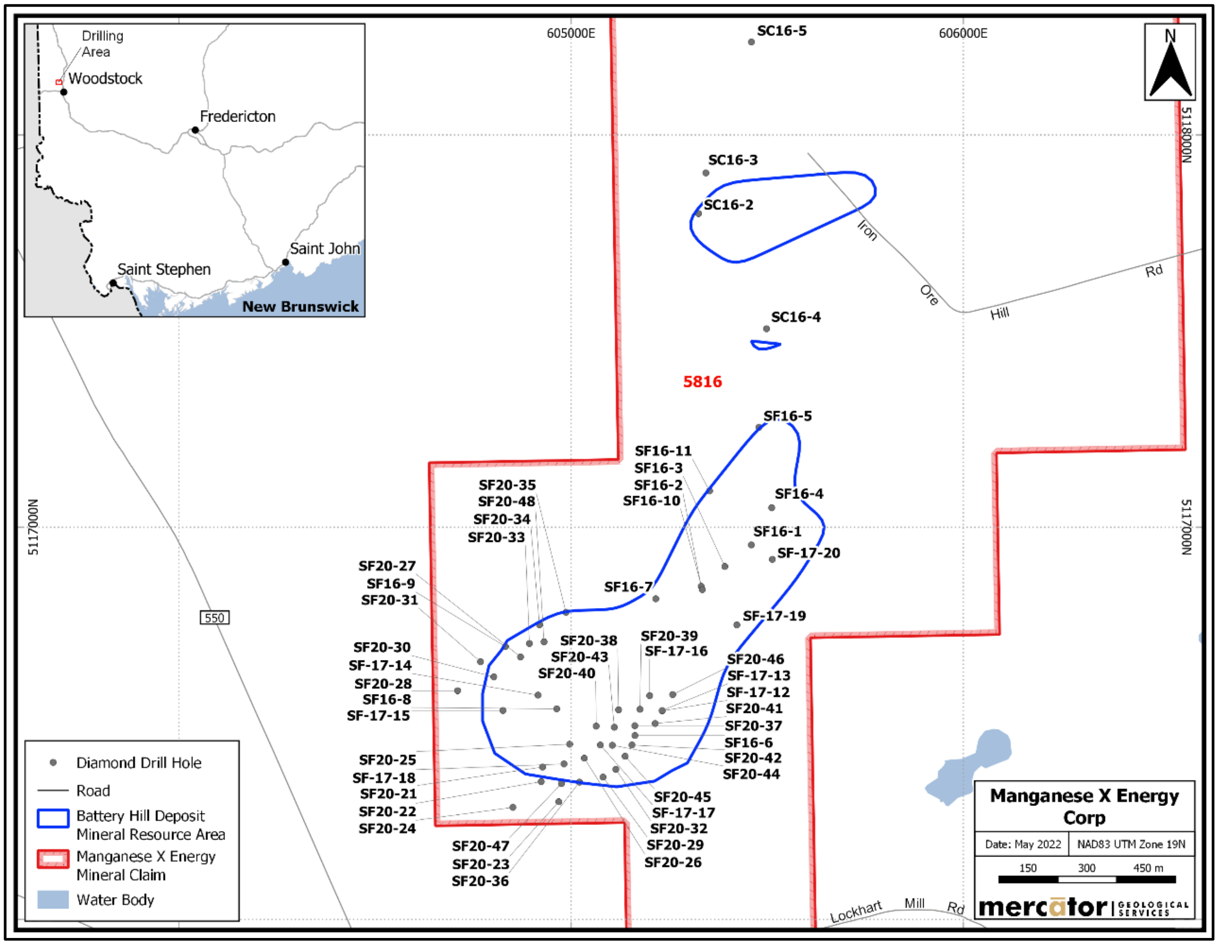
Results of the block modelling were reviewed in three dimensions on a section-by-section basis, and it was determined that block grade distributions had acceptable correlation with grade distribution of the underlying drill hole data. Block volume estimates for each area were also shown to have acceptable correlation with the supporting solid model volume reports. Average grade values for each area compared favorably with the average grade values of the underlying assay composite dataset. The 2017 program by Mercator was subsequently expanded upon through completion of additional core drilling in 2020 but formed an important initial aspect of the modelling program completed in support of the Mineral Resource estimate described in this Report.

10.0 DRILLING

This section describes the diamond drilling programs completed by Manganese X in 2016, 2017, and 2020 on the Moody Hill, Sharpe Farm, and Iron Ore Hill target areas. Drill hole results from these three drilling programs are included in the current Mineral Resource estimate for the Project. Between March and April 2022, Manganese X completed one drill hole on Mineral Claim 5745 (Irish Settlement) located 11 km southeast of the Project, and three drill holes on Mineral Claim 5816 approximately 3.5 km north of the current Battery Hill Mineral Resource estimate. As of the effective date of this Report, core logging and assay results are pending for these four 2022 drill holes; however, these drill holes are not considered to have any material impact on the current Battery Hill Mineral Resource estimate, which has an effective date of May 12, 2022.

Details of the first two programs are reported in MacKinnon (2017) and Dahn (2018) and summarized below. The 2020 diamond drilling program was completed in November of 2020 and highlights were disclosed in a Manganese X news release dated February 16, 2021 and are also summarized below. Drill hole locations for the 2016, 2017 and 2020 drilling programs are shown in Figure 10-1. Manganese X provided Mercator with all supporting data and reports associated with these drilling programs, including a digital drilling database and complete certified records of laboratory analysis.

Figure 10-1: Drill Hole Locations for the 2016, 2017, and 2020 Manganese X Drilling Programs



Source: prepared by Mercator, dated 2021

10.1 2016 Drilling Program

In 2016, Manganese X completed a diamond drill program consisting of 16 drill holes for a total of 3,572 m of NQ-sized core. Diamond drilling was completed by Maritime Diamond Drilling Ltd. (Maritime Drilling) of Brookfield, Nova Scotia using an EF-50 drill rig and Lantech Drilling Services Inc. (Lantech) of Dieppe, New Brunswick using a Longyear 38 drilling rig. Drilling activities focused on the southern area of Mineral Claim 5816 (Jacksonville) where the strongest anomalies occurred in the 2016 magnetometer survey. Five holes totalling 1,051 m were drilled on the Iron Ore Hill area of the claims, while the remaining 2,521 m was drilled on the Moody Hill and Sharpe Farm areas. All permits required for drilling were obtained, including access permission from the private landowner. A total of 1,041 samples were selected for laboratory testing using XRF whole rock analysis methods.

The core was logged and marked for sampling and details of lithologies, structure, alteration, and mineralization were recorded in a digital spreadsheet template. Prior to sampling, all drill core was photographed using a standardized format and digital camera to provide a permanent pre-sampling record for each hole. Core selected for sampling was cut in half using a diamond saw and a sample tag was stapled in the core boxes at the beginning of each sample interval. Excessive core loss was not encountered. All drill holes were surveyed by a local surveyor using a digital global positioning system (DGPS) surveying equipment.

The average strike of the rocks in the Iron Ore Hill area is 020° azimuth and the tight folding plunges steeply to the northwest. Drilling on the site was carried out along sections oriented at 110° azimuth. All 16 holes were drilled with a -45° dip. Down hole survey measurements were taken at an average of 50 m intervals with a Reflex downhole tool. Many of the drill holes had trouble securing the casing, which often vibrated loose and additional casing had to be added. This was due to soft and fractured rock present near surface, which resulted in poor recovery for the first few metres. Below this point, the core recovery improved with approximately 100% recovery, except for a few areas where cavities were intersected. These minor core recovery issues noted above do not have an impact on accuracy and reliability of the drilling results. QAQC samples including blanks and CRMs were inserted into the sample stream at regular intervals for laboratory analyses along with blind duplicates.

Specific gravity (SG) measurements for all holes except SC16-1 and SC16-2 were recorded when the geological unit in the hole changed. The Archimedes method was used, and two digital weight scales were used to take required measurements. A dry representative portion of the unit was first weighed in air on one of the scales. The same sample portion was then placed in a container of water located on the second scale and weighed to determine the sample weight in water. The SG value was calculated by dividing the dry measurement by the difference between the dry and wet measurements. The general equation for this calculation is:

Specific Gravity = Weight (air) / (Weight (air) – Weight (water))

Non mineralized material returned SG values of approximately 2.78, while the mineralized material returned a maximum SG value of 3.75.

Drill core from the 2016 drilling program is currently stored at the New Brunswick Department of Natural Resources core storage facility in Sussex, New Brunswick.

10.1.1 Iron Ore Hill Target

Five diamond drill holes (SC16-1 to SC16-5) totalling 1,051 m were drilled at the Iron Ore Hill target area. This drill hole program was designed to target mineralization in the historical Iron Ore Hill workings area and to test for extension of manganese mineralization along the high magnetic anomalies identified in the 2016 magnetometer survey completed for Manganese X. Drilling revealed that bedrock sequences are predominately comprised of black, grey, green, and various shades of red fine-grained siltstones. Calcareous siltstone and minor tuffaceous beds were also present. The highest manganese value returned correlates with an interval of grey green siltstone. A summary of the Iron Ore Hill drill holes is shown in Table 10-1 and significant intercepts are shown in Table 10-2.

Table 10-1: Summary of Iron Ore Hill 2016 Diamond Drill Holes

Hole No.	Easting (m)	Northing (m)	Elevation (m)	Azimuth (degree)	Dip (degree)	Total Depth (m)
SC16-1	605500.3	5117825.9	185.4	135	-45	173
SC16-2	605325.1	5117799.6	177.5	135	-45	284
SC16-3	605343.7	5117903.3	175.8	135	-45	149
SC16-4	605498.4	5117505.7	187.7	135	-45	203
SC16-5	605459.9	5118237.2	179.5	135	-45	242

Note: All coordinates shown in NAD83 Zone 19.

Table 10-2: Significant Intercepts for the Iron Ore Hill 2016 Drilling Program

Hole No.	From (m)	To (m)	*Length (m)	Mn (%)	Fe (%)
SC16-1	52.0	74.0	22.0	8.16	11.38
Incl.	64.0	74.0	10.0	9.11	11.87
SC16-1	142.6	149.7	7.1	4.12	9.92
SC16-2	41.6	66.0	24.4	7.31	10.29
Incl.	41.6	58.0	16.4	8.55	11.79
Incl.	50.7	58.0	7.3	11.19	13.9
SC16-2	80.0	95.4	15.4	4.22	8.33
SC16-2	101.0	109.0	8.0	9.52	13.15
SC16-2	157.0	163.0	6.0	9.92	14.18
SC16-2	187.0	195.0	8.0	6.83	11.56
SC16-2	203.0	229.0	26.0	11.03	17.00
Incl.	215.0	227.0	12.0	16.66	23.32
SC16-3	135.0	143.0	8.0	9.74	16.99
SC16-4	11.0	17.0	6.0	7.81	14.99
SC16-4	47.0	59.0	12.0	9.39	13.07
SC16-5	47.6	49.6	2.0	11.72	14.35

10.1.2 Sharpe Farm and Moody Hill Targets

Eleven diamond drill holes totalling 2,521 m were drilled at the Sharpe Farm and Moody Hill target areas. Several surface measurements on bedrock trends in these areas indicate the strike of the rock units to be approximately 040 to 050° (azimuth), which agrees with the alignment of the linear high magnetic anomalies. The drilling program was designed to test for an extension of manganese mineralization along the high magnetic anomalies identified in the 2016 magnetometer survey completed for Manganese X. Drilling intercepted bedrock sequences comprised of fine-grained siltstones varying in shades of black, grey, green, buff and shades of red. Calcareous siltstone was also present. Manganese mineralization in the Sharpe Farm target area is dominantly hosted by fine grained, dark grey to black siltstones with some green to grey or buff-colored sequences. Little to no red or mixed types occur within the Sharpe Farm drill holes.

A summary of the Sharpe Farm and Moody Hill drill holes completed in 2016 is shown in Table 10-3 and significant intercepts are shown in Table 10-4.

Table 10-3: Summary of Sharpe Farm and Moody Hill 2016 Diamond Drill Holes

Hole No.	Easting (m)	Northing (m)	Elevation (m)	Azimuth (degree)	Dip (degree)	Total Depth (m)
SF16-1	605459.5	5116954.6	191.3	135	-45	276
SF16-2	605331.9	5116849.1	184.8	135	-45	246
SF16-3	605392.1	5116899.6	189.2	135	-45	211
SF16-4	605511.6	5117049.5	199.9	135	-45	170
SF16-5	605479.2	5117254.6	203.2	135	-45	152
SF16-6	605162.9	5116468.5	167.9	135	-45	207
SF16-7	605215.9	5116817.3	179.9	135	-45	304
SF16-8	604963.6	5116536.7	158.3	135	-45	303
SF16-9	604832.7	5116695.6	139.5	135	-45	198
SF16-10	605334.7	5116840.6	183.8	135	-45	170
SF16-11	605353.2	5117092.3	211.3	135	-45	302

Note: All coordinates shown in NAD83 Zone 19.

Table 10-4: Significant Intercepts for the Sharpe Farm and Moody Hill 2016 Drilling Program

Hole No.	From (m)	To (m)	Length (m)	Mn (%)	Fe (%)
SF16-1	4.00	91.70	87.70	9.35	16.54
Incl.	4.00	32.80	28.80	11.03	19.97
Incl.	40.80	50.25	9.45	10.42	14.35
Incl.	50.20	63.10	10.90	10.36	15.46
Incl.	72.15	91.70	19.55	11.03	17.53
SF16-2	8.50	21.00	12.50	6.82	10.78
SF16-2	35.10	112.00	78.90	8.89	13.41
Incl.	56.00	96.00	40.00	10.76	15.81
SF16-2	126.00	131.50	5.50	6.58	8.94
SF16-2	179.00	182.00	3.00	10.46	20.26
SF16-3	11.70	52.00	40.30	8.24	13.15
Incl.	26.65	41.00	14.35	12.10	16.88
SF16-3	76.50	87.15	10.65	7.06	10.44
SF16-3	118.50	132.00	13.50	10.53	16.06
SF16-3	145.15	152.85	7.70	8.65	11.14
SF16-4	19.40	24.50	5.10	7.49	8.55
SF16-4	31.50	55.60	24.10	6.50	10.71
Incl.	46.30	54.00	7.70	9.65	14.63
SF16-4	74.50	160.00	85.50	9.31	14.52
Incl.	74.50	114.00	39.50	10.51	16.07
Incl.	127.00	160.00	33.00	9.90	14.45
SF16-5	38.40	91.00	52.60	10.75	16.75
SF16-6	49.00	90.00	41.00	10.40	14.49
SF16-6	116.00	128.00	12.00	8.59	17.20
SF16-7	14.00	47.00	33.00	8.06	11.76
SF16-7	59.40	64.40	5.00	11.59	14.69
SF16-7	72.40	81.40	9.00	8.06	11.76
SF16-7	88.20	104.00	15.80	9.05	15.98
SF16-8	5.30	24.00	18.70	8.59	7.31
SF16-8	61.10	136.60	75.50	9.38	12.84
Incl.	103.75	136.60	32.85	12.96	14.99
SF16-9	33.00	64.50	31.50	8.10	13.40
SF16-9	80.00	117.80	37.80	7.65	14.54
Incl.	95.00	116.60	21.60	8.97	16.96
SF16-9	153.40	173.00	19.60	8.76	13.01
SF16-9	186.70	192.00	5.30	9.74	13.94
SF16-10	5.00	18.00	13.00	6.66	11.01
SF16-10	113.50	118.50	5.00	6.23	10.82
SF16-11	27.00	39.40	12.40	6.62	10.01
SF16-11	71.00	86.00	15.00	9.55	14.12

Note: True widths are estimated to range between 70 and 85% of core sample lengths.

10.2 2017 Drilling Program

Manganese X completed nine drill holes totalling 1,598 m of NQ-sized core on the Sharpe Farm and Moody Hill target areas between May 17, 2017, and June 8, 2017. The drilling program was completed by Maritime using an EF-50 drill rig. This program was designed to further delineate, expand, and improve the structural understanding of the manganese mineralization identified during the 2016 drilling program (MacKinnon, 2017). All drill holes were surveyed by a local surveyor using a DGPS surveying equipment. The same core logging and sampling, assaying, and QAQC protocols used in the 2016 drilling program were also utilized for the 2017 drilling program.

The core was logged and marked for sampling noting lithologies, structure, alteration, and mineralization. A spreadsheet template was used to enter logging and sampling information. Prior to sampling, all drill core was photographed using a standardized format and digital camera to provide a permanent pre-sampling record for each hole. Core selected for sampling was cut in half using a diamond rock saw, and a sample tag was stapled in the core boxes at the beginning of each sample interval. Excessive core loss was not encountered. Down hole survey measurements were taken at an average of 50 m intervals with a Reflex downhole tool. Many of the drill holes had trouble securing the casing, which often vibrated loose and additional casing had to be added. This was due to soft and fractured rock present near surface, which resulted in poor recovery for the first few metres. Below this point, the core recovery improved with approximately 100% recovery, except for a few areas where cavities were intersected. These minor core recovery issues noted above do not have an impact on accuracy and reliability of the drilling results. QAQC samples including blanks and CRMs were inserted into the sample stream at regular intervals for laboratory analyses along with blind duplicates.

SG determinations were carried out at the time of core logging using the same procedures applied in 2016 and discussed in Section 10.1. Non-mineralized material generally returned an SG value of approximately 2.78 whereas the manganese-iron mineralized material had a maximum value measured at 3.88.

Drill core from the 2017 drilling program is stored at the New Brunswick Department of Natural Resources core storage facility in Sussex, New Brunswick.

10.2.1 Moody Hill Target

The 2017 diamond drilling program in the Moody Hill area consisted of seven diamond drill holes totalling 1,315 m. To address key structural questions and to improve the overall structural understanding of the area, three holes (SF17-17, SF17-19 and SF17-20) were completed to scissor cut specific 2016 drilling intersections. The Moody Hill area drilling results define three main mineralized trends that are named from west to east: Moody West, Moody Hill Central and Moody Hill East. Moody Hill West has only been intersected by one drill hole (SF16-9). Moody Hill Central has been intersected by six drill holes (SF16-8, SF17-12, SF17-15, SF17-16, SF17-17, and SF17-18) over an approximate 300 m strike length to a maximum vertical depth of approximately 150 m (SF17-15). Moody Hill East has been intersected by two drill holes (SF16-6 and SF17-13) located approximately 100 m grid north of drill hole SF16-6. Most of the mineralization consists of mixed and red lithotypes with significant, but lesser, amounts of grey hosted mineralization. Each of these mineralized zones remains open for further resource expansion drilling. Highlighting the 2017 drill program results was hole SF17-18 that intersected 74.0 m grading 9.39% Mn and 14.72% Fe. A summary of the Moody Hill drill hole data for the 2017 program is shown in Table 10-5 and significant intercepts are shown in Table 10-6.

Table 10-5: Summary of Sharpe Farm and Moody Hill 2017 Diamond Drill Holes

Hole No.	Easting (m)	Northing (m)	Elevation (m)	Azimuth (degree)	Dip (degree)	Total Depth (m)
SF17-12	605232.4	5116531.6	171.8	315	-45	215
SF17-13	605232.4	5116532.6	171.8	135	-45	145
SF17-14	604916.1	5116571.6	151.8	315	-80	110
SF17-15	604826.3	5116532.5	137.6	135	-45	269
SF17-16	605200.4	5116570.4	170.5	315	-45	170
SF17-17	605074.8	5116444.6	166.2	315	-45	224
SF17-18	604982.1	5116396.2	158.4	315	-45	182
SF17-19	605422.9	5116750.7	173.6	315	-45	170
SF17-20	605513.3	5116917.8	187.1	315	-45	113

Note: All coordinates shown in NAD83 Zone 19.

Table 10-6: Significant Intercepts for the Sharpe Farm and Moody Hill 2017 Drilling Program

Hole No.	From (m)	To (m)	Length (m)	Mn (%)	Fe (%)
SF17-12	92.7	118.0	25.3	8.83	11.99
Incl.	92.7	107.0	14.3	11.25	13.53
SF17-13	31.0	37.0	6.0	6.18	10.58
SF17-13	64.7	69.6	4.9	6.94	10.00
SF17-13	117.4	124.0	6.6	6.28	10.26
SF17-15	177.1	192.0	14.9	6.78	8.68
SF17-15	208.0	214.0	6.0	9.47	11.48
SF17-16	32.4	77.0	44.6	10.21	13.40
Incl.	32.4	56.0	23.6	13.45	15.87
SF17-17	17.0	30.0	13.0	8.35	16.93
SF17-17	66.5	125.3	58.8	8.39	11.84
Incl.	66.5	100.0	33.5	10.22	13.12
Incl.	83.0	93.0	10.0	14.25	16.16
SF17-17	130.5	144.5	14.0	5.5	9.70
SF17-17	206.0	211.0	5.6	7.66	11.68
SF17-18	40.0	114.0	74.0	9.39	14.72
Incl.	40.0	94.0	54.0	10.56	16.45
Incl.	60.5	92.0	31.5	12.33	18.99
SF17-19	29.3	42.1	12.8	5.63	10.29
SF17-19	60.0	123.0	63.0	7.4	12.60
SF17-19	77.0	109.8	32.8	9.17	14.43
SF17-19	84.5	108.0	23.5	10.35	14.59
SF17-20	37.5	81.5	44.0	7.94	12.22
Incl.	37.5	70.0	32.5	8.42	12.95
Incl.	55.8	64.0	8.2	12.11	18.07

10.2.2 Sharpe Farm Target

Two drill holes totalling 283 m were completed on the Sharpe Farm target to improve on the structural understanding of this area. Drill holes SF17-19 and SF17-20 were drilled in a westerly direction to scissor SF16-2 and SF16-1, respectively.

These drill holes were collared in grey, highly calcareous Whitehead Formation before intersecting the host manganese-rich siltstone assemblage. From 60 to 123 m, the average grade returned was 7.4% Mn and 12.6% Fe over 63.0 m. Within this wide zone, a 32.8 m higher-grade interval beginning at a downhole depth of 77 m returned a grade of 9.17% Mn and 14.43% Fe. Interpretation of these drill holes indicates that the overall dip of the mineralization and stratigraphy in this area is approximately 70 to 75° to the southeast.

Hole SF17-20 also collared in the calcareous Whitehead Formation and continued in it until a depth of 14.9 m. Significant mineralization intersected included 7.94% Mn and 12.22% Fe over 44.6 m, beginning at a downhole depth of 32.4 m, including 7.5 m of 12.11% Mn. Similar to drill hole SF17-19, SF17-20 confirmed a southeastern dip to the mineralization and stratigraphy in the Sharpe Farm target area.

Based on the drilling completed to date on the Sharpe Farm target, it appears that stratigraphy along the eastern side of the magnetic feature dips to the southeast, and on the western side of the magnetic feature dips are sub-vertical to northwest dipping. This magnetic feature suggests either a domal anticlinal or synclinal structure with apparent closure at both ends.

10.3 2020 Drilling Program

Manganese X completed a total of 28 drill holes totalling 4,509 m of NQ-sized core on the Moody Hill target areas between October 1, 2020, and November 29, 2020 (Table 10-7). The drilling program was completed by Lantech and Maritime using a Morooka track-mounted drilling rig and a skid-mounted EF50 drilling rig, respectively. This program was designed to further delineate, expand, and improve the structural understanding of the manganese-iron mineralization identified during the 2016 and 2017 drilling programs and to provide additional drilling data required to support preparation of a Mineral Resource estimate for the Project. All drill holes were surveyed by a local surveyor using a DGPS surveying equipment. The same core logging and sampling, assaying, and QAQC protocols used in the 2016 and 2017 drilling program were also utilized for the 2020 drilling program (refer to Section 10.1 and 10.2 for further details).

The core was logged, photographed and sampled, noting lithologies, structure, alteration, and mineralization. Excessive core recovery loss was not encountered and does not have an impact on accuracy and reliability of the drilling results.

SG determinations were carried out on representative core samples using the Archimedes method described above in Section 10.1. Non-mineralized material generally returned an SG value of approximately 2.78 whereas the manganese-iron mineralized material had a maximum value measured at 3.88.

Drill core from the 2020 drilling program is currently stored at a core storage facility located on the Property area.

Table 10-7: Summary of 2020 Moody Hill Diamond Drill Holes

Hole No.	Easting (m)	Northing (m)	Elevation (m)	Azimuth (degree)	Dip (degree)	Total Depth (m)	Target Area
SF20-21	604927.4	5116388.3	144.7	315	-45.0	108	Moody Central
SF20-22	604923.8	5116351.1	142.2	315	-50.0	149	Moody Central
SF20-23	604968.8	5116299.9	139.7	335	-51.0	218	Moody Central
SF20-24	604851.8	5116285.4	129.9	315	-46.5	134	Moody Central
SF20-25	604996.5	5116446.6	159.6	315	-46.0	137	Moody Central
SF20-26	605033.9	5116410.9	159.4	315	-45.0	209	Moody Central
SF20-27	604871.3	5116669.1	143.1	135	-45.0	140	Moody West
SF20-28	604710.8	5116583.0	125.9	135	-45.0	134	Moody West
SF20-29	605081.6	5116362.8	153.8	315	-47.0	230	Moody Central
SF20-30	604803.2	5116618.2	136.1	135	-45.0	122	Moody West
SF20-31	604769.2	5116656.8	136.3	135	-45.0	188	Moody West
SF20-32	605114.3	5116382.4	157.8	135	-45.0	166	Moody East
SF20-33	604893.9	5116703.2	144.5	135	-45.0	161	Moody West
SF20-34	604919.6	5116751.1	147.9	135	-45.0	191	Moody West
SF20-35	604987.0	5116783.0	156.7	135	-45.0	128	Moody West
SF20-36	605021.5	5116349.7	149.2	315	-45.0	191	Moody Central
SF20-37	605162.6	5116493.9	170.3	315	-48.0	161	Moody Central
SF20-38	605121.1	5116534.2	169.7	315	-45.0	98	Moody Central
SF20-39	605176.0	5116535.7	170.8	315	-45.0	128	Moody Central
SF20-40	605064.1	5116492.5	168.4	315	-45.0	134	Moody Central
SF20-41	605214.7	5116499.4	171.7	313	-50.0	203	Moody Central
SF20-42	605155.4	5116444.4	165.1	315	-48.0	233	Moody Central
SF20-43	605110.2	5116489.7	169.1	315	-46.0	155	Moody Central
SF20-44	605105.2	5116443.8	163.7	315	-48.0	221	Moody Central
SF20-45	605137.8	5116415.8	161.6	315	-52.0	196	Moody Central
SF20-46	605259.2	5116573.1	171.0	315	-45.0	118	Moody Central
SF20-47	604975.6	5116346.1	146.2	319	-47.0	179	Moody Central
SF20-48	604931.2	5116707.6	150.3	135	-45.0	77	Moody West

Note: All coordinates shown in NAD83 Zone 19.

The 2020 diamond drilling program was designed to increase drill hole density within the extents of the Moody Hill mineralization, that includes the Moody Hill Central, Moody Hill East, and Moody Hill West target areas, to support the preparation of a Mineral Resource estimate and to provide a better understanding of the geology and structure. Drill hole spacing was predominantly 50 m, which consistently confirmed significant widths of mineralization from surface to a maximum vertical depth of approximately 150 m, over a strike length of approximately 500 m (previous Figure 10-1).

A summary of the significant drill hole intercepts in the Moody Hill target area is shown in Table 10-8 (Moody Hill Central) and Table 10-9 (Moody Hill West and Moody Hill East). A summary of the interpretation of all relevant drill results are illustrated in Section 14 of this Report.

Table 10-8: Significant Intercepts for the 2020 Moody Hill Central Diamond Drilling Program

Hole No.	From (m)	To (m)	Length (m)	Mn (%)	Fe (%)
SF20-21	7.0	45.8	38.8	7.14	9.02
	7.0	21.7	14.7	9.68	9.53
SF20-22	37.6	57.3	19.7	7.01	10.17
Incl.	37.6	47.3	9.7	8.02	9.20
and	54.6	57.3	2.7	13.46	12.82
SF20-23	148.5	151.0	2.5	12.84	17.37
SF20-24	31.8	51.0	19.2	11.72	14.30
SF20-25	8.5	58.5	50.0	7.92	12.47
Incl.	15.6	36.0	20.4	9.82	14.72
SF20-26	72.6	123.0	50.4	9.00	13.36
Incl.	72.6	86.0	13.4	12.88	15.05
and	108.0	123.0	15.0	10.92	15.02
SF20-29	147.0	201.0	54.0	9.18	14.13
Incl.	147.0	183.0	36.0	10.16	14.84
SF20-36	108.9	136.1	27.2	9.87	11.01
Incl.	146.0	160.0	14.0	7.16	9.65
SF20-37	90.0	132.0	42.0	8.15	12.37
Incl.	90.0	110.0	20.0	10.24	14.26
SF20-38	30.0	52.0	22.0	9.09	14.92
Incl.	34.0	48.0	14.0	11.00	17.23
and	68.0	80.0	12.0	7.52	12.39
SF20-39	66.0	100.0	34.0	9.00	13.88
Incl.	66.0	84.0	18.0	11.42	16.76
SF20-40	36.0	70.0	34.0	8.76	12.78
Incl.	42.0	52.0	10.0	13.43	15.74
and	80.0	102.0	22.0	6.04	10.99
SF20-41	44.0	48.0	4.0	7.33	6.96
Incl.	60.0	66.0	6.0	7.10	6.91
and	120.0	140.0	20.0	10.56	14.20
SF20-42	120.0	164.0	44.0	8.51	12.82
Incl.	120.0	140.0	20.0	11.12	14.93
SF20-43	16.5	22.5	6.0	8.04	11.87
	28.6	34.6	6.0	8.84	12.03
	57.7	109.0	51.3	9.99	14.67
Incl.	61.5	88.0	26.5	12.77	17.36

Hole No.	From (m)	To (m)	Length (m)	Mn (%)	Fe (%)
	120.0	128.0	8.0	7.02	11.61
SF20-44	88.0	138.0	50.0	9.16	13.27
Incl.	88.0	120.0	32.0	10.32	13.70
	140.0	148.0	8.0	7.19	11.52
	154.0	168.0	14.0	7.68	12.24
SF20-45	104.0	112.0	8.0	11.65	8.26
	132.0	168.0	36.0	8.69	12.72
Incl.	132.0	154.0	22.0	10.27	13.71
SF20-46	2.5	19.5	17.0	8.00	11.33
	39.0	82.2	43.2	6.98	11.76
Incl.	39.0	60.0	21.0	8.18	13.21
	73.0	80.2	7.2	8.07	11.34
SF20-47	103.0	144.0	41.0	6.60	11.54
Incl.	103.0	122.8	19.8	7.60	12.09

Table 10-9: Significant Intercepts for the 2020 Moody Hill West and Moody Hill East Diamond Drilling Program

Hole No.	Azimuth (degree)	Dip (degree)	Easting	Northing	From (m)	To (m)	Length (m)	Mn (%)	Fe (%)
Moody Hill West Zone Results									
SF20-27	135	-45	604871	5116669	14.0	33.5	19.5	9.08	16.68
				including	22.0	30.0	8.0	11.57	17.91
SF20-28	135	-45	604711	5116583	No Significant Values				
SF20-30	135	-45	604803	5116618	No Significant Values				
					59.0	63.0	4.0	9.46	13.56
SF20-31	135	-45	604769	5116657	26.0	46.3	20.3	8.48	11.83
					57.5	67.5	10.0	7.56	12.68
					73.6	89.2	15.6	8.52	15.03
				including	75.6	85.6	10.0	9.82	12.52
SF20-33	135o	-45	604894	5116703	49.0	67.0	18.0	9.06	16.50
				including	49.0	63.0	14.0	10.17	17.60
SF20-34	135	-45	604920	5116751	7.5	10.5	3.0	8.16	11.75
					68.0	100.0	32.0	9.15	14.19
				including	68.0	92.0	24.0	10.31	14.93
				or	82.0	92.0	10.0	13.17	18.46
					144.0	150.0	6.0	8.75	17.62
SF20-35	135	-45	604987	5116783	55.1	61.0	5.9	8.86	9.79
SF20-48	135	-45	604931	5116708	3.5	16.8	13.3	9.13	16.77
Moody Hill East Zone Results									
SF20-32	135	-45	605114	5116382	82.0	88.0	6.0	9.52	9.97
				and	108.0	116.0	8.0	9.58	11.99

10.4 2022 Drilling Program

Manganese X completed a total of four diamond drill holes on the Property between March 23 to April 3, 2022 resulting in 589 m of NQ-sized core (Table 10-10). The objective of the 2022 drilling program was to test known manganese occurrences in areas nearby but separate from the current Mineral Resource estimate to determine if there may be other manganese occurrences in the area that Manganese X should be focusing on, in addition to Battery Hill.

Table 10-10: Summary of 2022 Diamond Drill Holes

Hole No.*	Easting (m)	Northing (m)	Azimuth (degree)	Dip (degree)	Total Depth (m)
IS22-1	595737	5110663	120	-45	176
MH22-1	605820	5120671	110	-45	68
MH22-2	605902	5120748	290	-45	209
MH22-3	605882	5120672	110	-45	136

Note: * Drill holes have yet to be surveyed and actual elevations are unknown at this time. All coordinates shown are in NAD83 Zone 19 and determined using a handheld GPS unit.

A single drill hole (IS22-1) was completed on Mineral Claim 5745 (Irish Settlement) located 11 km southwest of the Project and approximately 1.5 km east of the Maine, USA border. Three drill holes (MH22-1 to MH22-3) were drilled on Mineral Claim 5816 in an area referred to as Maple Hill, located approximately 3.5 km north of the current Mineral Resource estimate. Lantech completed the drilling program, and all holes were downhole surveyed using a Reflex tool. The same core logging and sampling, assaying, and QAQC protocols used in the 2016, 2017, and 2020 drilling programs are being utilized for the 2022 drilling program (refer to Section 10.1 and 10.2 for further details).

As of the effective date of this Report none of these drill holes have been sampled and sent for assay analyses and only three of the drill holes have been logged by Manganese X. Therefore, assay results from these four drill holes are still pending. As the core has yet to be fully logged by Manganese X, core recovery factors are also unknown at this time. These four drill holes are not considered to have any material impact on the current Battery Hill Mineral Resource estimate, which has an effective date of May 12, 2022, as they were completed outside the current Mineral Resource estimate constraining pit shell.

11.0 SAMPLE PREPARATION, ANALYSES, AND SECURITY

11.1 Sampling Methods

11.1.1 2016 Drilling Program

During the 2016 Manganese X diamond drilling program, core was taken from the core tube at the drill by the drill crew and placed in core boxes. Once full, individual core trays were lidded and secured using sturdy rubber bands or fibre tape. Core was then delivered by the drilling company or Manganese X staff to the Manganese X core shed, a large, secure, multi-purpose garage located near Woodstock.

The core was logged by professional geologists, marked for splitting with a red crayon, photographed then cut longitudinally with one of two Husqvarna overhead, water cooled, diamond blade core saws. The core saws were operated by local workers and Manganese X staff trained in standard core cutting procedures and QAQC protocols. Once the core was cut, one half was returned in place in the core box (archive) and the other half placed in a heavy duty, clear poly bag labelled with the sample number, along with a tag bearing the sample number. A second, duplicate sample tag was placed under the split core near the start of the sample in the core box. Red crayon was also used to mark the beginning and end of each sample in the box.

The sample tag number was written in indelible marker on the outside of the poly bag for easy identification at the laboratory. The sample bag was zip tied and placed in a larger fiber bag for shipping to the laboratory. The fiber bag (holding four to seven samples) was also zip tied and the range of numbers for the samples contained within were marked with indelible marker on the outside.

When a sufficient number of full fiber bags had accumulated, they were itemized on a submission form which listed the samples included in the shipment, then securely loaded on a truck and driven by Manganese X staff directly to the Actlabs preparation laboratory in Fredericton, New Brunswick or shipped to their main laboratory located in Ancaster, Ontario.

11.1.2 2017 Drilling Program

During the 2017 diamond drilling program, consultant Perry MacKinnon, P. Geo., and staff logged and sampled all drill core. The core recovery and RQD were determined, and core samples sent to Actlabs for preparation and analysis using the same techniques as those used in the 2016 drilling program.

11.1.3 2020 Drilling Program

During the 2020 diamond drilling program, consultant MacKinnon and staff similarly logged and sampled all drill core. The core recovery and RQD parameters were determined, and core samples sent to Actlabs for preparation and analysis using the same techniques as those used in the 2016 and 2017 drilling programs. Samples averaged 2 m in length and true widths of the intercepts were not determined at the time, but the structure is near vertical and the average core angle in the mineralization is 50°, from which it can be concluded that the average true width of intercepts is approximately 75% of the sampled length. All bagged half-core samples were taken by Manganese X personnel to the Actlabs preparation facility in Fredericton, where they were typically prepped and the pulps forwarded to Actlabs in Ancaster, for analysis.

11.1.4 2022 Drilling Program

The 2022 diamond drilling program completed by Manganese X used the same core logging, sampling, and QAQC protocols as the 2016, 2017, and 2020 drilling programs and described below. The drilling program was supervised by Manganese X gegologists. As of the effective date of this Report, not all drill core from the 2022 drilling program had been logged by Manganese X and none of the drill holes had been sampled and submitted for assay analyses.

11.2 Sample Preparation and Analysis

Actlabs preparation procedures included drying and crushing the entire sample (up to 5 kg) to 80% -10 mesh, riffle splitting and pulverizing a 350 g subsample (500 g bowl) to 95% passing 150 mesh. A clean sand was processed in the pulverizer between core samples to avoid cross-contamination. Crushing and pulverizing equipment typically used include TM Engineering Terminator and TM MAX 2 units operating under a dust control system. One in 40 samples had a second pulp prepared from the reject as a QC check. Pulp duplicates were also routinely prepared at a nominal frequency of one in 20. Quality of the rejects and pulps are routinely monitored to ensure proper preparation procedures are performed.

The analytical method chosen for the 2016, 2017, and 2020 drilling programs was XRF-Fusion (Actlabs Code 4C) in which samples are initially fused with lithium metaborate/tetraborate in platinum crucibles using automated fluxers at 1150°C. The molten mixture is poured into heated platinum molds and allowed to cool. The glass disc formed is then analyzed with Panalytical Axios Advanced or PW2400 wavelength dispersive XRF instrumentation. Analytical results were received in digital spreadsheet (.xls format) and laboratory certificate (pdf format) forms by email from Actlabs. Detection limits for MnO is 0.001% and Fe_2O_3 is 0.01%. Actlabs is an international, COLA accredited, analytical services firm registered to the ISO 17025 ISO 9001:2008 standards. Actlabs is fully independent of Manganese X.

Half core samples were collected during the 2016 and 2017 drilling programs and the sample stream included QAQC program blanks, duplicates, and CRMs (standards). A total of 1,691 half core and quarter core duplicate samples were collected during the 2020 drilling program and the Company used the same CRMs and blank material as used in the 2016 and 2017 drilling programs (see Section 11.3).

11.3 QAQC Protocol and Results

The Manganese X QAQC protocol applied in all drilling programs includes insertion in the sample stream of CRM samples, blank samples consisting of silica sand, duplicate pulp split samples and quarter core duplicate samples. The CRM samples were inserted after every 20 to 25th sample, nominally, and quarter core duplicate sampling was completed at approximately every 20th sample. In addition, six check samples of pulp material were prepared for use as third-party check samples in 2016.

The CRM used was either OREAS 171 or OREAS 700, both obtained from Ore Research and Exploration Pty Ltd. of Bayswater North, Victoria, Australia. The CRM's consisted of supergene manganese mineralization ore from Lower Cretaceous sediments of the Northern Territory of Australia (OREAS 171) and tungsten-magnetite skarn (OREAS 700) from New South Wales, Australia. Table 11-1 presents CRM details.

Table 11-1: Certified Reference Materials details

Certified Reference Material		Certified Value (%)	95% Confidence Low	95% Confidence High
OREAS 171				
Mn mineralization	Mn (%)	35.1	34.84	35.36
	Fe (%)	3.66	34.84	35.36
OREAS 700				
W-magnetite Skarn	Mn (%)	0.321	0.315	0.327
	Fe (%)	16.06	15.95	16.16

The six check samples of 2016 drill program assay pulps were sent to SGS for check analysis and results in comparison with original sample results are shown in Table 11-2. SGS is an international, COLA accredited, analytical services firm registered to the ISO 17025 ISO 9001:2008 standards. SGS is fully independent of Manganese X. A single sample of each of the CRM samples was also tested as part of the 2016 program. No check sampling was completed during the 2017 and 2020 drilling programs, other than independent witness samples as discussed in Section 12 of this Report.

Table 11-2: 2016 Check Sample Results

Independent Lab Results		Actlabs Fe_2O_3 (%)	SGS Fe_2O_3 (%)	Actlabs MnO (%)	SGS MnO (%)
Sample # Original	**Sample # Check**	**Value Original**	**Value Check**	**Value Original**	**Value Check**
1400332	319401	23.35	23.20	14.90	15.00
1400342	319402	16.71	16.10	20.53	20.40
319148	319403	22.90	23.50	16.20	16.31
319155	319404	24.88	25.10	20.54	20.20
319165	319405	19.83	19.70	9.651	9.77
319175	319406	14.15	13.60	8.091	8.30
CRM 700	319407	22.96	22.80	0.415	0.42
CRM171	319408	5.23	5.14	45.32	44.90

11.3.1 QAQC Results

The QP reviewed QAQC results for the 2016, 2017, and 2020 drilling programs. There were five instances found where an incorrect QAQC sample number was reported for a CRM or blank. Each instance was investigated by the QP and corrected within the QAQC database. In each instance, the sample number entered was one sample number off from the true CRM or blank sample number. Three such instances were corrected in the 2016 and 2017 QAQC dataset and two were corrected in the 2020 QAQC dataset.

11.3.1.1 Certified Reference Materials

Two CRM samples (OREAS 171 and OREAS 700) were submitted blindly with drill core samples for the 2016, 2017 and 2020 drilling programs. The blind CRMs were inserted into the sample stream at intervals that varied from approximately every 10 to 30 samples. In total, 99 CRMs were submitted during the 2016 and 2017 drilling programs and 89 CRMs were submitted during the 2020 drilling program. Certified iron and manganese values for the CRMS are given in Table 11-3.

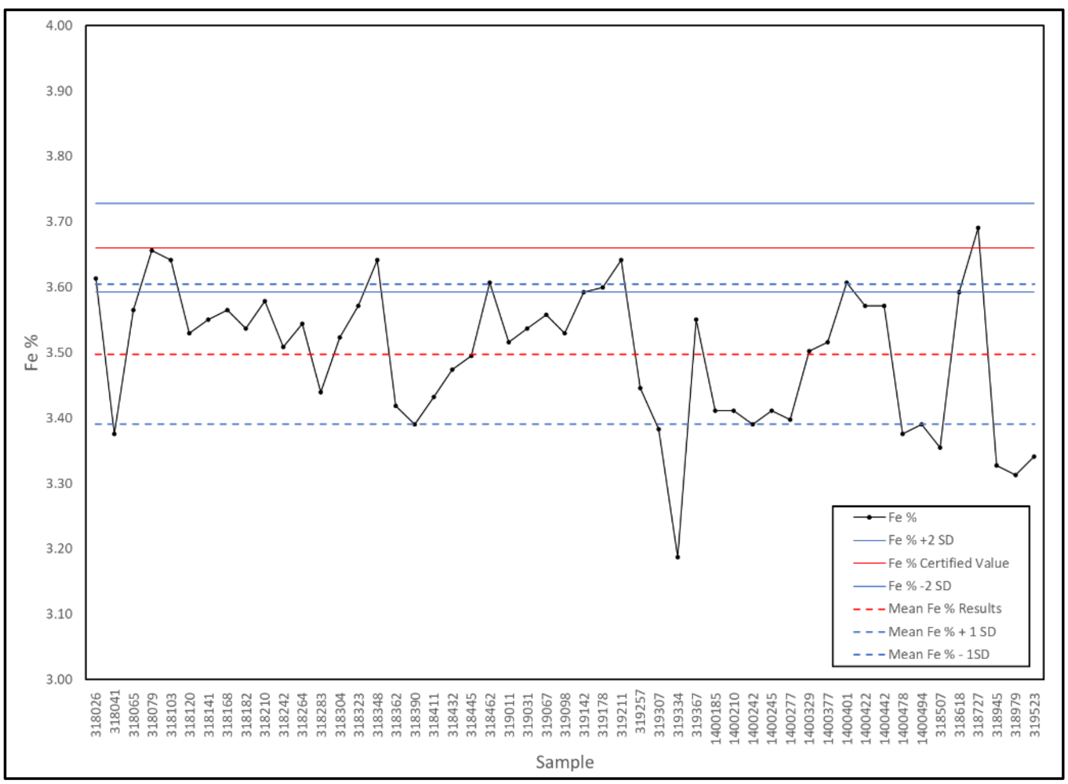
Table 11-3: Certified Reference Material Mean Total Fe % and Mn % Values Determined by Lithium Borate Fusion and X-ray Fluorescence Analysis

Reference Material	Certified Mean Total Fe ± 2 SD%	Certified Mean Total Mn ± 2 SD%	Number Submitted	
			2016 and 2017	2020
OREAS 171	3.66 ± 0.068	35.10 ± 0.334	51	47
OREAS 700	16.06 ± 0.35	0.328 ± 0.008	48	47

Note: SD = standard deviation

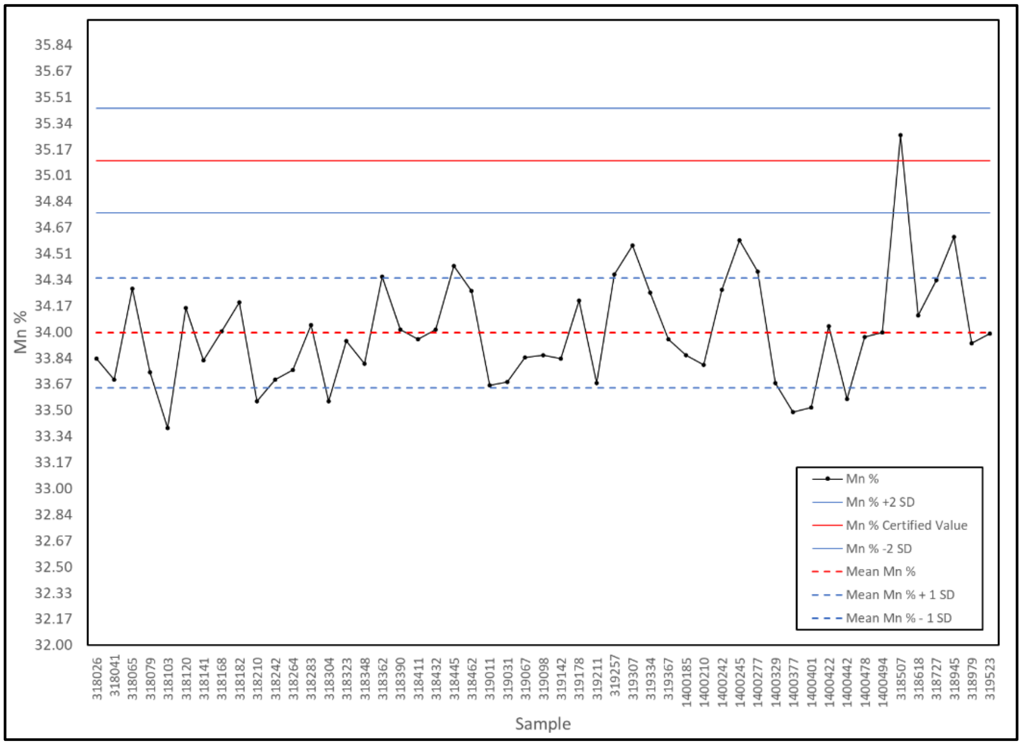
The 2016 and 2017 iron and manganese results for the OREAS 171 standards are plotted in Figure 11-1 and Figure 11-2, respectively. Both iron and manganese are consistently lower than the certified values. The mean iron value returned for OREAS 171 is 3.50 ± 0.11%, approximately 0.1% below the certified value, and for manganese is 34.00 ± 0.35%, approximately 1.1% below the certified value. Most of analyses fall within two standard deviations of the respective means and only one iron and one manganese analysis exceeds three standard deviations.

Figure 11-1: 2016 and 2017 Drilling Programs CRM OREAS 171 Results for Fe (N = 51)



Source: prepared by Mercator, dated 2021

Figure 11-2: 2016 and 2017 Drilling Programs CRM OREAS 171 Results for Mn (N = 51)



Source: prepared by Mercator, dated 2021

The 2016 and 2017 iron and manganese results for the OREAS 700 standards are plotted in Figure 11-3 and Figure 11-4, respectively. Most of returned iron values and all manganese fall within two standard deviations of the certified mean values. The mean OREAS 700 returned value for iron is 16.24 ± 0.13%, 1.14% above the certified mean value. The mean returned value for manganese is 0.323 ± 0.004%, 0.005% below the certified mean value. Of the 48 CRM analyses, three iron values fall between two and three standard deviations of the mean value and no values exceed the mean plus ± three standard deviations level.

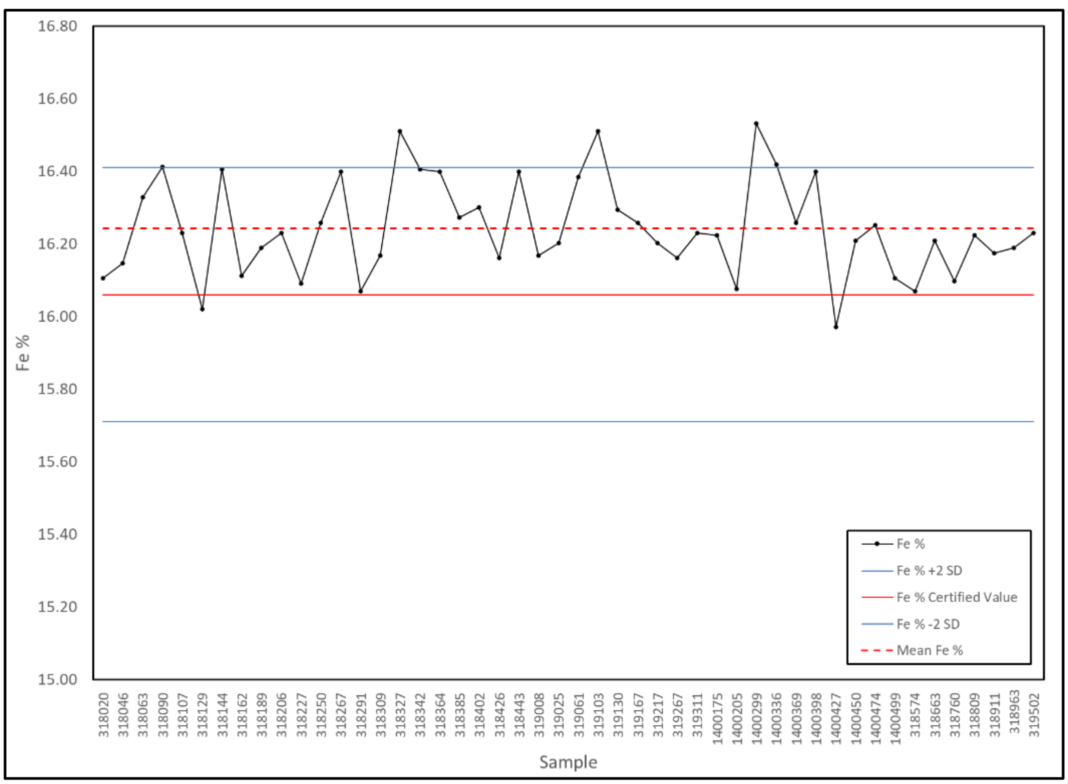
The 2020 iron and manganese results for the OREAS 171 standards are plotted in Figure 11-5 and Figure 11-6, respectively. Similar to the 2016 and 2017 programs, both iron and manganese are consistently slightly lower than the certified values. The mean OREAS 171 returned value for iron is 3.37 ± 0.06%, 0.29% below the certified mean value. The mean returned value for manganese is 33.57 ± 0.42%, 1.53% below the certified value. All returned iron and manganese values fall below two standard deviations of the mean returned values.

The 2020 iron and manganese results for the OREAS 700 standards are plotted in Figure 11-7 and Figure 11-8, respectively. The mean OREAS 700 returned value for iron is 16.19 ± 0.28%, 0.13% above the certified mean value.

The mean returned value for manganese is 0.343 ± 0.015%, 0.15% above the certified value. These results are consistent with the values returned during the 2016 and 2017 drilling program, though the variance is higher during the 2020 program. One sample returned 14.61% Fe, well below the two standard deviations level of the certified mean iron value, and nine spikes of manganese exceed the mean plus two standard deviations level of the certified mean value.

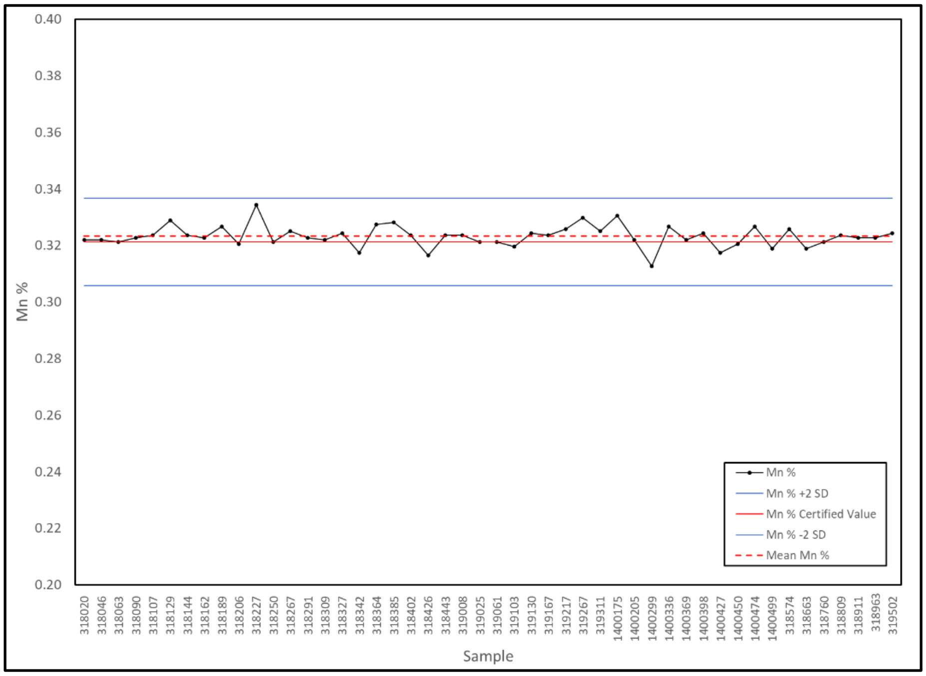
Neither standard is an ideal fit for the manganese grades observed at Battery Hill, but it is recognized that there is a limited number of CRMs available to select from. The discrepancy between the certified and returned values for the high-grade OREAS 171 CRM is of particular note and should be investigated further. The more consistent results for the low-grade OREAS 700 CRM and the consistency between check samples and original assays from two different laboratories (see Section 12.2) suggest that the issue lies with the OREAS 171 CRM material used at the site rather than with the sampling and analytical procedures. The QP also reviewed the results of interval QAQC CRMs analyzed by Actlabs as reported in respective laboratory certificates and did not find any discrepancies, which further supports the conclusion that an issue existed with the OREAS 171 CRM material used at the site.

Figure 11-3: 2016 and 2017 Drilling Programs CRM OREAS 700 Results for Fe (N = 48)



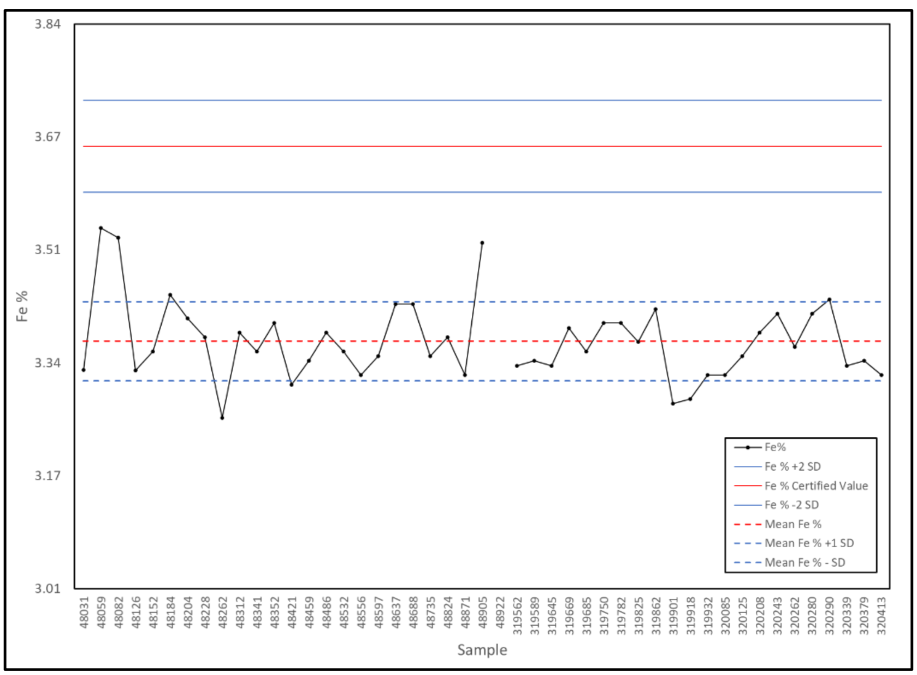
Source: prepared by Mercator, dated 2021

Figure 11-4: 2016 and 2017 Drilling Programs CRM OREAS 700 Results for Mn (N = 48)



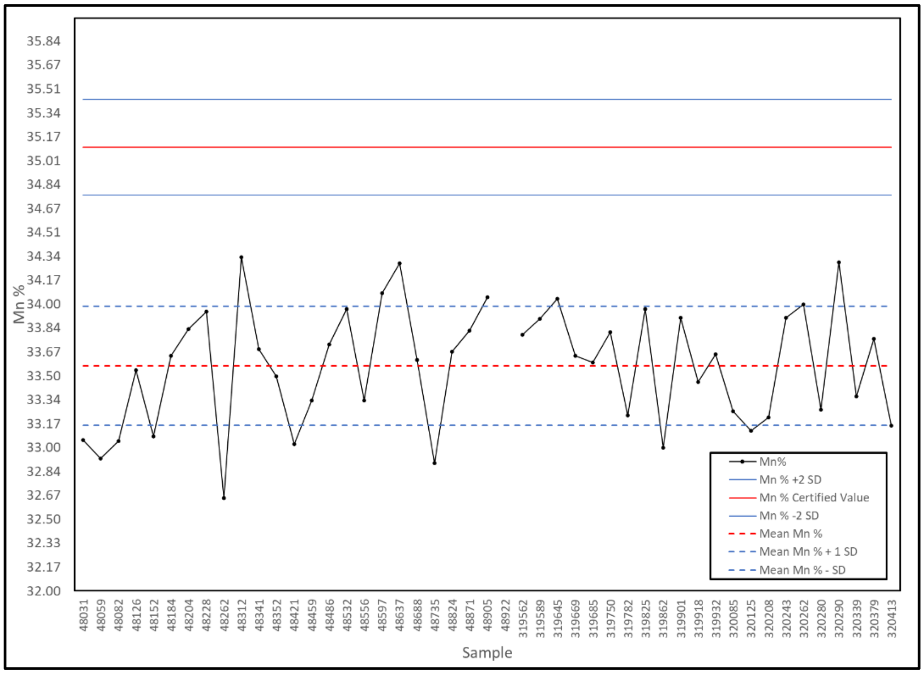
Source: prepared by Mercator, dated 2021

Figure 11-5: 2020 Drilling Program CRM OREAS 171 Results for Fe (N = 47)



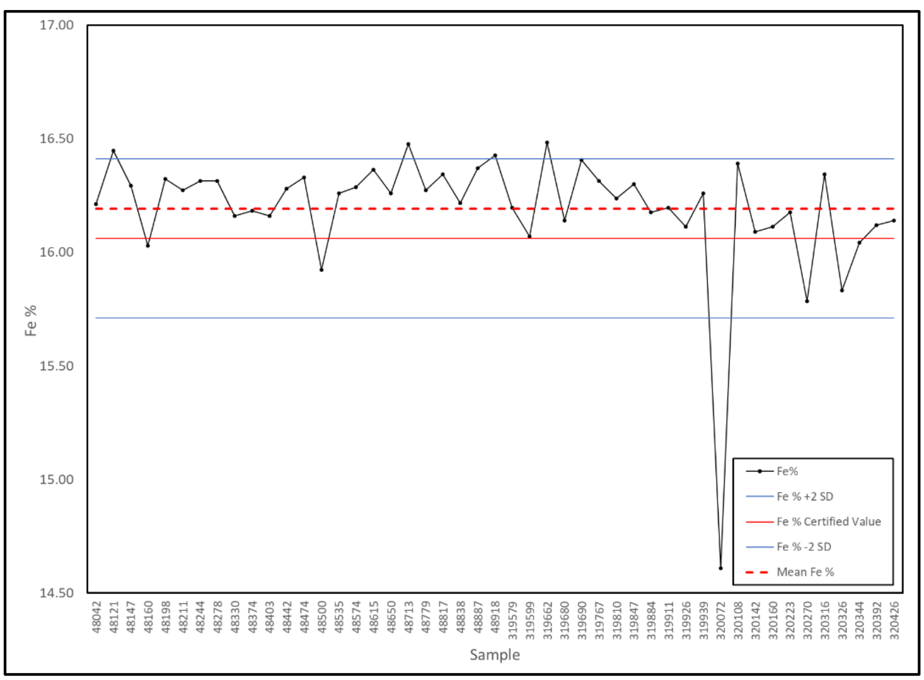
Source: prepared by Mercator, dated 2021

Figure 11-6: 2020 Drilling Program CRM OREAS 171 Results for Mn (N = 47)



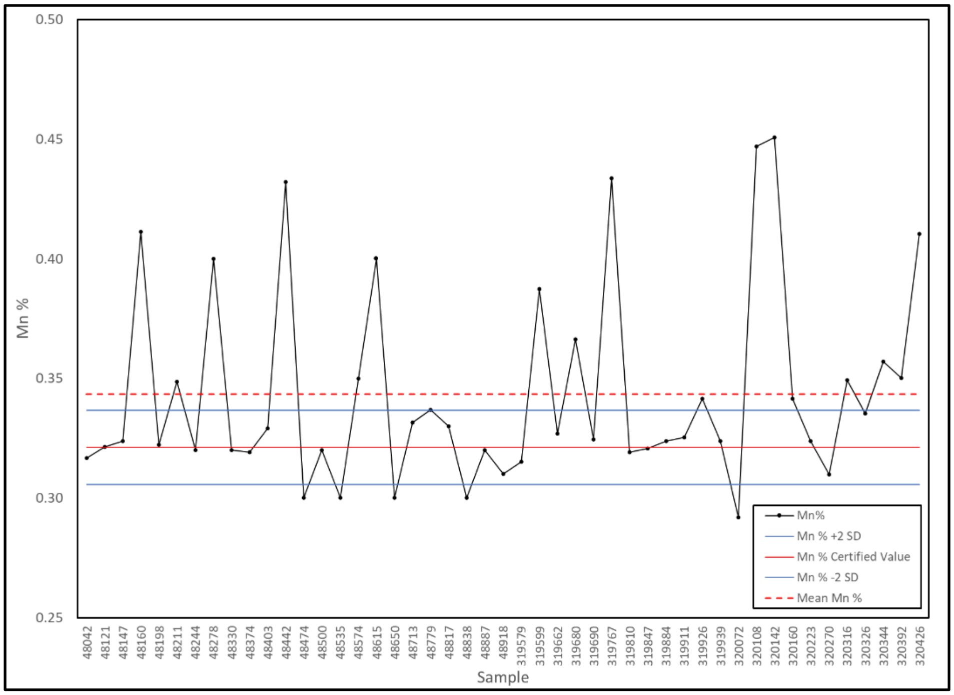
Source: prepared by Mercator, dated 2021

Figure 11-7: 2020 Drilling Program CRM OREAS 700 Results for Fe (N = 47)



Source: prepared by Mercator, dated 2021

Figure 11-8: 2020 Drilling Program CRM OREAS 700 Results for Mn (N = 47)



Source: prepared by Mercator, dated 2021

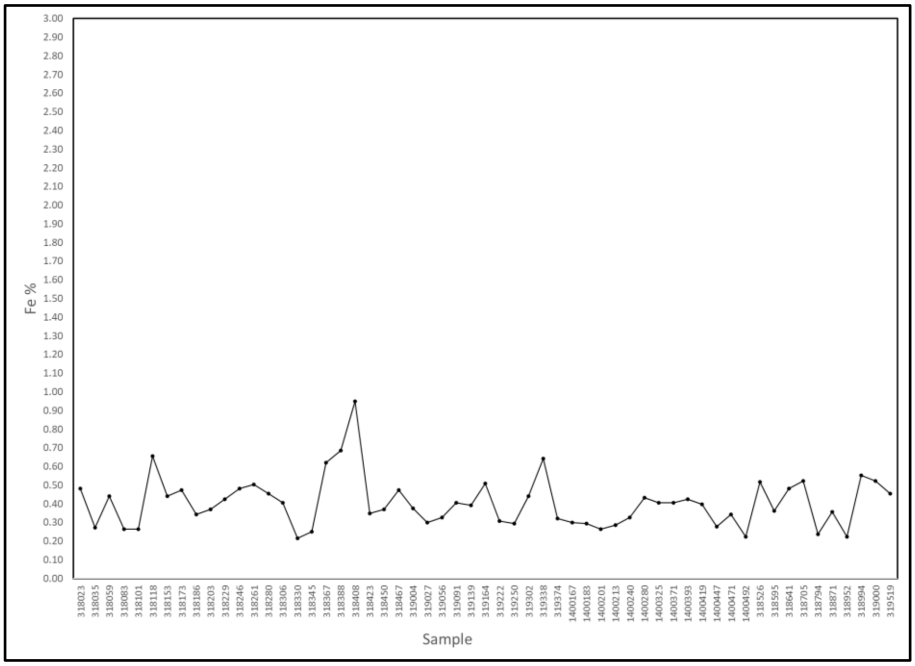
11.3.1.2 Blanks

Blank material consisted of silica sand and was inserted into the sample stream in similar irregular intervals as the CRMs. In total, 57 blank samples were submitted during the 2016 and 2017 drilling program and 95 blank samples were submitted during the 2020 drilling program.

The 2016 and 2017 iron and manganese results for the blank material are plotted in Figure 11-9 and Figure 11-10, respectively. The mean returned value for iron is 0.406 ± 0.135% with the highest value not exceeding 0.95%; and for manganese is 0.015 ± 0.022%, with the highest value not exceeding 0.13%.

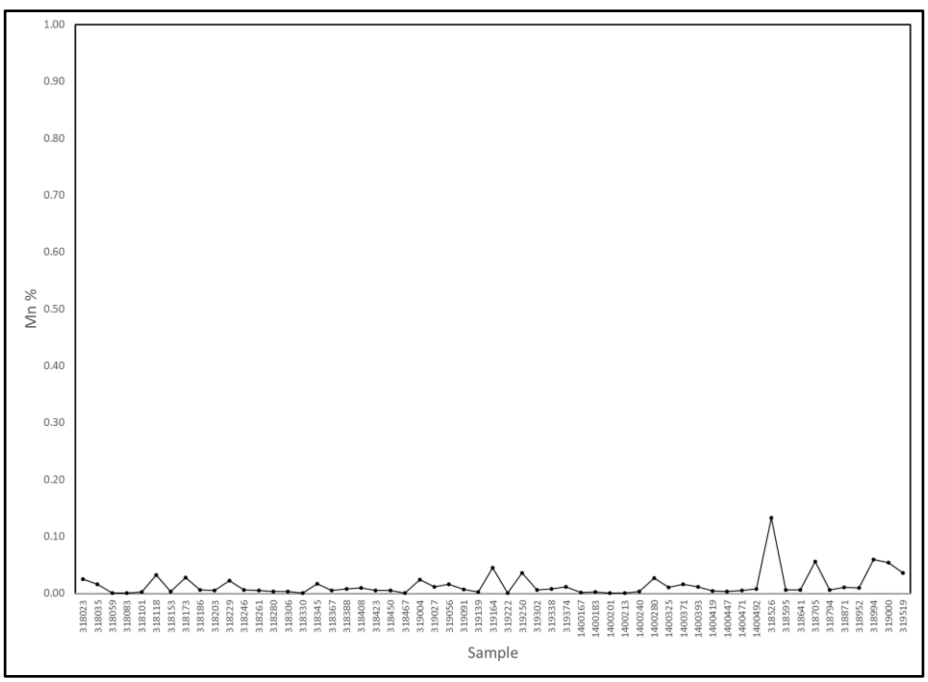
The 2020 iron and manganese results for the blank material are plotted in Figure 11-11 and Figure 11-12, respectively. Two different background levels of iron and manganese are observed in the blank material, and these reflect a change in the blank material used later in the program. For the 48034 to 48928 sample series, the mean returned value for iron is 1.370 ± 0.298% with the highest value not exceeding 2.231 and for manganese is 0.054 ± 0.030%, with the highest value not exceeding 0.170%. For the 319567 to 320482 sample series, the mean returned value for iron is 1.00 ± 0.60% with only one value exceeding 1.24%; and for manganese is 0.44 ± 0.03% with the highest value not exceeding 0.57%. The one iron value that exceeds 1.24% is 4.91%.

Figure 11-9: 2016 and 2017 Drilling Program Blank Results for Fe (N = 57)



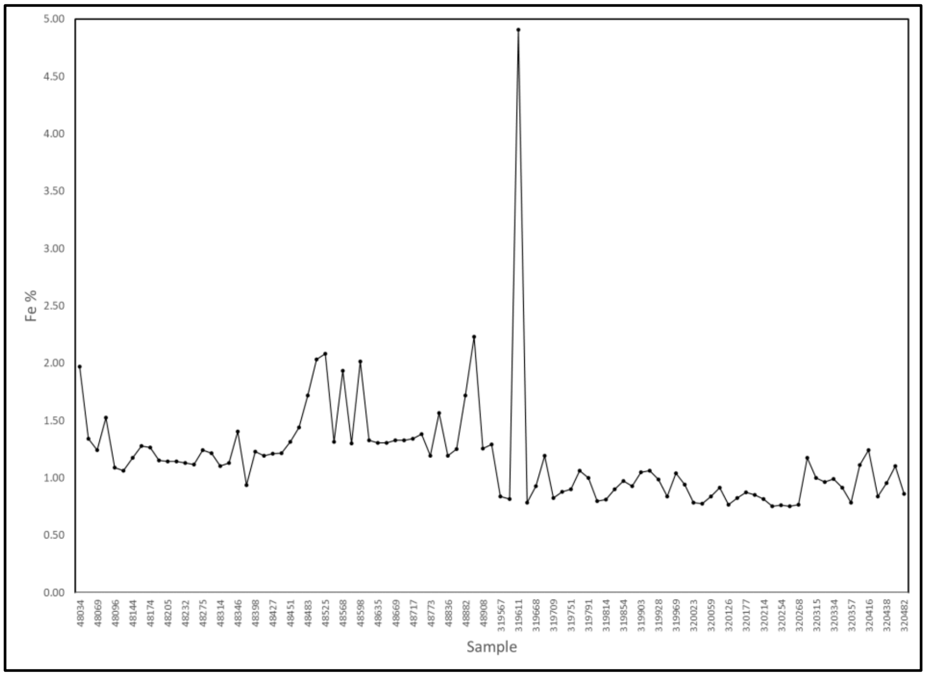
Source: prepared by Mercator, dated 2021

Figure 11-10: 2016 and 2017 Drilling Program Blank Results for Mn (N = 57)



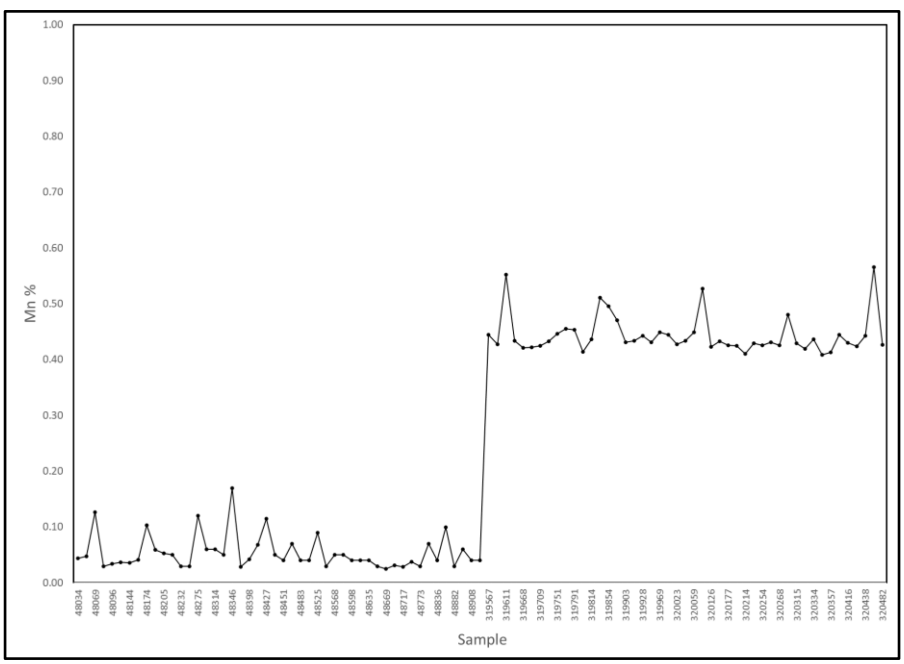
Source: prepared by Mercator, dated 2021

Figure 11-11: 2020 Drilling Program Blank Results for Fe (N = 95)



Source: prepared by Mercator, dated 2021

Figure 11-12: 2020 Drilling Program Blank Results for Mn (N = 95)



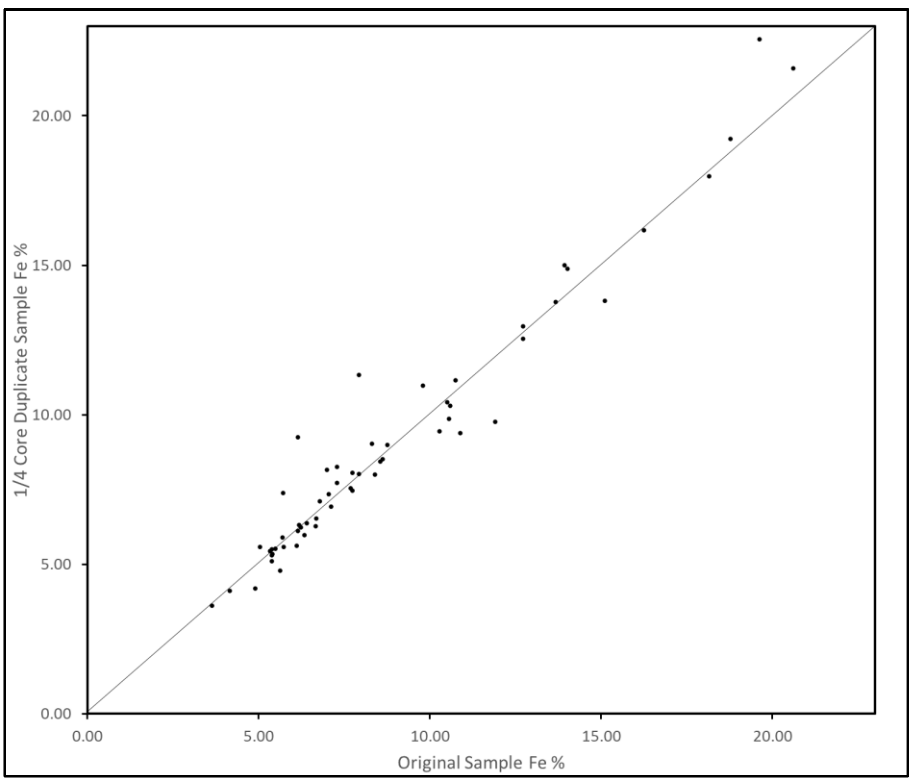
Source: prepared by Mercator, dated 2021

11.3.1.3 Duplicates

Manganese X also carried out a quarter core duplicate sampling program to check sample variability during the 2016, 2017 and 2020 diamond drilling programs. During the 2016 and 2017 drilling program, a total of 58 core duplicates were analyzed. Duplicate ¼ core split samples were included in the laboratory sample shipment sequence in intervals that ranged from every 15 to 70 samples. Total iron and manganese results for duplicate – original pairs are presented in Figure 11-13 and Figure 11-14, respectively. The correlation coefficient (R2) between pairs for iron and manganese is 0.95 in both cases and results group closely along respective 1:1 equality lines.

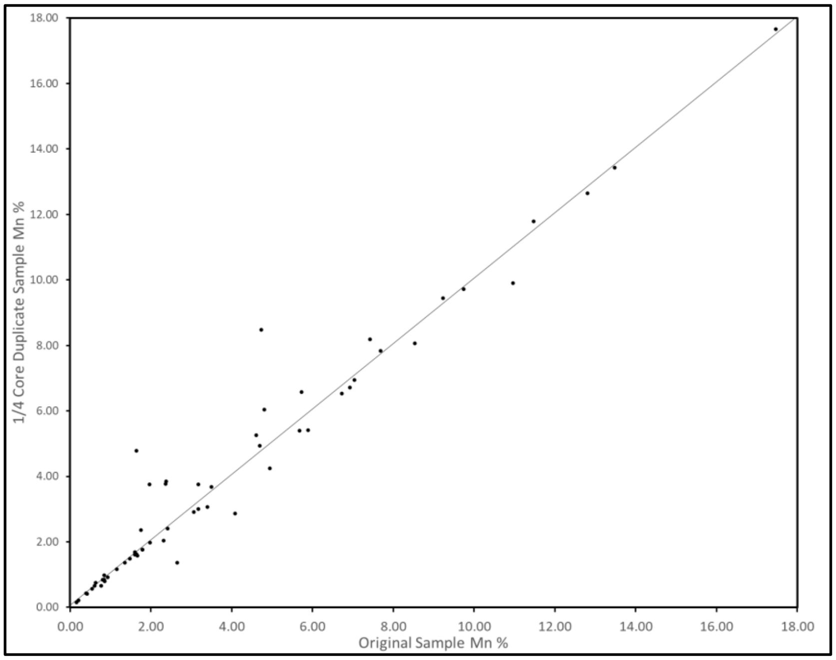
During the 2020 drilling program, a total of 93 quarter core duplicates samples were analyzed. These were inserted into the laboratory sample shipment sequence in intervals that range between six and 50 samples. Total iron and manganese results for sample pairs are presented in Figure 11-15 and Figure 11-16. The correlation coefficient (R2) between sample pairs for iron and manganese is 0.97 in both cases and results group closely along respective 1:1 equality lines.

Figure 11-13: 2016 and 2017 Duplicate ¼ Core Sample Results for Fe (N = 58)



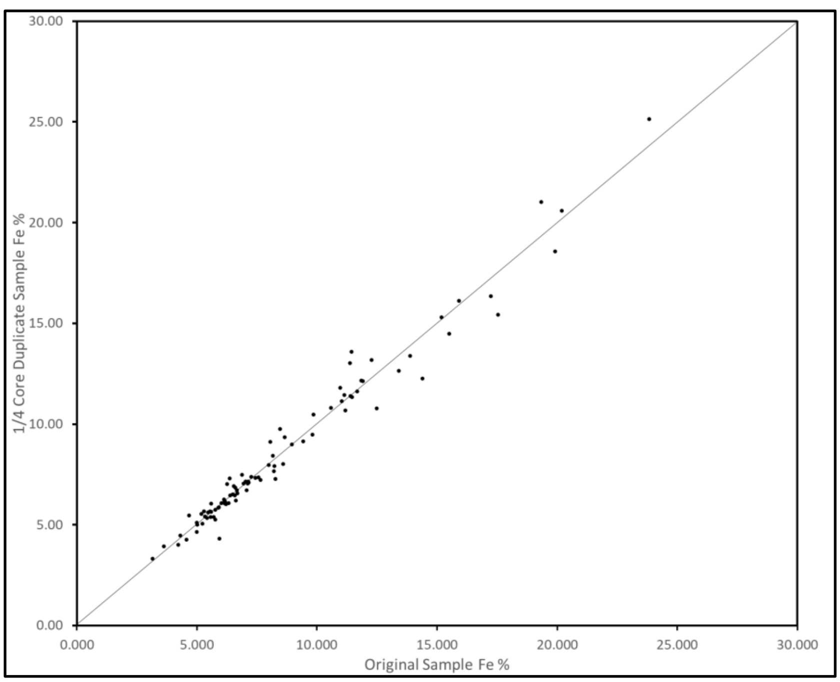
Source: prepared by Mercator, dated 2021

Figure 11-14: 2016 and 2017 Duplicate ¼ Core Sample Results for Mn (N = 58)



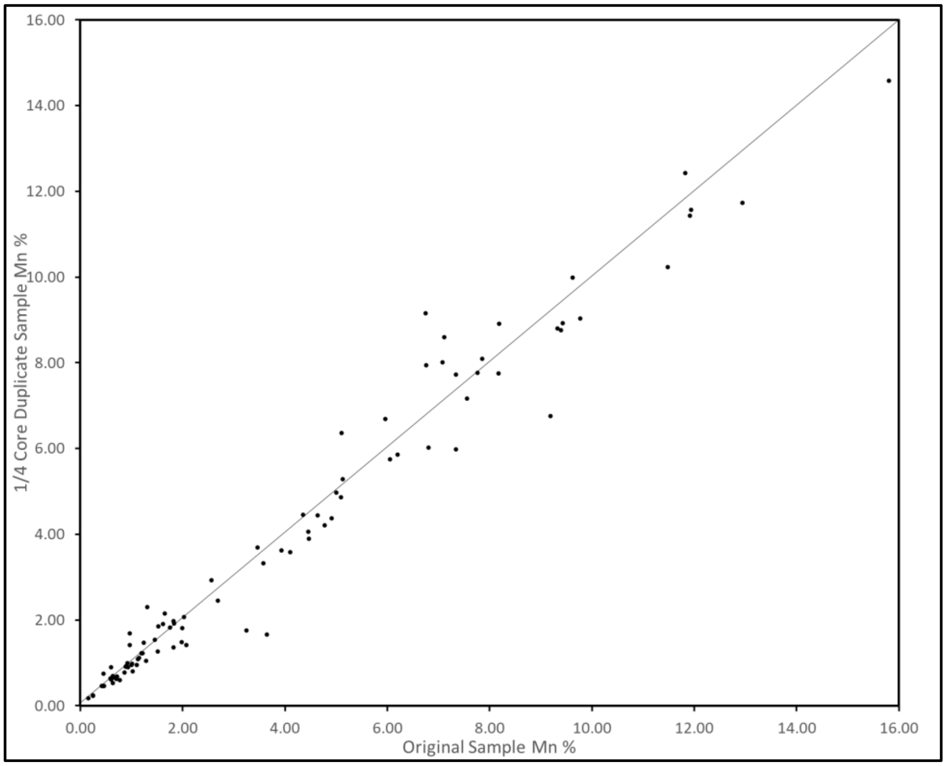
Source: prepared by Mercator, dated 2021

Figure 11-15: 2020 Duplicate ¼ Core Sample Results for Fe (N = 93)



Source: prepared by Mercator, dated 2021

Figure 11-16: 2020 Duplicate ¼ Core Sample Results for Mn (N = 93)



Source: prepared by Mercator, dated 2021

11.4 Summary of QAQC Program Results

Review of associated datasets has shown that CRM samples chosen for the three referenced drilling programs did not perform consistently when compared to separate laboratory CRM results and results of third-party check sampling analysis carried out by Manganese X. Low-level under reporting of manganese levels occurred in all programs and in results for both CRMs. OREAS 700 results are also sometimes positively spiked in the 2020 data set, and this stands out from prior years. In general, the CRM's performed better in the 2016 and 2017 programs than in 2020 and it is possible that bulk CRM materials used for the program were degraded during the intervening storage period.

Blank sample results for all programs do not indicate the presence of any systematic trends of preparation-stage cross contamination. Results of the quarter core duplicate split program show good correlation between sample pairs. Similarly, results of a 2016 third-party check sampling program show very good correlation between the two commercial laboratories involved.

11.5 Report Author Opinion on Analytical Results

The QP is of the opinion that the quality of the analytical results from the Manganese X 2016, 2017, and 2020 diamond drilling programs are sufficiently reliable and adequate to support their use in the Mineral Resource estimate for the Project. Sample preparation, analysis, security procedures, and QAQC procedures undertaken by Manganese X staff were performed in accordance with CIM exploration best practices and mining industry standards. It is recommended that custom CRM samples be developed by a commercial laboratory for use in any future Manganese X drilling programs, based on mineralization samples from the Project.

12.0 DATA VERIFICATION

12.1 Overview

Data verification procedures carried out by QP author P. Ténière consisted of two main components:

- (1) Review of public record and internal source documents cited by previous operators and Manganese X with respect to key geological interpretations, previously identified geochemical or geophysical anomalies, and historical and current exploration and drilling results that support the current Mineral Resource estimate for the Project.
- (2) Completion of a Property site visit and collection of independent witness samples. No issues were identified that negatively impact the findings and conclusions of this Report.

Mercator were responsible for assisting with data compilation, designing, and implementing the drilling programs and interpreting data sets for future exploration targeting using mining industry standards and CIM Mineral Exploration Best Practice Guidelines. Mercator and P. Ténière completed data verification procedures throughout the entire process including review of QAQC procedures and results.

12.2 Review of Supporting Documents and Previous Technical Reports

QP author P. Ténière obtained copies of relevant historical assessment work reports as part of the data validation procedures. Additional documents such as the 2020 NI 43-101 Technical Report (MacKinnon, 2020) that summarizes drilling program results were also reviewed. Key aspects of this historical reporting are in part referenced in this Report and were obtained through online searching of historical assessment reports available through the provincial government online report database and previous technical reporting. Results of the reference documentation checking program showed that in all instances considered, digital and hard copy records accurately reflect content of referenced source documents.

QP authors P. Ténière and M. Harrington also validated project database entries for 2016, 2017, and 2020 diamond drilling programs to support the current resource estimate. This included systematic checking of database entries against source documents, with correction of deficiencies where necessary. Checking of database content consisted of collar coordination checks for all drill holes against source records, spot checks of core sample record entries and checking of assay results entries against source laboratory reports and certificates (including the check assay program described above). In addition to these manually coordinated checks, routine digital assessment of the drill hole datasets for issues such as end of hole errors, conflicting sample records, survey record errors, etc., were carried out using scripts run within the Gemcom-Surpac modelling software. Minor discrepancies were addressed as required and noted in the database meta-data. No substantive issues were identified.

12.3 QP Author P. Ténière Site Visit and Independent Witness Sampling

QP author P. Ténière completed a Property site visit on February 24, 2021 and a visit to the Sussex core library on December 17, 2020. The personal inspection of the Project was completed via roadside observations on Iron Ore Hill Road, near Jacksonville, New Brunswick which transects the northern part of the Moody Hill area and is the main access into the northern part of the deposit. Drill hole collars were not observed due to winter conditions and thick snow cover. During his site visit he confirmed the following:

- Manganese mineralization is evident in the core samples reviewed and sample intervals are properly documented in core boxes and in the core logging database.
- Access to the Property is excellent through secondary roads and well-maintained trails owned by private landowners with agreements in place. Exploration and drilling activities can be carried out easily without material obstacle.
- The Manganese X core facility at the Property is well organized with evidence of proper QAQC procedures in place for core logging and sampling.

As part of the personal inspection, QP author P. Ténière also examined and sampled a total of 14 quarter core independent witness samples from eight drill holes (SF16-02, SF16-06, SF16-08, SF17-15, SF17-20, SF20-32, SF20-34, and SF20-37) at the Manganese X core storage facility (three samples from 2020 drill holes) during his February 2021 site visit and NBDNR core storage facility in Sussex, New Brunswick (11 samples from 2016 and 2017 drill holes) during his December 2020 site visit.

During the December 17, 2020, and February 24, 2021, core storage facility visits, he confirmed the presence of Mn-Fe mineralization in drill core at depths specified in Manganese X drill logs and also verified various lithological descriptions in logs, against corresponding core intervals. and the independent witness samples were submitted for laboratory analysis along with one blank sample and one CRM included in the sample stream. QP author P. Ténière supervised all aspects of core marking, cutting, and bagging with respect to the check samples and securely held and delivered the samples to the ALS in Moncton, New Brunswick for preparation and subsequent analysis using XRF methods. ALS is a commercial laboratory that is CALA-accredited and ISO 9001 and ISO/IEC 17025 certified. ALS is fully independent of Manganese X.

Fe % and Mn % results for the check sampling program are presented in Table 12-1, Figure 12-1, and Figure 12-2. These show that good correlation exists between the check analysis values and the corresponding project database values from the original assay results. A numbering error occurred with respect to sample 3051 and it does not represent the sample interval assessed by sample 319257. This accounts for the discrepancy of corresponding sample pair results in Figure 12-1.

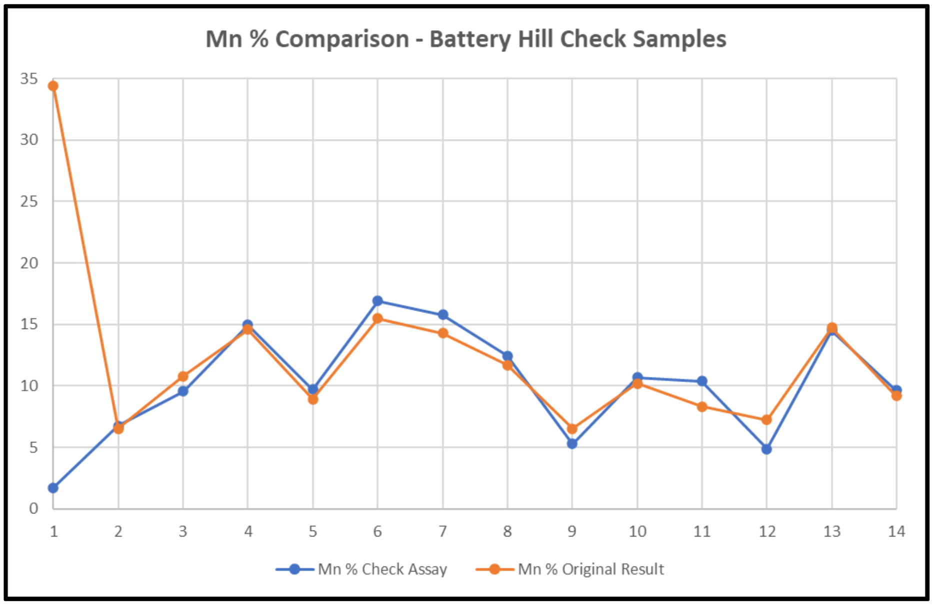
12.4 QP Author Opinion on Data Verification Procedures

QP author P. Ténière is of the opinion that results from the data verification program components discussed in this section indicate that industry standard levels of technical documentation and detail are evident in the recent 2016, 2017, and 2020 diamond drilling results for the Project. In addition, QP authors P. Ténière and M. Harrington are of the opinion that the associated drilling digital database is acceptable for Mineral Resource estimation use.

Table 12-1: QP author P. Ténière Independent Witness Sample Results (2016, 2017, and 2020 Drilling Programs)

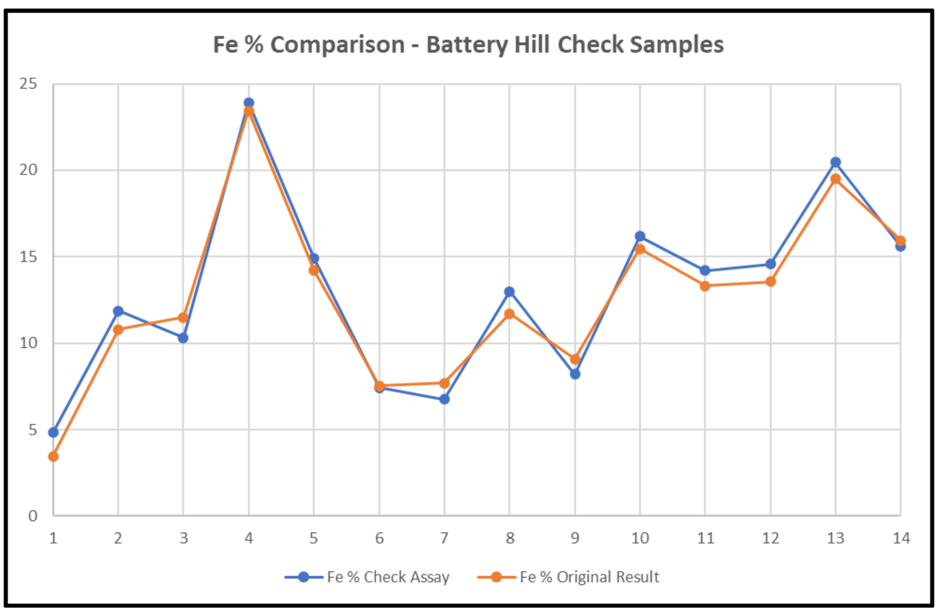
Check Sample ID	ID	Hole ID	From (m)	To (m)	Thick (m)	Fe (%) Check	Mn (%) Check	Comments	Original Sample ID	Fe (%) Original	Mn (%) Original
3051	1	SF16-06	112.00	115.00	3.0	4.82	1.74	Not a standard, sample ID error	319257	3.45	34.40
3052	2	SF16-06	118.00	120.00	2.0	11.88	6.77	red	319260	10.79	6.55
3053	3	SF16-06	126.00	128.00	2.0	10.32	9.56	red green mixed	319265	11.49	10.79
3054	4	SF16-02	88.00	90.00	2.0	23.91	14.95	red green mixed	1400349	23.43	14.59
3055	5	SF16-02	96.00	98.00	2.0	14.90	9.72	red green mixed	319003	14.19	8.93
3056	6	SF16-08	121.80	123.8	2.0	7.43	16.90	green	318410	7.53	15.50
3057	7	SF16-08	132.25	133.25	1.0	6.75	15.80	green	318418	7.68	14.30
3058	8	SF17-15	230.00	232.00	2.0	13.00	12.45	red-brown	318707	11.71	11.69
3059	9	SF17-15	247.50	249.30	1.8	8.20	5.31	green	318715	9.08	6.52
3060	10	SF17-20	55.80	58.00	2.2	16.18	10.70	green	319513	15.46	10.22
3061	11	SF17-20	66.00	68.00	2.0	14.20	10.40	green	319518	13.31	8.32
3064	12	SF20-32	74.00	76.00	2.0	14.58	4.89	average green	320219	13.55	7.26
3065	13	SF20-34	90.00	92.00	2.0	20.45	14.50	High grade mixed	320455	19.49	14.75
3066	14	SF20-37	102.00	104.00	2.0	15.60	9.64	avg mixed	48176	15.93	9.21
3062						16.02	0.324	CRM OREAS700 (acceptable result)			
3063						1.27	0.054	blank silica sand (acceptable result)			
						16.06	*0.321*	CRM OREAS700 (acceptable result)			

Figure 12-1: Mn% Witness Sample Results 2016, 2017, and 2020 Drilling Programs



Source: prepared by Mercator, dated 2021

Figure 12-2: Fe% Witness Sample Results 2016, 2017, and 2020 Drilling Programs



Source: prepared by Mercator, dated 2021

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Summary of Testwork

From 2017 the following testwork has been carried out on the Battery Hill property by Manganese X.

- Mineralogical testing in 2017 conducted by SGS Canada Inc (SGS Canada)
- Diagnostic leach and purification testing conducted by Kemetco Research Inc. (Kemetco) in Richmond, British Columbia and Kingston Process Metallurgy (KPM) in Kingston, Ontario
- Manganese upgrading testing in 2018 conducted by the National Research Council (NRC) and SGS Lakefield
- Pre-concentration testing in 2018 conducted by Steinert US (Steinert) in Walton, Kentucky and ST Equipment & Technology LLC (ST Equipment) in Needham, Massachusetts
- Flowsheet development testing in 2020 conducted by Kemetco
- 2020 to 2021 testwork program conducted by Kemetco.

13.2 Historical Metallurgical Testwork

Materials from manganese-iron deposits in the Woodstock New Brunswick area were reportedly smelted to produce iron as early as the 1840s, with operations continuing until 1884. After that, the earliest information regarding metallurgical work on manganese-bearing materials from these formations comes from a report in the 1940s, details of which are not available.

Between 1953 and 2014, extensive metallurgical testwork has been carried out in the area. The testwork included various beneficiation, pyro- and hydrometallurgical processes. The results obtained from the various tests have been mixed, although the later testing in 2010 and 2014 employing beneficiation techniques combined with hydrometallurgical processing returned promising results.

Whilst the Battery Hill mineralization was included in testwork at various times, the majority of this testwork was conducted on mineralization outside of the Manganese X property boundary. Although cursory examinations show there are similarities between the material tested and the mineralized zones located on the Manganese X claims, there can be no assurance that the same processes will be applicable to the mineralization that exists on the Manganese X claims. This historical testwork was reported in greater detail in previous reports.

13.3 Pre-2020 Testwork

The information presented in this section has been sourced from the 2021 technical report prepared by Mercator (Ténière et al.,2021).

13.3.1 Sample Selection

Beginning in 2017, Manganese X initiated a series of mineralogical and metallurgical related studies, as described in the following sections.

The Battery Hill property covers the northern portion of a belt of sediment-hosted manganese-iron formations which include three principal types of manganese mineralization. These are brick-red to maroon-coloured siltstones, green-grey to black siltstones, and a banded mix of the red and grey siltstones. These three types of mineralized siltstones have been termed Red, Grey and Mixed, respectively, for simplicity of sample descriptions. These mineralization types appear to be directly analogous to separate rock types tested in metallurgical programs conducted by Canadian Manganese Company Inc. (CMC) on their adjacent property. That material came from drill core obtained from the Plymouth deposit, located approximately 5 km south of the Battery Hill property. In that work, it was determined that the brick-red siltstones and green-grey to black siltstones had differing mineralogy, resulting in significant differences in acid consumption and leachable iron content between the two materials.

The mineralogical and metallurgical studies undertaken to date by Manganese X have primarily used two composite samples, one of Red and the other of Grey mineralization, with a separate Mixed composite also used in some cases. The primary (master) composite samples for this testwork were prepared from assay sample reject material from exploration drill holes SF16-6, SF16-8 and SF16-9 drilled on the Moody Hill target and holes SF16-2, SF16-4 and SF16-5, drilled on the Sharpe Farm target. The drill holes fall within the pit shell as defined in this study. The composite samples of Red and Grey mineralization totalled 98.8 and 251.8 kg, respectively. Sampling and compositing were completed at the core logging facility in March 2017. The weights of rejects from each assay sample added to a given composite were recorded to allow the calculation of a composite head assay, based on the weighted average of the assays of the individual sample intervals. Details of the Red and Grey composite samples are presented in Table 13-1.

Composite samples were delivered to RPC Science and Engineering (RPC) in Fredericton, New Brunswick for homogenization and preparation of sub-samples. The two Master Composite samples (designated J2035 Red and J2035 Grey) were securely stored at RPC and representative sub-samples were shipped to contractor facilities for mineralogical and metallurgical testwork as needed.

Table 13-1: Red and Grey Mineralization Master Composite Samples

Composites	Drill Hole	Target	Mn (%)	Fe (%)	Weight (%)
Red Composite[1]					
100% of rejects	SF16-6	Moody Hill	9.33	17.65	18.55
100% of rejects	SF16-8	Moody Hill	9.39	7.63	37.03
100% of rejects	SF16-9	Moody Hill	8.80	13.20	43.25
Grey Composite[2]					
50% of rejects	SF16-2	Sharpe Farm	10.88	15.99	44.41
50% of rejects	SF16-4	Sharpe Farm	9.87	15.50	49.11
50% of rejects	SF16-5	Sharpe Farm	10.70	16.71	58.62
100% of rejects	SF16-8	Moody Hill	13.57	10.55	26.78
100% of rejects	SF16-9	Moody Hill	8.67	14.46	58.98
100% of rejects	SF16-9	Moody Hill	9.74	13.94	13.92

Note: (1) Weighted average grade of rejects is 9.12% manganese and 11.95% iron. Red composite was formed by combining 100% reject material from 19 samples from holes SF16-6, SF16-8 and SF16-9.
(2) Weighted average grade of rejects is 10.34% manganese and 15.01% iron. Grey composite was formed by combining 50% of reject material from 69 samples from holes SF16-2, SF16-4, SF16-5 and 100% of reject material from 23 samples from holes SF16-8 and SF16-9.

13.3.2 Mineralogical Testing – QEMSCAN

Four composite samples from the property were submitted to the Mineral Services group of SGS Canada for chemical analysis and mineralogical characterization by X-ray diffraction and QEMSCAN analysis. Two of the samples (Sample A (Red) and Sample B (Grey)) were from Globex Mining drill holes GNB-11-2 and GNB-11-3, drilled on the Iron Ore Hill occurrence in 2011. The other two samples were splits from the two Master Composites J2035 Red and J2035 Grey, which were from Manganese X drill holes on the Sharpe Farm and Moody Hill sections, as described in Section 13.3.1. The additional samples were included in the study to determine if the Red and Grey sedimentary rocks from different parts of the property showed similar mineralogy, manganese distribution and mineral grain liberation. The following discussion is derived from the SGS Canada's report (SGS Canada, 2017) that was summarized in the Mercator's technical report (Ténière et al., 2021).

The X-ray diffraction and QEMSCAN analyses detected several manganese bearing minerals. The analysis showed that the manganese phases have highly variable manganese concentrations. The QEMSCAN results include the modal mineralogy and various sets of deportment data illustrating the minerals by composition. Table 13-2 and Table 13-3 present the overall mineral distributions, while comparing the two Red samples and the two Grey samples, respectively. Table 13-4 and Table 13-5 show the distribution of manganese in these same samples, based on the overall mineral distributions obtained from the QEMSCAN analysis.

The mineralogy of these samples may be summarized as follows:

- Sample A (Red) from Iron Hill, was high in manganese silicates, and particularly manganese-iron silicates, in total accounting for over 35% of the mass, with manganese-bearing carbonates accounting for less than 10% of the mass, and an additional 5% made up of manganese-bearing clays. A further 12% of the mass occurred as iron oxides and silicates, and the remainder of the material was mainly made up of a mixture of quartz, plagioclase, feldspar, micas, apatite (calcium-phosphates), with minor amounts of clay and other alteration minerals.
- The results for the corresponding sample material of Red composite (J2035 Red) from Moody Hill/Sharpe Farm, showed a much lower content of manganese-iron silicates, with only marginally higher amounts of other manganese silicates (total manganese-silicates 18%). The total mass of manganese-bearing carbonate minerals was; however, significantly higher than Sample A (13.4%). While the content of other iron minerals was similar to Sample A (11.5%), there were less oxides and more silicates. Remaining gangue minerals were similar between the two samples, but with proportionately higher quartz and mica in the composite sample (31% of the mass) along with more chlorite (11%).
- Sample B (Grey) from Iron Hill also showed a large part of the mass (28.7%) to be made up of manganese-bearing silicate minerals, but manganese-containing carbonate minerals also represented a larger fraction than seen in the Red samples (19.4%). Iron oxides were less than 1% in this sample, but manganese-free iron-bearing silicates still represented about 9% of the mass. Dominant gangue minerals were quartz and chlorite, but minor gangue minerals seen in the Red material were also present in similar amounts. This sample had the highest sulphide mineral content (2%), likely representing additional iron content in the form of iron sulphide minerals.
- The Grey composite sample from Moody Hill/Sharpe Farm (J2035 Grey), showed much less variation from the Iron Hill Grey sample (Sample B) than seen with the Red samples. Total manganese-bearing silicates were a little less (25.2%), while the manganese-containing carbonate content was almost the same for both samples (20%). Iron-bearing minerals in the gangue were again primarily present as silicates rather than oxide minerals. Other gangue minerals were similar between samples, but with chlorite making up a more significant fraction relative to quartz and other silicates (14.9%).

Table 13-2 shows the difference in manganese-silicate mineral content between the two Red samples collected from different parts of the property. While the general mineral make-up is similar, there are important differences in the manganese-bearing minerals present. The composite shows much less of the manganese mineralization in silicates and significantly more in carbonates. This may have important implications for leach performance and reagent consumption. Of note was the lack of non-manganese carbonates in both samples, supporting previous findings of lower acid consumption with this rock type.

Table 13-2: QEMSCAN Mineral Identification and Classification. Modal Distributions (mass %) for each Red Sample, with Variance between Samples Highlighted

LIMS # Sample Name Deposit Name	MI5022-FEB17 Sample A (Red) Houston Woodstock	MI5028-MAR17 J2035 Red Battery Hill	Difference
Mn-Silicate	1.65	2.02	-0.37
Mn-Ca Silicate	2.84	4.53	-1.68
Mn-Ca-Al Silicate	2.48	1.63	0.85
Mn-Fe Silicate (± Al, Ca, Mg)	29.80	9.76	20.03
Mn Mica / Clays	4.83	3.32	1.51
Ca-Mn-Fe Carbonate	1.96	1.13	0.83
Mn-Ca Carbonate	7.30	7.54	-0.25
Mn-Fe Carbonate	0.33	0.32	0.02
Mn-Carbonate	0.09	4.39	-4.30
Mn Others	0.00	0.03	-0.03
Quartz	4.96	12.61	-7.65
Plagioclase	5.72	3.83	1.90
K-Feldspar	1.14	2.25	-1.12
Sericite / Muscovite	6.51	9.50	-2.98
Biotite	3.17	8.65	-5.48
Chlorite	2.45	11.05	-8.60
Clays	4.26	1.85	2.42
Fe-Al Silicate	1.74	4.44	-2.70
Other Silicates	0.06	0.12	-0.06
Rutile	0.48	0.72	-0.24
Siderite	1.52	0.74	0.78
Fe-Oxides	9.10	6.22	2.89
Other Oxides	0.03	0.12	-0.09
Carbonates	0.02	0.12	-0.11
Ca-Phosphate (low impurities)	6.23	2.78	3.45
Barite	0.11	0.18	-0.07
Sulphides	1.16	0.04	1.11
Other	0.05	0.11	-0.06

Table 13-3: QEMSCAN Mineral Identification and Classification. Modal Distributions (mass %) for Each Grey Sample, with Variance between Samples Highlighted

LIMS # Sample Name Deposit Name	MI5022-FEB17 Sample B (Grey) Houston Woodstock	MI5028-MAR17 J2035 Grey Battery Hill	Difference
Mn-Silicate	0.85	0.61	0.24
Mn-Ca Silicate	0.74	0.88	-0.14
Mn-Ca-Al Silicate	1.54	0.83	0.72
Mn-Fe Silicate (± Al, Ca, Mg)	24.56	21.39	3.17
Mn Mica/Clays	1.20	1.52	-0.32
Ca-Mn-Fe Carbonate	7.73	4.82	2.91
Mn-Ca Carbonate	6.43	8.14	-1.70
Mn-Fe Carbonate	2.47	4.24	-1.77
Mn-Carbonate	2.76	2.82	-0.06
Mn Others	0.00	0.01	-0.01
Quartz	12.49	8.36	4.13
Plagioclase	0.39	2.16	-1.77
K-Feldspar	1.12	1.20	-0.08
Sericite/Muscovite	3.94	5.76	-1.82
Biotite	1.95	2.29	-0.34
Chlorite	11.08	14.92	-3.84
Clays	1.74	1.41	0.33
Fe-Al Silicate	4.93	7.54	-2.61
Other Silicates	0.05	1.35	-1.30
Rutile	0.62	0.61	0.01
Siderite	4.05	0.65	3.40
Fe-Oxides	0.64	1.10	-0.47
Other Oxides	0.16	0.24	-0.08
Carbonates	0.34	0.27	0.07
Ca-Phosphate (low impurities)	6.08	5.13	0.95
Barite	0.00	0.00	0.00
Sulphides	2.06	1.58	0.49
Other	0.07	0.17	-0.10

Table 13-4: Manganese Distribution (normalized mass %) for Each Red Sample, with Variance between Samples Highlighted

Minerals	Sample A (Red)	J2035 Red	Difference
Mn-Silicate	5.92	7.26	1.34
Mn-Ca Silicate	2.80	5.04	2.23
Mn-Ca-Al Silicate	2.45	1.87	-0.58
Mn-Fe Silicate (± Al, Ca, Mg)	44.08	16.39	-27.68
Mn Mica/Clays	3.22	2.78	-0.43
Ca-Mn-Fe Carbonate	6.16	3.91	-2.25
Mn-Ca Carbonate	27.35	32.54	5.19
Mn-Fe Carbonate	0.92	0.95	0.04
Mn-Carbonate	0.40	23.31	22.91
Mn Others	0.00	0.19	0.18
Chlorite	0.56	2.63	2.07
Other Silicates	0.01	0.00	-0.01
Other Oxides	0.00	0.01	0.01
Ca-Phosphate (low impurities)	6.14	3.12	-3.02
Sulphides	0.00	0.00	0.00
Other	0.00	0.00	0.00

Table 13-5: Manganese Distribution (normalized mass %) for Each Grey Sample, with Variance between Samples Highlighted

Minerals	Sample A (Grey)	J2035 Grey	Difference
Mn-Silicate	2.41	1.82	-0.59
Mn-Ca Silicate	0.61	0.76	0.15
Mn-Ca-Al Silicate	1.28	0.70	-0.58
Mn-Fe Silicate (± Al, Ca, Mg)	30.49	27.35	-3.14
Mn Mica/Clays	0.85	0.85	-0.01
Ca-Mn-Fe Carbonate	20.35	13.16	-7.19
Mn-Ca Carbonate	20.24	26.33	6.09
Mn-Fe Carbonate	5.69	10.22	4.53
Mn-Carbonate	10.91	11.37	0.46
Mn Others	0.01	0.06	0.05
Chlorite	2.11	2.96	0.85
Other Silicates	0.01	0.00	0.00
Other Oxides	0.01	0.02	0.01
Ca-Phosphate (low impurities)	5.03	4.40	-0.63
Sulphides	0.00	0.00	0.00
Other	0.00	0.00	0.00

Table 13-3 shows the mineral distribution for the Grey samples from Iron Hill (Sample B) and Moody Hill/Sharpe Farm (J2035 Grey). In this case, the samples show much less variation than for the Red samples. Both show relatively high proportions of both silicate and carbonate host minerals for manganese. As with the Red samples, the gangue shows a wide distribution of quartz and silicate minerals typical of sedimentary formations. The Grey mineralization is much lower in iron oxides, which likely accounts for the colour difference. The Grey mineralization also contains a small amount of non-manganese bearing carbonates, higher sulphide content and more chlorite.

Based on SEM-EDS analysis of the mineral phases present, the manganese content of each phase was calculated to determine the manganese distribution through the manganese-bearing minerals. These results are presented in Table 13-4 for the two Red samples, and Table 13-5 for the Grey samples. As with the mineral distributions, the variations between the Iron Hill sample and the Moody Hill/Sharpe Farm composite are also included in these tables. For the Red samples, this analysis indicates the relative importance of the carbonate minerals when compared with the mineral distributions, indicating a higher average manganese grade in the carbonate minerals than the manganese-bearing silicate minerals.

This analysis also shows more clearly the significance of the differences between the manganese mineral distribution between Sample A and the drill core composite. While in Sample A, all carbonates account for approximately 35% of the manganese present, this increases to over 60% for the composite. In particular, pure manganese carbonate (rhodochrosite) accounts for nearly 25% of the manganese in the composite, but is essentially absent from Sample A.

As noted, Table 13-5 shows the calculated manganese distribution in each sample, based on average manganese content determined by SEM-EDS. Again, this analysis shows the relative importance of the carbonates as a source of manganese, which in this case is more consistent between the two samples. The main difference between these samples was a small variation in the relative importance of different mixed carbonate minerals. For the Moody Hill/Sharpe Farm composites (J2035 Red and Grey), the distribution of the manganese to carbonate minerals was consistent between the Red and Grey samples, at approximately 60%. Based on these results the majority of the manganese in the carbonates occurred as mixed manganese-calcium carbonates, which could indicate potential challenges for rejecting alkalinity in any pre-concentration processes.

13.3.3 Diagnostic Leach and Purification Testing

Manganese X's first metallurgical programs for Battery Hill material consisted of diagnostic leach testing, carried out by two separate firms, Kemetco and KPM. Both programs were carried out using sub-samples from the two Master Composite Red and Grey samples (J2035 Red and J2035 Grey) prepared from Sharpe Farm and Moody Hill drill core. In addition, KPM completed testwork on a composite sample of Mixed mineralization from Moody Hill Central. This Mixed composite sample was prepared from drill core sample rejects from 2017 drill holes SF17-16, SF17-17, and SF17-18. The weighted average head grade of this composite was calculated as 12.9% Mn and 17.5% Fe. A second sample of Moody Hill mixed material, grading 11.7% Mn and 15.8% Fe, was tested using the same procedures at a later date.

The laboratory bench-scale sulphuric acid leach tests were conducted to determine the achievable manganese extraction, investigate the leach kinetics of the major leachable elements and to measure the acid consumption for the main types of mineralization on the property (Red, Grey, and Mixed).

The test results were encouraging, with the best manganese extraction results exceeding 95%. Test results from KPM and Kemetco showed a similar leach response and sample characteristics, as summarized below:

- Both mineralization types (Red and Grey) showed high manganese extraction, exceeding 95% under the best conditions, using an elevated temperature sulphuric acid leach, indicating that the manganese occurred primarily in readily extractible mineral forms
- The presence of high free acid levels (50 g/L) had a minor effect on manganese leach extraction, but a much more pronounced effect on the amount of impurities (iron, calcium, magnesium) reporting to the leachate
- The manganese extraction was rapid, with extractions complete within two hours for the Red mineralization, but slower (within four hours) for the Grey mineralization
- Iron extraction varied significantly between the two mineralization types, with the Grey showing much higher leachable iron. This is likely to lead to process differences between the two materials, with lower process costs associated with manganese and impurity iron extraction for the Red mineralization
- The mixed composite showed intermediate kinetics, with slightly lower manganese extraction than the other two samples. The impurity iron extraction was also intermediate between the other two types of mineralization, while the magnesium extraction was the lowest of all the materials tested

- Overall, manganese extraction varied from 84 to 96%, depending on the feed mineralization and the test conditions.

As a follow-up to the diagnostic leach testing, Manganese X enlisted Kemetco to complete a program of manganese sulphate purification and crystallization testing. The objective was to produce a high purity manganese sulphate product suitable for use in battery manufacturing or other high-technology applications. The leach solution was subjected to two stages of impurity removal, the first stage primarily to remove iron and aluminum and the second to precipitate calcium and magnesium.

Initial results showed that the two stages of purification, which involved neutralization with lime and precipitation of calcium and magnesium, were very effective at removing iron and aluminum contamination, and also removed most of the calcium and magnesium, but residual reagents remained in solution, which reduced the grade of the final crystals. A third purification step, involving manganese carbonate precipitation and redissolution, was added to remove the residual reagent, resulting in a clean solution feeding the evaporation and crystallization stage. Crystal washing steps allowed further purification of the HPMSM crystals, and the resulting crystal purities were above 99.9%. Based on these results, it could be projected that even lower levels of impurity could be achieved in the final product, if needed, through additional washing steps. Determining the degree of additional impurity removal that can be achieved was limited by the available analytical methods. While many of the target impurities were below the analytical detection limits, the high manganese content of the final manganese sulphate product limited the lower detection levels that could be measured, which added uncertainty to very low-level impurity calculations.

Following demonstration of the level of manganese sulphate purity that could be obtained, additional process solution was treated in the same manner to provide a high-purity sample product to Manganese X for outside testing and evaluation, as needed. This scoping-level test program demonstrated that the use of bulk purification techniques could produce HPMSM product to a purity of 99.95%, with low levels of targeted contaminants. While the product was not tested directly for high-tech applications, the measured contaminant levels appeared to be consistent with use as a component in the production of Electric Vehicle (EV) and storage batteries. These results led to recommendations for follow-up process development work to develop a complete process flowsheet, evaluate the effects of lower cost process steps, and to develop mass balance and recovery data for the process.

13.3.4 NRC—Manganese Upgrading and Purification Testing

As recommended by Thibault and Associates and KPM for CMC's Plymouth deposit to the south, in 2018 Manganese X contracted the National Research Council (NRC) to investigate the potential for mineralization upgrading processes to remove acid consuming minerals to reduce the acid requirements for leaching, and potentially reduce the alkali metals in the leachate. Manganese X sent a total of 70 kg of crushed composite material, including 66 kg sent to NRC's Montreal Road campus and 4 kg sent to SGS's Lakefield laboratory for testing. The following results were reported:

- Gravity separation using a laboratory shaking table with sized sample fractions demonstrated limited separation
- Magnetic separation demonstrated some selectivity. The combined magnetics, grading 15.0% Mn, recovered 77.9% of the manganese in 61.8% of the mass, giving an upgrading factor of 1.26.
- Two flotation reagent schemes based on fatty acid and hydroxamic acid collectors were investigated, with the best result giving a 17.3% Mn concentrate with 64.1% recovery.

13.3.5 Preliminary Pre-concentration Research

The average grade range of mineralization on the Battery Hill property is projected to be 8 to 10.5% Mn. Manganese X recognized that upgrading technologies could be a key to improving the economics of a potential mining and processing operation. During 2017, Manganese X initiated preliminary studies of two upgrading technologies, sensor-based ore-sorting and 'Tribo-Electrostatic' separation.

13.3.5.1 Ore Sorting Testwork

The objective of this preliminary program was to determine whether there was potential for an ore sorting technology to significantly upgrade the mineralized material through the rejection of gangue minerals and/or lower grade manganese-bearing material. To provide significant improvements to project economics, a level of upgrading to provide an average 15% Mn in the process feed was targeted. The preliminary test results from Steinert were encouraging, with product grades of 14.7% Mn being achieved, although recovery rates were somewhat lower than anticipated.

The sample material for the ore sorting testwork was ½ cut NQ drill core from hole SF17-18, located in Moody Central. The sample material was collected in July 2017 and sent to RPC for preparation. The material was crushed to produce a 1" x ½" sized sample for shipment to the Steinert where testing was conducted in August 2017. The 74-m core interval sampled totalled 88 kg and had an average grade of 9.39% Mn and 14.72% Fe, based on the original core assays. The interval included all three mineralization types (Grey, Red and Mixed), as well as lower grade (<3% Mn) material (Table 13-6) and was therefore felt to represent a good broad composite sample for an initial ore sorting scoping test program.

The testwork used the Steinert Combi-Sensor KSS 100 XT FLI sorter within five steps. This sorter utilized a combination of sensor types, including dual-energy X-ray transmission (XT), colour camera (F), 3D Laser (L) and Induction (I). XRT sorting is the preferred technology for mining applications and can therefore provide a dry beneficiation process.

The grade of the feed sample was established to be 10.54% Mn. The highest manganese grade achieved (14.72% Mn) occurred at the Step 2 sensitivity setting, which combined the products of the red hematite/iron oxide material (colour sensor) and the densest fraction determined by the X-ray transmission sensor. At that stage, the manganese recovery was 56.6%. By Step 3, the manganese was upgraded from 10.54% to 14.55%, and recovery was 68.4%, with a mass pull to the product of 54.7% (the grade of the 45.3% of mass rejected was 5.68% Mn). The cumulative results for five steps of sorting and the manganese grade-recovery response are illustrated in Figure 13-1.

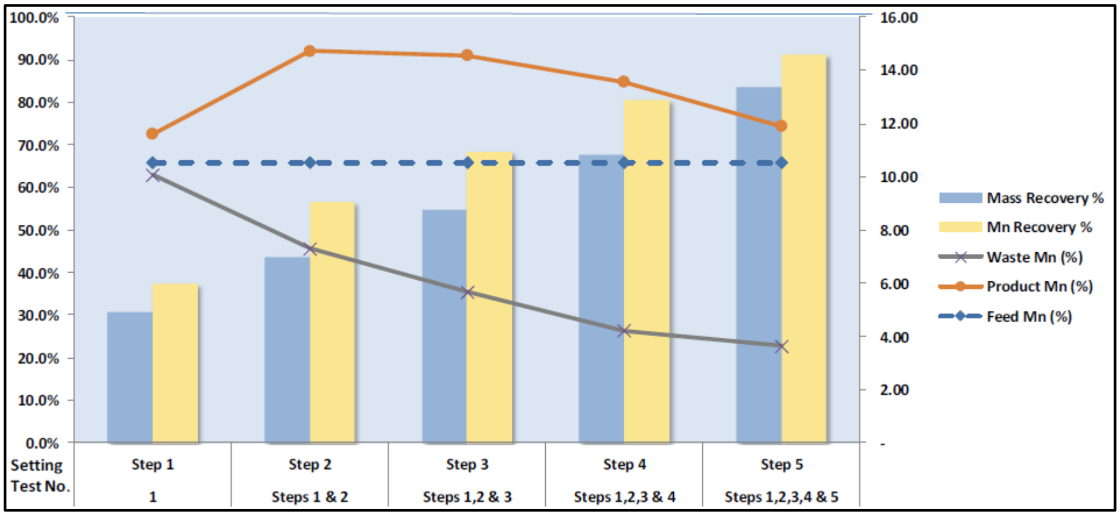
Steinert made the following conclusions:

- The sorter was shown to be effective in upgrading the sample under a range of sensitivity settings.
- With each step in the sensitivity setting, the manganese and iron recovery were increased, with lowering product grades.
- Manganese and iron show good correlation.
- Step 2 on the sensitivity scale tested provided the highest grade manganese product, with a grade of 14.72% Mn.
- Further bulk testing was recommended.

Table 13-6: Ore Sorting Composite Sample Details (40.0 to 114.0 m depth)

Mineralization Type	Sample Width (m)	Percentage (%)	Mn (%)	Fe (%)
Grey	22.5	30.4	8.13	12.49
Red + Mixed	44.3	59.9	11.29	17.45
Low Grade (<3%)	7.2	9.7	1.69	4.89
Combined Total	**74.0**	**100.0**	**9.39**	**14.72**

Figure 13-1: Ore Sorting Preliminary Scoping – Step 1 to 5 Manganese Grade Recovery



Source: Hundley, 2017

13.3.5.2 Tribo-Electrostatic Separation Test

In July 2017, the tribo-electrostatic separation potential was evaluated through an initial test study on a 3 kg sample of the Grey mineralization (J2035 Grey). The electrostatic separation test was performed by ST Equipment.

Preliminary testing did not lead to a significant separation or upgrading of the manganese under normal test conditions, likely due to the intimate association of manganese-bearing carbonate and silicate species with gangue silicate minerals. Further testwork was not recommended and a report was not completed.

13.3.6 Flowsheet Development Testing

Following the successful preliminary manganese sulphate crystallization and purification testing conducted by Kemetco, a follow-up program was initiated in May 2020, aimed at defining the principal unit operations of a flowsheet for the production of high purity manganese sulphate. This work was conducted using the Red composite (J2035 Red), due to its lower acid consumption and high manganese extraction rates determined from previous testwork. The work program included investigation of leaching methods and the effects of principal leaching parameters, solid-liquid separation methodology, and primary and secondary purification processes.

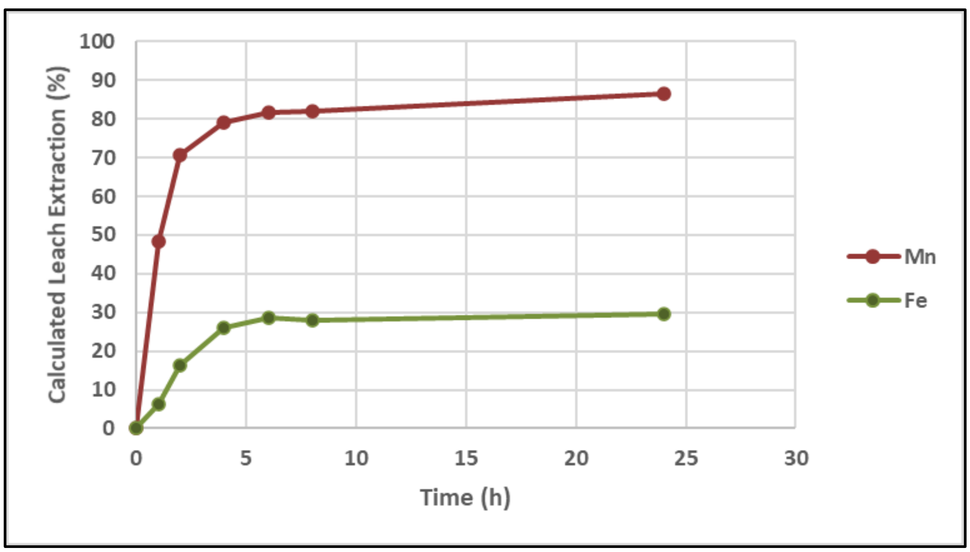
13.3.6.1 Bulk Leaching and Leach Parameter Testing

The bulk leach testing involved a single six-hour sulphuric acid leach controlled at pH 1.5 and 60ºC, with the slurry then allowed to cool overnight while mixing. The test feed was crushed assay reject, as received without grinding, giving a feed P80 of approximately 2 mm. Table 13-7 shows a summary of the overall mass balance for the bulk leach after neutralization and solid-liquid separation, with close to 75% manganese extraction, while leaching 25% of the iron. Free acid in solution was maintained at approximately 25 g/L and the overall acid consumption was 570 kg/t. Kinetic sampling (Figure 13-2) showed that most of the leaching occurred within the first four hours, with iron levelling off after that, while manganese extraction continued to increase at a low rate. The higher calculated manganese extraction in the leach shown in Figure 13-2 reflected solution assays prior to losses in the neutralization and solid-liquid separation stages, which are not yet optimized.

Table 13-7: Bulk Leach Summary after Neutralization

Product	Weight (kg)	Assay (% or g/L)		Distribution (%)	
		Mn	Fe	Mn	Fe
Feed ore	15.45	12.7%	16.5%	100.0	100.0
Leachate	43.1	32.2 g/L	9.76 g/L	74.4	24.5
Residue	15.25	3.3%	12.6%	25.6	75.5

Figure 13-2: Bulk Leach Test – Kinetic Extraction Curves for Manganese and Iron



Source: Ténière et al., 2021

Following the bulk leach, a series of bench-scale sulphuric acid leach tests were conducted to identify the most significant of the principal test parameters. These tests started from the baseline conditions used in the bulk leach and tested a series of parameters that included temperature, free acid addition, pulp density, particle size and solution reducing potential. These tests also incorporated a post-leach neutralization stage to allow solid-liquid separation.

Results from all bench-scale leach tests are summarized in Table 13-8, including the vat leach test described in Section 13.3.6.1. The results showed the importance of maintaining high acidity, either through a lower pH set point or by limiting solids loading with lower pulp density. Particle size had the most significant impact on recovery with recovery increasing to 85% with a moderate grind. There was a lesser but significant temperature effect. Addition of a reducing agent (SMBS) to a leach with ground material resulted in a further improvement in recovery but had a more significant unwanted effect on iron and magnesium extraction. This confirmed that refractory oxidized manganese minerals are not a major component of the manganese present in this material. Acid consumption was lower in these tests than in the bulk leach. The baseline test had a consumption of 320 kg/t, and other tests ranged from about 200 to 400 kg/t, with a general correlation between acid consumption and manganese extraction.

Table 13-8: Summary of Test Performance – Leach Parameter Testing

Test	Mn Extract. (%)	Mn in Leach (g/L)	Fe in Leach (g/L)	Mn in Residue (%)	Treated Solution Assay (g/L)					Mn:Mg Ratio	Max. Setl. Rate (cm/min)	Init. Filt. Rate (mL/min)
					Mn	Fe	Mg	Ca	Al			
0 (vat)	41.5	49.3	11.36	8.34	32.1	6.95	2.14	0.62	1.87	15.0	-	-
1	73.5	42.4	9.79	3.86	32.3	5.90	1.23	0.49	0.05	26.3	0.20	170
2	70.2	38.4	5.69	4.58	29.7	3.03	1.38	0.49	0.08	21.5	1.17	200
3	76.1	37.1	9.76	3.38	30.4	6.18	1.96	0.47	0.02	15.5	1.57	100
4	55.1	25.7	2.86	6.43	22.2	1.90	0.93	0.47	0.06	23.9	0.66	90
5	77.1	26.6	8.15	3.15	20.0	4.60	1.57	0.46	0.02	12.8	2.58	316
6	53.6	51.6	8.84	6.56	37.6	5.33	1.91	0.47	0.11	19.7	0.09	120
7	86.3	45.9	9.62	2.05	34.3	6.30	2.09	0.48	0.11	16.4	0.23	100
8	91.0	43.2	15.28	1.35	29.7	8.90	2.56	0.47	0.03	11.6	0.20	80

13.3.6.2 Vat Leach Testing

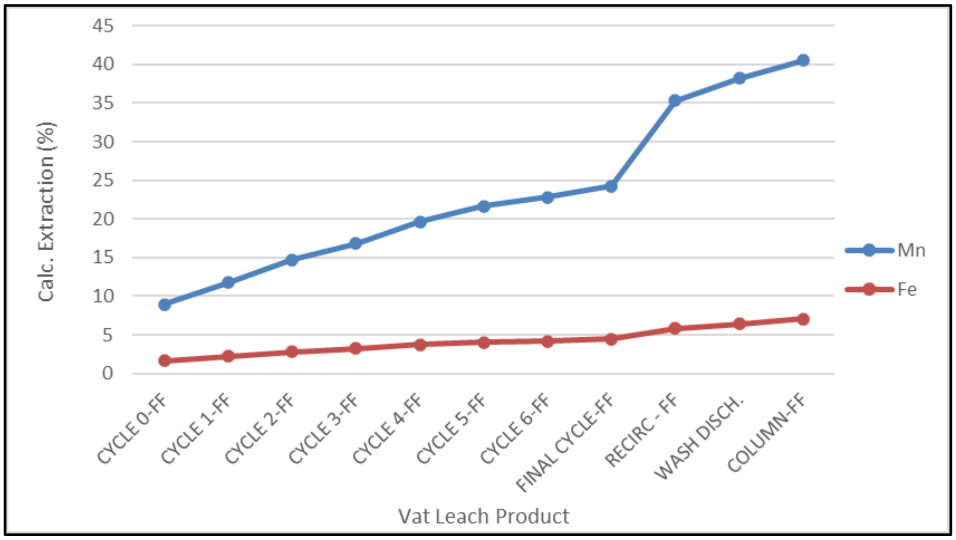
A single small-scale vat leach test was completed on an agglomerated sample of as-received Red composite material. This test incorporated multiple fill-drain cycles at elevated temperature with acid make-up between cycles. This was a preliminary screening test, which gave significantly lower recoveries, but also successfully demonstrated an alternate approach to leaching that could have economic advantages if successfully optimized. The vat leach also proved to be a potential method of handling fine solids, as drained leach solutions were low in suspended solids and could be filtered without neutralization. Acid consumption was relatively low, at 156 g/kg, but this was likely a reflection of the low manganese recovery (Table 13-9). Significant additional optimization work would be needed to determine if this could be used as a viable alternative to grinding and tank leaching as the primary extraction process.

Table 13-9: Vat Leach Summary

Product	Weight (kg)	Assay (% or g/L)		Distribution (%)	
		Mn	Fe	Mn	Fe
Feed ore	1.70	12.3%	15.6%	100.0	100.0
Leachate	4.50	18.4 g/L	3.91 g/L	41.5	10.3
Residue	1.46	8.34%	16.3%	58.5	89.7

Figure 13-3 shows extraction of manganese and iron through each cycle including final wash stages. Continuing increases in manganese extraction in the later cycles, including a final solution recirculation stage, suggest that higher extraction levels could be achieved with optimized leach conditions. These preliminary results also pointed to the potential for increased selectivity for manganese in the leach, as iron extraction was lower than in tank leach tests.

Figure 13-3: Vat Leach Test – Kinetic Extraction Curves for Manganese and Iron



Source: Ténière et al., 2021

13.3.6.3 Neutralization and Solid-Liquid Separation Testing

Earlier leaching testwork showed that solid-liquid separation after tank leaching was very challenging, with long filtration times and manganese losses due to poor washing efficiency. Therefore, for the bulk leach, the leached slurry was divided into four equal test lots to evaluate solid-liquid separation after partial neutralization, using a range of temperature and pH conditions for the neutralization step. The test results identified a pH and temperature at which solid-liquid separation improved dramatically. This method of handling the leach slurry had the additional potential benefit of eliminating one solid-liquid separation stage by allowing the leaching and first purification stages to run sequentially on the whole slurry. Effective solid-liquid separation also allowed for the inclusion of normal cake washing or potential counter-current decantation (CCD) configurations that would minimize manganese losses to the resulting solid residue.

Following each of the bench-scale leach optimization tests, the acidic leach slurry was neutralized following the procedures developed from the bulk leach neutralization testing. Settling and filtration data were collected for the resulting neutralized slurries. These neutralizations used lime slurry addition to reach a targeted pH, with aeration, over a two- to four-hour period with an additional one hour of aeration after the pH was stabilized. Comparative settling and filtration data for each test are included in Table 13-8.

13.3.6.4 Leach Solution Purification

Aluminum was removed through hydroxide precipitation as the pH increased and was complete for all tests. Iron removal also occurred through hydroxide precipitation but required oxidation of any ferrous iron to the ferric state for complete precipitation. Iron removal was successful for all tests with a higher pH target, although higher pH levels also increased manganese oxidation, leading to losses from solution. At the highest pH tested, iron removal was rapid but manganese losses also became significant. At a lower pH, manganese losses were minimized, but iron removal was significantly slower.

In the second stage of purification, prior to final manganese sulphate crystallization, calcium and magnesium levels were lowered through precipitation by adding a reagent (Reagent A) to the leachate after iron and aluminum removal. Addition of the reagent needed to be kept close to stoichiometric levels to prevent manganese losses. The objective was to minimize calcium, and especially magnesium relative to manganese, allowing high purity manganese sulphate to be crystallized from evaporated solutions. A series of tests were conducted to better define the reagent additions required to maximize calcium and magnesium removal while minimizing manganese losses. Results indicated that at an optimal stoichiometric excess both calcium and magnesium were reduced to below 100 mg/L in solution, whilst manganese losses were below 2.9%.

13.4 2020-2021 Testwork

13.4.1 Overview

A Phase 2 test program was initiated in 2020 to further investigate the purification process and the achievable product quality. Later in the year the program was expanded to include more detailed flowsheet development work. In addition to demonstrating a higher product purity (>99.9%), this Phase 2 testwork defined principal unit operations for leach extraction, solid-liquid separation, and primary purification stages, which were incorporated into a preliminary overall process flowsheet for the generation of HPMSM.

In early 2021 a Phase 3 metallurgical program conducted by Kemetco (2022) was initiated in support of a PEA. The work program was aimed at refining the process flowsheet (Figure 17-1), establishing major equipment requirements, reagent consumptions, manganese recovery and evaluating alternative process options for potential cost savings.

13.4.2 Characterization

Three composite samples (Moody Central, Moody West and Sharpe Farm) were prepared from five bagged samples containing core from different areas of the deposit as detailed in Table 13-10. The drill holes are located within the pit shell as defined in this study and are representative of the deposit. These composites will be used for extraction, purification and crystallization testing. Head samples were split from each composite and pulverized before being submitted for a range of analyses.

Table 13-11 summarizes the results of these analyses, including metals, total carbon (C_{TOT}), total sulphur (S_{TOT}), rock specific gravity and final crush size. This table also includes Whole Rock analysis results, including standard trace elements, by X-Ray Fluorescence (XRF).

Table 13-10: Battery Hill Bagged Samples

Deposit Location	Drill Hole	Sections	Length (m)	Weight (kg)	Mn (%)	Fe (%)
North Moody Central	SF20-39	17	34.0	81.9	9.14	13.93
Central Moody Central	SF20-43	16	30.3	79.3	12.26	17.05
South Moody Central	SF20-36	14	27.2	69.0	10.00	11.14
West Moody	SF20-33	7	14.0	33.8	10.33	17.76
Sharpe Farm	SF17-19	12	23.5	52.3	10.51	14.58
Total		**66**	**129.0**	**316.3**		

Table 13-11: Head Sample Analyses

Head Analysis	ICP Digestion (mg/kg) Mn	Fe	Al	Ca	Co	K	Mg	Na	Ni	P	Zn	C TOTAL (%)	S TOTAL (%)	S.G.	P_{80} (µm)
Moody Central Composite	117418	146274	31409	28813	92	3155	23735	663	55	6122	59	3.00	0.59	2.96	4018
Moody West Composite	104134	179309	32015	28493	95	4407	23656	1547	45	6574	52	2.83	0.32	2.88	3898
Sharpe's Farm Composite	120417	156701	33007	20559	104	3250	17842	975	54	5076	57	2.87	0.36	3.09	4083

Head Analysis	XRF/Fusion (%) SiO_2	Al_2O_3	$Fe_2O_{3(T)}$	MnO	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	LOI	Total
Moody Central Composite	33.22	9.05	20.15	12.77	3.61	3.89	0.56	1.29	0.37	1.17	12.34	98.43
Moody West Composite	30.17	8.01	24.50	11.90	3.65	3.91	0.58	1.00	0.33	1.37	12.89	98.32
Sharpe's Farm Composite	33.26	9.39	21.30	13.16	2.78	2.86	0.67	1.04	0.39	1.00	13.15	98.99

Note: LOI = Loss on ignition

13.4.3 Comminution Testing

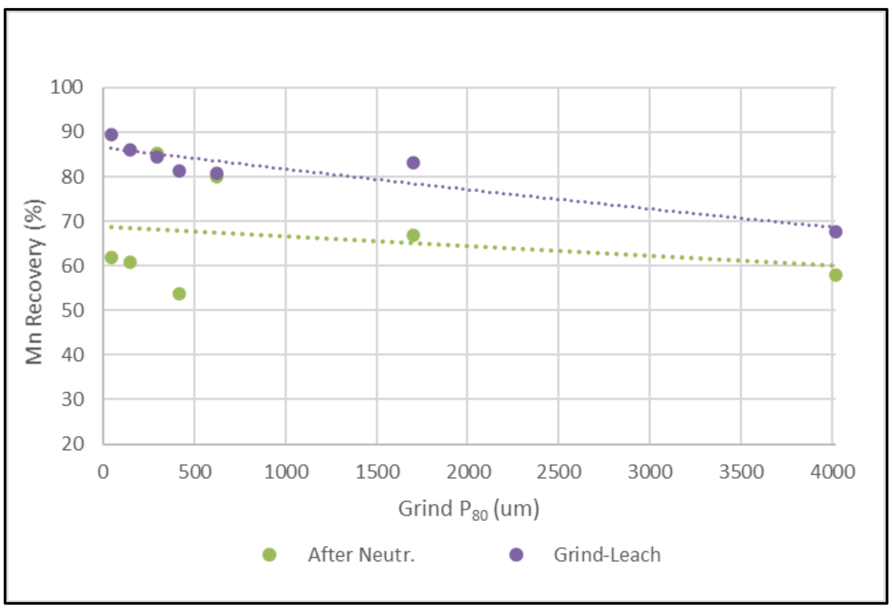
Approximately 76 kg of material was sent to ALS Metallurgy in Kamloops, British Columbia for comminution testing, including a coarse surface sample and a coarsely crushed (-¾") split of the Moody Central composite. Three standard comminution tests were carried out with results as follows:

- Bond low impact crusher work index of 3.3 KWh/t, based on the average of 20 specimens (very soft)
- Bond rod mill work index of 18.0 kWh/t (moderately hard)
- Bond ball mill work index of 18.1 kWh/t (moderately hard).

13.4.4 Leaching and Neutralization

Initial leaching and neutralization tests were aimed at defining a grind response using the Moody Central composite. Results presented in Figure 13-4 show improved manganese extraction with size reduction down a 44 µm P_{80}, but the neutralization test procedure used at this time resulted in significant loss of manganese to the precipitated solids. A 400 µm P_{80} was selected initially but this was revised to a 150 µm P_{80} when further work identified neutralization procedures which avoid significant loss of manganese.

Figure 13-4: Effect of Grind Size on Manganese Extraction, in Leach and after Neutralization



Source: Kemetco, 2022

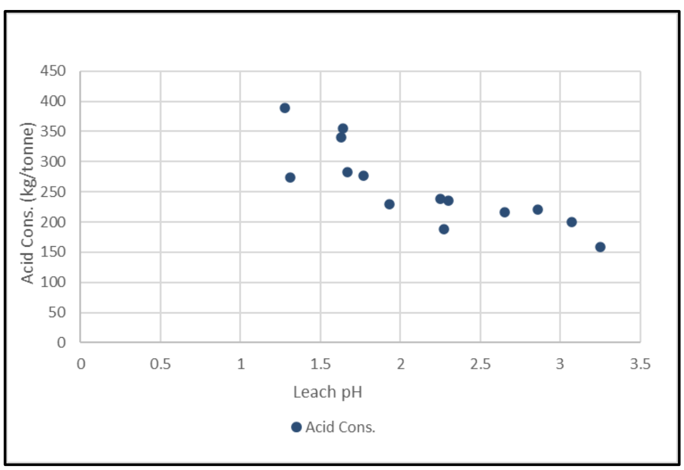
Further investigation of leach and neutralization conditions was done in a sequence of tests. Proceeding with the initial target P_{80} of 400 µm, a total of 14 optimization tests were conducted using the Moody Central composite evaluating the pH, temperature and pulp density in the leach, while also testing the effects of varying neutralization parameters following the leach. Initial testing looked at variations of temperature and pulp density, followed by multi-stage neutralization, while keeping a low target leach pH. The focus was shifted to operating the leach at higher pH levels, mainly at elevated temperatures, but with varying pulp densities. For later tests the neutralization stage was reduced to two stages and then a single stage at elevated temperature and lower target pH. In two of the later tests calcium carbonate was used instead of lime as the neutralizing reagent.

Several trends were identified from the overall test results. In general, manganese losses during neutralization were minimized when the neutralization was carried out at a relatively low target pH. Keeping the temperature high during the neutralization stage also allowed strong iron removal with a relatively short duration neutralization stage, even with the lower pH level.

Further analysis of the results showed that leaching at elevated temperatures allowed satisfactory manganese recovery with substantially reduced acid consumption as shown in Figure 13-5. The observation of effective manganese leaching at higher pH values suggests an opportunity to further reduce acid by oxidation of iron during the leach.

Neutralization at elevated temperatures resulted in satisfactory filtration properties of the leach residue as well as faster oxidation and precipitation of iron. Manganese loss to the precipitate decreased substantially in comparison to previous results from neutralization at near ambient temperature.

Figure 13-5: Acid Consumption vs. Leach pH on Moody Central Composite



Source: Kemetco, 2022

13.4.5 Variability

The final set of bench scale leaching and neutralization tests were six variability tests, including three each using the Moody West and the Sharpe's Farm composites matching test conditions used in tests with the Moody Central composite. These included one at the lower pH initially targeted and two using higher leach pH levels to match later optimized tests.

In general, manganese extractions were somewhat lower than those obtained with Moody Central material; however, there was no optimization specific to these composites. Also, the range of test conditions covered just in these tests resulted in a wide range of recovery values, suggesting considerable room for additional optimization.

For Moody West leach recovery ranged from 50 to 68%, while Sharpe Farm recoveries were between 50 and 76%. Neutralized solution recoveries were generally slightly lower, but the losses to this stage were low.

The only major variable tested meaningfully in this series was leach pH. Analysis of leach recoveries, acid consumption and magnesium and manganese ratios for these tests did not identify strong trends, but there was indication of lower acid consumption and higher manganese and magnesium ratios when using higher leach pH levels, which fits with results seen from the Moody Central composite. Acid consumption was generally higher for the Sharpe Farm's composite, which showed significantly higher iron concentrations in the leachate than for other composites, which also had poor manganese recovery. The manganese and magnesium ratios were generally lower than the best values obtained from the Moody Central composite. Additional testing would be needed to determine the extent to which these results could be improved with additional optimization specific to these composites.

13.4.6 Residue Characterization and Environmental Stability Testing

Solid residues were dewatered and analyzed for each leach-neutralization test conducted. For the final Moody Central tests, and for the variability tests, additional dewatering data was collected for each, including filtration rates for the neutralized test slurries and flocculated settling rates from small slurry subsamples.

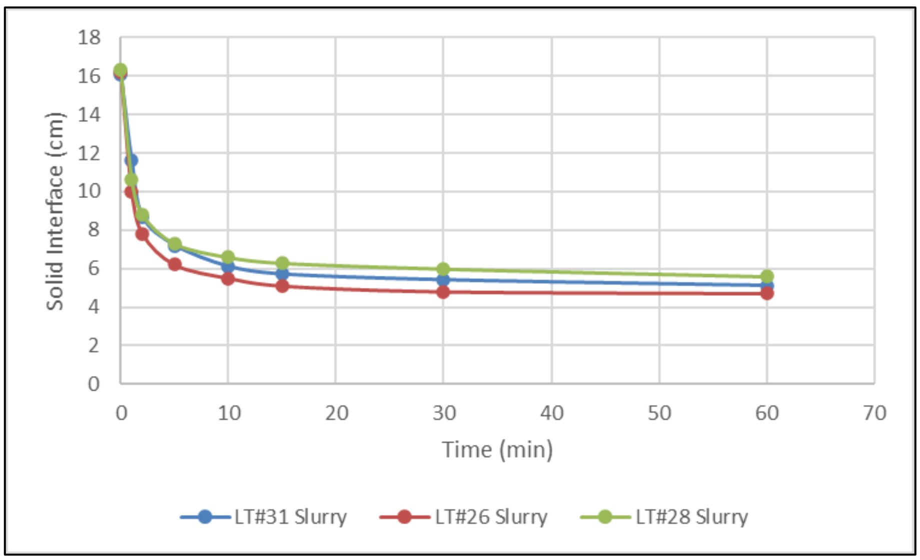
Aliquots used for settling tests did not typically show fast settling, but did show a sufficient settling response to indicate thickening as a viable process step.

Rates varied significantly between tests, but initial settling rates as high as 6.2 cm/min were obtained, and clear supernatants were obtained for all materials (Figure 13-6).

From the same final series of tests, one test residue from each composite was selected for a basic suite of ARD generation potential tests. Washed residues from Moody West, Sharpe Farm and Moody Central were prepared by drying at low temperature and pulverizing before being submitted for acid-base accounting (ABA) and non-acid generating (NAG) testing, with ultra-trace metal analysis on the prepared solids. All results show that leach residues present no acid drainage risks.

Similarly, results presented in Table 13-12 confirm that hazardous metals are present at acceptable levels in water equilibrated with leach residue in accordance with US Environmental Protection Agency toxicity TCLP.

Figure 13-6: Best Settling Curves for Each Composite



Note: LT#31 – Moody Central (blue), LT#26 – Moody West (red),
LT#28 – Sharpe Farm (green). Source: Kemetco, 2022

Table 13-12: TCLP Test Results

Sample Tested	LT#25 Washed Residue TCLP Soln (mg/L)	LT#29 Washed Residue TCLP Soln (mg/L)	LT#25 Washed Residue (dup) TCLP Soln (mg/L)	LT#25 Washed Residue TCLP Soln (mg/L)	TCLP Limit (mg/L)
Silver	<0.05	<0.05	<0.05	<0.05	5.0
Aluminum	3.01	2.58	2.63	5.45	-
Arsenic	<0.2	<0.2	<0.2	<0.2	5.0
Boron	<0.5	<0.5	<0.5	<0.5	-
Barium	0.08	0.06	0.06	0.06	100.0
Beryllium	<0.02	<0.02	<0.02	<0.02	-
Bismuth	<0.2	<0.2	<0.2	<0.2	-
Calcium	844	792	809	835	-
Cadmium	<0.02	<0.02	<0.02	<0.02	1.0
Cobalt	0.20	0.18	0.18	0.10	-
Chromium	<0.05	<0.05	<0.05	0.08	5.0
Copper	<0.1	<0.1	<0.1	<0.1	-
Iron	0.11	0.74	0.76	1.22	-
Potassium	33.6	9.95	10.4	16.9	-
Lithium	<0.1	<0.1	<0.1	<0.1	-
Magnesium	7.60	6.70	6.88	4.68	-
Manganese	220	169	173	115	-
Molybdenum	<0.1	<0.1	<0.1	<0.1	-
Sodium	1437	1459	1455	1472	-
Nickel	0.09	<0.05	0.05	0.18	-
Phosphorus	<0.5	<0.5	<0.5	<0.5	-
Lead	<0.2	<0.2	<0.2	<0.2	5.0
Sulphur	754	738	757	730	-
Antimony	<0.2	<0.2	<0.2	<0.2	-
Selenium	<0.2	<0.2	<0.2	<0.2	1.0
Silicon	11.2	9.49	9.70	8.91	-
Tin	<0.2	<0.2	<0.2	<0.2	-
Strontium	11.1	2.92	3.02	4.43	-
Titanium	<0.1	<0.1	<0.1	<0.1	-
Thallium	<0.2	<0.2	<0.2	<0.2	-
Uranium	<0.5	<0.5	<0.5	<0.5	-
Vanadium	<0.1	<0.1	<0.1	<0.1	-
Zinc	<0.05	<0.05	<0.05	<0.05	-

13.4.7 Purification and Crystallization Testing

Major elements of concern for meeting HPMSM specifications are magnesium and calcium. Purification testwork within the 2022 program has focused on removal of these elements.

Results confirm that up to 90% of calcium and magnesium can be removed from Moody Central composite bulk leachate by reaction with a confidential reagent at a slight stoichiometric excess.

The data also indicates that there is a requirement to identify near optimum operating conditions to reduce solution entrainment and other losses within the purification circuits. Laboratory scale batch and locked-cycle testwork are required to obtain better process definition ahead of any plan to undertake pilot testing. The best quality crystal products to date have retained 86 to 108 ppm of calcium and 67 to 83 ppm of magnesium. These impurity levels are within the envelope of acceptability for lithium-ion cathode precursor chemical supply.

13.4.8 Partial Locked-Cycle Testing

To obtain additional process data related to purification and crystallization, including the effects of bleed processing and other circulating loads, a partial locked-cycle test series was completed. The locked-cycle portion of the testing was limited to purification, crystallization, and bleed processing. Leaching and neutralization were conducted as a single bulk test to provide a uniform feed solution to the purification stage of each cycle. The partial locked-cycle was limited to three cycles due to limited amount of leachate.

Bulk leach conditions were based on the bench test optimization with a target grind size P_{80} of 150 µm. After the leach, the neutralization was carried out in the same mix vessel with aeration for two hours. Neutralization was with calcium carbonate. Leach results were every positive, with 84% manganese extraction achieved after neutralization. Acid consumption increased to 322 kg/t and was attributed to the finer grind.

After a polishing step to remove the residual iron, the clean neutral leachate was divided into three test aliquots for locked-cycle testing of the purification, crystallization, and bleed processing stages. For each cycle, the first stage was to evaporate the cleaned leachate to produce a purification feed solution of a target manganese concentration. Results showed good removal of calcium and magnesium was achieved in each cycle.

The filtered purification products were subjected to two stages of evaporation and crystallization, with an intervening redissolution and filtration stage. Centrate from the first crystallization was further treated in the bleed processing stage, while the centrate from the second crystallization was added to the feed to the first crystallization in the following cycle to maintain manganese recoveries while minimizing buildup of soluble impurities.

The feed to the bleed stream precipitation was the first crystallization centrate (the process bleed stream). Results show a fairly consistent process although further investigation of the main parameters such as contacting methods, seeding, reaction time and temperature are required to optimize the use of the precipitation reagent.

The final steps covered in the partial locked-cycle testing were the evaporation of the filtrate and wash from the bleed stream precipitation to recover a mixed manganese precipitate, and then to crystallize the remaining dissolved solids into an impure product, which also acts as the final bleed for impurities from the system.

13.5 Deleterious Elements

Deleterious elements in HPMSM crystal product fall into two general categories: those present as precipitates (mainly calcium and magnesium, secondarily silica); and the others present mainly or completely as entrained mother liquor from crystallization.

Calcium and magnesium enter the crystallization stage at or very near saturation, so near complete removal prior to manganese sulphate crystallization is necessary. For the other impurities, optimization of the crystal form and size is required to facilitate removal of mother liquor by filtration and washing with a minimum of clean water addition to control loss of manganese to the wash solution.

13.6 Metallurgical Recovery Estimate

For final recovery of manganese to HPMSM product, the testwork (both batch optimization and locked cycle) was done principally on the Moody Central composite containing 11.7% Mn. Leach extractions under optimized conditions were between the 83 and 88%. The overall recovery to revenue product is estimated to be 78%, determined by a simulation of the process using test data as inputs.

Comparable leach extraction values for the Moody West composite (10.4% Mn) and Sharpe Farm composite (12.0% Mn) were 68 and 76%, respectively. It should be noted that no attempt to optimize the leaching conditions for these different feed materials was included in the testing.

Clearly, manganese content alone is not an acceptable predictor of metallurgical recovery. Future documentation of resource materials other than that represented by the Moody Central composite will require additional work including leach optimization and test definition of reagent requirements in purification.

14.0 MINERAL RESOURCE ESTIMATES

14.1 Summary

The definition of Mineral Resource and associated Mineral Resource categories used in this Report are those incorporated by reference into NI 43-101 and set out in CIM Definition Standards (May 10, 2014). Assumptions, metal threshold parameters and deposit modelling methodologies associated with the Project resource estimate are discussed below.

The Mineral Resource estimate for the Project was prepared under the supervision of Mr. Matthew Harrington, P. Geo., with an effective date of May 12, 2022. A summary of the Battery Hill Mineral Resource constrained within a conceptual open pit shell is presented in Table 14-1.

Table 14-1: Battery Hill Mineral Resource Estimate – Effective Date: May 12, 2022

Cut-off (Mn %)	Category	Tonnes (Mt)	Mn (%)	Fe (%)
1.5	Measured	11.32	6.72	10.94
	Indicated	23.82	6.24	10.50
	Measured Plus Indicated	35.14	6.39	10.64
	Inferred	27.72	6.46	10.73

Note: (1) The QP for the Mineral Resource statement is Mr. Matthew Harrington P. Geo. who is an employee of Mercator.

(2) Mineral Resources were prepared in accordance with the CIM Definition Standards (May 10, 2014) and CIM MRMR Best Practice Guidelines (November 2019).

(3) Mineral Resources are constrained within an optimized pit shell with average pit slope angles of 45° and a 2.9:1 strip ratio (waste: mineralized material).

(4) Pit optimization parameters include pricing of US$2,900 ($3,625)/t for HPMSM (HPMSM = 32% Mn; $1.25 to US$1.00 exchange rate), mining at $7.43/t, a 3% gross metal royalty, combined processing and G&A (1,000 t/d process rate) at$126.31/t processed, an overall Mn recovery to HPMSM of 78%, and a selling cost of US$65.00 ($81.25)/t HPMSM. Fe content did not contribute to the pit optimization process but was applied for bulk density determination purposes (see note 7).

(5) Mineral Resources are reported at a cut-off grade of 1.5 % Mn within the optimized pit shell. The cut-off grade reflects the marginal cut-off grade used in pit optimization to define reasonable prospects for eventual economic extraction by open pit mining methods.

(6) Mineral Resources were estimated using Ordinary Kriging methods applied to 3 m downhole assay composites. No grade capping was applied. Model block size is 5 m x 5 m x 5 m.

(7) Bulk density was applied using a regression curve based on Mn % and Fe % block grades. Average bulk density for Mineral Resources is 3.01 g/cm^3. Only manganese is considered having reasonable prospects for economic extraction; iron is reported for quality and density determination purposes.

(8) Mineral Resources may be materially affected by environmental, permitting, legal, title, taxation, sociopolitical, marketing, or other relevant issues.

(9) Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.

(10) Figures may not sum due to rounding.

14.2 Geological Interpretation Used in Resource Estimation

The Battery Hill manganese-iron deposit is interpreted as a stratiform deposit of sedimentary origin that is comprised of an assemblage of manganese carbonate and manganese carbonate-silicate-oxide mixed with iron oxide minerals, occurring within a steeply dipping, folded sedimentary sequence of Silurian age. Mineralized units show substantial drill section to drill section continuity and have been modelled as laterally continuous bedded deposits.

14.3 Methodology of Resource Estimation

14.3.1 Overview of Estimation Procedure

The Mineral Resource estimate is based on verified results of 55 diamond drill holes (10,056 m), including 16 drill holes (3,572 m) completed in 2016, nine drill holes (1,598 m) completed in 2017, and 28 drill holes (4,509 m) completed in 2020 by Manganese X. Two drill holes completed in 2011 (377 m) by Globex also contributed to the resource estimate. Solid modelling was performed using GEOVIA Surpac™ 2021 (Surpac) and Seequent Leapfrog™ Geo 6 (Leapfrog) modelling software. Block model volume, grade, and density modelling was performed using Surpac with manganese percent and iron percent values for the block model estimated using ordinary kriging (OK) interpolation methodology from 3 m down hole assay composites. Block specific gravity values were assigned using a regression curve based on the cumulative block manganese and iron percent. The resource block model was set up with a block size of 5 m x 5 m x 5 m. The predominant manganese compound in the deposit is manganese carbonate ($MnCO_3$).

Metal grade assignment was peripherally constrained by solid models based on sectional geological interpretations and a minimum included grade of 2.5% manganese over 6 m down-hole. A total of 24 separate solid models were developed for the three deposit areas being Moody Hill (10 solids), Sharpe Farm (seven solids) and Iron Ore Hill (seven solids). The three deposit areas trend along strike southwest-northeast for approximately 1,850 m, range in width from 100 to 500 m, and are defined to a maximum vertical depth of approximately 250 m. They are separated by discontinuity in the mineralization trends along strike that could potentially be related to cross-cutting faults. The deposit has a folded geometry with near vertical, to steeply dipping eastern and western limbs, and the solid models reflect tabular stacked horizons of above cut-off mineralization. The Moody Hill and Sharpe Farm areas are interpreted to predominantly occur on the eastern limb, supporting near-vertical to steeply eastern dips, and the Iron Ore Hill area is interpreted to predominantly occur on the western limb, supporting near-vertical to steeply western dips. To assess the distribution of reduced and oxidized host stratigraphy blocks were assigned a lithology colour code of grey, red, or mixed using solid models developed from logged Manganese X colour intervals.

Interpolation ellipsoid ranges and orientations were developed through assessment of variography, combined with geological interpretations and drill hole spacing. Major axis orientations conform to the strike direction, between an azimuth of 036° and 073°, with no plunge. The semi-major axes occur in the dip direction and perpendicular to the major axes, while minor axes are oriented at a high angle to stratigraphy in the down hole direction. Manganese and iron grade interpolation was completed independently and constrained to block volumes using a three-interpolation pass approach. Interpolation passes, implemented sequentially from pass one to pass three progress from being restrictive to more inclusive in respect to ellipsoid ranges, composites available, and the number of composites required to assign block grades. Grade domain boundaries were set as hard boundaries for grade estimation. Grade interpolation was restricted to the 3 m assay composites associated with the drill hole intercepts assigned to each deposit area solid.

The requirement for reasonable prospects for eventual economic extraction was assessed by means of developing an optimized open pit shell to constrain Mineral Resources. This shell was based on the mineral deposit block model and developed by Wood through application of operating and recovery parameters deemed appropriate for the style of mineralization present. Pit optimization parameters include metal pricing of US$2,900/t for HPMSM = 32% Mn (HPMSM = 32%), an exchange rate of $1.25 to US$1.00, mining at $7.43/t, combined processing and G&A at $126.11/t processed, an overall manganese recovery to HPMSM of 78%, a 3% gross metal royalty, and a selling cost of US$65/t HPMSM. No value for the deposit's iron content was assigned for optimization purposes. The optimized pit shell supports a 2.9:1 strip ratio with average pit slopes of 20° in overburden and 45° in bedrock.

Mineral Resources are reported at a cut-off grade of 1.5% Mn within the optimized pit shell. This cut-off grade reflects the marginal cut-off grade used in pit optimization and is considered to define reasonable prospects for eventual economic extraction by open pit mining methods.

Measured, Indicated, and Inferred Mineral Resources are defined as all blocks with interpolated manganese grades from the first, second or third interpolation pass, respectively, that meet the specified pit-constrained cut-off grade and demonstrate reasonable continuity. Orphan blocks and discontinuous zones of mineral resource categorization were refined through application of categorization solid models.

14.3.2 Data Verification

The Mineral Resource estimate is based on verified results of 55 diamond drill holes totalling 10,056 m of drilling. This includes 377 m from two historical surface diamond drill holes completed in 2011 Globex, 3,572 m from 16 surface diamond drill holes completed in 2016 by Manganese X, 1,598 m from nine surface diamond drill holes completed in 2017 by

Manganese X, and 4,509 m from 28 surface diamond drill holes completed in 2020 by Manganese X.

Drill hole coordinates are located in UTM NAD83 Zone 19 coordination. Manganese X staff logged drill hole results in Microsoft® Excel software and provided Mercator drill hole database results as a Microsoft® Excel output. Mercator compiled a Microsoft® Access database of the project drill hole data and subsequently completed a 30% verification to acceptable results. A total of 3,332 core samples and 1,468 specific gravity determinations are compiled on the deposit and a total of 2,169 core samples and 948 specific gravity determinations occur within the limits of the grade domain solid models.

Verification checks to identify any overlapping intervals, inconsistent drill hole identifiers, improper lithological assignment, unreasonable assay value assignment, and missing interval data were performed. Checking of database analytical entries was also carried out against laboratory records supplied by Manganese X.

14.3.3 Modelling: Topography, Lithology, and Grade

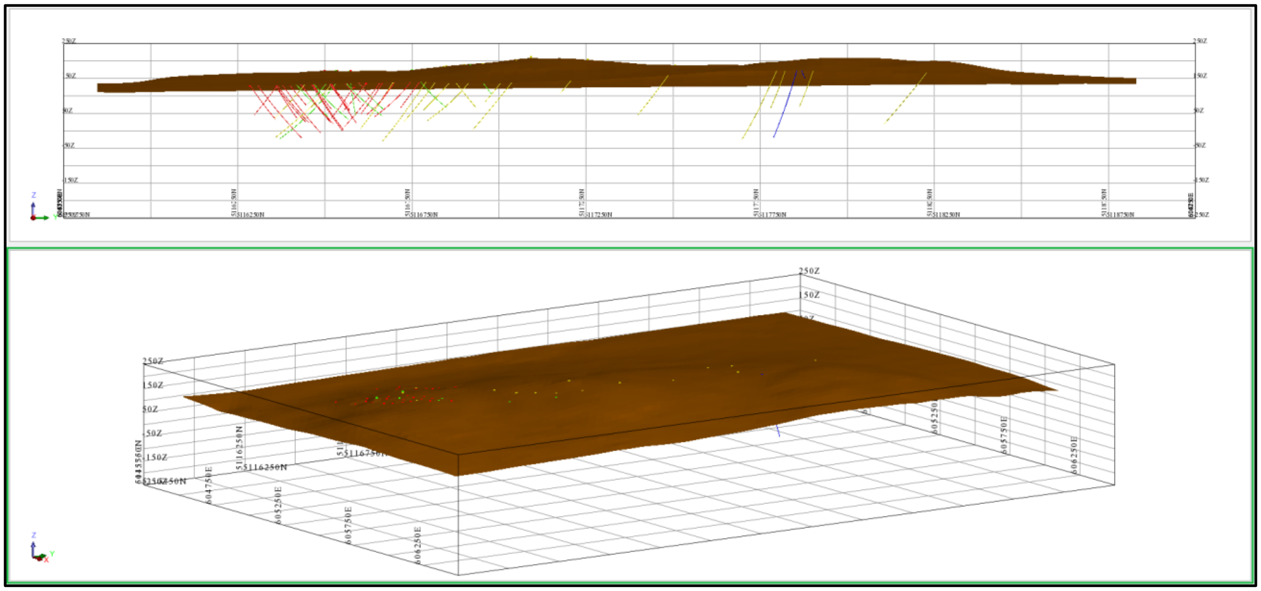
14.3.3.1 Topography Surface

A digital terrain model (DTM) point dataset for the Property was acquired by the QP from the New Brunswick GeoNB geographic information platform. The elevation dataset supports a spacing of approximately 70 m and the absolute vertical accuracy of a single point is approximately 2.5 m. The GeoNB elevation point dataset and project drill collar elevation dataset were merged and a DTM of topography was developed in Leapfrog using an adaptive resolution of 100 m. Lateral extents measure approximately 2,000 m east-west and 3,000 m north-south over the deposit area. The QP reviewed drill collar positions in respect to the surface and an acceptable agreement is present. Figure 14-1 presents longitudinal and isometric views of the DTM of topography.

14.3.3.2 Overburden Solid Model

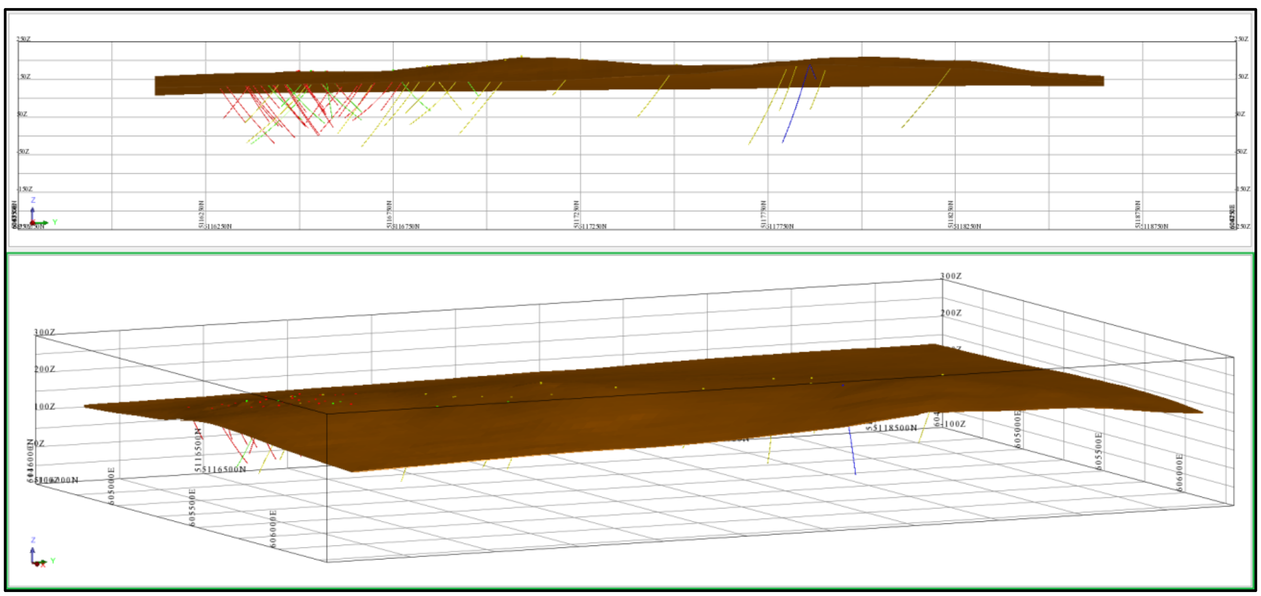
An overburden solid model was developed in Leapfrog at a resolution of 2.5 m from drill hole litho-codes and the topography surface. The topography surface and/or overburden solid model were used to constrain the surface projections of the grade domain and lithological solid models. Overburden thickness averages approximately 3 m, with maximum thicknesses of approximately 10 m, in the deposit area. Figure 14-2 presents longitudinal and isometric views of the overburden solid model.

Figure 14-1: Longitudinal View (West) and Isometric View (Northwest) of the DTM of Topography



Source: prepared by Mercator, dated 2022

Figure 14-2: Longitudinal View (West) and Isometric View (Northwest) of the Overburden Solid Model



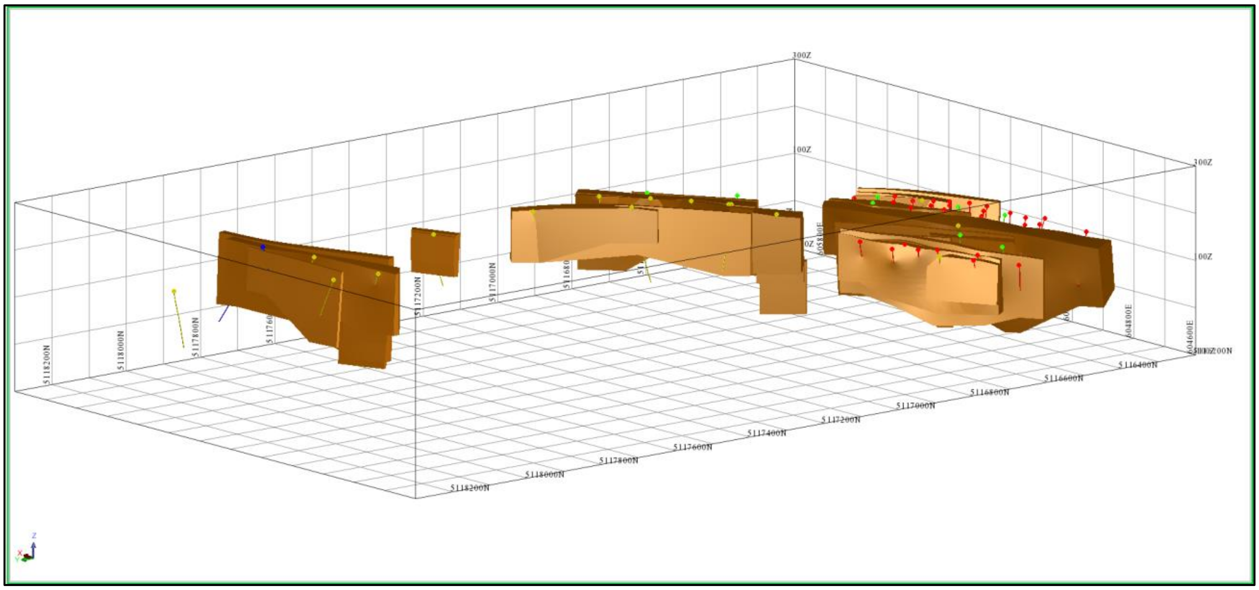
Source: prepared by Mercator, dated 2022

14.3.3.3 Grade Domain Solid Models

To best assess manganese and iron mineralization, grade based peripheral constraint solid models were developed using a minimum threshold of 2.5% manganese over 6 m downhole lengths from downhole analytical results displayed on vertical northwest-southeast geological sections. Adjacent intercepts at the 2.5% over 6 m downhole threshold were merged if the included dilution was less than 6 m and the maximum hanging wall and footwall contacts of mineralization demonstrated continuity with similar intervals of mineralization along strike and dip. The 2.5% manganese grade domain solid models were first developed in Leapfrog at a 2.5 m resolution and subsequently imported into Surpac and validated for volumization and intercept snapping. Solid models were snapped to the respective intercepts and extended half the distance to a constraining drill hole or 50 m where constraining drill hole data was not present. Solid models defined by more than one drill hole were projected to surface if the vertical distance was less than 100 m.

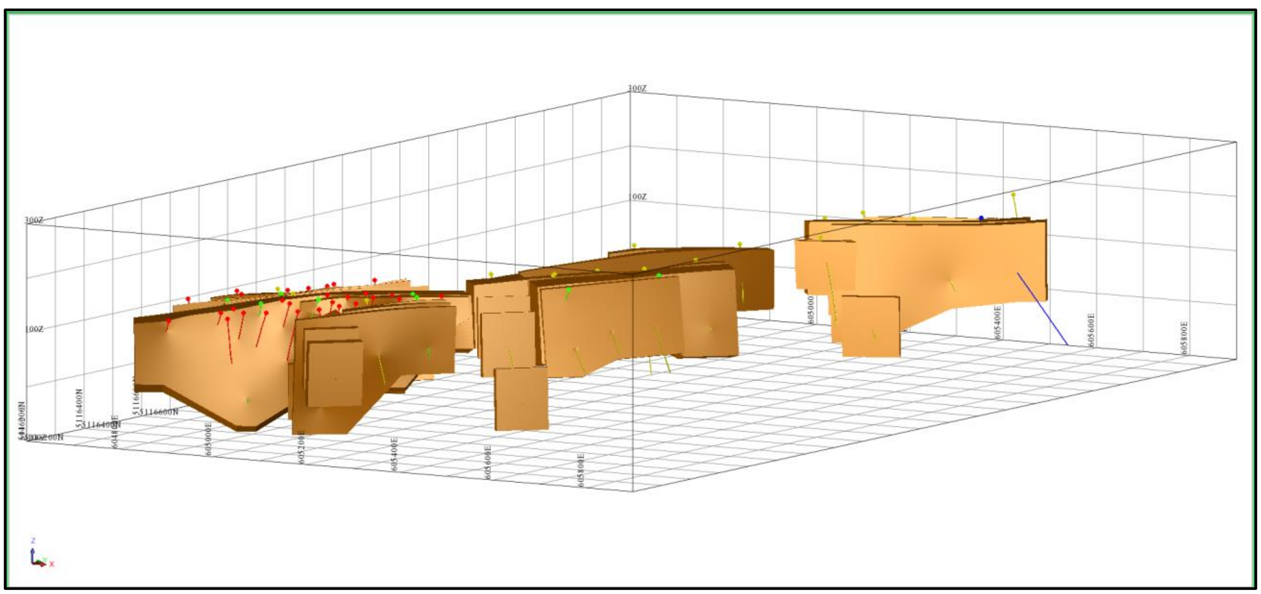
A total of 24 separate solid models were developed for the three areas of the Property, Moody Hill (10 solids), Sharpe Farm (seven solids) and Iron Ore Hill (seven solids). The three deposit areas trend along strike southwest-northeast for approximately 1,850 m, range in width from 100 to 500 m, and are defined to a maximum vertical depth of approximately 250 m. They are separated by discontinuity in the mineralization trends along strike that could potentially be related to cross-cutting faults. The deposit has a folded geometry with near vertical, to steeply dipping eastern and western limbs, and the solid models reflect tabular stacked horizons of above cut-off mineralization. The Moody Hill and Sharpe Farm areas are interpreted to predominantly occur on the eastern limb, supporting near-vertical to steeply eastern dips, and the Iron Ore Hill area is interpreted to predominantly occur on the western limb, supporting near-vertical to steeply western dips. Figure 14-3 to Figure 14-5 present isometric views of the grade domain solid models.

Figure 14-3: Isometric View (Southeast) of the Grade Domain Solid Models



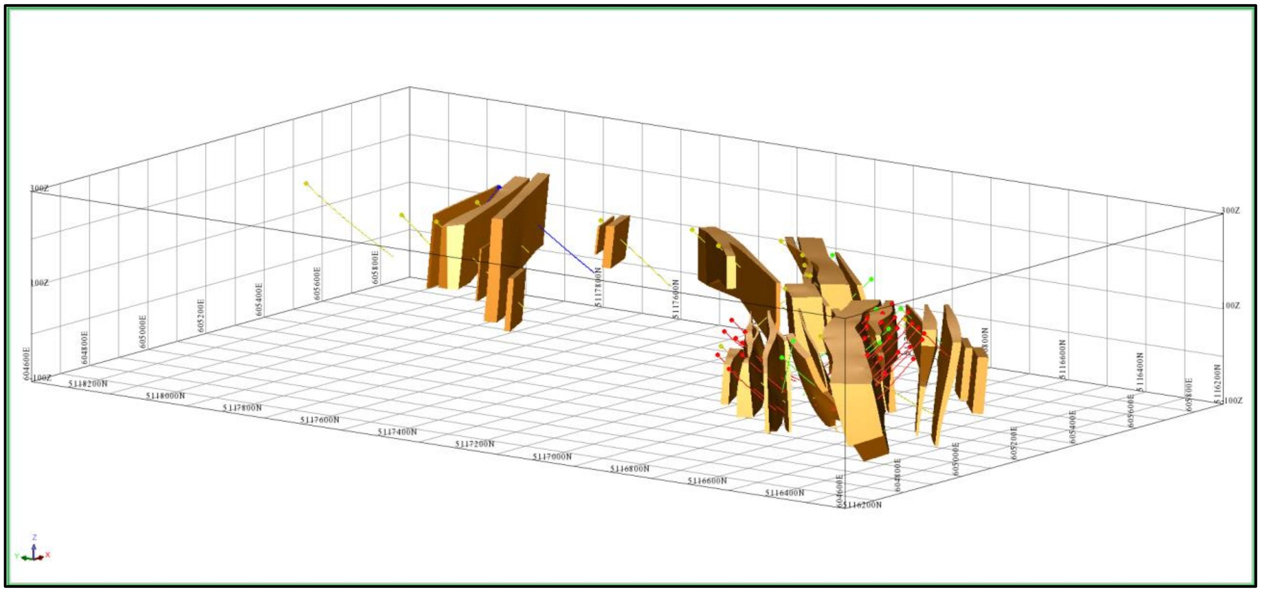
Source: prepared by Mercator, dated 2022

Figure 14-4: Isometric View (Northwest) of the Grade Domain Solid Models



Source: prepared by Mercator, dated 2022

Figure 14-5: Isometric View (Northeast) of the Grade Domain Solid Models

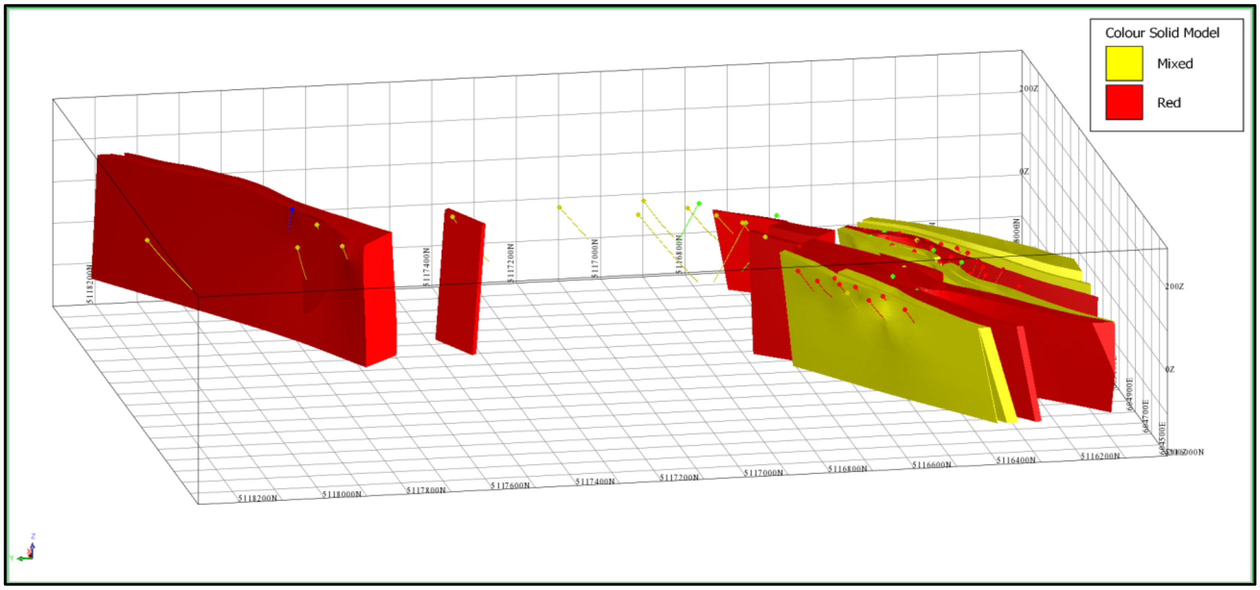


Source: prepared by Mercator, dated 2022

14.3.3.4 Colour Solid Models (Reduced and Oxidized Stratigraphy)

To best assess the distribution of reduced and oxidized host stratigraphy the QP developed solids models of rock colour to assign rock colour block values. Manganese X staff logged the host stratigraphy with either a red, grey, or mixed (also referred to as xmas) colour code. Intervals assigned with the mixed colour code are typically described as dark red siltstone with varying amounts of green siltstone and whitish iron-carbonate. Colour code distribution was evaluated in Leapfrog and grouped to define continuous zones of the respective colour. Colour solid models were developed in Leapfrog for the red and mixed grouped units at a 5 m resolution and were used to code a red or mixed colour assignment to intersecting blocks. All blocks occurring outside of the red and mixed solid models were assigned a colour of grey. Figure 14-6 presents an isometric view of the red and mixed colour solid models.

Figure 14-6: Isometric View (East) of the Red and Mixed Colour Solid Models



Source: prepared by Mercator, dated 2022

14.3.4 Assay Sample Assessment and Down Hole Composites

The predominant manganese compound in the deposit is manganese carbonate ($MnCO_3$). The laboratory reports manganese oxide percentage (MnO%) and iron oxide percentage (Fe_2O_3%) to achieve a balance of all elements as compounds. Respective oxide values were converted to manganese percentage (Mn%) and iron percentage (Fe%) respectively, using a factor of 0.774 for Mn and a factor of 0.699 for Fe.

The drill core analytical dataset used in the Mineral Resource estimate contains 3,332 sample records. Manganese percent results are present for all sample records and iron percent results, which are missing for the Globex 2011 drill holes, are present for 3,126 sample records. A total of 2,169 sample records occurred within the grade domain solid models. Sample length statistics for the solid constrained sample records define a sample length range of 0.16 to 4.4 m and an average sample length of 2 m, with 80% of samples measuring 2 m or less and 90% of samples measuring 3 m or less.

Downhole assay composites over 3 m intervals were developed for manganese percent and iron percent using the Surpac™ best fit option set to a 3 m target value. Assay composites generated outside of a 25% tolerance interval of the nominal length were either manually re-generated or merged with adjacent composites to meet the selection conditions. Compositing was constrained based on the drill hole intersections with the grade domain solid models. The Globex 2011 drill holes missing iron percent values are located in the Iron Ore Hill area and were excluded from compositing for the iron percent assay composites. All other intervals missing assay values for manganese and/or iron percent were set to a null value, zero percent, prior to compositing.

Descriptive statistics were calculated for both manganese percentage and iron percentage from the 3 m composite datasets within each deposit area and for the global composite population (Battery Hill) are presented in Table 14-2.

No high-grade capping factors were applied to the 3 m assay downhole composites or the contributing drill core sample analytical results. Through analysis of metal grade distribution, by means of frequency histogram, cumulative frequency plots, probability plots, rank/percentile, and decile analysis, it was concluded that maximum grade values that occur in the dataset are consistent with the mineralization styles present and do not represent high-grade outliers. Higher-grade values lay within zones where drill log descriptions of lithology and mineralogy support presence of spatially correlative higher-grade material.

Table 14-2: Manganese and Iron Statistics for the 3 m Assay Composites

	Area / Deposit							
	Moody Hill		Sharpe Farm		Iron Ore Hill		Battery Hill	
Item	Mn (%)	Fe (%)	Mn (%)	Fe (%)	Mn (%)	Fe (%)	Mn (%)	Fe (%)
Number of Samples	981	981	305	305	127	73	1,413	1,359
Minimum Value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum Value	19.20	23.86	15.87	23.95	19.06	27.15	19.20	27.15
Mean	6.22	10.44	6.98	11.57	5.95	9.90	6.36	10.66
Variance	12.77	15.67	11.96	17.11	16.08	25.64	13.01	16.78
Standard Deviation	3.57	3.96	3.46	4.14	4.01	5.06	3.61	4.10
Coefficient of Variation	0.58	0.38	0.50	0.36	0.67	0.51	0.57	0.38

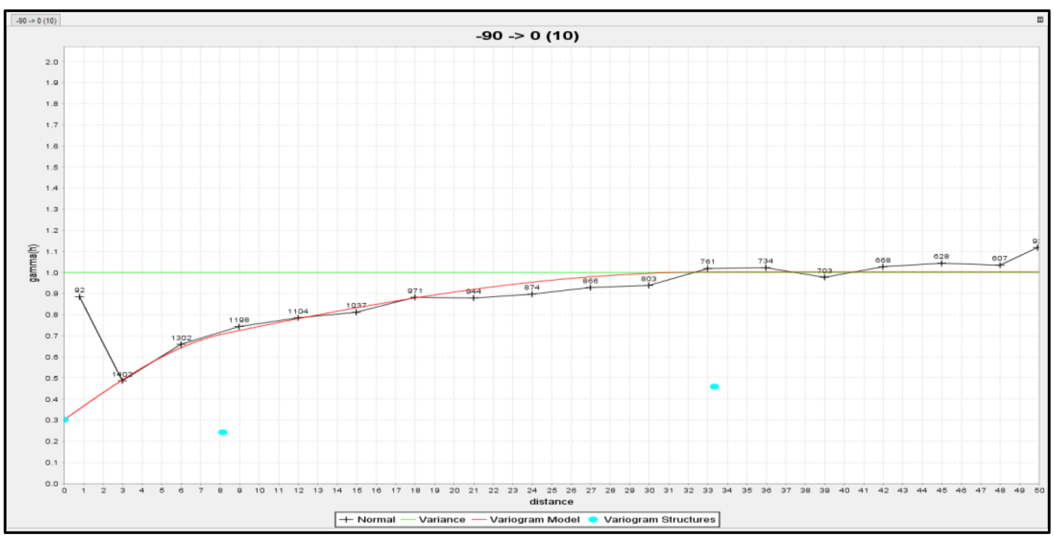
14.3.5 Variography and Interpolation Ellipsoids

Manually derived models of geology and grade distribution provided definition of the primary southwest-northeast and sub-vertical trend associated with the folded host stratigraphy. To assess spatial aspects of grade distribution within the Battery Hill manganese-iron deposit, downhole and directional variograms were developed for manganese percentage based on the 3 m downhole composite dataset defined by the grade domain solid models. Variogram assessment was not completed on iron percent due to not being a metal of economic interest and the iron percent composite dataset has less spatial distribution than the manganese percent composite dataset.

Downhole variograms provided definition of a normalized nugget of 0.30 (Figure 14-7) and spherical model results with two structures. The first structure supported a normalized sill of 0.24 and a range of 8 m and the second structure supported a normalized sill of 0.46 and a range of 33 m. The downhole variogram provides guidance and definition of nugget values and minor axis ranges for the directional variogram assessment.

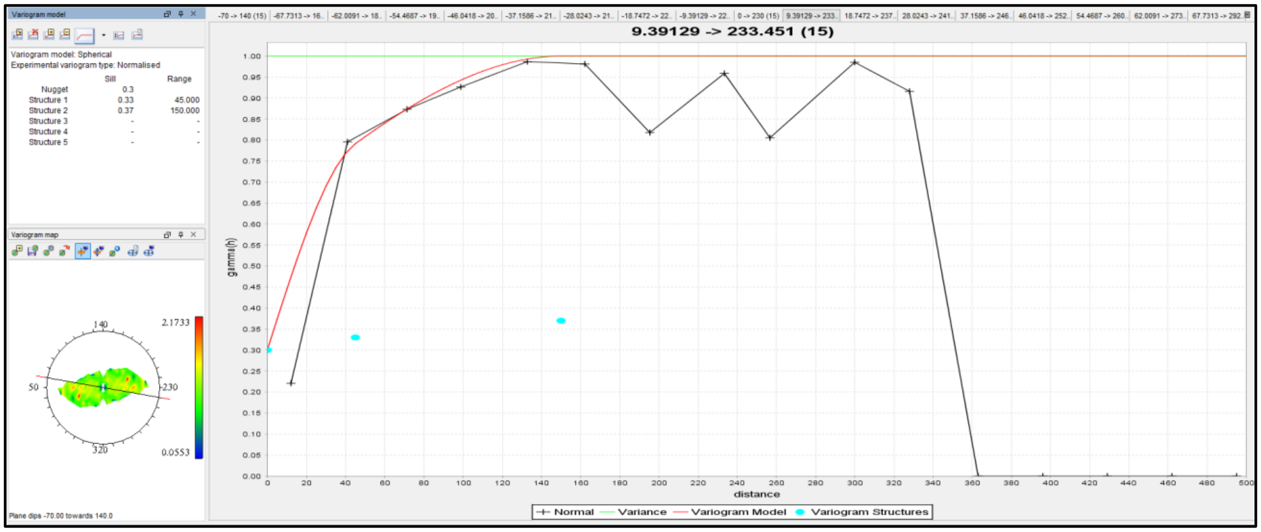
Best directional experimental variogram results were developed within a plane trending towards an azimuth of 140° and a plunge of 70° using a spread angle of 15° and a spread limit of 20°. The plane orientation corresponds to the down-dip trend of the Moody Hill area and assesses grade continuity along strike and in the down-dip direction. Application of spherical models provided definition of an anisotropy ellipsoid along an azimuth of 233° with a plunge of 9° and a dip of 80° using Surpac's ZXY LRL (left-right-left) axes of rotation convention. Two structures were modelled for the primary axis trend supporting a normalized sill of 0.33 and a range of 45 m for the first structure and a normalized sill of 0.37 and a range of 150 m for the second structure. Maximum ranges of continuity of 88 m for the secondary axis trend and 25 m for the third axis trend were defined. Figure 14-8 presents results of the primary variogram assessment, Figure 14-9 presents results of the secondary variogram assessment, and Figure 14-10 presents variogram results along all axes.

Figure 14-7: Downhole Manganese Variogram



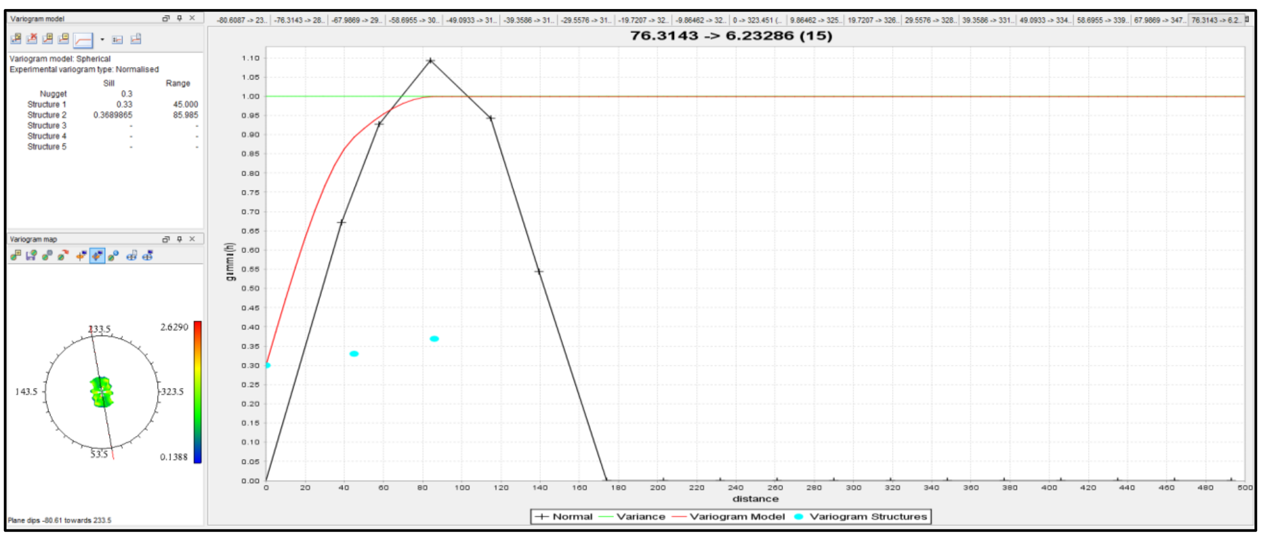
Source: prepared by Mercator, dated 2022

Figure 14-8: Manganese Variogram Model for the Major Axis of Continuity



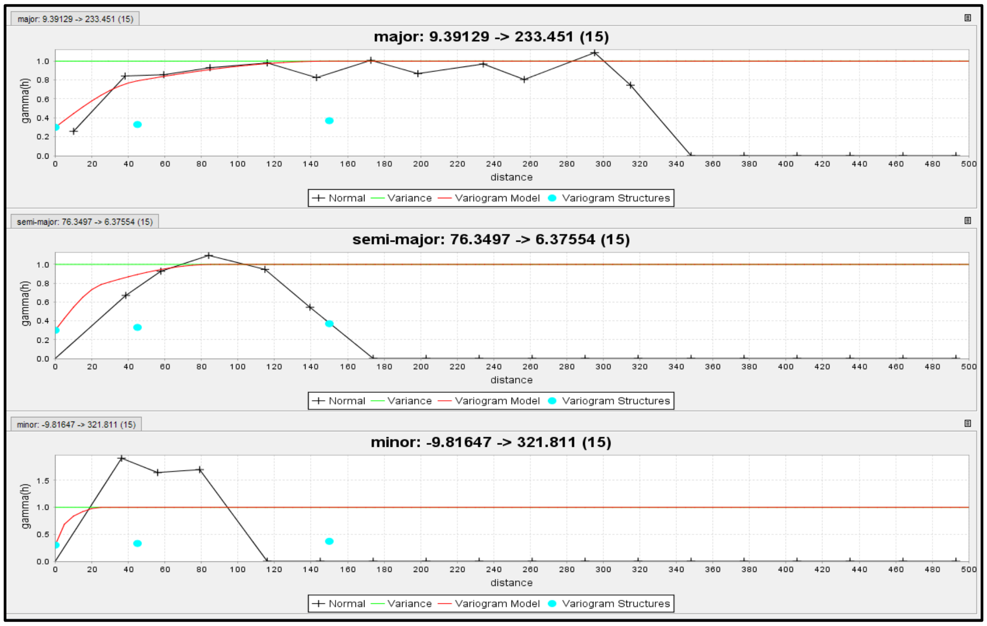
Source: prepared by Mercator, dated 2022

Figure 14-9: Manganese Variogram Model for the Semi-Major Axis of Continuity



Source: (prepared by Mercator, dated 2022

Figure 14-10: Manganese Variogram Model



Source: prepared by Mercator, dated 2022

Interpolation ellipsoid ranges and orientations were developed through the consideration of the variogram assessment in combination with geological interpretations and drill hole spacing. A total of 31 interpolation domains were developed for the 24 grade domains solid models. Interpolation domains were created to accommodate local variations in deposit geometry and to independently assess more restricted occurrences of mineralization. Major axis orientations conform to the strike direction, between an azimuth 036° and 073°, with no plunge. The semi-major axes occur in the dip direction, ranging from near vertical to 70° and perpendicular to the major axes, while minor axes are oriented at a high angle to stratigraphy in the downhole direction. Ranges of 150 m, 90 m, and 30 m were derived for the major, semi-major and minor axes, respectively, from the variogram assessment.

14.3.6 Setup of the Three-Dimensional Block Model

The block model extents are presented in Table 14-3 and were defined using UTM NAD83 (Zone 19) coordination and elevation relative to sea level. No rotation was applied to the block model. Standard block size for the model is 5 m x 5 m x 5 m with no units of sub-blocking allowed.

Table 14-3: Block Model Parameters

Type	Y (Northing m)	X (Easting m)	Z (Elevation m)
Minimum Coordinates	5,116,150	604,650	-150
Maximum Coordinates	5,118,100	605,950	250
User Block Size	5	5	5
Minimum Block Size	5	5	5
Rotation	0	0	0

Note: UTM NAD83 Zone 19 coordination and sea level datum

14.3.7 Mineral Resource Estimate

Block model volumes were estimated from the Project solid models. Blocks were assigned a deposit code of air, overburden, grey, red, or mixed based on their spatial relationship with the DTM of topography, overburden solid model, and colour solid models. Blocks assigned with a deposit code of grey, red, or mixed were accepted as eligible for grade domain volumization. Eligible blocks intersecting the grade domain solids were accepted for manganese and iron block grade interpolation and coded with the respective solid model identifier to correspond with the appropriate 3 m assay composite dataset and interpolation parameters.

OK grade interpolation was used to assign block manganese and iron grades from the 3 m assay composite datasets. Interpolation ellipsoid orientation and range values used in the estimation reflect a combination of trends determined from the manganese variography assessment and interpretations of geology and grade distribution for the deposit. Manganese and iron grade interpolation was completed independently, with the parameters derived from assessment of manganese also applied to the iron grade interpolation. A three-interpolation pass approach was applied, implemented sequentially from pass 1 to pass 3, that progresses from being restrictive to more inclusive in respect to ellipsoid ranges, composites available, and number of composites required to assign block grades. Interpolation pass ranges reflect 50%, 100%, and 150% of the ranges defined from variogram assessment for the first pass, second pass, and third pass, respectively. A total of 31 interpolation domains, each with unique interpolation ellipsoid orientation, were applied. Grade domain boundaries were set as hard boundaries for grade estimation purposes. Block discretization was set at 2 x 2 x 2. Interpolation parameters are summarized in Table 14-4.

Table 14-4: Summary of Battery Hill Interpolation Parameters

	Range			Contributing Composites		
Interpolation Pass	Major (m)	Semi-Major (m)	Minor (m)	Minimum	Maximum	Maximum per Drill Hole
1	75	45	15	7	12	3
2	150	90	30	4	9	3
3	225	135	45	1	4	4

14.3.8 Density

A total of 1,468 specific gravity determinations are available in the drill hole database, including 1,454 water immersion determinations completed by Manganese X during the 2016, 2017, and 2020 drill programs. From the total dataset, 1,292 determinations can be correlated with an associated manganese percent and iron percent grade and 948 determinations occur within the mineralized area. The specific gravity determinations are accepted to represent a density determination of the rock measured.

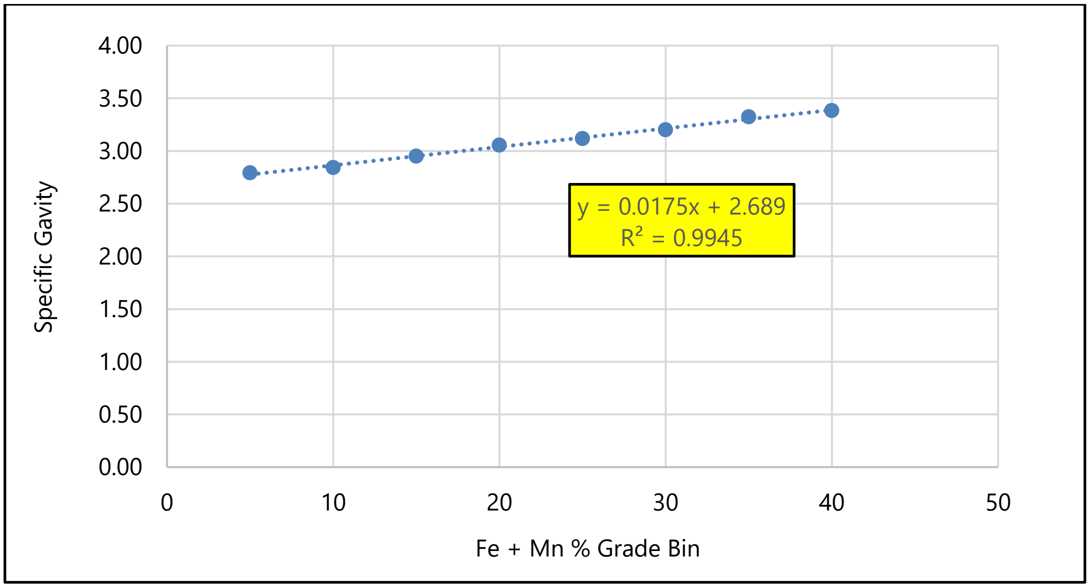
Complete coverage of density determinations over the deposit area is not available. On this basis, a regression curve and equation were developed relating the 1,292 determinations with results for manganese and iron with those values (Figure 14-11). The regression curve was developed by averaging density values in grade bin intervals of 5% manganese and iron. Average density values range from 2.79 g/cm^3 in the less than 5% manganese and iron bin to 3.37 g/cm^3 in the greater that 35% manganese and iron bin.

The following regression equation was developed:

*specific gravity (density) = 0.18 *(Mn% + Fe%) + 2.70*

The regression curve was applied to all blocks with an accepted interpolated manganese percent and iron percent value.

Figure 14-11: Regression Curve between Specific Gravity and Manganese Plus Iron Grade

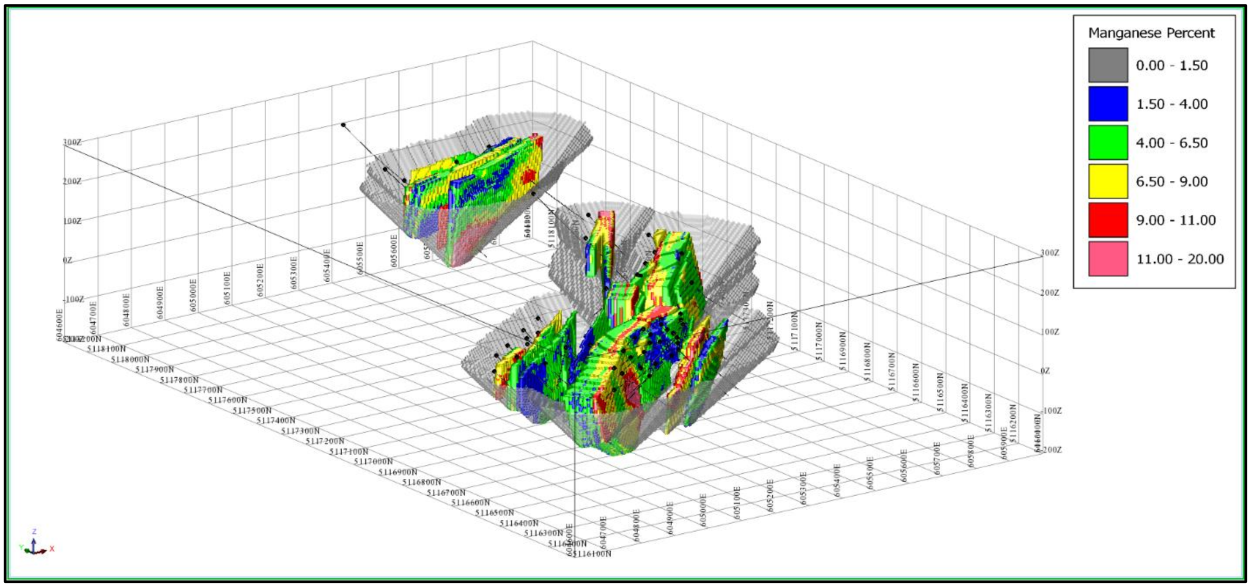


Source: prepared by Mercator, dated 2022

14.4 Model Validation

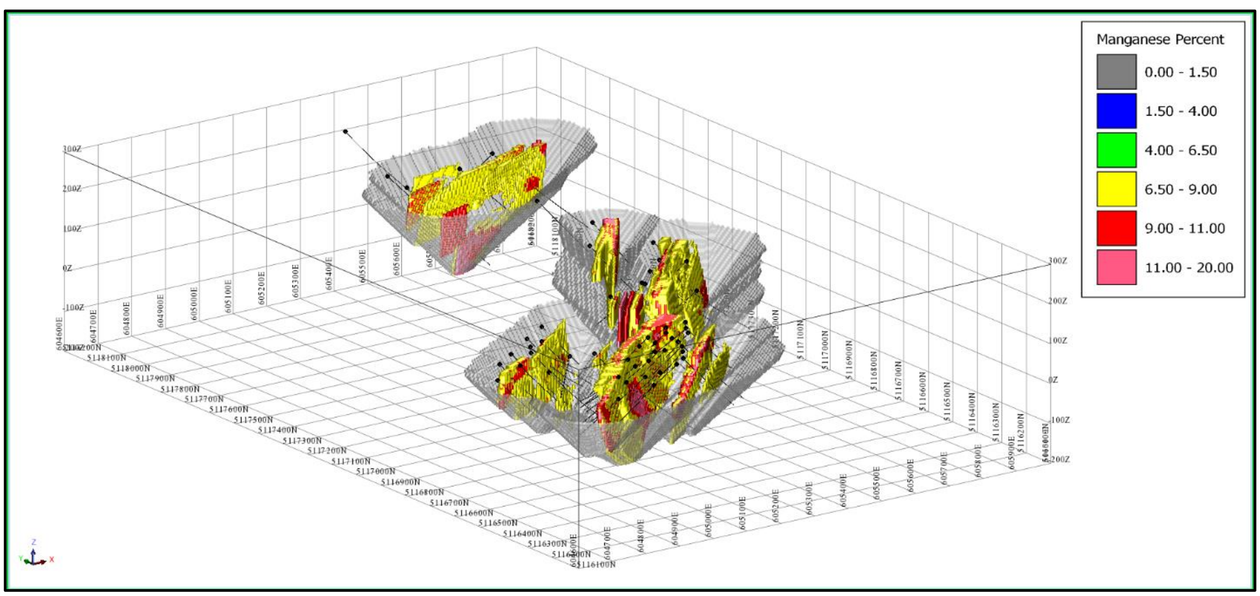
Block volume estimates for each Mineral Resource solid were compared with corresponding solid model volume reports generated in Surpac™ and results show good correlation, indicating consistency in volume capture and block volume reporting. Results of block modelling were reviewed in three-dimensions and compared with deposit interpretations for geology and grade distribution. Block grade distribution was shown to have acceptable correlation with the grade distribution of the underlying drill hole data (Figure 14-12 to Figure 14-16).

Figure 14-12: Oblique View Looking Northeast of Manganese Values Above a 1.5% Mn Cut-off within the Optimized Pit Shell (Grey)



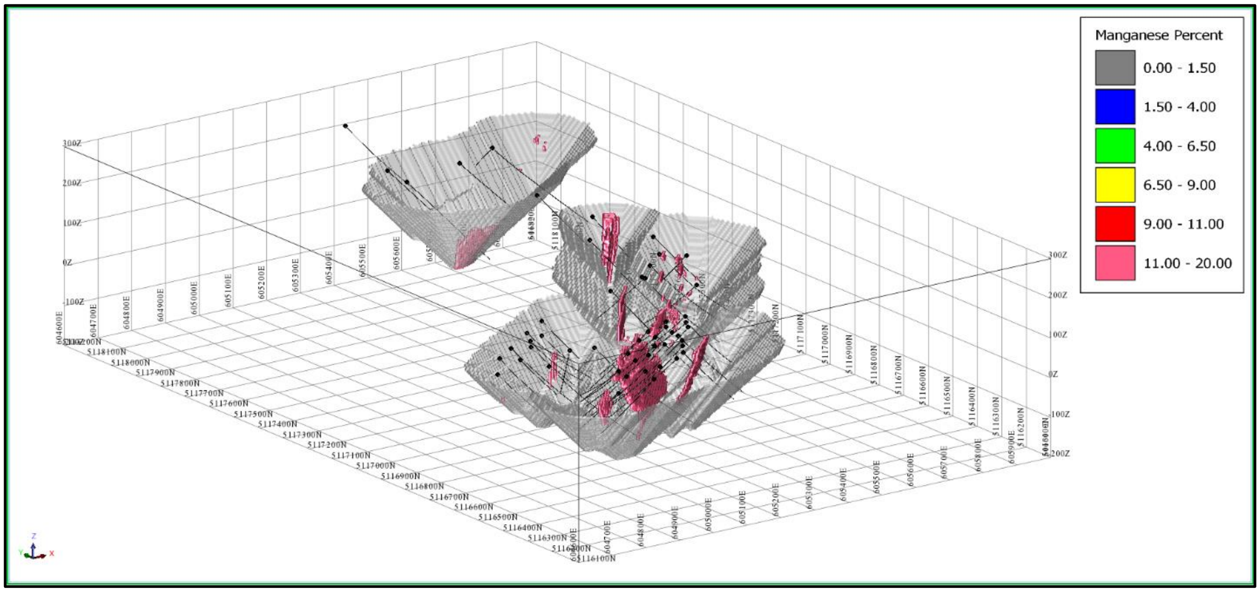
Source: prepared by Mercator, dated 2022

Figure 14-13: Oblique View Looking Northeast of Manganese Values Above a 6.5% Mn Cut-off within the Optimized Pit Shell (Grey)



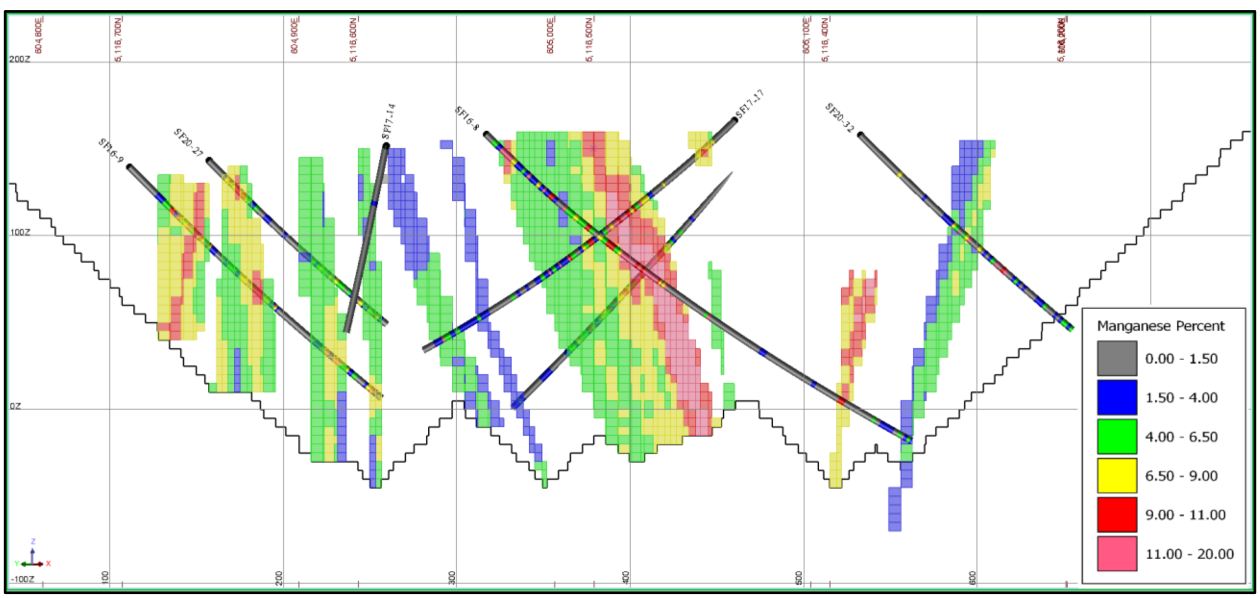
Source: prepared by Mercator, dated 2022

Figure 14-14: Oblique View Looking Northeast of Manganese Values Above a 11% Mn Cut-off within the Optimized Pit Shell (Grey)



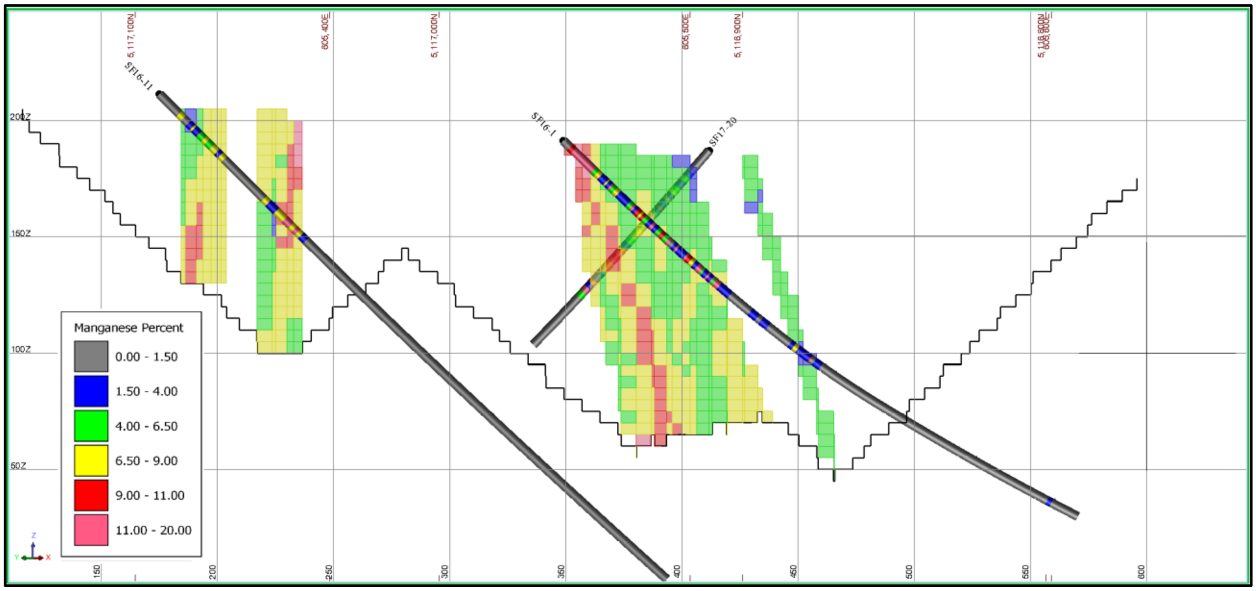
Source: prepared by Mercator, dated 2022

Figure 14-15: Representative Cross-Section Looking Northeast of the Moody Hill Area Comparing OK Blocks and Assay Manganese Values (Optimized Pit Shell in Black)



Source: prepared by Mercator, dated 2022

Figure 14-16: Representative Cross-Section looking Northeast of the Sharpe Farm Area Comparing OK Blocks and Assay Manganese Values (Optimized Pit Shell in Black)



Source: prepared by Mercator, dated 2022

Descriptive statistics were calculated for the drill hole composite values used in block model grade interpolations and these were compared to values calculated for the individual blocks (Table 14-5 to Table 14-7). The mean weighted average drill hole composite grades for the Battery Hill deposit areas compare well with the respective block values.

Table 14-5: Moody Hill Area Manganese and Iron Statistics for Block Values and 3 m Composites

	Type			
	Blocks		Composites	
Item	Mn (%)	Fe (%)	Mn (%)	Fe (%)
Number of Samples	97,958	97,958	981	981
Minimum Value	0.67	1.11	0.00	0.00
Maximum Value	15.26	19.18	19.20	23.86
Mean	6.02	10.17	6.22	10.44
Variance	5.09	6.09	12.77	15.67
Standard Deviation	2.26	2.47	3.57	3.96
Coefficient of Variation	0.37	0.24	0.58	0.38

Table 14-6: Sharpe Farm Area Manganese and Iron Statistics for Block Values and 3 m Composites

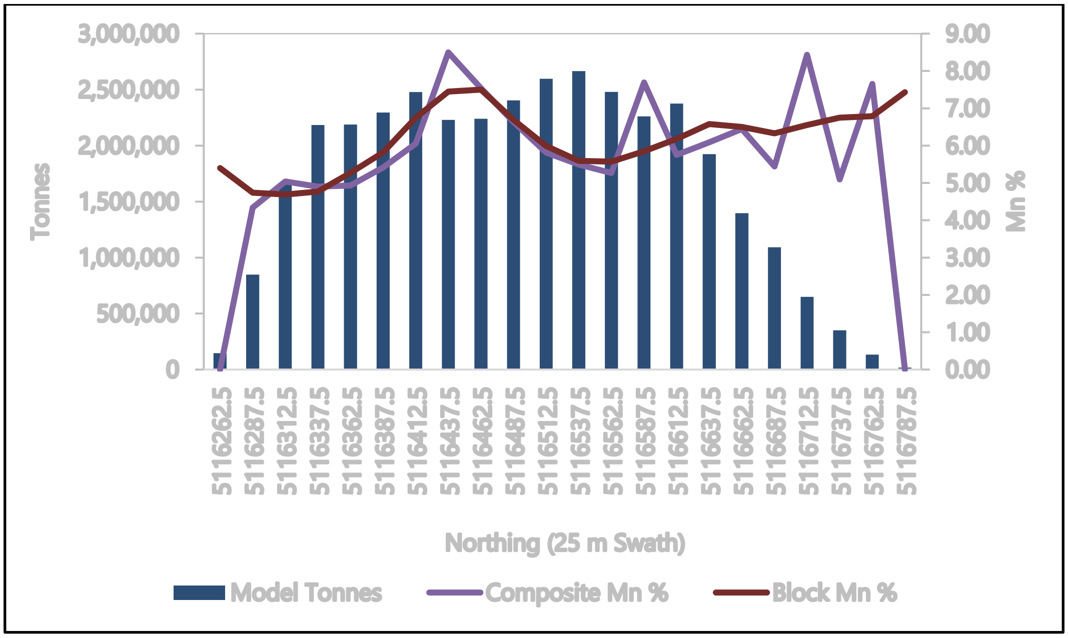
Item	Type			
	Blocks		Composites	
	Mn (%)	Fe (%)	Mn (%)	Fe (%)
Number of Samples	49,901	49,901	305	305
Minimum Value	1.07	2.79	0.00	0.00
Maximum Value	14.04	21.21	15.87	23.95
Mean	7.15	11.86	6.98	11.57
Variance	5.05	7.50	11.96	17.11
Standard Deviation	2.25	2.74	3.46	4.14
Coefficient of Variation	0.31	0.23	0.50	0.36

Table 14-7: Iron Hill Area Manganese and Iron Statistics for Block Values and 3 m Composites

Item	Type			
	Blocks		Composites	
	Mn (%)	Fe (%)	Mn (%)	Fe (%)
Number of Samples	29,073	29,073	127	73
Minimum Value	0.76	0.00	0.00	0.00
Maximum Value	18.92	27.13	19.06	27.15
Mean	5.58	9.32	5.95	9.9
Variance	6.23	11.94	16.08	25.64
Standard Deviation	2.50	3.46	4.01	5.06
Coefficient of Variation	0.45	0.37	0.67	0.51

Mercator created swath plots in the easting, northing, and vertical directions comparing average composite grades and global volume weighted block grades for each deposit area (Figure 14-17 to Figure 14-25). Swath plots show an acceptable correlation between the two grade populations and limited local bias. Areas of higher variance between composite grades and block grades is typically related to low composite density and/or low tonnages.

Figure 14-17: Moody Hill Area South-North Swath Plot of Mineral Resource and 3 m Composite Mn % Grades

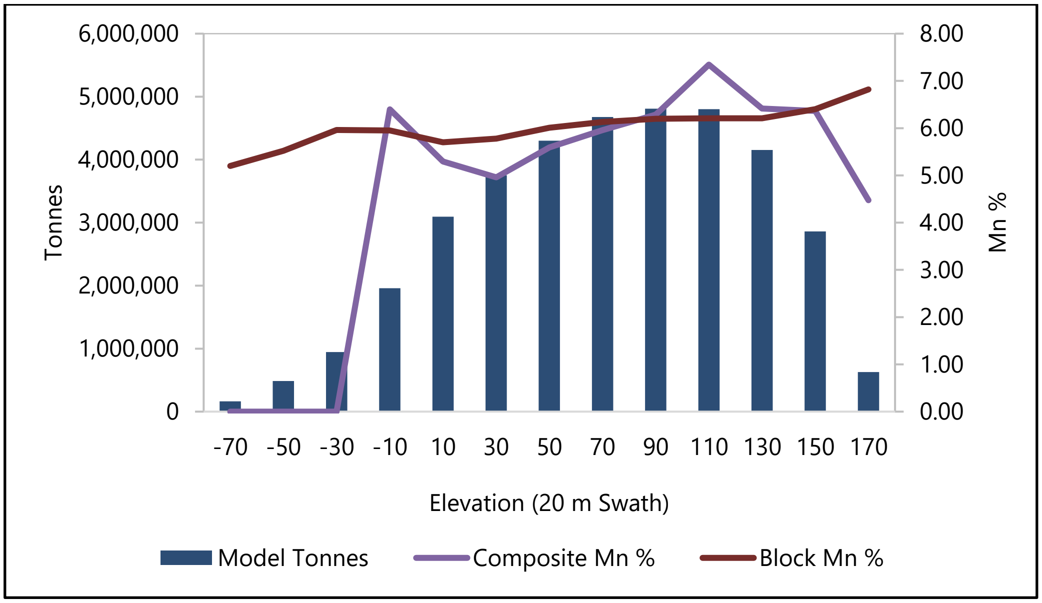


Source: prepared by Mercator, dated 2022

Figure 14-18: Moody Hill Area West-East Swath Plot of Mineral Resource and 3.0 m Composite Mn % Grades

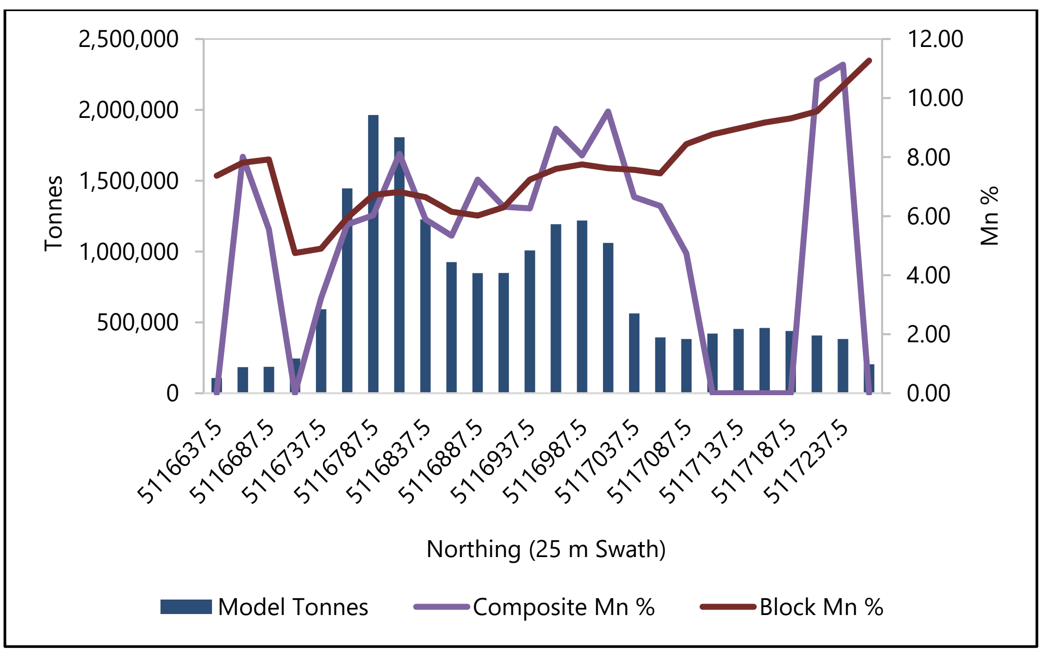
Source: prepared by Mercator, dated 2022

Figure 14-19: Moody Hill Area Elevation Swath Plot of Mineral Resource and 3.0 m Composite Mn % Grades



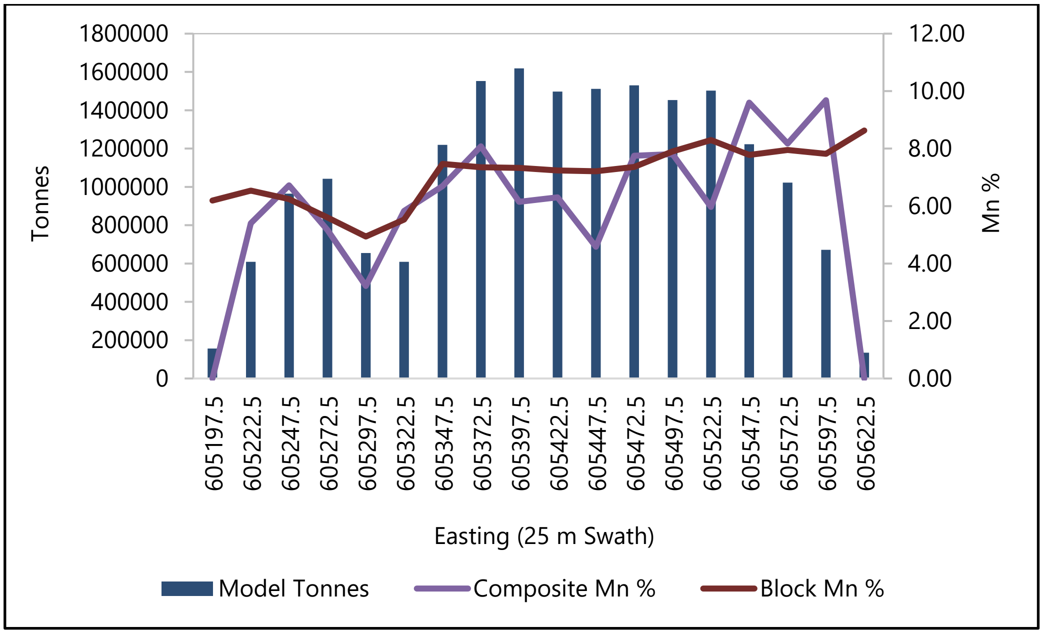
Source: prepared by Mercator, dated 2022

Figure 14-20: Sharpe Farm Area South-North Swath Plot of Mineral Resource and 3.0 m Composite Mn % Grades



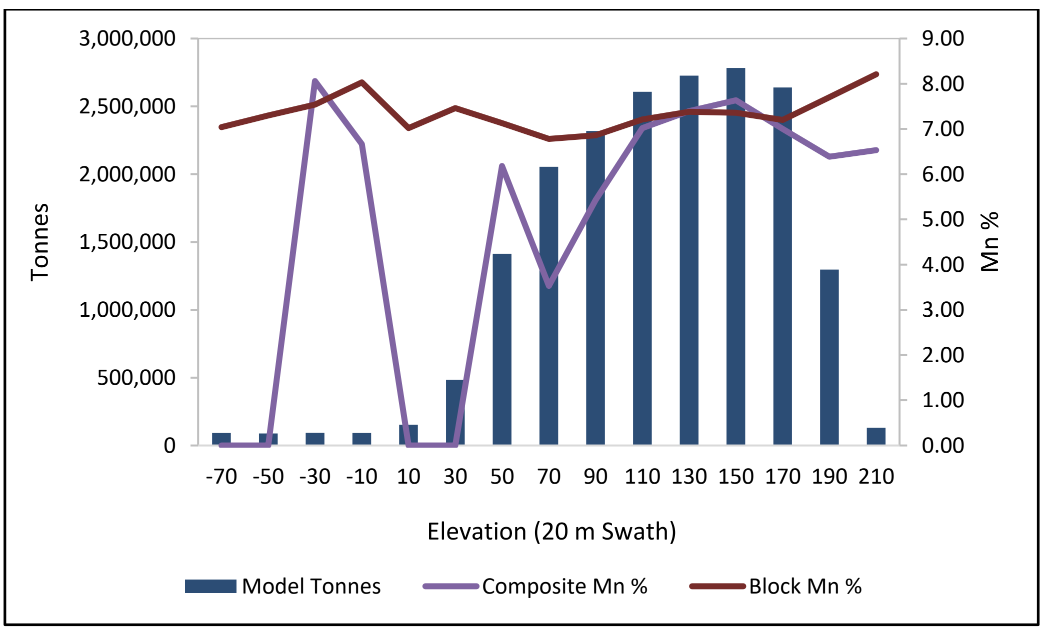
Source: prepared by Mercator, dated 2022

Figure 14-21: Sharpe Farm Area West-East Swath Plot of Mineral Resource and 3.0 m Composite Mn % Grades



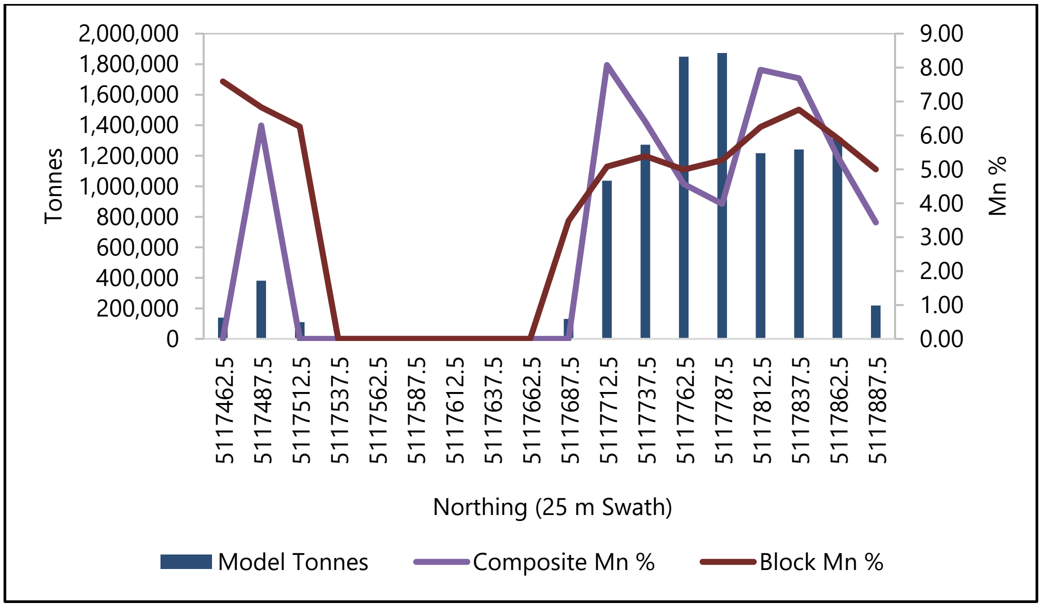
Source: prepared by Mercator, dated 2022

Figure 14-22: Sharpe Farm Area Elevation Swath Plot of Mineral Resource and 3.0 m Composite Mn % Grades



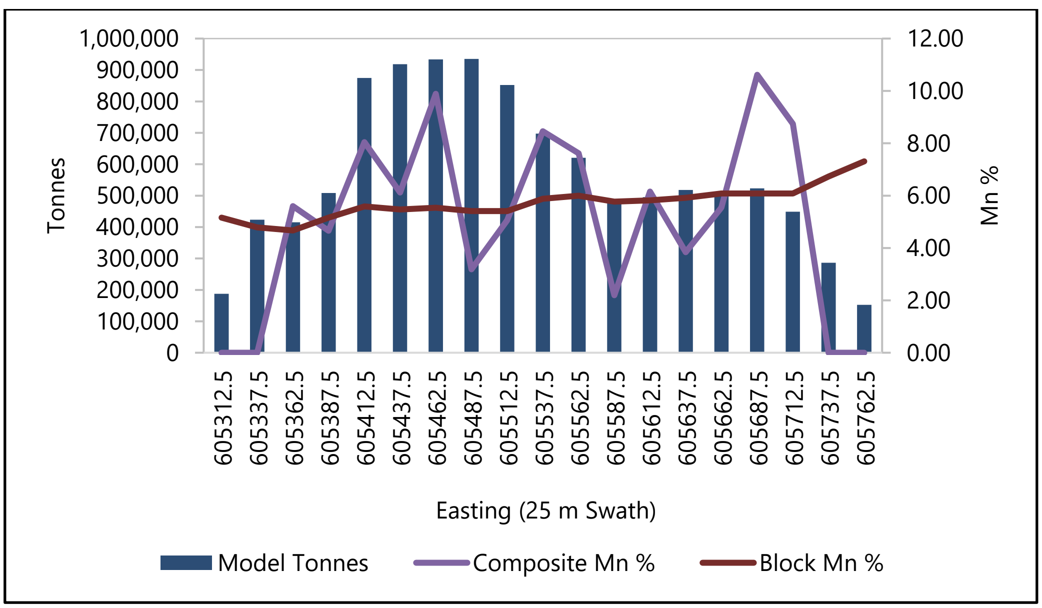
Source: prepared by Mercator, dated 2022

Figure 14-23: Iron Hill Area South-North Swath Plot of Mineral Resource and 3.0 m Composite Mn % Grades



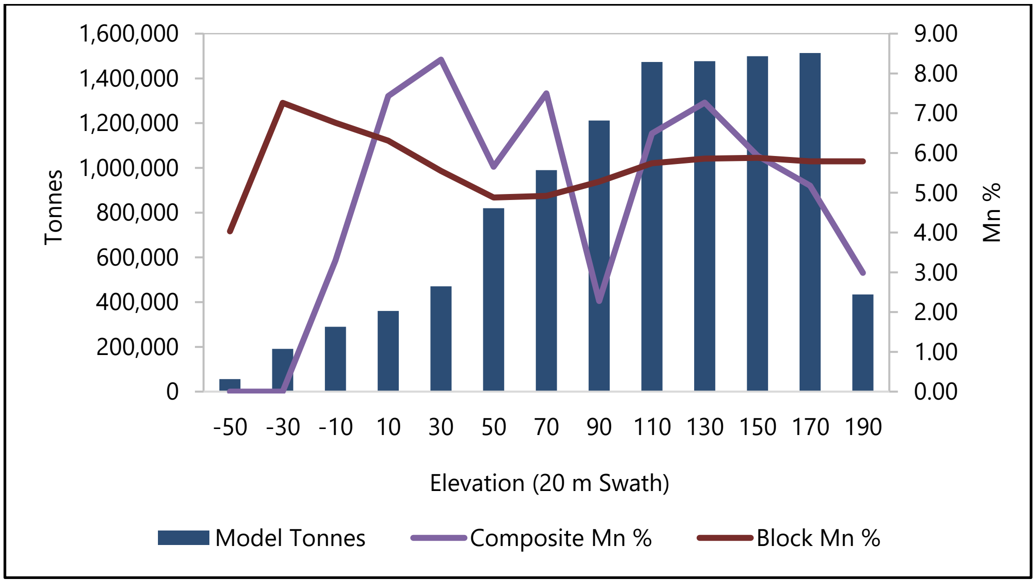
Source: prepared by Mercator, dated 2022

Figure 14-24: Iron Hill Area West-East Swath Plot of Mineral Resource and 3.0 m Composite Mn % Grades



Source: prepared by Mercator, dated 2022

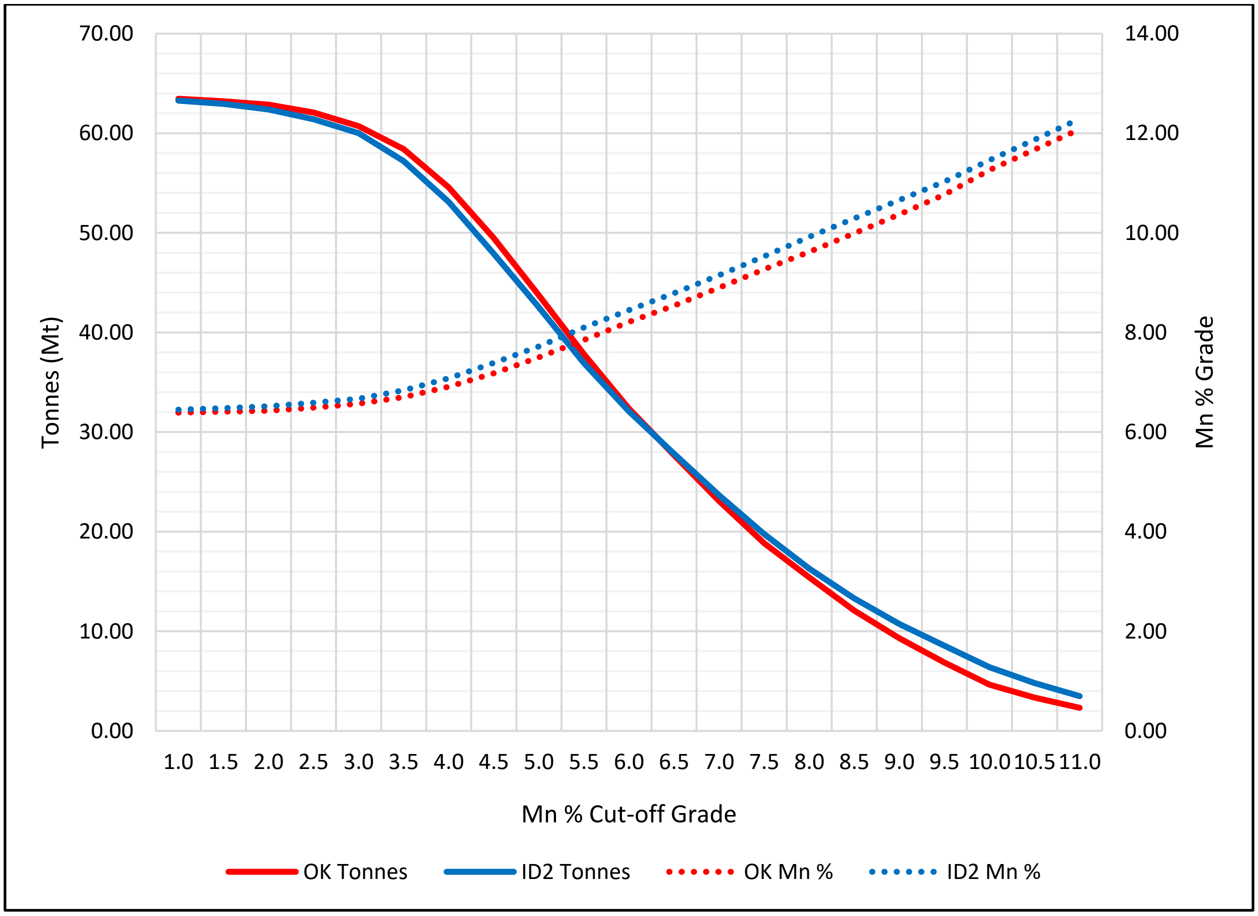
Figure 14-25: Iron Hill Area Elevation Swath Plot of Mineral Resource and 3.0 m Composite Mn % Grades



Source: prepared by Mercator, dated 2022

Mercator completed a comparative interpolation model for manganese percent using inverse distance (ID2) methods and the 3.0 m composite population as a check against the OK interpolation results. Results are presented in Figure 14-26 and the models are considered acceptably comparable. The OK model results in marginally larger tonnages below a 6.5% Mn cut-off, whereas the ID2 model results in marginally larger tonnages above a 6.5% Mn cut-off. The ID2 model supports marginally higher average manganese grades at all cut-offs.

Figure 14-26: Grade and Tonnage Relationship of OK and ID2 Interpolation Methodologies



Source: prepared by Mercator, dated 2022

14.5 Reasonable Prospects for Eventual Economic Extraction

To report a Mineral Resource in accordance with CIM Definition Standards (May 10, 2014), the Mineral Resource estimate must demonstrate reasonable prospects for eventual economic extraction.

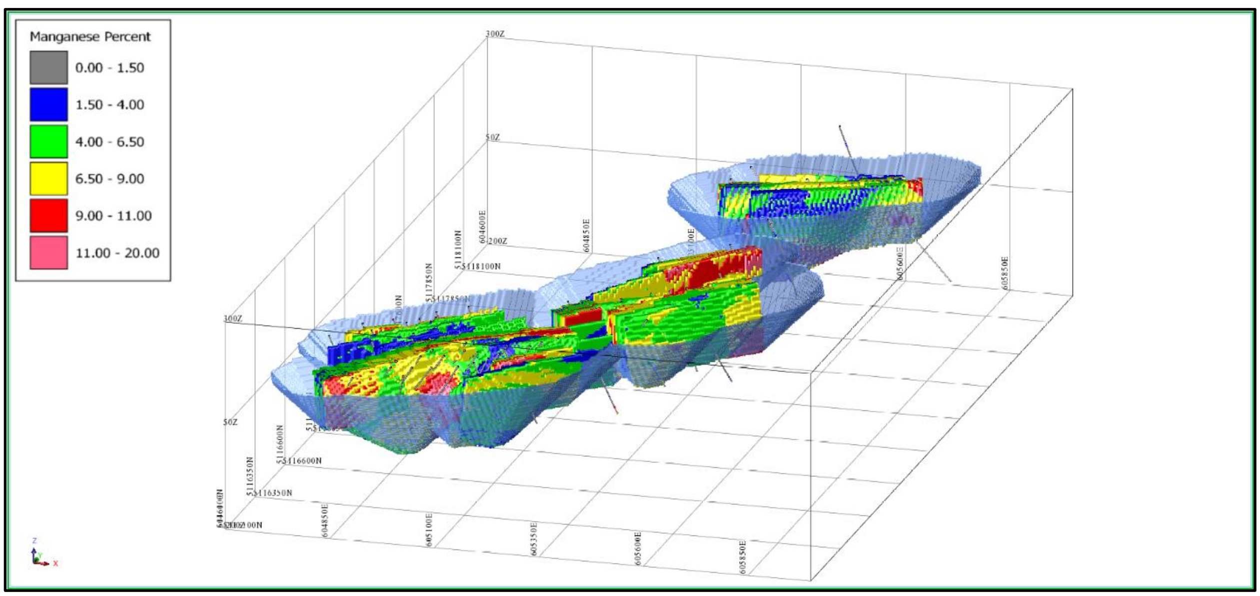
To report the Mineral Resources, an optimized open pit shell obtained using the Lerchs-Grossman (LG) algorithm was used to constrain the potentially economic mineralization. Wood generated the pit shell with Whittle™ mining software using the input parameters summarized in Table 14-8. Section 19 discusses the development of a risk managed commodity price established for use as input to the base case for Mineral Resource estimation when determining reasonable prospects for eventual economic extraction. Based on these parameters, a cut-off grade of 1.5% Mn was determined.

Images showing the optimized pit shell and resource are presented in Figure 14-27 and Figure 14-28.

Table 14-8: Pit Optimization Parameters

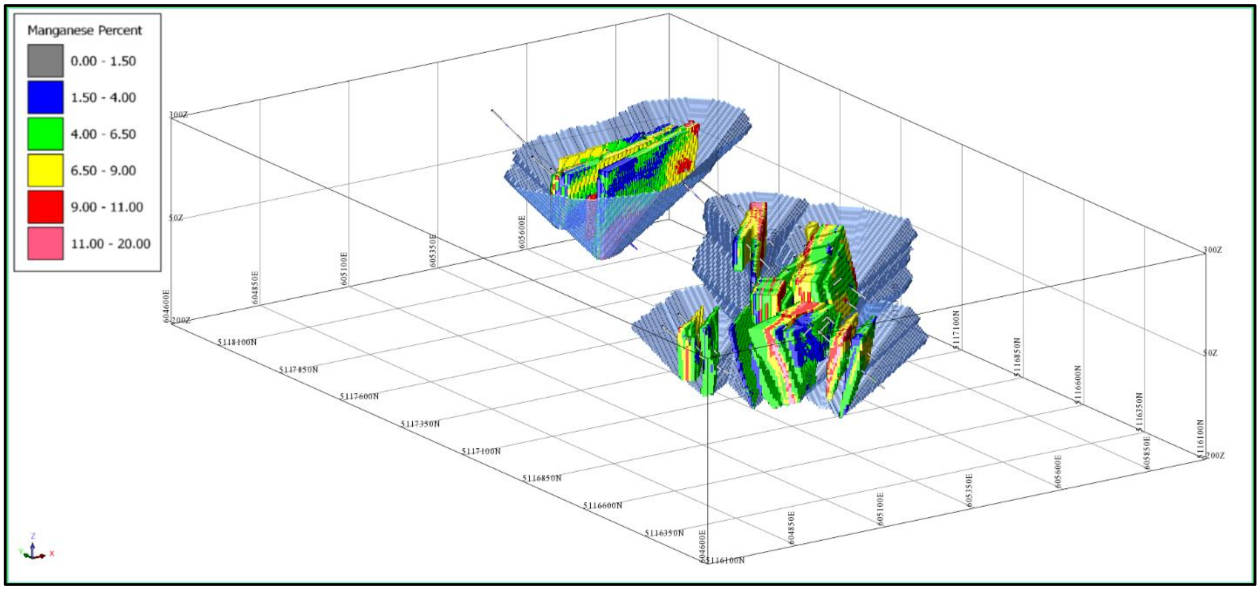
Parameter	Unit	Value
Mining cost	$ /t moved	7.43
Process cost	$/t processed	110.00
Stockpile rehandle	$/t processed	1.46
Sustaining cost	$/t processed	4.25
Closure and tailings cost	$/t processed	3.00
G&A	$/t processed	7.60
Processing rate	t /d	1,000
Processing recovery	%	78
Gross metal royalty	%	3.0
Metal price	US$/t HPMSM (32% Mn)	2,900
Selling cost	US$/t HPMSM (32% Mn)	65
Exchange rate	CA$:US$	1.25:1.00
Pit slope angle	degree	45

Figure 14-27: Oblique View Looking Northwest of the Optimized Pit Shell



Source: prepared by Mercator, dated 2022

Figure 14-28: Sectional View Looking Northeast of the Optimized Pit Shell



Source: prepared by Mercator, dated 2022

14.6 Resource Category Parameters Used in Current Mineral Resource Estimate

Definitions of Mineral Resources and associated Mineral Resource categories used in this Report are those set out in the CIM Definition Standards (May 10, 2014) as referenced in NI 43-101. Measured, Indicated, and Inferred categories have been assigned to the Battery Hill deposit.

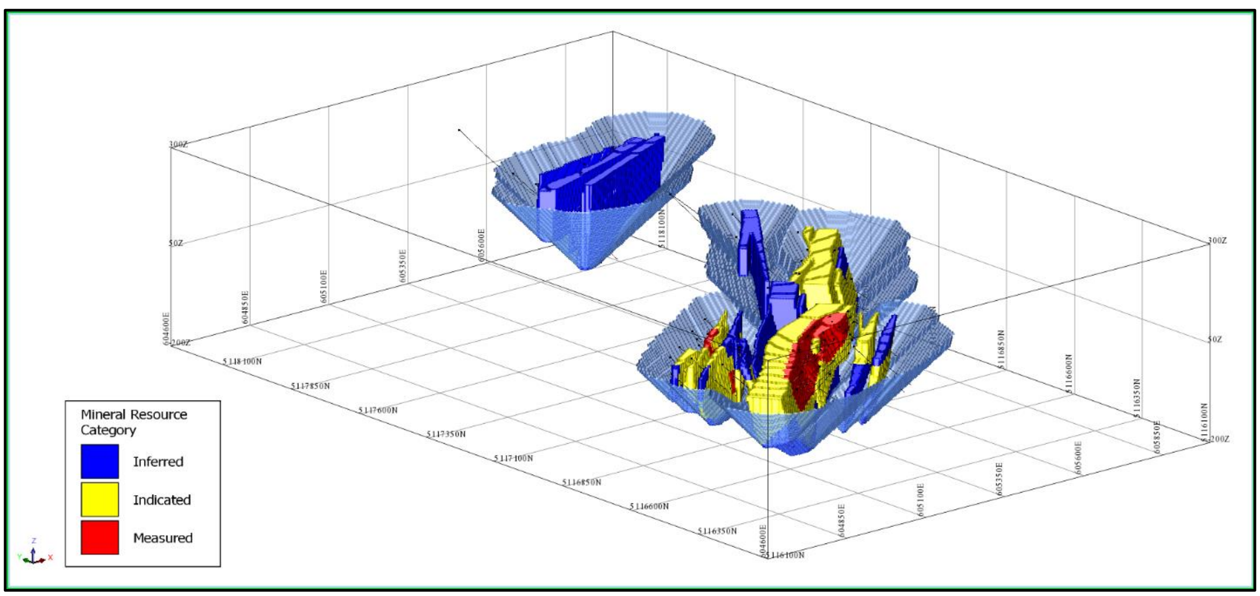
Several factors were considered in defining resource categories, including drill hole spacing, geological interpretations and number of informing assay composites and average distance of assay composites to block centroids. Specific definition parameters for each resource category applied in the current estimate are set out below.

- *Measured Resources*: Measured Mineral Resources are defined as all blocks with interpolated manganese grades from the first interpolation pass that meet the specified pit-constrained cut-off grade.
- *Indicated Resources*: Indicated Mineral Resources are defined as all blocks with interpolated manganese grades from the first and second interpolation passes that were not previously assigned to the Measured category and meet the specified pit constrained cut-off grade.
- *Inferred Resources*: Inferred Mineral Resources are defined as all blocks with interpolated manganese grades from the first, second, and third interpolation passes that were not previously assigned to the Measured or Indicated category and meet the specified pit constrained cut-off grade.

Application of the selected Mineral Resource categorization parameters specified above defined distribution of Measured, Indicated, and Inferred Mineral Resource estimate blocks within the block model. To eliminate isolated and irregular category assignment artifacts, the peripheral limits of blocks in close proximity to each other that share the same category designation and demonstrate reasonable continuity were wireframed and developed into discrete solid models. All blocks within these "category" solid models were re-classified to match that model's designation. This process resulted in more continuous zones of each Mineral Resource category and limited occurrences of orphaned blocks of one category as imbedded patches in other category domains.

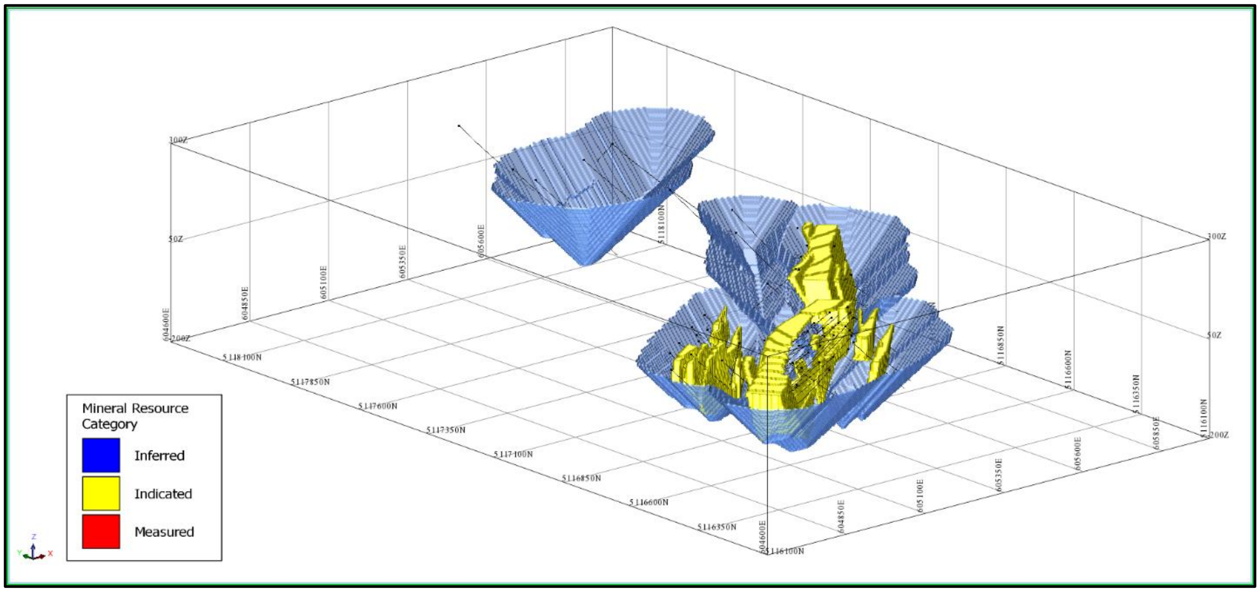
Mineral Resource category distribution demonstrates continuous zones of each category designation (Figure 14-29 to Figure 14-31). Measured and Indicated Mineral Resources are restricted to the Moody Hill and Sharpe Farm areas that are supported by a higher density of core drilling.

Figure 14-29: Oblique View Looking Northeast of the Mineral Resource Categorization within the Optimized Pit Shell (Blue)



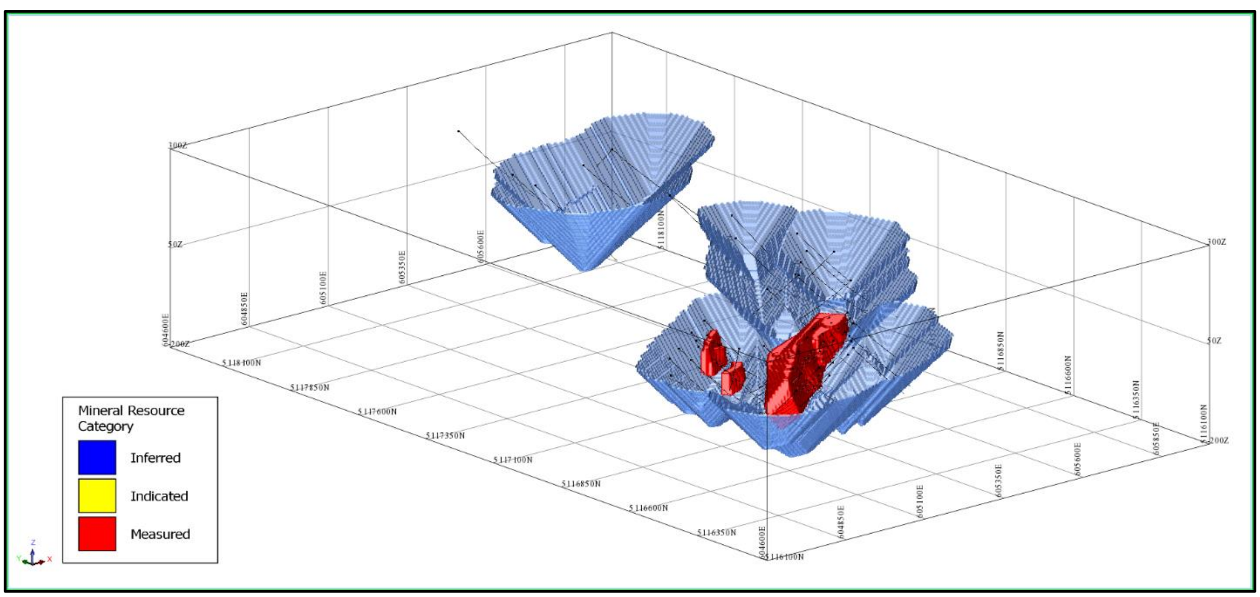
Source: prepared by Mercator, dated 2022

Figure 14-30: Oblique View Looking Northeast of the Indicated Mineral Resource within the Optimized Pit Shell (Blue)



Source: prepared by Mercator, dated 2022

Figure 14-31: Oblique View Looking Northeast of the Measured Mineral Resource within the Optimized Pit Shell



Source: prepared by Mercator, dated 2022

14.7 Mineral Resource Statement

Block grade, block density and block volume parameters for the Battery Hill deposit were estimated using methods described in preceding sections. Subsequent application of resource category parameters set out above resulted in the Mineral Resource estimate presented in Table 14-9. Mineral Resources are defined at a manganese cut-off grade of 1.5%. Results are reported in accordance with CIM Definition Standards (May 10, 2014). Mineral Resources allocated to each deposit area are presented in Table 14-10. A cut-off grade sensitivity tabulation is presented in Table 14-11 for comparative purposes but does not constitute part of the Mineral Resource statement. Figure 14-32 illustrates the relationship of cut-off grade to Mineral Resource tonnage within the optimized pit shell. The 1.5% Mn cut-off grade is based on the parameters discussed in Section 14.5 above and reflect reasonable prospects for eventual economic extraction using conventional open pit mining methods.

Table 14-9: Battery Hill Mineral Resource Estimate – Effective Date: May 12, 2022

Cut-off (Mn %)	Category	Tonnes (Mt)	Mn (%)	Fe (%)
1.5	Measured	11.32	6.72	10.94
	Indicated	23.82	6.24	10.50
	Measured Plus Indicated	35.14	6.39	10.64
	Inferred	27.72	6.46	10.73

Note: (1) The QP for the Mineral Resource statement is Mr. Matthew Harrington P. Geo. who is an employee of Mercator.

(2) Mineral Resources were prepared in accordance with the CIM Definition Standards (May 10, 2014) and CIM MRMR Best Practice Guidelines (November 2019).

(3) Mineral Resources are constrained within an optimized pit shell with average pit slope angles of 45° and a 2.9:1 strip ratio (waste: mineralized material).

(4) Pit optimization parameters include pricing of US$2,900 ($3,625)/t for HPMSM (HPMSM = 32% Mn; $1.25 to US$1.00 exchange rate), mining at $7.43/t, a 3% gross metal royalty, combined processing and G&A (1,000 t/d process rate) at $126.31/t processed, an overall Mn recovery to HPMSM of 78%, and a selling cost of US$65.00 ($81.25)/t HPMSM. Fe content did not contribute to the pit optimization process but was applied for bulk density determination purposes (see note 7).

(5) Mineral Resources are reported at a cut-off grade of 1.5 % Mn within the optimized pit shell. The cut-off grade reflects the marginal cut-off grade used in pit optimization to define reasonable prospects for eventual economic extraction by open pit mining methods.

(6) Mineral Resources were estimated using Ordinary Kriging methods applied to 3 m downhole assay composites. No grade capping was applied. Model block size is 5 m x 5 m x 5 m.

(7) Bulk density was applied using a regression curve based on Mn % and Fe % block grades. Average bulk density for Mineral Resources is 3.01 g/cm^3. Only manganese is considered having reasonable prospects for economic extraction; iron is reported for quality and density determination purposes.

(8) Mineral Resources may be materially affected by environmental, permitting, legal, title, taxation, sociopolitical, marketing, or other relevant issues.

(9) Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.

(10) Figures may not sum due to rounding.

Table 14-10: Battery Hill Mineral Resource Estimate for Each Deposit Area – Effective Date: May 12, 2022

Deposit Area	Cut-off (Mn %)	Category	Tonnes (Mt)	Mn (%)	Fe (%)
Moody Hill	1.5	Measured	11.32	6.72	10.94
		Indicated	15.42	5.84	9.93
		Measured and Indicated	26.74	6.21	10.36
		Inferred	8.27	6.09	10.28
Sharpe Farm	1.5	Measured	-	-	-
		Indicated	8.40	6.96	11.56
		Measured and Indicated	8.40	6.96	11.56
		Inferred	9.89	7.47	12.36
Iron Ore Hill	1.5	Measured	-	-	-
		Indicated	-	-	-
		Measured and Indicated	-	-	-
		Inferred	9.55	5.74	9.44

Note: (1) The QP for the Mineral Resource statement is Mr. Matthew Harrington P. Geo. who is an employee of Mercator.

(2) Mineral Resources were prepared in accordance with the CIM Definition Standards (May 10, 2014) and CIM MRMR Best Practice Guidelines (November 2019).

(3) Mineral Resources are constrained within an optimized pit shell with average pit slope angles of 45° and a 2.9:1 strip ratio (waste: mineralized material).

(4) Pit optimization parameters include pricing of US$2,900 ($3,625)/t for HPMSM (HPMSM = 32% Mn; $1.25 to US$1.00 exchange rate), mining at $7.43/t, a 3% gross metal royalty, combined processing and G&A (1,000 t/d process rate) at $126.31/t processed, an overall Mn recovery to HPMSM of 78%, and a selling cost of US$65.00 ($81.25)/t HPMSM. Fe content did not contribute to the pit optimization process but was applied for bulk density determination purposes (see note 7).

(5) Mineral Resources are reported at a cut-off grade of 1.5 % Mn within the optimized pit shell. The cut-off grade reflects the marginal cut-off grade used in pit optimization to define reasonable prospects for eventual economic extraction by open pit mining methods.

(6) Mineral Resources were estimated using Ordinary Kriging methods applied to 3 m downhole assay composites. No grade capping was applied. Model block size is 5 m x 5 m x 5 m.

(7) Bulk density was applied using a regression curve based on Mn % and Fe % block grades. Average bulk density for Mineral Resources is 3.01 g/cm^3. Only manganese is considered having reasonable prospects for economic extraction; iron is reported for quality and density determination purposes.

(8) Mineral Resources may be materially affected by environmental, permitting, legal, title, taxation, sociopolitical, marketing, or other relevant issues.

(9) Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.

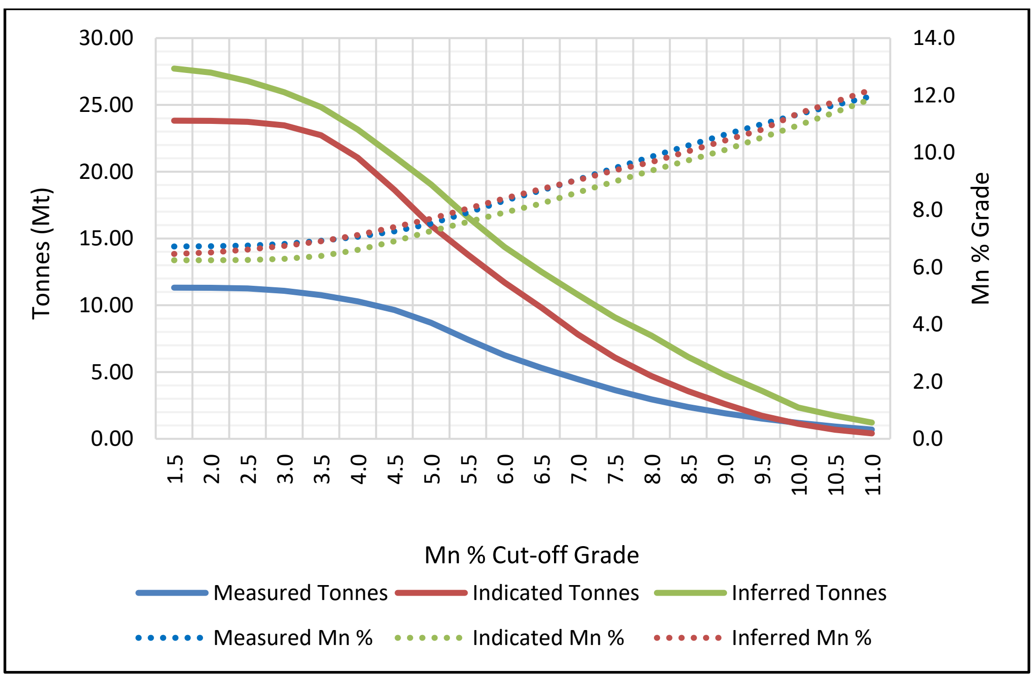
(10) Figures may not sum due to rounding.

Table 14-11: Battery Hill Project Cut-off Grade Sensitivity Analysis Within Mineral Resources

Cut-off (Mn %)	Category	Tonnes (Mt)	Mn (%)	Fe (%)
1.5	**Measured**	**11.32**	**6.72**	**10.94**
	Indicated	**23.82**	**6.24**	**10.50**
	Measured and Indicated	**35.14**	**6.53**	**10.76**
	Inferred	**27.72**	**6.46**	**10.73**
3	Measured	11.08	6.81	11.02
	Indicated	23.47	6.29	10.56
	Measured and Indicated	34.55	6.46	10.71
	Inferred	25.94	6.74	10.99
6	Measured	6.25	8.32	12.44
	Indicated	11.71	7.91	12.35
	Measured and Indicated	17.96	8.05	12.38
	Inferred	14.36	8.40	12.64
9	Measured	1.91	10.63	14.36
	Indicated	2.60	10.09	14.07
	Measured and Indicated	4.51	10.32	14.19
	Inferred	4.77	10.42	14.97

Note: This table shows sensitivity of the May 12, 2022 Mineral Resource Estimate to cut-off grade. The base case at a cut-off value of 1.5 % Mn is bolded for reference. See detailed notes on Mineral Resources in Table 14-9.

Figure 14-32: Tonnage/Grade Relationship Within Mineral Resources



Source: prepared by Mercator, dated 2022

14.7.1 Project Risks that Pertain to the Mineral Resource Estimate

The accuracy of a Mineral Resource estimate is a result of the quantity and quality of available data and the assumptions and judgements used in the geological interpretation and engineering. This is, in part, dependent on analysis of drilling results and statistical conclusions which may prove to be unreliable or inaccurate. The estimation of a Mineral Resource is inherently uncertain, involves subjective judgement about many relevant factors, and may be materially affected by, among other things, environmental, permitting, legal, title, taxation, sociopolitical, and marketing issues. Inferred Mineral Resources are uncertain in nature and there has been insufficient exploration to define Inferred Mineral Resources as Indicated or Measured Mineral Resources. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.

Factors that may materially impact the Mineral Resource include, but are not limited to, the following:

- Changes to the long-term HPMSM prices assumptions including unforeseen long term negative market pricing trends, and changes to the CA$:US$ exchange rate
- Changes to the deposit scale interpretations of mineralization geometry and continuity
- Variance associated with density assignment assumptions and/or changes to the density values applied
- Inaccuracies of deposit modelling and grade estimation programs with respect to actual metal grades and tonnages contained within the deposit
- Changes to the input values for mining, processing, and G&A costs to constrain the Mineral Resource
- Changes to metallurgical recovery assumptions including metallurgical recoveries that fall outside economically acceptable ranges
- Variations in geotechnical, hydrological, and mining assumptions
- Changes in the assumptions of marketability of the final product
- Issues with respect to mineral tenure, land access, land ownership, environmental conditions, permitting, and social license

At this time, the QP does not foresee any other significant risks and uncertainties that could reasonably be expected to affect the reliability or confidence in the drilling information and associated Mineral Resource estimate disclosed in this Report. The QP is of the opinion that Mineral Resources were estimated using industry accepted practices and conform to the CIM Definition Standards (May 10, 2014) and CIM MRMR Best Practice Guidelines (November, 2019).

15.0 MINERAL RESERVE ESTIMATES

This Report summarizes a PEA study which cannot be used to support Mineral Reserves. There are no Mineral Reserves for the Project.

16.0 MINING METHODS

The PEA mine plan includes Inferred Mineral Resources that are considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as Mineral Reserves.

16.1 Overview

The PEA considers mining a single deposit from multiple pits. Moody Hill, Sharpe Farm, and Iron Ore Hill areas will each have two pits located approximately along a northeast/southwest strike direction over several kilometres.

The mine plan assumes conventional open pit mining using a contract mining equipment fleet at a total mining rate of 1.0 Mt/a to provide a mill feed of 365 kt/a, or 1,000 t/d. The mine plan will utilize a stockpile for mineralized material to enhance project economics and to sustain mill operations 24-hours per day, seven-days per week at a single, central processing facility. The mining operations will have a 40-year mine production life, with a two-year pre-production period, and seven-years of stockpile reclaim feed at the end of mine life. Table 16-1 shows the subset of Mineral Resources within the mine plan.

Table 16-1: Subset of the Battery Hill Mineral Resource Estimate within the Mine Plan

Classification	Cutoff (Mn %)	Tonnage (Mt)	Grade (Mn %)	Contained Mn (kt)
Measured	3.3	5.90	7.65	451
Indicated	3.3	6.37	7.26	462
Total Measured and Indicated		**12.26**	**7.45**	**913**
Inferred	3.3	4.73	8.26	391
Total Inferred		**4.73**	**8.26**	**391**

Note: (1) Mineral Resources within the mine plan were estimated using open pit mining methods and include Inferred Mineral Resources that are too speculative geologically to have economic considerations applied to them that would enable them to be categorized as Mineral Reserves.

(2) Input assumptions to the pit shells that constrain the Mineral Resource estimate include an HPMSM price of US$2,900/t, mine operating cost of $7.43/t, process operating cost of $110/t, G&A cost of $7.60/t, stockpile reclaim cost of $1.46/t, closure cost of $3.00/t, selling cost of US$65/t, process recovery of 78%, a gross metal royalty of 3%, and a pit slope of 45°.

(3) Tonnes, grades and contained metal may not sum due to rounding.

16.2 Pit Optimization

The open pit mine designs are based on pit shells obtained using the LG algorithm for pit optimizations in Whittle™ mining software. Optimization inputs are based on an open pit bulk mining method. Contract mining is assumed for a contractor using a small equipment fleet. The Mineral Resource model was used without adjustments for mine planning. Mining loss and dilution are accounted for in the block size (5 m x 5 m x 5 m), and no additional dilution or losses were applied. The surface topography is from lidar survey.

Key optimization inputs is summarized in Table 16-2.

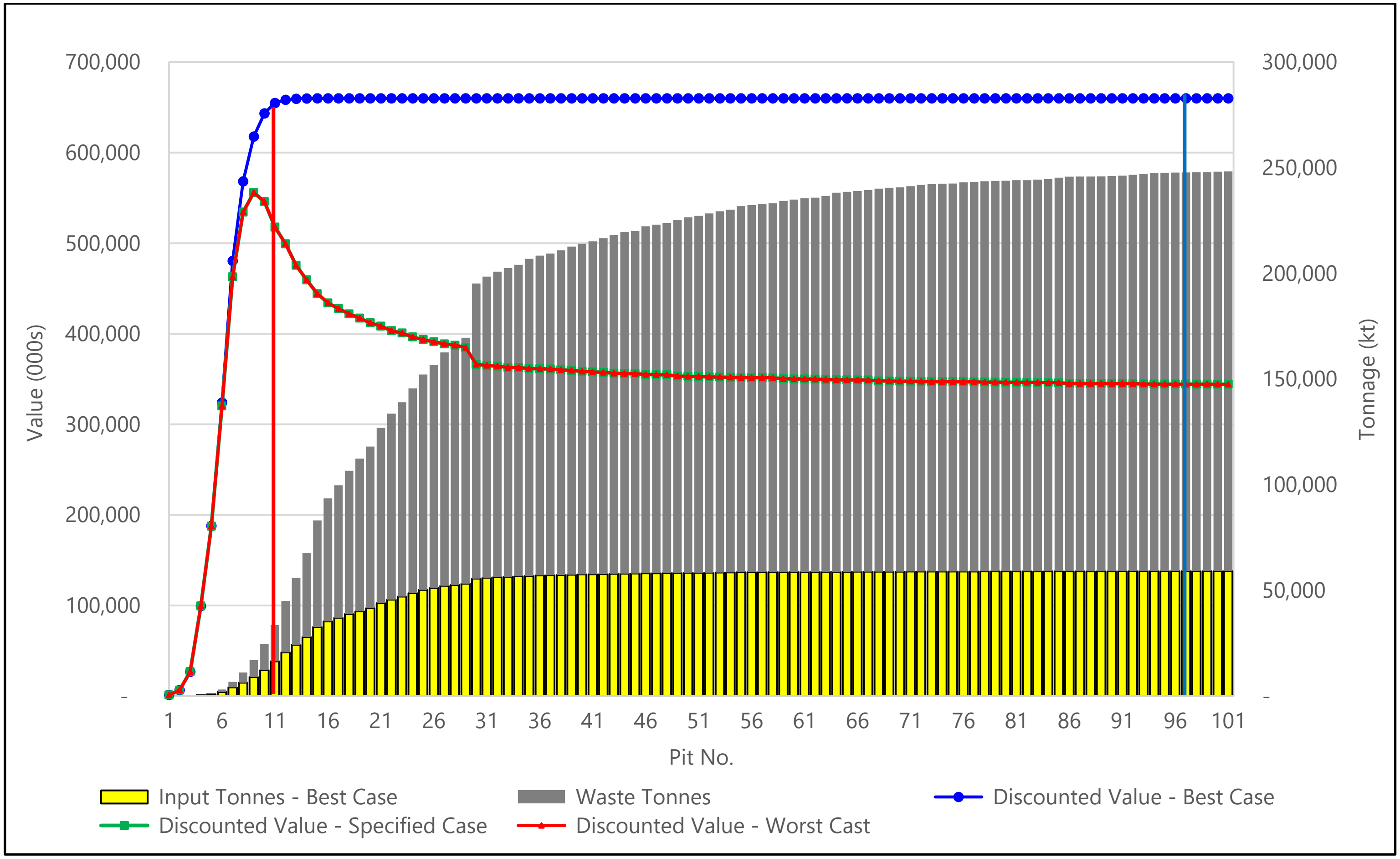
Table 16-2: Pit Optimization Parameters

Parameter	Unit	Value
Economic Parameters		
HPMSM price	US$/t	2,900
Discount rate	%	10
Royalties	% and basis	3.0
Mining Parameters		
Mine operating cost	$/t	7.43
Pit slope angle	degrees	45
Process Parameters		
Processing rate	kt/a	365
Process recovery	%	78
Process cost	$/t	110.00
Process sustaining cost	$/t	4.25
Other		
Stockpile reclaim cost	$/t	1.46
G&A cost	$/t	7.60
Closure cost	$/t	3.00
Selling costs	US$/t	65.00

Note: HPMSM – 32% Mn

Pit optimizations were undertaken using a range of HPMSM prices while keeping all other mining economic parameters constant. The resulting pit-by-pit grade–tonnage graphs are shown in Figure 16-1.

Figure 16-1: Pit Optimization Results, Pit-by-Pit Grade-Tonnage Graph



Note: Pit 97 (blue) is base scenario, US$2,900/t HPMSM. Pit 11 is the ultimate pit selected for mine planning, US$676/t HPMSM (red).
Source: prepared by Wood, dated 2022

Pit shell 97 (blue) corresponds to a product market price of US$2,900/t HPMSM and was the base optimization scenario. Pit shell 11 (red) was selected as the ultimate pit for mine planning to drive the project economics with an elevated cut-off grade strategy, and corresponds to a US$676/t HPMSM. Beyond pit 11 (>11), the marginal value results in diminishing financial returns for the Project, with the value of additional mineralized material offset by the cost of additional waste stripping. Selecting a smaller pit shell (<11) would have resulted in lost marginal value.

16.3 Open Pit Design

General pit and mine design criteria are shown in Table 16-3 and discussed in the following sections.

Table 16-3: Pit and Mine Design Criteria

Criteria	Inputs
Design Pit Parameters	
Annual production rate	365 kt/a Mill feed
Inter-ramp angles by sector	45° OSA
Single/double bench configuration	double bench
Bench height	2.5 m double benched
Ramp width	16 m two-way traffic and 10 m one way traffic to accommodate up to 40 tonne trucks
Minimum mining width	18 m in pit bottom and 20 m on benches
Max mine development rate	Maximum vertical advance per phase per year is 12, 5 m benches.
Grade control	Blast hole drilling and blast hole assaying
WRSF Parameters	
OSA	3:1 (h:v)
Lift height	20 m bench height and 5 m berms
Maximum height	60 m
Swell (in dump, after compaction)	32%

Note: OSA – overall slope angle

16.3.1 Geotechnical and Hydrological / Hydrogeological Considerations

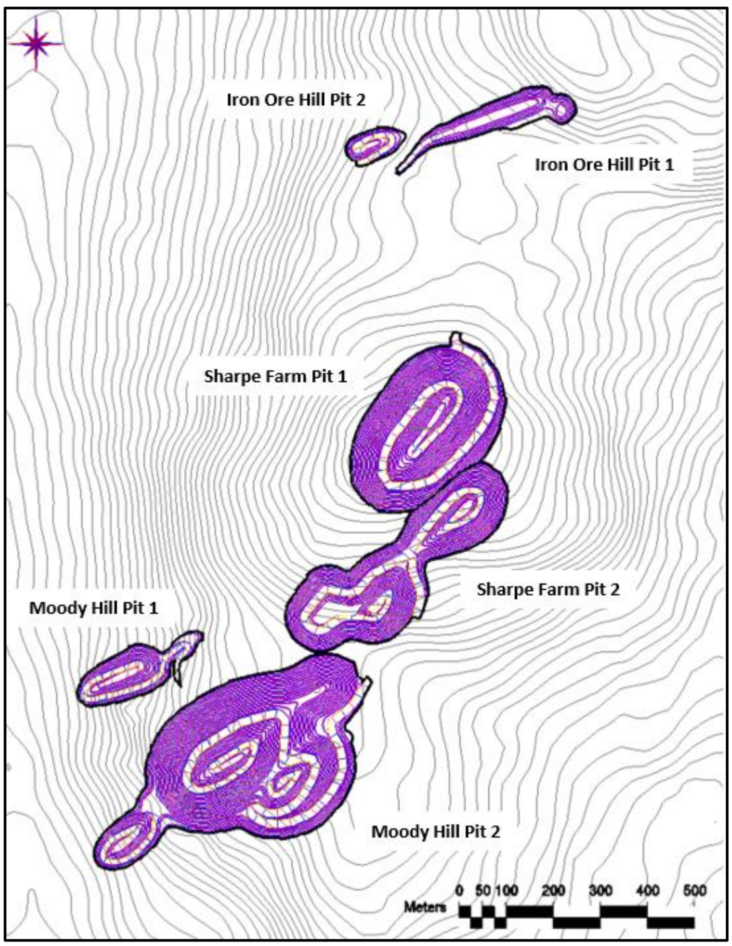
Geotechnical recommendations were based on an analysis completed from RQD values available in the drill hole database. Wood recognizes the need for further geotechnical investigations and has assumed an overall slope angle (OSA) of 45° based on dry conditions and the preliminary economic assessment pit design geometry recommendations.

Limited information on hydrology and hydrogeology is available and for design purposes it was assumed that significant pit dewatering in advance of mining is not necessary. Generally, localized areas of in pit groundwater and surface runoff are anticipated and expected to be collected within the pit in sumps and pumped to surface ponds. Pit depths beyond the natural groundwater table may require the addition of wells for dewatering purposes.

16.3.2 Ultimate Pit Design

The ultimate pit designs are based on pit shell 11 reflecting a market price of US$676/t HPMSM. Six standalone pits were designed for the Project. Figure 16-2 shows a plan view of these ultimate pits.

Figure 16-2: Ultimate Pits Moody Hill, Sharpe Farm, and Iron Ore Hill Zones



Source: prepared by Wood, dated 2022

16.3.3 Pit Phases

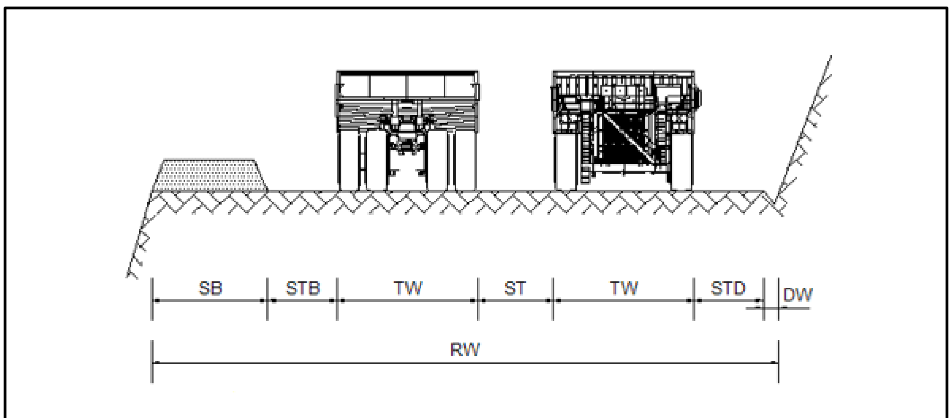
In total, 19 pit phases were developed for the Project. Phases one through seven, and phase 17 are mined from the two Moody Hill ultimate pits. Phases eight though 16 are mined from the two Sharpe Farm ultimate pits. Phases 18 and 19 are mined from the two Iron Ore Hill ultimate pits.

Smoothed pit designs were not completed for internal phases, rather pit shells were incorporated in the production schedule. Individual phases were selected from the different pit shells within the ultimate pit and based on operational parameters such as bench advance, pushback widths, and quantities of resource. Table 16-4 provides a summary of the forecast tonnes and manganese grade by phase.

16.4 Haul Roads

The haul roads are designed to accommodate 40 tonne articulated haul trucks with a maximum gradient of 10% and an overall in-pit width of 16 m. Access into the final pit bottoms will be gained by way of a section of single-lane road that will be 10 m wide. The mine site road network layout connects the mining pits with the ROM stockpile, and WRSFs. Temporary roads will be developed to access the upper benches of both pits. A typical ramp cross-section is shown in Figure 16-3. The mine site road network can be seen in Figure 16-4.

Figure 16-3: Typical Ramp Cross-Section



SB:	Safety Berm	2.7	m	8.95	ft
STB:	Space Between Truck and Safety Berm	1.8	m	5.74	ft
TW:	Truck Width	3.5	m	11.48	ft
ST:	Space Between Trucks	1.8	m	5.74	ft
TW:	Truck Width	3.5	m	11.48	ft
STD:	Space Between Truck and Ditch	1.8	m	5.74	ft
DW:	Ditch Width	1.0	m	3.28	ft
RW:	Ramp Width	16.0	m	52.41	ft

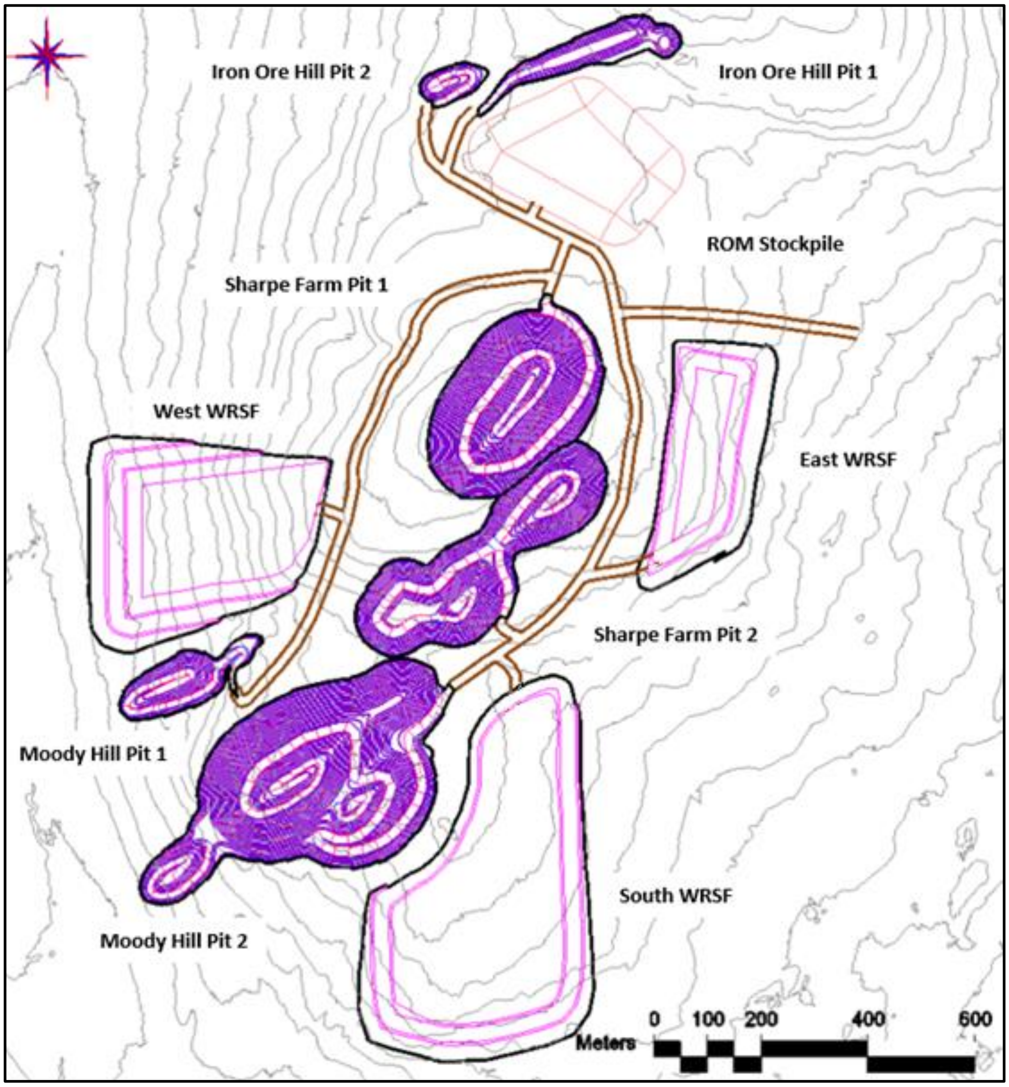
Source: prepared by Wood, dated 2022

Table 16-4: Phase Summary

	Mineralized Material			Mineralized Reject			Process Feed			Waste		
Phase	Insitu (kt)	Mn (%)	Contained Mn (kt)	Waste (kt)	Mn (%)	Contained Mn (kt)	Process (kt)	Mn (%)	Contained Mn (kt)	Waste (kt)	Total Waste & Reject (kt)	Total (kt)
1	398	9.78	39	10	2.68	0.257	388	9.95	39	71	80	468
2	359	8.81	32	14	3.00	0.420	345	9.04	31	100	114	459
3	1,487	7.62	113	78	3.40	2.644	1,409	7.85	111	699	776	2,186
4	1,928	8.01	154	51	3.26	1.676	1,877	8.14	153	1,654	1,705	3,582
5	1,384	6.97	97	136	3.23	4.407	1,248	7.38	92	1,253	1,389	2,637
6	1,736	6.89	120	146	3.26	4.757	1,590	7.22	115	1,953	2,099	3,689
7	2,722	6.09	166	170	3.19	5.441	2,551	6.28	160	4,625	4,796	7,347
8	94	8.90	8	-	-	-	94	8.90	8	47	47	141
9	372	7.65	28	0	3.83	0.014	372	7.66	28	119	119	491
10	574	7.37	42	2	2.62	0.048	573	7.39	42	168	170	743
11	931	6.95	65	22	2.62	0.572	909	7.05	64	436	458	1,367
12	1,858	6.65	124	16	2.80	0.446	1,842	6.68	123	1,995	2,011	3,854
13	674	10.07	68	-	-	-	674	10.07	68	577	577	1,251
14	994	9.16	91	-	-	-	994	9.16	91	1,400	1,400	2,394
15	1,170	8.94	105	5	3.40	0.174	1,164	8.97	104	3,276	3,281	4,445
16	279	7.79	22	22	3.47	0.773	257	8.17	21	2,915	2,937	3,194
17	311	7.61	24	-	-	-	311	7.61	24	496	496	807
18	373	6.61	25	73	2.73	2.006	299	7.56	23	236	310	609
19	122	5.99	7	31	2.98	0.918	91	7.00	6	80	110	202
Total/Avg	**17,767**	**7.48**	**1,328**	**777**	**3.16**	**25.000**	**16,990**	**7.67**	**1,304**	**22,098**	**22,876**	**39,865**

Note: Tonnes, grades and contained manganese may not sum due to rounding.

Figure 16-4: Conceptual Layout Plan – Pits, Waste Rock Storage Facilities, and ROM Stockpile



Source: prepared by Wood, dated 2022

16.5 Waste Rock Storage Facilities

Three WRSFs were designed for a total capacity of 24.4 Mt (Table 16-5). Only non-acid generating (NAG) material will be placed during the LOM. There is currently no potentially-acid generating (PAG) material identified on the Project site. The WRSF's were designed to an OSA of 3:1 (h:v) with 20 m bench heights and 5 m berm widths.

Waste material will also be used for construction of the perimeter buttresses of the FRSA, and will be available for use on site haulage roads and other construction needs.

The locations of the WRSFs have been designed to minimize haulage distances of waste rock and are shown in Figure 16-4. This figure also shows both planned pits and the proposed access roads.

Table 16-5: Waste Rock Storage Facility Summary

Waste Rock Storage Facility	Tonnage (kt)
East WRSF	3,760
South WRSF	10,360
West WRSF	10,320
Total	**24,440**

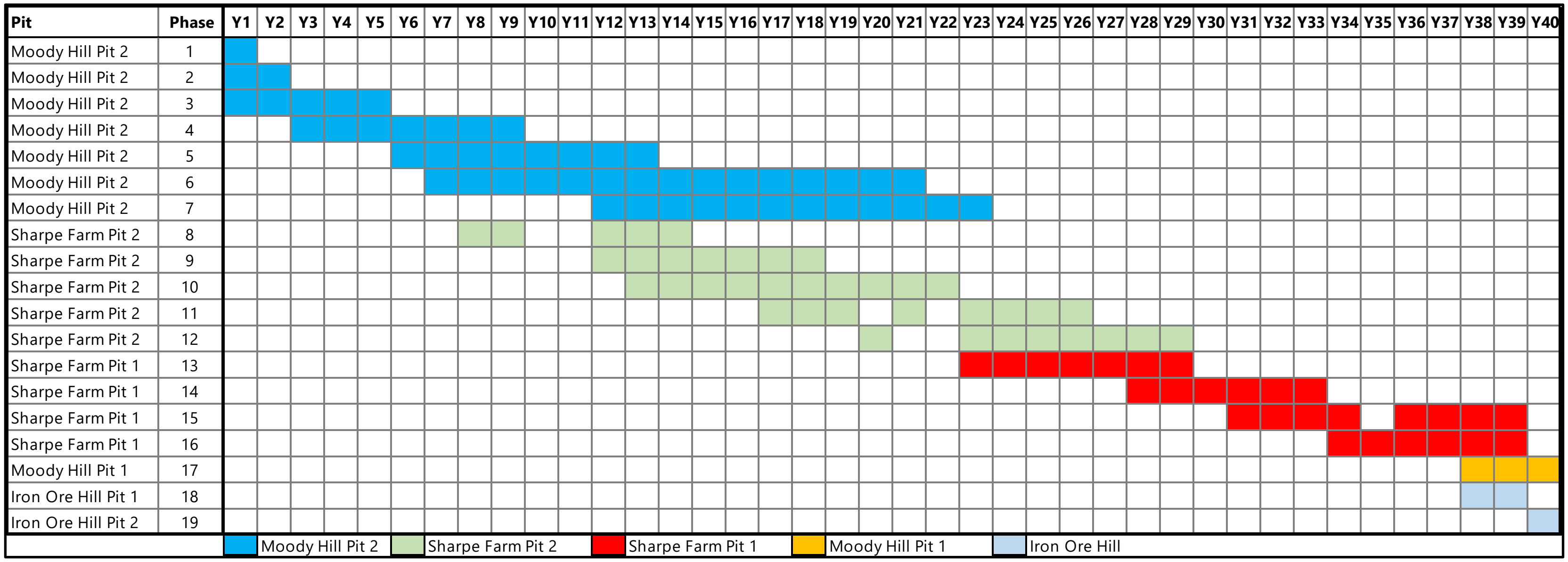
16.6 Production Plan

Wood used Whittle SIMO™ to produce a mining schedule that:

- Feeds material to the mill at a constant 365 kt/a
- Limits total material mined to 1.0 Mt/a
- Incorporates stockpiling to maximize project economics
- Limits bench advance to 12 benches per year per mining area.

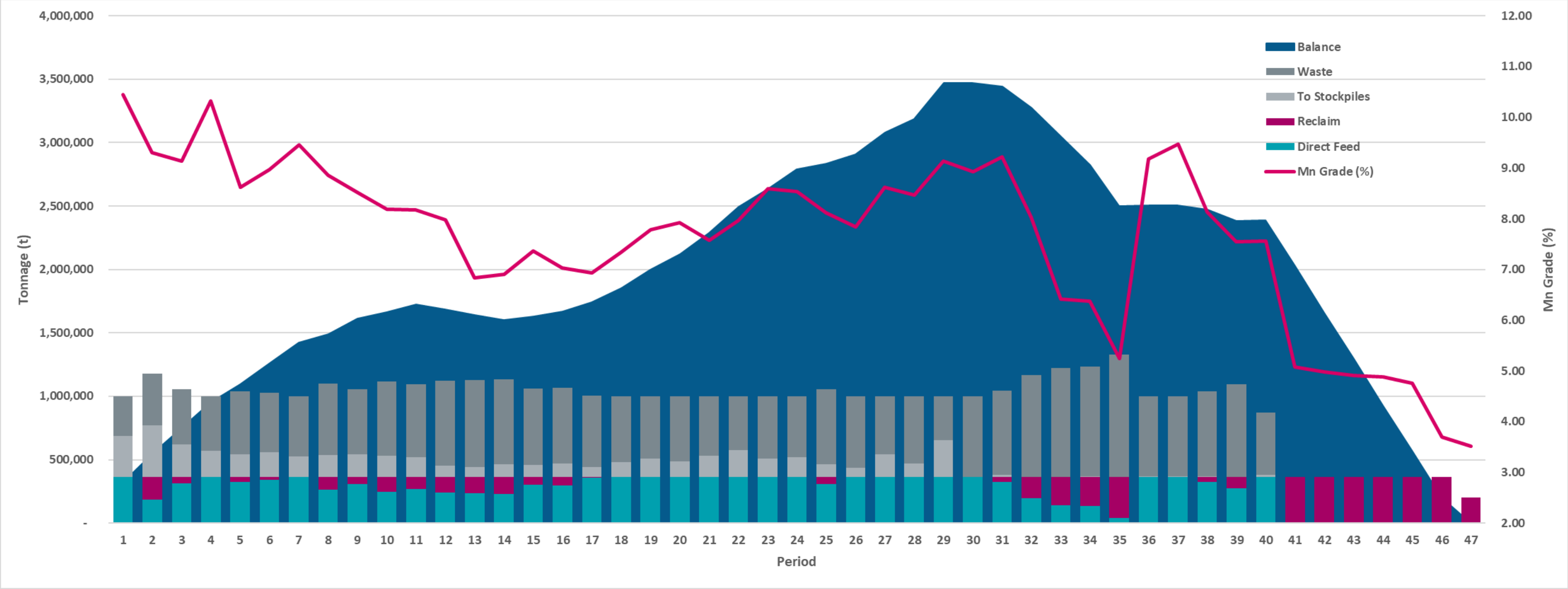
Mining will begin at Moody Hill Pit 2 before moving to the Sharpe Farm pits. Subsequent mining will target the smaller Moody Hill and Iron Ore Hill pits. In total, the LOM production plan is 47 years. Mining activities conclude after Year 40, with the remaining seven years of mill feed being provided by stockpile reclaim material. A ROM stockpile is incorporated into the mine plan to enable an elevated cut-off grade strategy and drive project economics. It is located adjacent to the crushing facility. A maximum stockpile balance of 3.5 Mt occurs in Year 30. Figure 16-5 shows the proposed mine phase sequence. Figure 16-6 shows the mine material movement plan. The annual mine schedule is summarized in Figure 16-7.

Figure 16-5: Proposed Mine Phase Sequence



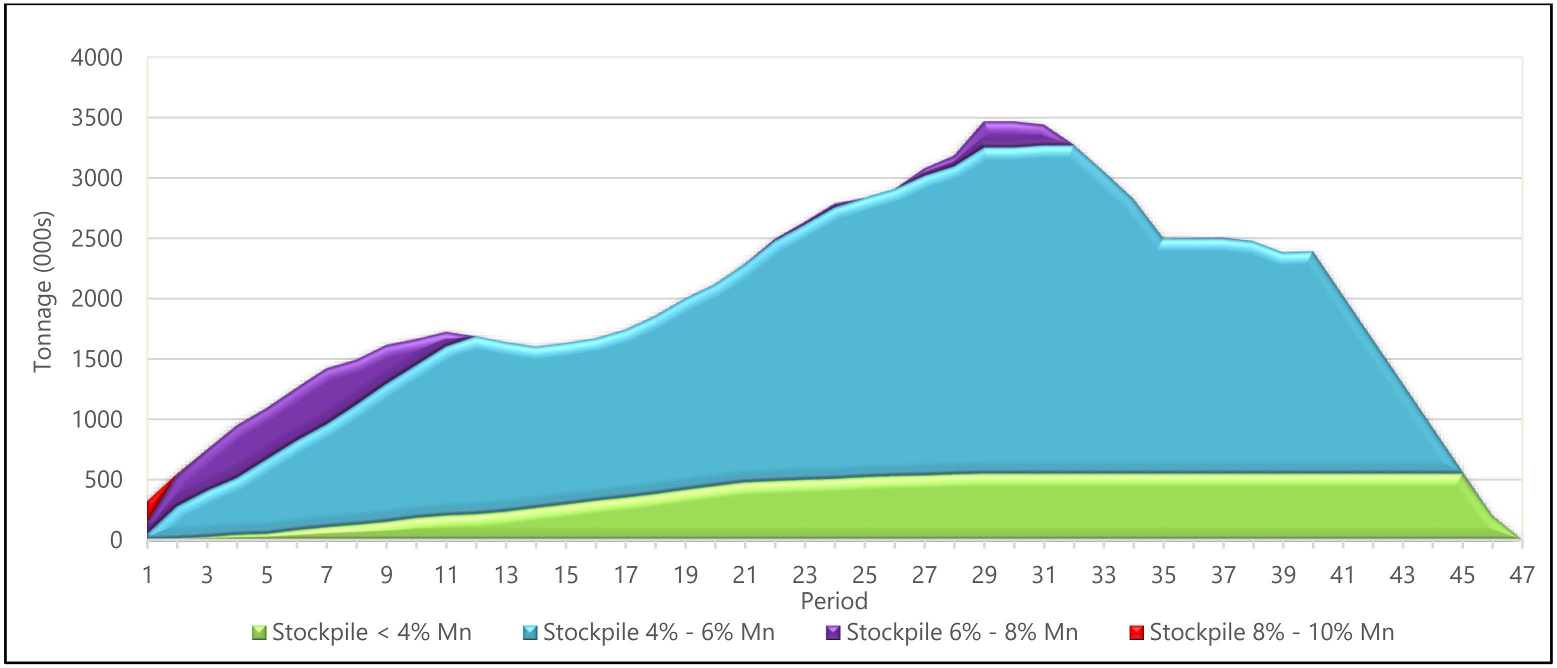
Source: prepared by Wood, dated 2022

Figure 16-6: Conceptual Layout Plan Mine Material Movement Plan



Source: prepared by Wood, dated 2022

Figure 16-7: Conceptual Stockpile Grade Summary



Source: prepared by Wood, dated 2022

Table 16-6: Proposed Mine Production Schedule

	Process Feed									Stockpiles			Total	
	Direct Feed			Reclaim			Total Feed							
Year	(kt)	Mn (%)	Mn (kt)	(kt)	Mn (%)	Mn (kt)	(kt)	Mn (%)	Mn (kt)	Total Stockpiles (kt)	Reclaim (kt)	Balance (kt)	Total Waste[1] (kt)	Total Mined (kt)
1	365	10.44	38	-	-	-	365	10.44	38	319	-	319	316	1,000
2	187	9.50	18	178	9.08	16	365	9.30	34	404	178	545	409	1,000
3	313	9.41	29	52	7.54	4	365	9.14	33	254	52	747	433	1,000
4	365	10.32	38	-	-	-	365	10.32	38	206	-	953	429	1,000
5	326	8.78	29	39	7.25	3	365	8.62	31	179	39	1,093	495	1,000
6	339	9.12	31	26	7.02	2	365	8.97	33	192	26	1,259	469	1,000
7	365	9.45	34	-	-	-	365	9.45	34	163	-	1,422	472	1,000
8	265	9.54	25	100	7.04	7	365	8.86	32	171	100	1,493	564	1,000
9	308	8.84	27	57	6.77	4	365	8.52	31	179	57	1,615	513	1,000
10	248	8.84	22	117	6.78	8	365	8.18	30	166	117	1,664	586	1,000
11	270	8.68	23	95	6.74	6	365	8.17	30	155	95	1,724	575	1,000
12	241	8.66	21	124	6.64	8	365	7.97	29	88	124	1,688	671	1,000
13	237	7.77	18	128	5.11	7	365	6.84	25	78	128	1,638	685	1,000
14	229	7.97	18	136	5.09	7	365	6.90	25	98	136	1,601	673	1,000
15	303	7.83	24	62	5.09	3	365	7.37	27	91	62	1,630	606	1,000
16	299	7.45	22	66	5.09	3	365	7.02	26	104	66	1,668	597	1,000
17	358	6.97	25	7	5.08	0	365	6.93	25	79	7	1,740	563	1,000
18	365	7.33	27	-	-	-	365	7.33	27	116	-	1,855	519	1,000
19	365	7.78	28	-	-	-	365	7.78	28	143	-	1,999	492	1,000
20	365	7.92	29	-	-	-	365	7.92	29	120	-	2,118	515	1,000
21	365	7.58	28	-	-	-	365	7.58	28	168	-	2,286	467	1,000
22	365	7.96	29	-	-	-	365	7.96	29	208	-	2,494	427	1,000
23	365	8.59	31	-	-	-	365	8.59	31	141	-	2,635	494	1,000
24	364	8.54	31	1	6.94	0	365	8.53	31	153	1	2,788	482	1,000

	Process Feed									Stockpiles			Total	
	Direct Feed			Reclaim			Total Feed							
Year	(kt)	Mn (%)	Mn (kt)	(kt)	Mn (%)	Mn (kt)	(kt)	Mn (%)	Mn (kt)	Total Stockpiles (kt)	Reclaim (kt)	Balance (kt)	Total Waste[1] (kt)	Total Mined (kt)
25	310	8.50	26	55	6.03	3	365	8.12	30	100	55	2,833	590	1,000
26	365	7.84	29	-	-	-	365	7.84	29	72	-	2,906	563	1,000
27	365	8.62	31	-	-	-	365	8.62	31	175	-	3,080	460	1,000
28	365	8.46	31	-	-	-	365	8.46	31	105	-	3,185	530	1,000
29	365	9.13	33	-	-	-	365	9.13	33	287	-	3,471	348	1,000
30	363	8.93	32	2	8.42	0	365	8.93	33	-	2	3,470	637	1,000
31	323	9.50	31	42	7.10	3	365	9.22	34	18	42	3,445	660	1,000
32	197	9.00	18	168	6.91	12	365	8.04	29	-	168	3,277	803	1,000
33	142	8.23	12	223	5.28	12	365	6.42	23	-	223	3,054	858	1,000
34	132	8.38	11	233	5.23	12	365	6.38	23	4	233	2,825	864	1,000
35	39	6.36	2	326	5.11	17	365	5.24	19	-	326	2,498	961	1,000
36	365	9.18	34	-	-	-	365	9.18	34	6	-	2,505	629	1,000
37	365	9.46	35	-	-	-	365	9.46	35	2	-	2,506	633	1,000
38	327	8.43	28	38	5.52	2	365	8.13	30	6	38	2,474	668	1,000
39	272	8.38	23	93	5.10	5	365	7.55	28	0	93	2,381	727	1,000
40	361	7.58	27	4	5.10	0	365	7.55	28	12	4	2,390	492	865
41	-	-	-	365	5.08	19	365	5.08	19	-	365	2,025	-	-
42	-	-	-	365	4.99	18	365	4.99	18	-	365	1,660	-	-
43	-	-	-	365	4.91	18	365	4.91	18	-	365	1,295	-	-
44	-	-	-	365	4.89	18	365	4.89	18	-	365	930	-	-
45	-	-	-	365	4.75	17	365	4.75	17	-	365	565	-	-
46	-	-	-	365	3.70	14	365	3.70	14	-	365	200	-	-
47	-	-	-	200	3.51	7	200	3.51	7	-	200	-	-	-
Total/Avg	**12,228**	**8.58**	**1,049**	**4,761**	**5.35**	**255**	**16,990**	**7.67**	**1,304**	**4,761**	**4,761**	**0**	**22,876**	**39,865**

Note: Tonnes, grades and contained manganese may not sum due to rounding. [1] Total waste is inclusive of 777,381 tonnes of non-economic mineralized reject.

16.7 Mine Operations

Contract mining is assumed for mining the pits on the following assumptions:

- Mining operations are based on a single 12-hour shift/day. Stockpile handling and crusher feeding operations are based on two 12-hour shifts/day.
- Drilling and blasting are required with an assumed powder factor of 0.25 kg explosive per tonne of waste rock and 0.30 kg explosive per tonne of mineralized material.
- Conventional truck and excavator operation with an assumed fleet of 40 tonne trucks and 3.8 m^3 excavators. A 3.8 m^3 wheel loader will support stockpile and crusher loading operation.
- Haul road, pit, and WRSFs will be maintained using a conventional fleet of support equipment inclusive of motorgraders, track dozers, and water trucks.
- Owner-supplied truck shop and office facilities.
- A long-term ROM stockpile will be utilized to balance feed flow into the crusher when necessary.

The Owner will be responsible for the following:

- Blast hole sampling and grade control
- Surveying
- Short-range and long-range planning
- Diesel Fuel.

16.8 Fleet Requirements

As mining will be completed by contractors, no Owner equipment fleet will be required.

The equipment fleet utilized will be determined by the contractor to best achieve the mine plan. An example of a representative fleet with nominal peak unit numbers is provided in Table 16-7.

Table 16-7: Representative Equipment List

Description/Equipment	Make	Model	Nominal Peak Requirements
Drilling			
Blasthole drill	Atlas Copco	ROC T45	2
Blasting			
ANFO truck	International	4900	1
Hauling			
Haul trucks	Caterpillar	745C	4
Loading			
Hydraulic excavator	Caterpillar	374	1
Stockpile			
Wheel loader	Caterpillar	966	1
Support			
Hydraulic excavator	Caterpillar	326D	1
Dozer	Caterpillar	D8	2
Rubber Tire Dozer	Caterpillar	814	1
Sand truck	Caterpillar	725	1
Water truck	Caterpillar	725	1
Motor grader	Caterpillar	12	1
Fuel/Lube truck	Caterpillar	725	1
Auxiliary			
Skid steer loader 36 kW			1
Crane mounted flatbed truck 40t			1
Light plant			5
Pickup ¾ t			2
Pickup 1 t			1
Forklift 3 t			1
Tire handler			1
Pump 47 kW			3

16.9 QP Comments on Section 16

The QP notes:

- Pit optimization was completed using the Mineral Resource block model. The PEA pit optimizations were unencumbered by property boundaries, existing surface infrastructure, and groundwater levels.
- The ultimate pit design was smoothed for ramp access. Internal mining phases utilized optimized pit shells without smoothed designs in the production schedule.
- The development progression for Battery Hill has been completed to maximize highest grade. Smaller satellite pits have been scheduled subsequent to the primary pits.
- Approximately 28% of the mill feed tonnage and 30% of the contained manganese metal tonnage within the mine plan is in the Inferred category.
- Land ownership and/or site access for mining activities has not been established.
- The equipment list shown is conceptual. The actual mining equipment fleet will be determined by the contractor to best achieve the mine plan.

17.0 RECOVERY METHODS

17.1 Introduction

The conventional route to HPMSM is via electrolytic manganese metal (EMM), itself a specialty product, which is dissolved in high purity sulphuric acid and crystallized as HPMSM from the resulting solution. This route is both energy and reagent intensive. Electrolytic reduction of manganese is a very challenging process to operate.

The process developed for the Project is based on a combination of the reactivity of the largely manganese silicate mineralization to dilute sulphuric acid, and multiple developmental test programs as summarized in Section 13. The process was modelled using Metsim to generate a mass, water, chemical and energy balance.

The process plant design involves treatment of selectively mined material through a sequence of:

- Two-stage crushing
- Ball mill grinding with hydrocyclone size classification
- Sulphuric acid leaching under specific temperature and acid tenor to dissolve contained manganese mineralization while minimizing co-dissolution of undesired elements, particularly magnesium, iron and aluminum
- Partial neutralization of the bulk leach slurry using limestone combined with sparged air oxidation to precipitate iron, alumina and silica in filterable form, allowing cake washing to recover dissolved manganese
- Staged evaporation and crystallization operations to generate first a crude and then a purified manganese sulphate
- Additional rejection of impurity cations by means of a proprietary process
- Washing, drying and packaging of the purified manganese sulphate for sale as battery grade HPMSM.

17.2 Process Design Basis

The key process design criteria for the process plant are listed in Table 17-1.

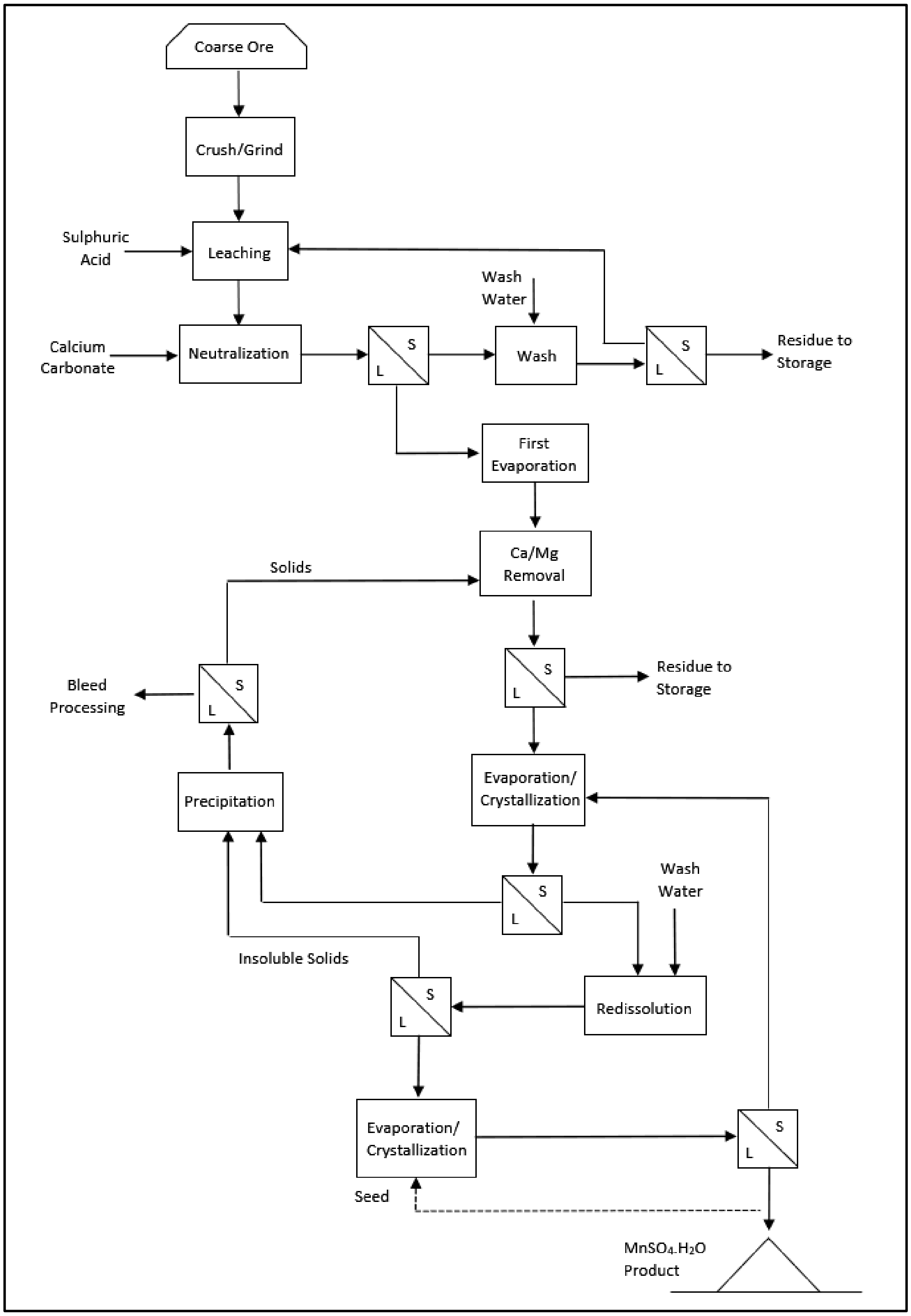
Table 17-1: Key Process Design Criteria

Design Parameter	Unit	Value
Operating hours	h	24
Operating days	d	365
Plant availability	%	92
Throughput	t/d	1,000
Design head grade as Mn	%	9.0
Recovery to HPMSM	%	78

17.3 Process Overview

Figure 17-1 presents a schematic of the process flowsheet. This is generally in accordance with the Kemetco test work but modified based on the outputs of the independently calculated mass balance. A conceptual list of major equipment is presented in Table 17-2.

Figure 17-1: Process Block Flow Diagram



Source: prepared by Wood, dated 2022

Table 17-2: Process Plant Major Equipment

Equipment List	Unit	Size	Installed kW
Primary jaw crusher	in x in	36 x 25	90
Secondary cone crusher	mm	100	150
Crushed ore silo	mØ x m	13 x 14	-
Ball mill	mØ x m	3.35 x 5.18	800
Leach tanks	mØ x m	6.5 x 6.5	-
Neutralization tanks	mØ x m	6.5 x 6.5	-
Leach residue thickener	mØ	22	-
Leach residue HVBF	m^2	2 x 80	400
Evaporator supply package			1,690
Ca/Mg reactor tanks	mØ x m	4 x 6.5	-
Ca/Mg filter	-	-	-
Primary $MnSO_4$ crystallizer package	-	-	600
Secondary $MnSO_4$ crystallizer package	-	-	1,120
$MnSO_4$ flash dryer	-	-	-
$MnSO_4$ bagging system	-	-	-
Precipitation tanks	mØ x m	2 x 3	-
Pressure filter	mm x mm	800 x 800	-
Sulphuric acid plant	-	-	-
Reagent storage	-	-	-
Cooling water system	-	-	-
Steam boiler (gas fired)	-	-	-
Water and process tanks	-	-	-
Pumps (total)	-	-	900

Note: HVBF = horizontal vacuum belt filter

17.4 Plant Design

17.4.1 Comminution

The crushing layout takes advantage of the terrain for discharge of ROM or stockpile reclaim material into the primary crushing feed. Primary jaw and secondary cone crushed products are conveyed together to a vibrating screen located above the crushed mineralized material silo. Undersize from the screen enters the crushed mineralized material silo while oversize passes to the secondary crusher. Ball mill feed has a P_{80} -8 mm.

The conveyor feeding the ball mill elevates over the mill building access road and discharges into the mill feed chute. Ball mill discharge is classified in a hydrocyclone cluster with overflow at a P_{80} -150 µm. The cyclone underflow returns to mill feed. The cyclone overflow advances to the leach feed thickener. The thickener overflow returns to grinding as dilution water and underflow is pumped to the first leach vessel.

17.4.2 Acid Leach

The underflow slurry from the leach feed thickener is pumped through a spiral heat exchanger to preheat the slurry and discharges into the leach conditioning tank, which also receives recycled liquors from downstream processes. The slurry discharges into the first of five mechanically agitated leach tanks arranged in series, with slurry cascading down the train for a total leach residence time of eight hours.

Sulphuric acid, which is produced from the onsite sulphuric acid plant, is added to the leach tanks to maintain the required acid concentration. The acid concentration is measured and controlled as pH, with additional conductivity measurement. The primary heating in the leach process is from the heat of dilution and reaction from the acid addition, resulting in an elevated leach slurry temperature.

The leach tanks are of 316 stainless steel construction and are covered and insulated. The tanks are located between the process plant enclosure and the acid plant storage, minimizing acid transfer distances. Gas emissions from carbonate reactions pass through a mesh type demister to an elevated vent.

17.4.3 Neutralization

The leached slurry overflows the last leach tank into the train of mechanically agitated neutralization tanks arranged in series. The neutralization tanks are provided with aeration for oxidation of ferrous iron and flushing of carbon dioxide. Finely milled limestone slurry is added to the slurry in response to pH measurement to partially neutralize the acidity. This results in a mixed precipitate forming that consists primarily of iron and aluminum oxyhydroxides, gypsum and silica.

The neutralization tanks are of 316 stainless steel construction and are covered and insulated.

17.4.4 Leach Residue Solid-Liquid Separation

One of the key results from the Kemetco test programs is identification of leach/neutralization conditions that permit effective solid-liquid separation of the primary leach residue.

The neutralized slurry discharges from the neutralization tanks and advances to a high-rate tailings thickener. The thickener overflow discharges to the pregnant leach solution (PLS) tank and the thickener underflow pumped to a horizontal vacuum belt filter for washing and dewatering.

The washed cake from the leach residue belt filter discharges to a bunker from which it is transferred by front-end loader to a truck for transport to the FRSA. The filtrate from the horizontal vacuum belt filter is collected in filtrate receivers and transferred to the PLS tank, from where it advances to the first stage evaporation.

17.4.5 First Stage Evaporation

The first evaporator is a large falling film type unit with a combination of thermal and mechanical vapour recompression (MVR) to make use of heat generated from the sulphuric acid plant.

The PLS is pumped into the sump of the evaporator and is recirculated and distributed within the evaporator body. Vapour exits the evaporator through demisters that remove droplets and clean the vapour. The vapour stream passes through a turbo fan where the vapour pressure is increased to the condensing temperature of the heater shell. The compressed vapour is desuperheated and sent to the heater shell. Excess vapour is discharged to atmosphere.

A stream of concentrated brine solution is bled from the external recirculation pump discharge. This brine discharge, which is the primary evaporator product liquor, is close to saturation in manganese sulphate and advances to the calcium/magnesium precipitation section.

Condensate from the shell side of the evaporator heat exchanger is recycled as lean process water.

17.4.6 Calcium / Magnesium Removal

The primary evaporator liquor is subjected to a proprietary calcium and magnesium removal process.

The filtered purified liquor advances to evaporation/crystallization.

17.4.7 Manganese Sulphate Crystallizers

The filtrate from the calcium/magnesium precipitation process is preheated in a counter-current heat exchanger using process condensate before being directed to the centrate tank. The combined feed and centrate is then fed to the first stage MVR forced circulation crystallizer.

An external recirculation pump circulates the brine from the crystallizer through an external heat exchanger. The heated brine flash boils and releases heat in the form of water vapour. The vapour is cleaned in internal mist eliminators and exits the crystallizer into the suction side of a two-stage radial compression system. The compressors compress the vapours which are then desuperheated by direct contact with condensed process liquor, and then routed to the external main heat exchanger. The compressed vapour condenses in the heat exchanger and thus provides the energy for evaporation.

As the water is driven from the brine in the crystallizer via the vapour phase, the brine liquor concentration increases. As the evaporation process continues the brine reaches the saturation limit and manganese sulphate solids will form in the brine forming a slurry. The resulting crystal slurry is drawn from the crystallizer to a centrifuge which separates the solids as a wet cake and the centrate which returns to the centrate tank. The wet cake is redissolved in a tank with hot water. The resulting liquor is filtered to remove undissolved solids and the filtrate advances to the second stage crystallizer. The undissolved solids will recycle back to the manganese precipitation circuit.

A brine bleed stream must be removed from the primary crystallizer to control minor amounts of soluble impurities including sodium and potassium. The brine bleed stream is pumped to the manganese precipitation tanks.

The redissolved manganese sulphate advances to the second stage crystallizer centrate tank. As with the first stage crystallization, the feed combines with centrifuge centrate to feed the crystallizer. The crystallization process is the same as for stage 1.

The brine bleed from the second stage crystallizer recycles back into the primary crystallizer feed.

The centrifuge product will advance to the drying area where the HPMSM is dried and packaged.

17.4.8 Manganese Precipitation

The insoluble solids from the redissolution filter and the brine bleed from the primary crystallizer report to the first of three manganese precipitation tanks arranged in series. A reagent is added to the precipitation tanks which reacts with the manganese sulphate in solution and precipitates manganese and minor amounts of calcium and magnesium.

The precipitate slurry is filtered in a pressure filter to remove the solids. The pressure filter solids are recycled back to the calcium and magnesium removal process. The pressure filter filtrate advances to the bleed stream crystallization process.

17.4.9 Bleed Crystallizer

The bleed crystallizer is a forced circulation crystallizer with MVR. The system consists of a single external heat exchanger and piping loop that connects to the crystallizer vapour body. The crystallizer discharges to a centrifuge that centrifuge separates the solids which are dried and bagged. The centrifuge centrate recycles back to the crystallizer.

17.4.10 Product Handling

HPMSM crystal product from the second stage centrifuge passes to a thermal dryer. Dryer discharge passes to a feeder which loads bulk bags that are weighed, closed and palleted for containerized shipment.

17.5 Sulphuric Acid Plant

The major components of the onsite sulphuric acid manufacturing plant include:

- Receiving/storage tanks for liquid sulphur sourced from the Irving Oil refinery in St. John and delivered by truck
- Liquid sulphur filtration and clean storage
- Acid manufacturing plant capacity of 300 t/d (100% basis) with heat recovery to low pressure steam for process use
- Steam distribution to leach and first evaporator
- Acid storage and pumping to the adjacent acid leach circuit.

A road corridor between the separately bunded sulphur and acid plant areas allows access for sulphur trucks.

17.6 Reagents

Facilities for reagents include:

- Reagent A – for cation removal is received bagged and in containers which are stored in a laydown area and/or warehouse as it may be sourced from overseas through the port of St John.
- Flocculant – for the leach residue thickener will be received in palleted bags and stored in the warehouse. Flocculant will be prepared for use (as a dilute solution) in a preparation plant which will be purchased as a package.

- Fine dry limestone – is received by truck via pneumatic transfer to storage silos adjacent to the neutralization tanks.

17.7 Utilities

17.7.1 Process Air

Requirements for air include:

- Compressors, filtration and storage for high pressure instrument and control air
- Blowers for process air to the neutralization tanks.

17.7.2 Process Water

Raw water enters the process through the ball mill circuit, so quality requirement is not high.

Water supplied from onsite groundwater wells is pumped to a raw/fire water storage tank for process water distribution. Major water consumption, totalling 25m^3/h derives from:

- Moisture in the leach residue filter cake (11m^3/h)
- Moisture in products including HPMSM (2m^3/h)
- Evaporative loss from cooling water for the multiple condensers. This is highly variable by season, peaking in summer at an estimated 10 m^3/h
- Contingency for plant washdown, dust control, etc. (2 m^3/h).

All evaporator condensates recycle within the chemical process.

Bottled water will be provided for drinking. Plant raw water is assumed to be of adequate quality for sanitary requirements which are negligible in the context of a 25m^3/h process demand.

17.7.3 Power Requirements

The power required for the process facilities has been estimated at approximately 7 MW which will be provided by overhead lines from which feeders will supply transformers adjacent to the process plant.

18.0 PROJECT INFRASTRUCTURE

18.1 Summary

Required infrastructure for the Project will include:

- Crushing facility
- Process plant
- Sulphuric acid plant
- ROM stockpile
- WRSFs
- FRSA
- Runoff ditches and sedimentation ponds
- Mining facilities including truck shop, warehouse, offices
- Administration and security trailer
- Haul roads
- Power supply and distribution
- Water supply and distribution
- Fuel storage and distribution.

Offsite infrastructure will include an extension off NBPower's 69 kV line located east of the site, by approximately 2 km to the west.

The proposed layout for the Project site is shown in Figure 18-1 and the process plant site is shown in Figure 18-2.

18.2 Site Access

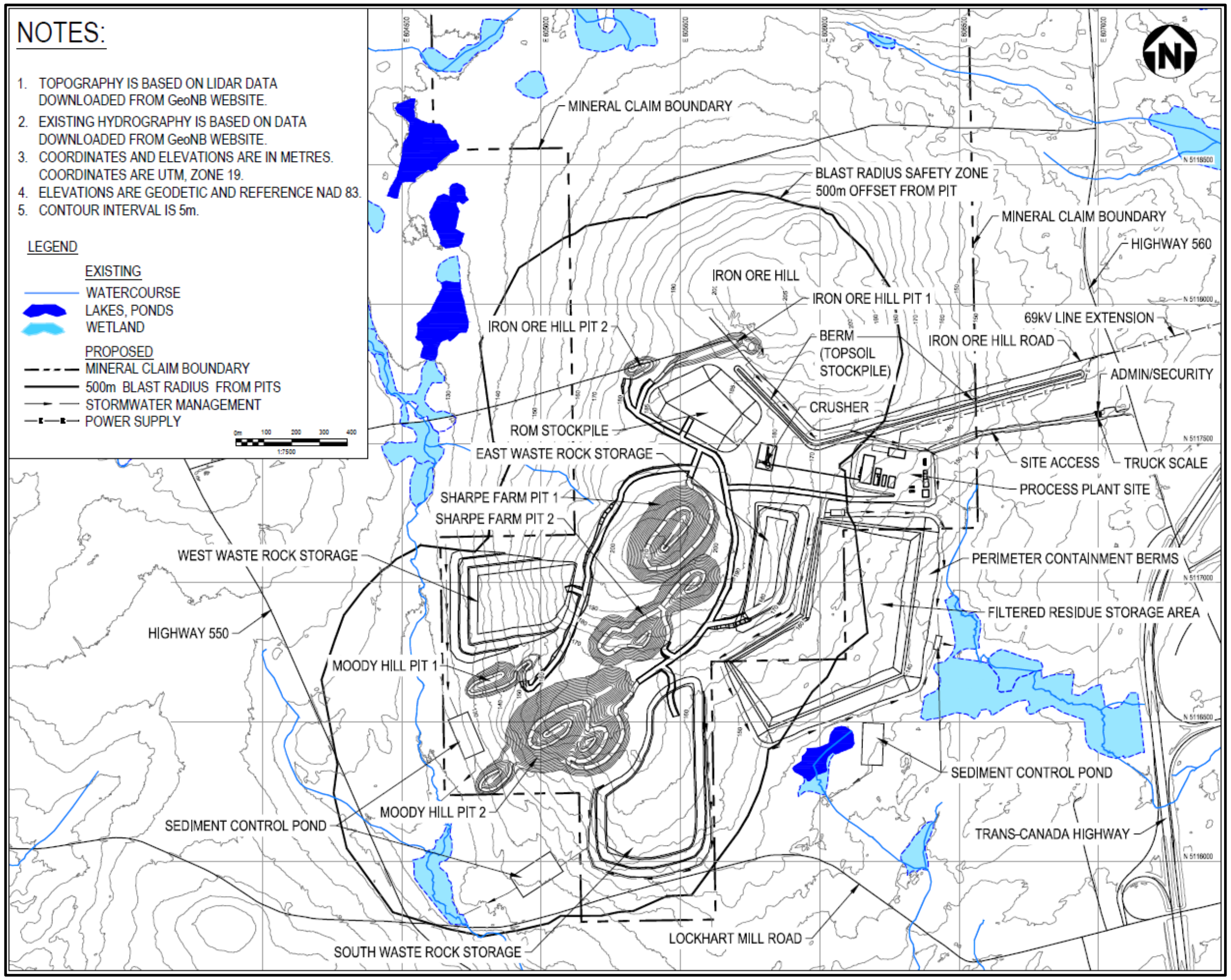
The Project site will be accessed to the east, from Highway 560. A 950 m long two-lane road will lead directly to the process plant and mining area.

18.3 Mine Rock Storage Facilities

Three WRSFs adjacent to the planned pits have been designated for waste rock storage with a combined capacity of 24.4 Mt. These facilities will store waste from the Moody Hill, Sharpe Farm and Iron Ore Hill pits that is not used for the construction of the FRSA buttresses or haul roads.

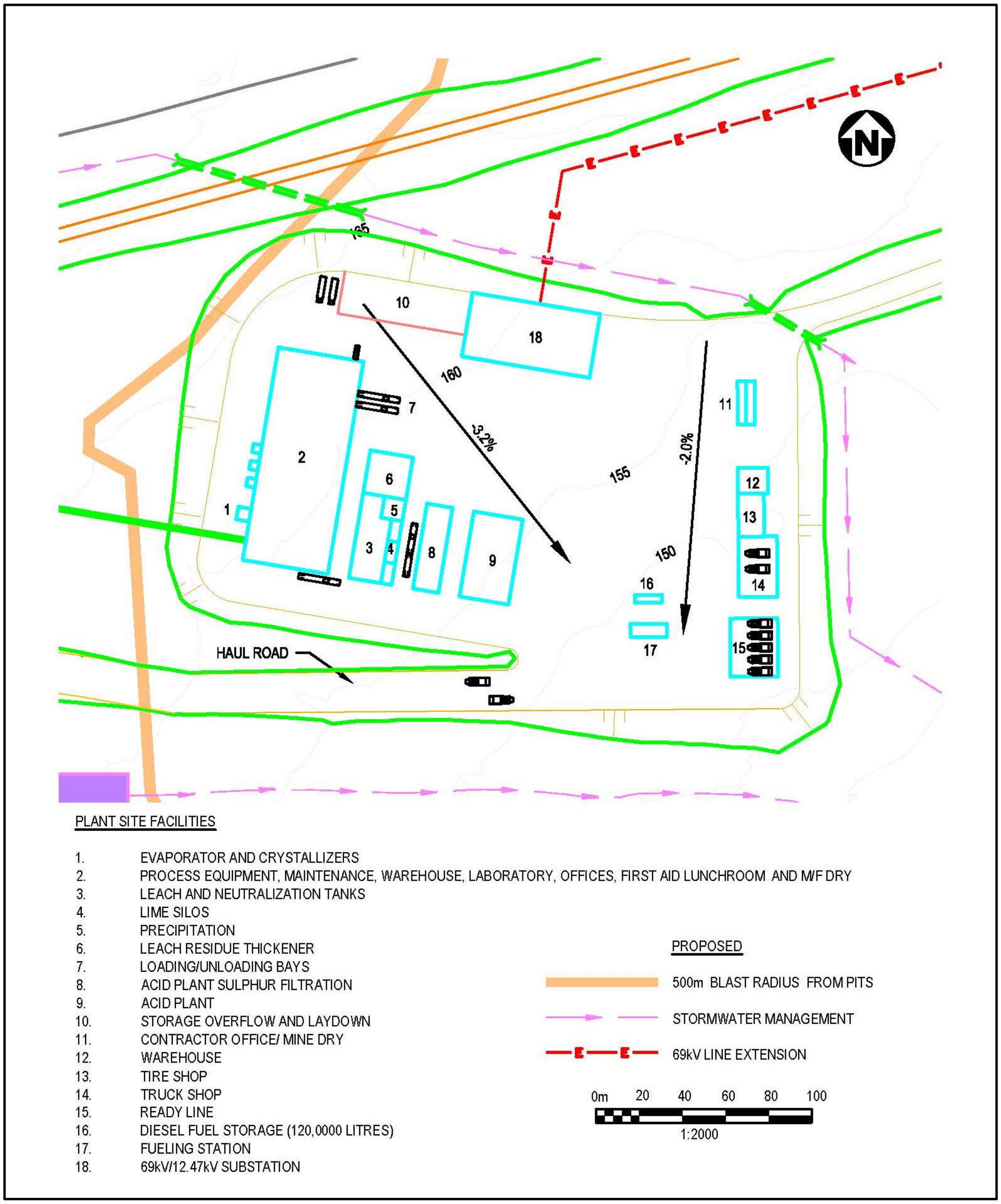
A ROM stockpile with a maximum capacity of 3.5 Mt will store ROM material for feed to the primary crusher when required.

Figure 18-1: Project Site Layout



Source: prepared by Wood, dated 2022

Figure 18-2: Process Plant Site Layout



Source: prepared by Wood, dated 2022

18.4 Filtered Residue Storage Area

For the first 24 years of production, filtered residue produced by the process plant will be trucked a short distance to the FRSA located just south of plant. With a moisture content of 20% and an assumed bulk density of 2.12 t/m^3, a dry density of 1.7 t/m^3 was calculated for the filtered residue. Approximately 17 Mt of filtered residue will occupy a volume of 10.0 Mm^3.

The location of the FRSA considered topography of the mine site, the location of open pits, existing water bodies, water courses and wetlands around the perimeter of the site. To accommodate this volume over the LOM, filtered residue will be stored in a contained area east of the pits as well as within Moody Hill Pit 2 once it has been fully mined.

For the area east of the pit, perimeter containment buttresses will be built out of mine rock to contain the residue. A starter rockfill buttress is planned to be built along the eastern perimeter and will have a 16 m crest width for passage of two-way over the road (OTR) trucks. Upstream slopes of the buttress will be at the angle of repose of rock (assumed 37°) and the downstream slopes will be at 2H:1V (horizontal:vertical) for long-term stability. Residue will be trucked to the impoundment area where a dozer will spread and nominally compact the residue. To arrest migration of residue particles through the large voids in the mine rock of the buttress, a graded finer rockfill layer will be provided along the upstream slopes of the perimeter buttress.

Geotechnical investigations will be required at the next stage of the study to characterize the foundation conditions and make necessary adjustments to the buttress slopes for long-term static and seismic stability.

The perimeter buttress will be extended along the western, southern and northern perimeters to provide additional area for residue storage. Subsequently the buttresses along the eastern, southern and northern perimeters will be upstream-raised to accommodate more residue.

In its final configuration the perimeter buttress crest will be at an elevation 167 m with residue impoundment level of 166 m providing a freeboard of 1 m. This configuration will accommodate 5.11 Mm^3 (8.69 Mt) of residue. The FRSA will provide residue storage for the first 24 years of mine operation after which residue will be trucked to Moody Hill Pit 2 that will accommodate the remaining 4.89 Mm^3 (8.3 Mt).

18.5 Water Management

The mine site and proposed WRSFs and FRSA are located on the southern slope of Iron Ore Hill. Under natural conditions, the surface runoff from the proposed development areas drains to several small streams located along the east, south and west perimeters of the site. It is understood that runoff generated from the three WRSFs and FRSA will not be acid generating.

However, this runoff is expected to contain elevated sediment concentrations, and must be collected and routed through a sedimentation facility prior to discharge into natural receiving water courses.

The proposed surface runoff management facilities for the site consist of the following:

- A diversion ditch that intercepts the natural runoff from an area to the north of the site and direct it to a small stream to the east of the site
- A runoff collection ditch located along the west perimeter and down gradient of the West WRSF with collected runoff routed through a sedimentation pond and discharged to a small stream to the west of the site
- Runoff collection ditches along the west, south and east perimeters of the South WRSF with collected runoff from this area routed through a sedimentation pond and discharged to the wetland area along a small stream to the west of the site
- Runoff collection ditches around the perimeters of the FRSA also used to collect runoff generated from the East WRSF. The final residue surface will be mildly sloped towards northwest corner of the FRSA for drainage. Due to the topographic conditions, the runoff collected by these ditches are routed through three sedimentation ponds. Discharges from these ponds are directed to small tributaries and wetland areas to the east of the site.

18.6 Water Supply

It is anticipated that all water supply needs including potable and process, can be obtained from drilling wells onsite and from in-pit dewatering. The position of water supply wells will be coordinated with the pit location and away from existing residences. The number of supply wells, their depth and their pumping rates will be determined based on hydrogeological properties of bedrock in the area and the water supply need for the mine site. Preliminary investigations will be required to supplement information gleaned from the provincial groundwater well data base for the surrounding area.

18.7 Power

The Battery Hill site will receive power from an extension off NBPower's 69 kV transmission line 0020. Line 0020 is just east of the Trans-Canada Highway and the extension is estimated to be 2 km in length. The 69 kV extension will terminate at a main substation located near the processing plant.

This new 69 kV/12.47 kV main substation will have a 69 kV primary breaker, 10/13.3 MVA, 69 kV/12.47 kV oil filled step-down transformer and two secondary breakers. The substation will be complete with fencing, grounding, lighting, yard gravel, foundations, oil containment, steel structures, lightning protection, protection and control (P&C) building and utility metering.

The total connected electrical load for the site is estimated to be 7.25 MW (9.06 MVA at 0.8 power factor) which includes an allowance for electrical service to ancillary buildings such as maintenance shops, security, and yard lighting.

Power distribution will be via two 12.47 kV overhead lines receiving their power from the main substation. Line L1 will distribute power around the site for general yard lighting and pole mounted transformers for the ancillary buildings. Line L2 will be dedicated to supplying power to the step-down transformers for the process loads and process plant building services.

The six step-down transformers for the process will be sized to accommodate the loads at the required utilization voltages of 6900 V, 4160 V and 600 V.

A back-up emergency diesel generator will provide power to critical loads should a plant-wide power outage occur.

General yard lighting consists of pole mounted streetlight style fixtures.

Power cabling associated with the installation of the electrical power distribution includes concrete encased duct banks complete with medium voltage cable to service the step-down transformer primaries, cable bus on the step-down transformer secondaries and cable bus for the diesel generator.

18.8 Process Facilities

Process facilities include:

- Crushing facility and conveying
- Sulphuric acid plant
- Process plant containing a maintenance and warehouse area, laboratory, offices and changerooms
- Evaporator and crystallizer towers, leach and neutralization tanks, precipitation, and leach residue thickener adjacent to the plant.

18.9 Mining Facilities

Mine facilities include:

- Trailer-type mining and contractor offices
- Tensioned fabric structure for truck shop, tire shop and warehouse.

A ready line area adjacent to the truck shop will serve as a holding area for trucks. It is anticipated that explosives storage will be managed by the contractor and will be provided onsite as needed.

18.10 Fuel

A fuel tank with a storage capacity of 120,000 litres will be installed to supply mine operations. Fuel will be distributed via a fuel station adjacent to the fuel tank.

18.11 Sewage

A packaged sanitary sewage treatment plant will be provided for the process plant site area, while remote locations with washroom facilities will use a holding tank that will be pumped out for proper disposal at local municipality as required. In the next phase of the Project an option to dispose of the sanitary sewage at local municipality via a forcemain should be explored.

18.12 Communications

It is anticipated that telecommunication transmission lines exist in close proximity to site and can be extended to supply office buildings with telephone and internet connections.

19.0 MARKET STUDIES AND CONTRACTS

19.1 Marketing Studies

In January 2022, Manganese X retained CPM to perform a commodity market research report on high purity manganese products, including HPMSM globally. CPM also provided a specific report on the high purity manganese (HPM) market in North America that included an analysis of the market balance and price forecasts for the intended product from the Battery Hill deposit, and a discussion on market entry strategies. One of the points made in the comprehensive CPM market research report was that the HPMSM market is relatively small and dominated by China with many aspects of the market considered sensitive corporate information and confidential. This makes market analysis and predictions difficult when compared to traditional freely traded metals where market information is more readily available.

CPM is an independent research and consultancy company based in New York and is an industry recognized expert in generating these types of commodity reports. The lead author of the CPM reports answered submitted questions and attended two video conference calls with Wood's QP and other senior technical staff, to assist Wood in understanding the basis of CPM's research, market forecasts, and the conclusions relevant to the Project. Wood's QP has confidence in the expertise of CPM and that the research reports provide a reasonable basis for the market assessment, commodity price projections, and market entry strategies for HPMSM production from the Project.

The following information has been summarized from the market overview provided by CPM.

19.1.1 Manganese Use in Batteries

Manganese is used as a feedstock in battery cell production as either:

- Electrolytic manganese dioxide (EMD)
- HPMSM

EMD is predominantly used to produce primary (non-rechargeable) batteries and a small proportion of rechargeable lithium-ion batteries. HPMSM is used in all other secondary (rechargeable) batteries requiring manganese in their cathodes. The EMD-using LMO (lithium, manganese oxide) chemistry accounted for only 0.25% of the battery market in 2021 and is expected to be practically phased out by 2025.

HPMSM is the key component of lithium-ion battery cathodes. Two products can be used by the battery industry including HPMSM and high purity electrolytic manganese metal (HPEMM) where HPEMM is dissolved in sulphuric acid to produce HPMSM. These high purity manganese products differ from their standard quality counterparts with HPEMM containing a minimum of 99.9% manganese with very low to no selenium compared to 99.7% manganese and up to 1,800 ppm of selenium and other impurities which is used almost exclusively in the metallurgical industry to produce steel and special alloys (EMM). HPMSM contains at a minimum 32% manganese or 99% HPMSM while the standard quality manganese sulphate monohydrate (MSM) contains a minimum of 31% manganese or 98% HPMSM and is more predominately used in the agricultural industry as animal feed supplement, as well as a fertilizer and fungicide component.

There are currently several lithium-ion battery chemistries in production or being explored and further developed with some using varying amounts of manganese including the favourable nickel, manganese, cobalt (NMC) family, as well as LMO and LNMO (lithium, nickel manganese oxide). CPM focused their research on NMC as the prevailing battery chemistry today and also very likely to dominate the EV market over the next two decades. LFPs (lithium, iron, phosphate) are also resurging with a Chinese battery and EV maker claiming long cycle life is possible making LFPs a viable alternative. The latest generations of LFP batteries also use manganese.

Many technical issues associated with the high nickel content of battery cathodes can be mitigated using cobalt and/or manganese in the mix of the cathode metals. However, cobalt comes with a high price tag and supply risk with over 70% of the world production coming from the Democratic Republic of Congo (DRC), an unstable African country ravaged by war and corruption. For these reasons, battery makers have tried for some time to engineer cobalt out of batteries or at least significantly reduce its use. Their preferred way of reducing cobalt use is to increase the use of manganese in the new chemistries.

19.1.2 Battery Markets

Since lithium-ion batteries were commercialized in the mid-1990s, they can largely be found in EVs, energy stationary storage (ESS), and the electronics products. In recent years the EV market accounted for 65% of lithium-ion batteries with the prediction that it will increase to 87% by 2025. In terms of HPMSM, it is expected that by 2031, the transportation segment will account for 83% of HPMSM demand with the remaining equally split between ESS and portable electronics.

The year 2021 saw 120% year-on-year EV sales growth. China led the charge followed by Europe in terms of market for electric cars. The United States remains far below that of China and many European markets. Supportive regulatory frameworks, additional incentives to safeguard EV sales from the economic downturn and reduced battery costs, and the expanding number of EV models have all contributed to the resilient EV sales during the covid pandemic. European Union's CO_2 emissions standards that come into force in 2022 limit the average CO_2 emissions per kilometre driven by new cars. Forcing car makers to meet this new obligation will mean they will need to increase the number of zero-emission vehicles sold. Several vehicle manufacturers have announced ambitious electrification plans with a shift away from hybrids and towards a pure battery electric vehicle (BEV).

With HPEMM and HPMSM constituting only around 0.9% of the global manganese production volume and the rapid rise and government support to produce electrical vehicles and their use of lithium-ion batteries, the demand for these products is estimated to increase more than 12 times by 2031.

ESS is an umbrella term for storing energy in some form for later use with battery storage becoming a predominant form of energy-storing in recent years. The ESS market currently favours the use of LFP batteries (over NMCs) which will not influence the demand for manganese, however if the new generation of LFPs with manganese (LMFPs) turns out to be suitable for ESS as well this situation may change.

Consumer electronics accounted for about 32% of the rechargeable battery market in recent years; however, the rapid growth of EV batteries will likely make the relative share of the portable segment to shrink to 5% by 2031. The NMC and LNMO batteries are expected to account for 47% of the portable electronics demand by 2031.

19.1.3 HPMSM Supply / Demand

Current supply of HPMSM to the battery industry shows 92.5% of all HPMSM is produced directly from ore while 7.5% is produced by dissolving HPEMM in sulphuric acid. China accounts for more than 90% of the HPMSM production capacity with more than 90% of the global output. Currently, there is only one non-Chinese producer of HPMSM from manganese ore located in Europe. There are four producers of HPMSM in Japan which make the sulphate from imported HPEMM, producing battery materials and make HPMSM in-house for their internal use. There is currently no HPMSM production in North America.

CPM does not currently see China flooding the market with cheap HPMSM and shows a significant deficit in HPMSM after 2025 (Figure 19-1) even with all Chinese plans fulfilled. However, a rapid increase in China production is still possible.

There are new, non-Chinese projects in the pipeline that are expected to come online before 2030. These projects could be available to the global market; however, as of the effective date of the Report, none have reached the final investment decision to build their plants. There are also several other early-stage projects that are unlikely go into production before 2030.

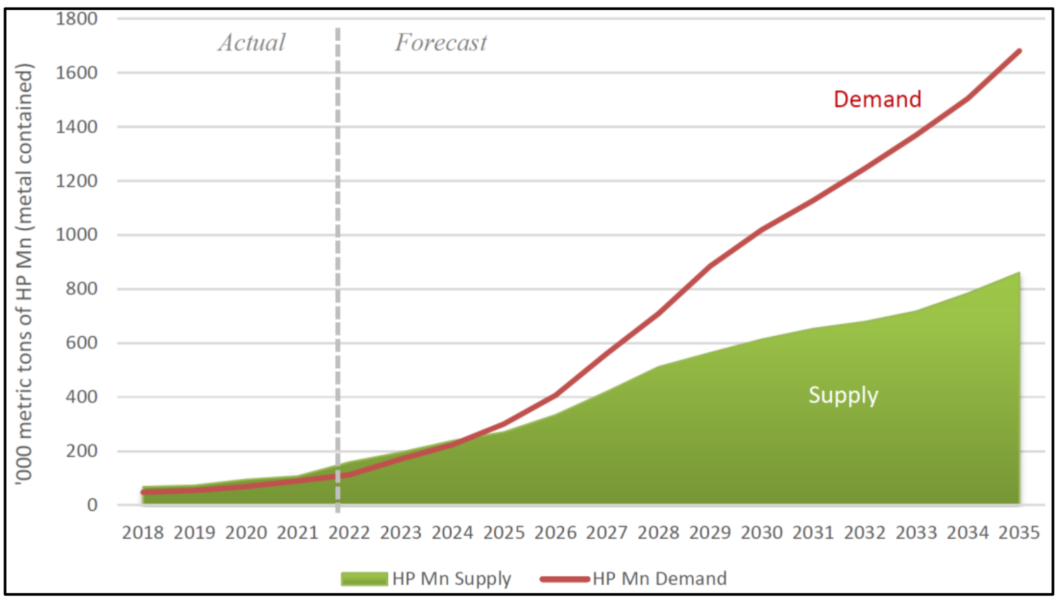
The global share of HPMSM-using batteries among all lithium-ion batteries (expressed in MWh) is expected to grow from about 44% in 2021 to 48% by 2025 and stabilize around that figure.

In Europe, this percentage could be as high as 60 to 70%, as the NMC and LNMO battery types are chemistries of choice for the European battery makers. In North America the percentage of Mn-using batteries is expected to be even higher – up to 90%.

In North America alone, there have been many announced plans to build gigafactories by 2030, with majority of them located in the eastern states. These gigafactories are estimated to require roughly 750 kt/a of HPMSM by 2031.

This translates into a significant increase in demand for high purity manganese products (Figure 19-1). To meet this demand, the high purity manganese global production must rise from the current approximately 127 kt/a (manganese contained in HPEMM and HPMSM) to 1,127 kt/a by 2030 and 1,680 kt/a by 2035. Meeting this increased demand will pose significant challenges as there are not enough high purity manganese projects in the pipeline to meet even the 2030 demand.

Figure 19-1: High Purity Manganese Supply and Demand from the Battery Industry Forecasted to 2035



Source: prepared by CPM, dated 2022

19.1.4 HPMSM Pricing

Before 2018 no HPMSM prices were published by any pricing service. The growing importance of HPMSM for the electric vehicles industry made the price reporting services turn their attention to the product. From early 2018 both Asian Metal (AM) and Shanghai Metal Markets (SMM) started reporting HPMSM prices in China. Now, the London-based Argus Media also reports prices of battery grade manganese sulphate.

The published HPMSM prices are based on an average price of HPMSM from several producers and are not a fair reflection of the real market as many different purities of the product are traded. Most prices are set for at least six months in advance and the spot market is limited. Pricing can vary greatly with the purity of the material and the ability of the HPMSM producer to maintain consistency of quality of the product.

As China is the largest producer and consumer of HPMSM, the natural currency of the market is in Chinese yuan (RMB) and prices reported in US dollars can be distorted by the currency exchange rate.

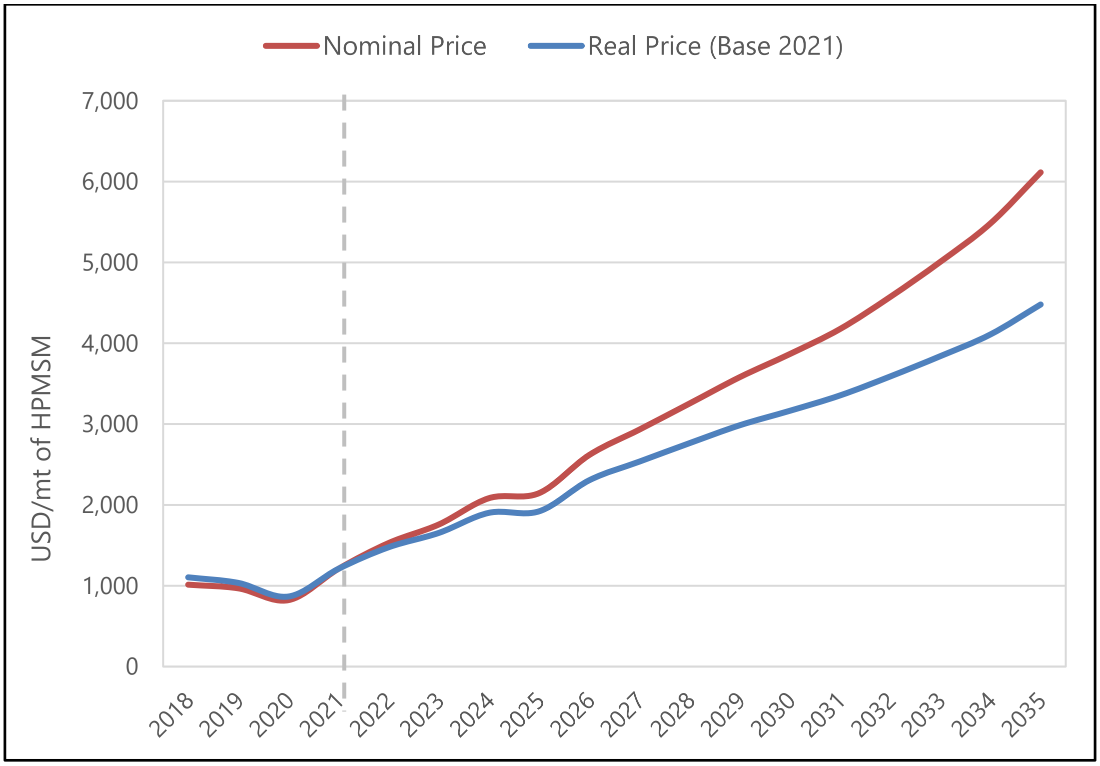
CPM forecasts strong HPMSM prices in China with the looming deficit in battery grade HPMSM motivating them to expand their production base. The projected supply gap (Figure 19-1) will impact the price of HPMSM and CPM predicts prices to remain firm and continue to generally rise. The CPM projection of HPMSM prices Ex Works China is shown in Figure 19-2.

HPMSM prices in Europe and North America may differ significantly from the Chinese prices for reasons of cost of transportation, import duties and a different supply-demand situation on the local market. There is no publicly available information about HPMSM prices paid by European buyers as this information is treated as a commercial secret.

At present, China would remain in near future, the main HPMSM supplier to Europe and North America with only one producer in Europe and none in North America. When estimating the price for HPMSM material imported from China CPM considered the following:

- Publicly quoted HPMSM price Ex Works China plus:
  - Cost of internal land transport in China and cost of customs clearance
  - Sea freight to the European or North American port and costs of customs clearance
  - Cost of inland transport in Europe and North America (to the cathode factory gate)
  - Import duty, currently 5% in Europe (suspended until 2024) and 14% in the US.

Figure 19-2: HPMSM Price Projections to 2035 in China



Source: prepared by CPM, dated 2022 (mt = metric tonne)

19.1.5 Battery Hill HPMSM Pricing

Given the Project's location near tide water on the east coast of Canada, and proximity to major North America road and rail networks, it is well-positioned to help meet the projected demand for battery grade HPMSM in North America and Europe. CPM provided a single HPMSM forecast price based on 80% of the Battery Hill product being sold to North American battery manufacturers and 20% to European producers.

The CPM forecast price factored the following:

- the projected supply-demand gap, with the particular focus on the expected gap that will occur from 2029 onward, when earliest production from Battery Hill can be expected.
- the transport cost advantage that Battery Hill has over China when supplying North America and European markets.
- the exemption from import duties that a Canadian producer has when supplying the USA and Europe.

The CPM analysis generated a single weighted average forecast price of HPMSM (80% North America/20% Europe) for the 2029 to 2035 period of US$4,200/t. The CPM price forecasts do not go beyond 2035 at present.

Wood requested CPM provide a forecast price which Wood can use as a "risk managed" base case scenario for the long-term period that would cover the LOM for the Project. CPM considers US$2,900/t HPMSM as reasonable for this purpose. Based on Wood's discussions with CPM, Wood's QP considers the US$2,900/t risk managed commodity price suitable for use as:

- the input to the base case cut-off for the Mineral Resource estimates when determining reasonable prospects for eventual economic extraction
- the input to the engineered pit and cut-off determination in the PEA mine plan
- the base-case commodity price in the economic analysis.

Wood's QP considers there is a reasonable expectation that the price received by Manganese X for their HPMSM production will meet or exceed the risk managed commodity price over a significant portion of the Project's estimated mine life. Wood's QP considers the US$4,200/t HPMSM price as a reasonable basis for the upside sensitivity analysis of the Project economics.

19.1.6 Battery Hill HPMSM Market Entry Strategy

CPM has indicated a world supply-demand deficit for high purity manganese (Mn metal contained) beginning in 2023, increasing to 900 kt/a by 2035. This market balance figure includes expected production from Battery Hill. The Project is projected to produced 80 kt/a of HPMSM which equates to approximately 25.6 kt/a of manganese metal. The CPM analysis supports a market capacity that can absorb the planned production from Battery Hill.

Manufacturers in general have had to re-assess the vulnerability of their supply chain to disruption and how they can mitigate these risks. The CPM analysis indicates battery manufacturers will favour diversifying their reliance on China as their main suppliers of HPMSM. A Canadian HPMSM supplier, with significantly shorter and less-complex transportation routes, that can avoid heavily congested ports, should offer an attractive alternative to North American and European based battery manufacturers.

A critical aspect of battery manufacturing is the purity of components used. Consistency of quality has been problematic with Chinese supply. Demonstrating the ability to consistently meet the purity standards required by the battery manufacturers will be an important market entry strategy for Manganese X.

Manufacturers recognize the importance to their investors of being able to demonstrate the green credentials of their suppliers. Manganese X can incorporate environmental, social and corporate governance (ESG) standards into the Project to assist with marketing its product and gaining recognition as a preferred supplier.

19.2 Contracts

The Project has no current contract or sales agreements in place for mining, concentrating, smelting, refining, transportation handling, sales or hedging. Manganese X does not currently have a committed customer or offtake purchaser for any HPMSM and there is no assurance that Manganese X will be able to market and sell any HPMSM at the price indicated in the report by CPM.

19.3 QP Comment on Section 19

The QP has reviewed the current marketing studies and analyses, and directly engaged with the lead author of the CPM commodity research reports. As a result, the QP considers the information as an acceptable basis for the HPMSM price assumptions used in the PEA and the basis for gaining a share of HPMSM market to place Battery Hill's forecast mine production.

20.0 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

20.1 Environmental Baseline Studies

GHD Limited (GHD) conducted environmental baseline studies for the general area in 2020 and 2021, including:

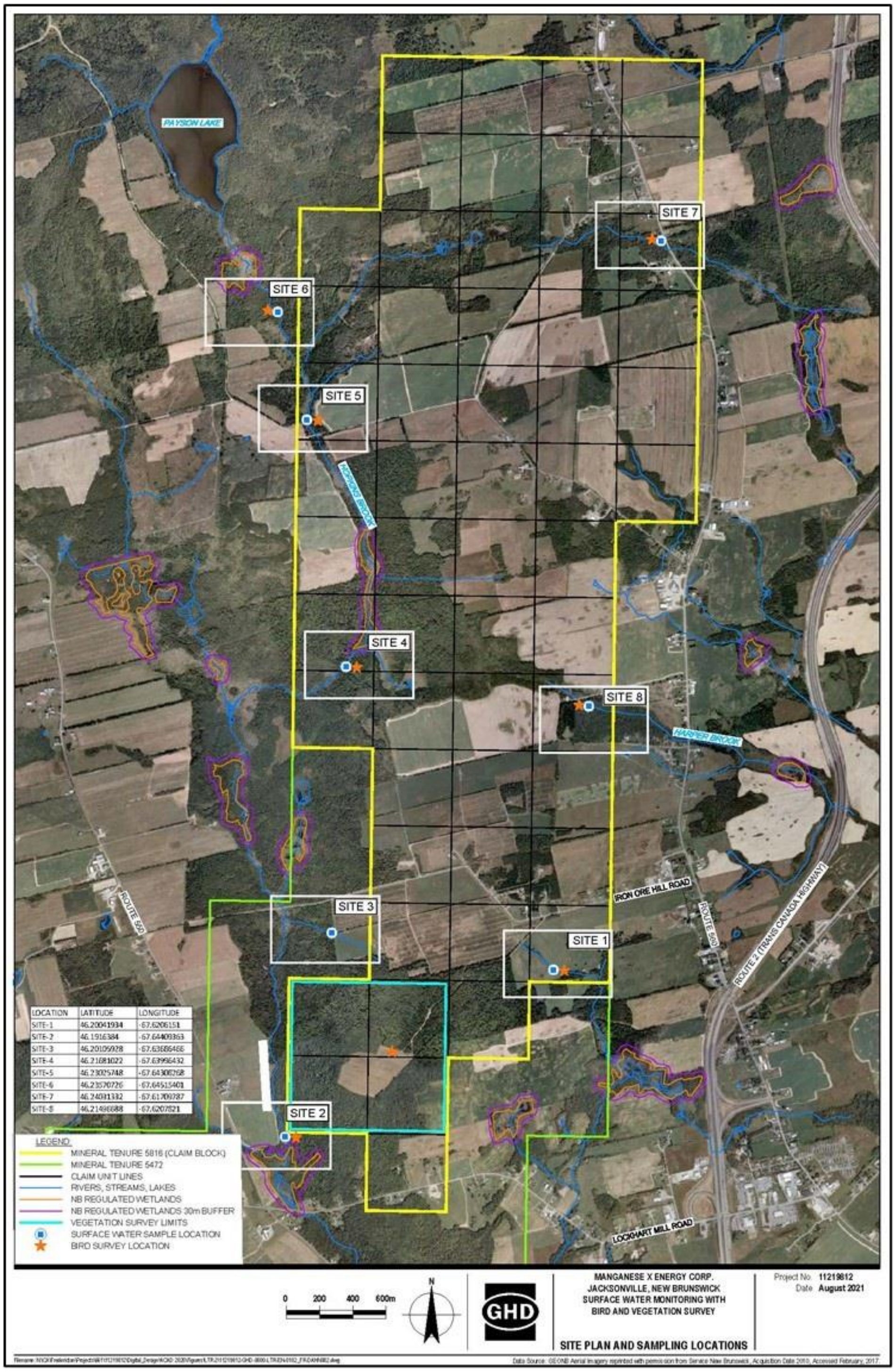
- Environmental Baseline Assessment and Sampling (GHD, 2021a)
- Surface Water Monitoring (Spring 2021) Vegetation and Bird Surveys (GHD 2021b)
- Surface Water Monitoring (Fall 2021) (GHD, 2021c).

The baseline studies describe the site of the proposed mine within the mining claim area (Mineral Claim 5816), and a few selected nearby watercourse locations outside the claim area (Figure 20-1). The Spring and Fall 2021 Surface Water Monitoring reports provide supplementary data on surface water quantity and quality needed to characterize seasonal changes in baseline conditions, and seasonally restricted vegetation and bird observations. The reports focus mainly on the southern half of the claim area around Moody Hill/Iron Ore Hill, west of Jacksonville, New Brunswick (in Wakefield Parish). Review of available databases and mapping plus some limited site surveys provide the following general site description.

The Project footprint is located in a rural landscape with a mixture of agricultural fields, forest areas, and a small number of residences scattered along local public roads (Figure 20-1). The Project area is located on private land parcels with multiple owners, although the majority of the proposed mining and processing area is under one owner. Access to the site is provided by secondary provincial highways (located between Routes 550 and 560) and local paved roads with connection to a primary provincial highway (Route 1 Trans-Canada Highway) within about 10 to 15 km.

The Project footprint occupies the higher part of a ridge trending north-south with natural drainage to the south and southeast. Waterbodies near the site include Marven Brook to the west and south, and a small tributary of Marven Brook to the southeast, and a larger tributary of Lanes Creek to the east of the site. Some small wetlands are mapped in association with the watercourses. These have been avoided in the Project design but are in close proximity. Local surface water quality is relatively good, although it is noted that some metals (possibly naturally occurring) are elevated in sediment samples which slightly exceed regulatory guidelines (CCME – Canadian Council of Ministers of the Environment).

Figure 20-1: Site Plan and Sampling Locations



Source: after GHD, 2021a

The nearest Protected Watershed Area is located approximately 30 km north in Bath, New Brunswick. The nearest Protected Wellfield Area is approximately 10 km south in Woodstock, New Brunswick.

Laboratory analysis of samples taken from the Project site (Kemetco Research ABA Test Results dated November 8, 2021) indicates that waste rock and tailings will be non-acid generating (acid generation potential < 0.9 kg $CaCO_3$/t [>4.5 is considered acid generating]). Residual metals in leachate are anticipated to be relatively minor and onsite mitigation will effectively remove trace metals below regulatory guidelines prior to release into the environment.

According to available mapping, the Project footprint overlaps an area of environmental interest identified as the Moody Hill Deciduous Stand ESA (environmentally significant area). This is not a protected area but is part of a provincial database of nominated areas of various ecological, scientific, or cultural value. This ESA is known for rare plants, most notably Butternut (Juglans cinera), a federally listed species at risk. The nearest Protected Natural Area (PNA) is the Meduxnekeag Valley PNA, approximately 2 km southwest of the site. The Meduxnekeag River is the downstream destination of Marven Brook and is known to support Atlantic Salmon; a species of high concern to regulators, conservation groups and Indigenous communities.

The Spring 2021 report (GHD, 2021a) indicates the area of the Moody Hill ESA is mainly mature growth forest with an open cleared grass field in the centre. One access road leads from the field, northeast, to Iron Ore Hill Road. During recent exploration drilling activities, several access trails for the drill rig were cut in this area. The forest in this part of the property consists of old growth maple, and white ash largely making up the canopy level, with smaller fir, and white birch in the under canopy.

Additional site-specific surveys will be needed to provide information requirements for Project approvals and detailed design.

20.1.1 Species at Risk

As part of the Environmental Baseline Assessment, a request for information was made to the ACCDC for any information on the subject property and surrounding properties.

Based on the information provided, several species at risk (SAR), both provincially and federally, have been observed within the Property, including Butternut (*Juglans cinerea*) and various birds species noted below:

- Wood Thrush (*Hylocichla mustelina*)
- Barn Swallow (*Hirundo rustica*)
- Chimney Swift (*Chaetura pelagica*)

- Bank Swallow (*Riparia riparia*)
- Canada Warbler (*Cardellina canadensis*)
- Bobolink (*Dolichonyx oryzivorus*)
- Rusty Blackbird (*Euphagus carolinus*)
- Olive-sided Flycatcher (*Contopus cooperi*)
- Evening Grosbeak (*Coccothraustes vespertinus*)
- Eastern Wood-Pewee (*Contopus virens*)
- Bald Eagle (*Haliaeetus leucocephalus*)

During the Spring 2021 bird monitoring, two of the above species were confirmed in the general area, including Canada Warbler and Bobolink, although neither was observed within the Project footprint.

In addition, Black Ash (*Fraxinus nigra*) has also been noted in the area by the ACCDC and is an important flora species for traditional indigenous usage. During the Spring 2021 survey, after a thorough search of the Moody Hill ESA area (see Figure 20-1), neither Butternut nor Black Ash were observed.

20.2 Key Environmental Issues

This section outlines key environmental concerns and standard protection measures and procedures that will be implemented during site activities.

Execution of the Project will require development of an Environmental Management Plan (EMP). The EMP will cover, at a minimum, the required authorizations and regulatory requirements; roles and responsibilities; environmental issues and protection measures; and contingency plans. Site personnel will be made aware of the requirements of the EMP through mandatory orientation sessions. These sessions will be held prior to commencement of the work.

20.2.1 Air Quality

The main air emission sources include land clearing and earthworks, crusher operation, blasting, and trucking. Issues associated with air quality relate to the production of particulate matter (fugitive dust), volatile organic compounds (VOCs), sulphur oxides (SOx), nitric oxides (NOx), and greenhouse gases (GHG). During Project activities, the primary air quality concern is the effect of particulate matter, mainly fugitive dust, on the surrounding environment. Standard mitigation measures can be implemented to allow the air quality to remain within permitted limits.

20.2.2 Acoustic Environment (Noise)

The main noise emission sources during bulk sample activities are the onsite equipment, including track-mounted drilling rig, blasting, crusher/screening plant, various conveyors, loaders, and trucks. Issues associated with the acoustic environment relate to noise exceedance effects during operation on the surrounding environment and population, including recommendations outlined by Health Canada. Noise levels at the nearest residential receptors are expected to be near or slightly above background (i.e., noticeable but not potentially harmful).

20.2.3 Wetlands and Fish Habitat

There are currently no mapped wetlands within the Project footprint, although some are located within 30 m. It is possible that some may be discovered following detailed wetland delineation surveys required for the provincial EIA. Therefore, an approval will be required under the *Watercourse and Wetland Alteration (WAWA) Regulation (Clean Water Act)*. Work near a wetland will not commence until a WAWA permit is obtained, and the construction will be conducted in compliance with the conditions of approval, such that no Project related impacts occur in a wetland, most particularly sedimentation from storm water runoff.

Two small watercourses are located approximately 50 to100 m east and west of the site. These are assumed to be fish bearing based on available information. Work near a watercourse will not commence without a WAWA Permit. Site runoff will be controlled using standard erosion control measures so that no sediment laden water is released into any wetland or waterbody. No mining process related fluid discharges are anticipated, and no metals or other industrial contamination is expected in site runoff during operation or post-closure.

Mitigation measures are required during construction and operation to prevent impacts on fish or fish habitat.

20.2.4 Surface Water and Groundwater

The nearest watercourses are relatively small tributary streams located approximately 50 to100 m east and west of the site. Local residences are located within 500 m northeast and south of the site. The primary concern is the degradation of surface water and groundwater quality from site runoff, blasting, mining, or accidental spill.

Since the site is predominantly located along the top of a ridge, there is little upgradient area from which to receive overland flow and the mine is not currently expected to produce significant seepage. Therefore, risk of site runoff to reach surface water features is expected to be low; however, measures to prevent erosion/sedimentation will include the use of silt fence along the downgradient edge of the site, and where needed a perimeter ditch, check-dams, and/or settling basins will be installed.

Project components that could potentially affect groundwater quality include equipment wash-water and accidental spills. Although blasting could impact nearby wells, it is anticipated that this risk is low, given the distance to nearest permanent residences (approximately 300 m) and blasting will be conducted by a certified contractor in accordance with a Blast Monitoring Plan.

It is anticipated that a condition of approval for the Project will include a groundwater monitoring plan consisting of multiple permanent monitoring wells around the site. The purpose is to collect groundwater quality samples at the site perimeter to confirm that no unforeseen impacts result due to the Project. This includes gathering of pre-construction baseline data for comparison with annual monitoring to help determine if changes at receptors can be associated with the Project.

Since a water withdrawal from onsite wells is currently proposed, there is a risk of impacting groundwater quantity at nearby residential wells. As part of the water withdrawal permit application, a water supply study will be required to characterize the potential risk. Currently, no impacts are anticipated. Mine dewatering is also a potential source of industrial water.

20.2.5 Migratory Birds

Potential effects to birds include alteration/displacement of habitat, noise/disturbance, behavioural changes, and destruction of active nests during vegetation clearing. Issues associated with birds relate to the disturbance and potential mortality of individual birds. Noise or physical disturbance could encourage adult birds to avoid, or be displaced from, feeding, breeding, or nesting habitat. Similarly, once eggs have been laid, abandonment of nests could occur if adult birds are displaced from the nest. Nests may also be directly harmed if vegetation clearing, or highly disturbing activities are conducted during the sensitive nesting period of 8 April to 31 August. Birds may attempt to nest on vehicles or equipment, in overburden stockpiles or open mined areas. These may include some SAR.

20.2.6 Waste

Issues associated with wastes are protection of local environments from improper disposal of waste materials and limiting wildlife encounters by eliminating attraction of wildlife to the site. Wastes are to be collected and disposed in a manner consistent with the applicable local and provincial regulations. Materials that can be reused or recycled are to be taken to the appropriate facilities.

20.2.7 Archaeological and Heritage Resources

To date, no archaeological or heritage resources have been identified within the Project area. However, there always remains some potential to encounter buried archaeological features. Therefore, during ground disturbing activities (e.g., clearing/grubbing/removal of overburden) additional mitigation is required.

20.3 Requirements for Waste and Tailings Disposal

See Section 18 for plans on waste and tailings disposal by way of FRSA.

20.4 Environmental Permitting

The following relevant Provincial/Municipal approvals will be required prior to the mine development (currently no Federal environmental approvals are anticipated):

- *Mining Lease* is required under Section 67 of the *Mining Act*. An application must be submitted (principally a Feasibility Study) as described in Section 68. A mining lease will not be issued until approvals have been obtained from the Minister of Environment and Climate Change and (if applicable) the Minister of Agriculture, Aquaculture and Fisheries.
- *EIA* under Section 5(2) (*EIA Regulation*) under the *Clean Environment Act*, all commercial extraction or processing of a mineral as defined in the Mining Act must be registered for EIA review. Water withdrawal greater than 50 m^3/d is also an EIA trigger (see water withdrawal permit below).
- *Approval to Operate* under Section 8(1) (*Water Quality Regulation*) of the *Clean Environment Act* and Section 5(3)(a) (*Air Quality Regulation*) of the *Clean Air Act*. The approval to operate ("operating approval" – OA) is required for any facility that generates emissions (usually air/dust, noise, or fluid discharges).
- *Development Permit* (Regional Service Commission 12) for a change of land use under New Brunswick *Regulation 11-SCC-045-00* (*South Central Carleton County Planning Area Rural Plan*) under Section 77 of the *Community Planning Act*. Likely an amendment to the regulation will be necessary to rezone the site for industrial use.
- *Water Withdrawal Permit* under Section 3(5) (*Water Quality Regulation*) of the *Clean Environment Act*. Required for development of a waterworks with a capacity greater than 50 m^3/d (currently proposed as approximately 25 m^3/h or 600 m^3/d). This application may require the completion of a Water Supply Source Assessment (WSSA) following provincial guidelines; typically, the WSSA is done concurrently with the EIA.

- *Watercourse and Wetland Alteration Permit* in accordance with the *Watercourse and Wetland Alteration Regulation* under Section 15(1)(b) of the *Clean Water Act*. Required for ground disturbing activities within 30 m of a watercourse or wetland (an "alteration"). Wetlands must be delineated onsite by a qualified specialist.

Other potentially applicable regulations which may require compliance are listed below.

Federal:

- *Canadian Environmental Protection Act* – guidelines for water quality of discharges
- *Fisheries Act* – prohibition of impacts on fish and fish habitat, metal and diamond mining effluent regulations
- *Migratory Birds Convention Act* – prohibition of impacts on migratory birds and bird nests
- *Species at Risk Act* – prohibition of impacts on species at risk
- *Transportation of Dangerous Goods Act* – storage and handling of hazardous material

Provincial:

- *Clean Environment Act* (Petroleum Product Storage & Handling Regulation) – onsite storage and handling of fuel (if applicable)
- *Species at Risk Act* – prohibition of impacts on species at risk
- *Forest Fires Act* – seasonal work restrictions
- *Topsoil Preservation Act* – topsoil conservation and handling
- *Transportation of Dangerous Goods Act* – storage and handling of hazardous material

General compliance objectives require that emissions meet applicable guidelines at the perimeter of the property or point of discharge to the environment. Downstream aquatic environments include SAR fish (Atlantic Salmon) and recreational and commercial fisheries, so impacts on receiving waterbodies will be a high concern.

General guidelines related to mining would be dust (Particulate Matter; PM) and fluid discharges (to surface water or groundwater). Usually, federal water quality objectives are adopted (CCME Guidelines for Aquatic Life: https://ccme.ca/en/current-activities/canadian-environmental-quality-guidelines). New Brunswick sets air quality guidelines (Maximum Permissible Ground Level Concentrations) for CO, H_2S, NOx, total suspended particulates, and SO_2: https://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/air_quality/clean_air/air_quality_regulation.html.

There are no regulatory noise guidelines in New Brunswick. Typically impacts are indicated by complaints received from the local community. Mine operators are obliged to record all complaints and report to the regulators. Mitigation is developed in consultation with the regulators and could include operational adjustments (e.g., restricted work hours) or physical barriers (e.g., berms, enclosures).

Generic mining (open pit) setbacks are prescribed in the New Brunswick "Rock Quarry Siting Standards". Larger setbacks could be assigned based on EIA/engineering study outcomes.

The identification of Butternut trees near the site has regulatory implications. It is protected under the *Canadian Species At Risk Act* (Schedule 1 – Endangered). This means no Butternut trees may be damaged and authorization of incidental harm is very unlikely. It will be expected that reasonable effort will be taken to identify Butternut trees in the Project footprint and to avoid them during the design process. There is a possibility that transplantation of discovered Butternut trees outside the footprint could be permitted under Section 73 of the *Species At Risk Act*. This would need to be applied for and the regulators are not obliged to approve the application. The likelihood of obtaining this approval depends on the site-specific conditions and the context of the potentially impacted Butternut relative to the local population.

20.5 Social and Community Related Requirements

The majority of land for the mine site is privately owned and will need to be purchased or a written agreement from the landowner will be required to obtain the mining lease. Current discussions with the core landowner by Manganese X indicate a general willingness to discuss terms.

The site is located in a rural, mainly agricultural, area with fairly direct access to public secondary highways and within about 10 km of a controlled-access major provincial highway. Adjacent landowners and residences along the secondary highways could be affected by the Project. It is likely that 100 to 150 residents are potentially affected, depending on whether the site is accessed from the east or the west. A few residences are located within the currently proposed mining limits in the northeast part of the site.

Local residents would experience some direct impacts from the mining activity including noise and vibration from blasting, dust, altered view-scape (if within line-of-site), and mine related traffic (heavy trucks) along access routes. Potential socio-economic benefits would include opportunities for high-wage employment, local spending and taxation.

As part of the required EIA, a public consultation process will be conducted. All potentially affected stakeholders must be contacted directly by mail or hand delivered letter including:

- Potentially affected landowners and residents
- Municipal government (Council or local service district) and Member of Parliament
- First Nations communities.

Information provided will include basic Project description and schedule. Following the EIA submission, a 30-day public review and comment period will be required. A final report of all stakeholder comments and responses by the proponent must be compiled and presented to regulators.

The site is located within traditional unceded territories of both Indigenous peoples of New Brunswick, including the Mi'Kmaq and Wolastoqay (Maliseet) First Nations. These communities claim rights to all private and Crown Land areas. The Supreme Court of Canada has determined that all government agencies have an obligation to "consult" with Indigenous communities prior to issuing approvals that may affect the Indigenous people. The governments may delegate responsibility for "engagement" to proponents and in New Brunswick engagement should be conducted following guidelines presented in the Interim Proponent Guide (NBDAA, 2019). This process ensures that First Nations Communities are informed about the Project and have an opportunity to express their concerns and the proponent can show that a robust engagement has taken place and that stakeholder concerns have been taken into consideration and a response has been provided. It is the responsibility of the regulators to ensure that "consultation" has been adequately conducted between the Crown and the Indigenous communities. There is no established timeline for this process and consultation activities can "stop-the-clock" on regulatory approval timelines. It is therefore crucial for proponents to develop good relations with First Nations in order to facilitate a timely and robust process to consultation and engagement.

20.6 Reclamation and Mine Closure

Financial security is required by the NBDERD as a condition of the mining lease approval based on the engineering costs for protection, reclamation, and rehabilitation of the environment. The Department of Environment and Local Government may also request financial securities for environmental protection, monitoring and wastewater treatment under the mandate of the Clean Environment Act, EIA and Operating Approvals for the mine site. A reclamation plan will be required, which must include a clear description of the proposed closure and restoration and a detailed (realistic) cost estimate with volumes and effort.

The NBDERD standard expectation is that the site closure conditions will be safe and stable. At a minimum, the site should be restored with topsoil and vegetated, or left in a stabilized condition that is acceptable to the landowner (e.g., industrial work surface). All buildings, equipment, and underground infrastructure shall be removed and waste in general will be disposed of off-site. Abandoned access roads will be removed and revegetated. Post-closure quarry walls will be contoured to a safe angle (minimum 3 horizontal to 1 vertical) and graded in preparation for final restoration, including a cover of overburden with a minimum depth of 10 cm topsoil. Safety features, such as fenced enclosures or access road barriers, may also be required to prevent third-party damages.

Post-closure pits may be allowed to flood naturally with groundwater to create ponds. The tailings management facility will be stabilized with a vegetated cover and may include the continuing operation of a discharge/seepage monitoring system and mitigation for impacted water quality. A groundwater monitoring system will be required for a period of time to be established in permits by regulators.

The schedule for reclamation shall be as soon as possible following the cessation of mining (ideally within one year) and if possible, should be implemented in phases during operation if areas of the mine are completed and unused. During temporary shutdowns, such as winter closures or economic downturns, site conditions will be stabilized as established in permit requirements and with notification of regulators.

Reclamation and closure costs have been estimated to be $6.1 million and considers the removal and disposal of buildings and infrastructure, reclamation of access and haul roads as well as for the FRSA and WRSFs and includes indirect costs, Owner's costs and contingency.

21.0 CAPITAL AND OPERATING COSTS

21.1 Summary

The capital and operating cost estimates are classified as a Class 5 estimate in accordance with AACE International Guidelines Practice No. 47R-11, with an expected accuracy of -30%/+40% of final project cost including contingency. All costs are expressed in fourth-quarter 2021 Canadian dollars.

The Project's pre-production capital cost estimate is summarized in Table 21-1 and is estimated at $438 million.

Operating costs were estimated for mining, processing, filtered residue storage, and G&A. Over the LOM, the operating costs average $152.86/t of material processed.

Table 21-1: Capital Cost Estimate Summary

Area	Cost ($M)	Percent of Total (%)
Open pit mine	4.0	0.9
Process facilities	220.4	50.3
FRSA	2.0	0.5
Infrastructure	19.1	4.4
Subtotal	245.5	56.0
Indirects	80.4	18.4
Owner's cost	14.7	3.4
Contingency	97.4	22.2
Total	**438.0**	**100.0**

Note: Figures may not sum due to rounding

21.2 Capital Cost Estimates

21.2.1 Basis of Estimate

Major process equipment costs (36%) were sourced from budgetary quotations. Bulk material and all remaining equipment costs were based on Wood's inhouse database of recent studies. A factored approach was taken for discipline costs including piping, electrical, instrumentation, concrete, and steelwork. Allowances were made for some services.

21.2.2 Mine Capital Costs

The mine capital costs are limited due to the use of contract mining, no pre-strip requirements, and minimal development requirements. The contract miner is assumed to supply the initial mine equipment fleet with the owner supplying the mine facilities, inclusive of truck shop, wash bay, mine offices, and tire change area. Mine capital costs are estimated at $4.0 million, less than 1% of the overall capital cost and include:

- Pre-production mining
- Support mobile equipment
- Mine buildings including truck shop, tire shop/yard, ready line, office trailers, explosive storage
- Mine development
- Mine utilities including refueling station.

21.2.3 Process Capital Costs

Process capital accounts for most of the initial capital expenditure. Process capital costs are estimated at $220.4 million, 50% of the overall capital cost and include:

- Crushing and grinding
- Leaching and neutralization
- Evaporation and Ca/Mg removal
- Crystallization
- Precipitation
- Sulphuric acid plant
- Reagents
- Process utilities
- Process buildings and mobile equipment.

21.2.4 Filtered Residue Storage Area Costs

FRSA capital costs are estimated at $2.0 million and include:

- Ground preparation
- Starter rockfill buttress.

21.2.5 Infrastructure Costs

Infrastructure capital costs are estimated at $19.1 million, just over 4% of the total capital cost and include:

- Site preparation
- Site development
- Non-production facilities including gatehouse, administration, warehouse, truck scale
- Onsite power supply and distribution
- Storm water management facilities
- Site utilities
- Offsite infrastructure including transmission line and connection to grid.

21.2.6 Indirect Costs

Indirect costs have been factored based on historical data and are estimated at $80.4 million, approximately 18% of the total capital cost. Indirect costs are determined as a percentage of the direct costs and consider the following areas:

- Engineering procurement construction management (EPCM) execution
- Construction indirect costs
- Mechanical vendor representatives (excluding the sulphuric acid plant)
- Commissioning
- Major capital spares
- First fills
- Freight and logistics.

21.2.7 Owner's Capital Costs

Owner's costs have been factored and are determined as a percentage of the direct costs and are estimated at $14.7 million, just over 3% of the total capital cost. It also considers the acquisition of surrounding land for the purposes of mining and infrastructure.

21.2.8 Contingency

Contingency is a monetary provision intended to cover items that have not been included in the described scope of work yet cannot be accurately defined at this stage. This is due to normal variability of quantities, productivity, unit rates, the current level of engineering and other factors that could affect the accuracy of the expected final cost of the Project. Contingency should be considered as expenditure that is predictable but nondefinable at this stage of the project, therefore contingency is expected to be spent. Contingency does not include for any project scope change.

A factored approached has been taken for contingency and is estimated at $97.4 million, which accounts for 30% of the direct and indirect costs.

21.2.9 Sustaining Costs

The basis for estimating the sustaining costs is similar to that used for estimating the initial capital costs in both methodology and the principles applied. Indirect costs, contingency and Owner's costs were applied and added to the direct sustaining capital cost to arrive at the total sustaining capital cost.

The sustaining capital costs as summarized in Table 21-2 relate to:

- Replacement of mining ancillary equipment
- Additional light plants for the FRSA
- Replacement of office trailers and fabric for fabric structures
- Replacement of mobile equipment at the plant.

Total sustaining capital over the LOM is estimated at $27.2 million.

Table 21-2: Sustaining Capital Costs over the LOM ($000s)

	Years													
Area	**Y1**	**Y6**	**Y11**	**Y15**	**Y16**	**Y21**	**Y23**	**Y26**	**Y30**	**Y31**	**Y36**	**Y41**	**Y46**	**Total**
Mining	-	449	1,586	-	449	1,586	-	449	-	1,590	449	848	71	**7,476**
FRSA	65	65	65	-	65	65	-	65	-	65	65	65	65	**645**
Infrastructure	-	-	-	347	-	-	100	-	347	-	-	-	-	**794**
Process	-	-	2,800	-	-	2,800	-	-	-	2,800	-	2,800		**11,200**
Indirect cost	-	-	-	35	-	-	10	-	35	-	-	-	-	**79**
Contingency	19	154	1,335	104	154	1,335	30	154	104	1,336	154	1,114	41	**6,035**
Owner's cost	3	26	223	17	26	223	5	26	17	223	26	186	7	**1,006**
Total	**87**	**693**	**6,009**	**503**	**693**	**6,009**	**145**	**693**	**503**	**6,014**	**693**	**5,011**	**183**	**27,235**

Note: Figures may not sum due to rounding

21.3 Operating Cost Estimates

21.3.1 Summary

Total operating costs over the LOM have been estimated at $2,597 million. Average operating costs have been estimated at $152.86/t of material processed and are summarized in Table 21-3.

Table 21-3: Total Operating Costs over LOM

Cost Area	$/t Processed	Total ($M)	Percent of Total (%)
Mining	23.03	391.3	15
Process	116.81	1,984.6	76
G&A	7.68	130.4	5
Filtered Residue Storage	5.35	90.9	3
Total	**152.86**	**2,597.1**	**100**

Note: Figures may not sum due to rounding.

21.3.2 Mine Operating Costs

Mining contractor costs represent the mining cost and were calculated from a first principals basis. The mine contract costs are inclusive of all costs to drill, blast, load, and haul both waste and mineralized material to the WRSF and to the mineralized material stockpile, respectively. Mine costs are also inclusive of support equipment used to maintain the mine roads, pit working area, WRSF, and mill feed stockpile area. The Owner’s costs account for mine management, engineering, grade control and geology costs.

To obtain a contract mining cost, the mining cost was increased by adding a 25% contractor profit rate and a 5% management fee rate to the mining estimates. Fuel, lubricants, and explosives were assumed to be provided by the owner and discounted from the contractor invoice.

Mine operating costs are estimated to average $8.77/t mined over the LOM, inclusive of stockpile reclaim tonnage. Mining costs amount to $23.03/t processed, or 15% of the total operating cost.

21.3.3 Process Operating Costs

The process operating cost estimates were developed from first principles, metallurgical test work, database salary and benefit guidelines and recent vendor quotations. The operating costs include reagents, consumables, personnel, electrical power, laboratory, maintenance, mobile equipment and sundry items.

Reagents and consumables accounts for most of these costs, with sulphur for sulphuric acid production and the confidential Reagent A the biggest contributors. A trade-off study indicated the viability of installing an onsite sulphuric acid plant. In addition to producing acid at a reduced cost, the steam generated from the acid plant provides a significant source of energy for the evaporation and crystallization circuits and reduces the electrical energy requirements.

The second biggest cost component is labour. The process plant will have a high degree of instrumentation and automation to reduce the number of operations personnel, although high technical skill levels will be required.

Table 21-4 provides a breakdown of the process operating costs

Table 21-4: Total Process Operating Costs over LOM

Cost Area	$/t Processed	Percent of Total (%)
Labour	14.37	12.3
Maintenance	8.76	7.5
Reagents and Consumables	76.30	65.3
Power	12.81	11.0
Miscellaneous	4.57	3.9
Total	**116.81**	**100.0**

21.3.4 General and Administration Costs

G&A labour costs are based on 12 full-time equivalent employees including management, human resources, information technology, environmental and community relations, health safety and environmental, and security costs.

G&A operating costs are estimated to be $7.68/t processed, or $130.4 million over the LOM as summarized in Table 21-5. G&A comprises 5% of the total operating cost estimate.

Table 21-5: G&A Operating Costs

Category	$/t processed
Labour	4.57
Operating	2.96
Equipment	0.14
Total	**7.68**

Note: Figures may not sum due to rounding

21.3.5 Filtered Residue Storage Costs

Filtered residue storage costs are estimated to be $5.35/t processed, or $90.9 million. Filtered residue storage operating costs are inclusive of haulage, storage, and compaction of filtered residue from the mill to the FRSA.

22.0 ECONOMIC ANALYSIS

22.1 Cautionary Statement

The results of the economic analysis in the PEA represents forward-looking information that is subject to a number of known and unknown risks, uncertainties, and other factors that may cause actual results to differ materially from those presented here. Forward-looking statements in this Report include, but are not limited to: timing and amount of future cashflows from mining operations, forecast production rates and amounts of HPMSM produced from the Battery Hill mining operation, estimation of the Mineral Resources and the realization of the Mineral Resource estimates within the PEA mine plans, the time required to develop the mine based on the PEA mine design, statements with respect to future price of HPMSM and the ability to capture a share of the HPMSM market, assumptions regarding mine dilution and losses, the expected grade of the material delivered to the mill, metallurgical recovery rates, and sustaining capital costs, NPV, IRR, payback period, LOM, production, cashflows and other financial and operational metrics, as well as mine closure costs and reclamation, timing and conditions of permits required to initiate mine construction, maintaining mining activities, mine closure, and assumptions regarding geotechnical and hydrogeological factors.

The reader is cautioned that the actual results of mining operations may vary from what is forecast. Risks to forward-looking information include but are not limited to unexpected variations in grade or geological continuity, as well as geotechnical and hydrogeological assumptions that are used in the mine designs. There could be seismic or water management events during the construction, operations, closure, and post-closure periods that could affect: predicted mine production, timing of the production, costs of future production, capital expenditures, future operating costs, permitting time lines, potential delays in the issuance of permits, or changes to existing permits, as well as requirements for additional capital. The plant, equipment or metallurgical or mining processes may fail to operate as anticipated. There may be: changes to government regulation of mining operations, environmental issues, permitting requirements, and social risks, or unrecognized environmental, closure costs and closure requirements, unanticipated reclamation expenses, title disputes or claims and limitations on insurance coverage. There are risks related to the ability to acquire surface rights at a reasonable cost and to the interpretation of the GMR set forth in Manganese X's option agreement dated 22 April 2016 with Globex, as described in Section 4.3.1 and Section 4.7.

The PEA is preliminary in nature, and a portion of the Mineral Resources in the mine plans, production schedules, and cashflows include Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the PEA will be realized. Due to the conceptual nature of the PEA, Mineral Resources cannot be converted to Mineral Reserves and therefore do not have demonstrated economic viability.

22.2 Methodology Used

The PEA has been evaluated using a discounted cashflow analysis. Cash inflows consist of annual revenue projections for the mine. Cash outflows such as capital, pre-production mining costs, operating costs, taxes, and royalties, are subtracted from the inflows to arrive at the annual cashflow projections. Cashflows are taken to occur at the end of each period.

To reflect the time value of money, annual net cashflow (NCF) projections are discounted back to the start of construction using a 10% discount rate. The discount rate appropriate to a specific project depends on many factors, including the type of commodity and the level of project risks, such as market risk, technical risk, and political risk. The discounted present values of the cashflows are summed to arrive at the NPV for the Project.

22.3 Financial Model Parameters

The financial analysis was based on: royalty agreements described in Section 4; the Mineral Resources presented in Section 14; the mine and process plan and assumptions detailed in Sections 16 and 17, respectively; the projected infrastructure requirements outlined in Section 18; the HPMSM price assumption in Section 19; the permitting, social and environmental regime discussions in Section 20; and the capital and operating cost estimates detailed in Section 21. All costs within the financial model are expressed in fourth-quarter 2021 US dollars.

22.3.1 Metal Recovery

Within the financial model, a fixed Mn metal recovery of 78% is estimated across all periods of mine life. The HPMSM product is comprised of 32% Mn metal. Section 16 provides a summary of the production schedule showing an approximate total of 3,178 kt HPMSM or 1,017 kt Mn recovered over the 47-year Project life.

22.3.2 Metal Price

A long-term HPMSM price of US$2,900/t HPMSM is assumed for the economic analysis. The long-term price guidance has been provided by CPM market study for two destinations, Detroit, USA, and Berlin, Germany (North America and Europe markets, respectively). It is anticipated that 80% of the total HPMSM product will be sold in the North America market and the remining 20% in the Europe market. The long-term HPMSM price was kept consistent throughout the life of the Project and final HPMSM price was a tonnage-weighted average of the two market destinations for the product.

22.3.3 Exchange Rate

For the purposes of the capital cost estimate, the operating cost estimate, and financial analysis, the assumed exchange rate for the LOM is CA$1.25:US$1.00. The exchange rate is what Wood considers to be an industry consensus on the forecast of the following sources: bank analysts' long-term forecasts; historical exchange rate averages; and prices used in recent publicly disclosed comparable studies.

22.3.4 Transportation and Selling Costs

Transportation costs payables are applied according to Section 19. The North American and European market product destinations have separate transportation costs, US$30/t HPMSM and US$125/t HPMSM, respectively. Selling costs of 5% of market selling price were incorporated.

22.3.5 Royalties and Metal Streams

Royalties in the financial model are applied according to the royalty agreements described in Section 4. A 3% GMR is applied to the HPMSM produced. In determining the royalty, no costs are deducted from the value of the HPMSM produced.

22.3.6 Bonds

The Project does not currently have any outstanding surety bonds.

22.3.7 Property Purchase Agreements

No property purchase agreements have been made. A sum of US$1.92 million has been identified by Manganese X for the purchase of properties in the study. This amount as been included with other capital expenses.

22.3.8 Taxes

Taxation within the model is based on Canadian and New Brunswick Provincial income and mining taxes. The following is a summary of the calculations and tax assumptions used in the cashflow model for the Project, including Canadian federal and New Brunswick provincial corporate income taxes, and New Brunswick mining tax.

Canadian federal income tax:

- Income tax rate of 15.0%
- Tax losses carried forward up to 20 years following the year of the loss. Three years carry back allowed
- Canadian exploration expenses (CEE) annual deduction rate of 100%
- Canadian development expenses (CDE) annual deduction rate of 30.0% on declining balance
- Undepreciated capital cost (UCC) annual depreciation rate of 25.0% on declining balance
- Accelerated Investment Incentive Factors (0.50, 1.0, 1.5 by year).

New Brunswick provincial income tax:

- Income tax rate of 14.0%
- Tax losses carried forward up to 20 years following the year of the loss. Three years carry back allowed.

New Brunswick mining tax (Mining Tax Act):

- 2% royalty based on annual net revenue derived from the mine where:
  - Tax becomes effective two years after a new mine is active and operations begin.
  - Processing allowance of 8% original cost of milling or concentrating assets plus 15% original cost of smelting or refining assets. The total deduction cannot exceed 25% of net revenue before processing allowance has been deducted.
  - Where, net revenue is the amount of the gross income from mining operations for the taxation year less the following deductions:
    - the actual cost of transportation of any output sold, if paid or borne by the operator of a mine
    - the actual and proper operating costs for smelting and further processing of mineral ore within the province by the operator, a subsidiary of the operator or by persons who, in the opinion of the Minister, are associated with the operator
    - the actual and proper costs of milling.
- 16% levy on net profits in excess of CA$100,000 where:
  - Depreciation allowance ranges from minimum 5 to 100% original cost of depreciable assets in new mine or process plant or major expansion
  - All other depreciable assets are subject to a maximum 33⅓% depreciation rate

- Processing allowance of 8% original cost of milling or concentrating assets plus 15% original cost of smelting or refining assets. The total deduction cannot exceed 65% of net profits before processing allowance has been deducted.
- Exploration expenditure allowance deduction equal to 150% of eligible exploration expenses associated with the new mineral exploration for the year.

The tax pool credits were applied to the Project are listed in Table 22-1.

Table 22-1: Tax Pool Credits

Tax Pool	Amount ($000s)
Income Tax Loss Initial Balance	8,914.54
UCC Capital Carryover	0.00
CDE Capital Carryover	962.24
CEE Capital Carryover	1,521.32

Note: Current tax pool credits are assumed to be valid and not expired by the start of the Project.

22.3.9 Working Capital

Working capital is the capital required to fund operations prior to receiving revenue from the finished product. It is defined as the current assets minus the current liabilities. The financial model estimates working capital by subtracting 45 days of direct operating costs from 60 days of revenue. Over the Project life, working capital nets to zero.

22.3.10 Closure and Reclamation

Closure costs are incurred in the initial year of the Project. The closure costs amounts by year are shown in Table 22-2.

Table 22-2: Closure Costs by Mine Site

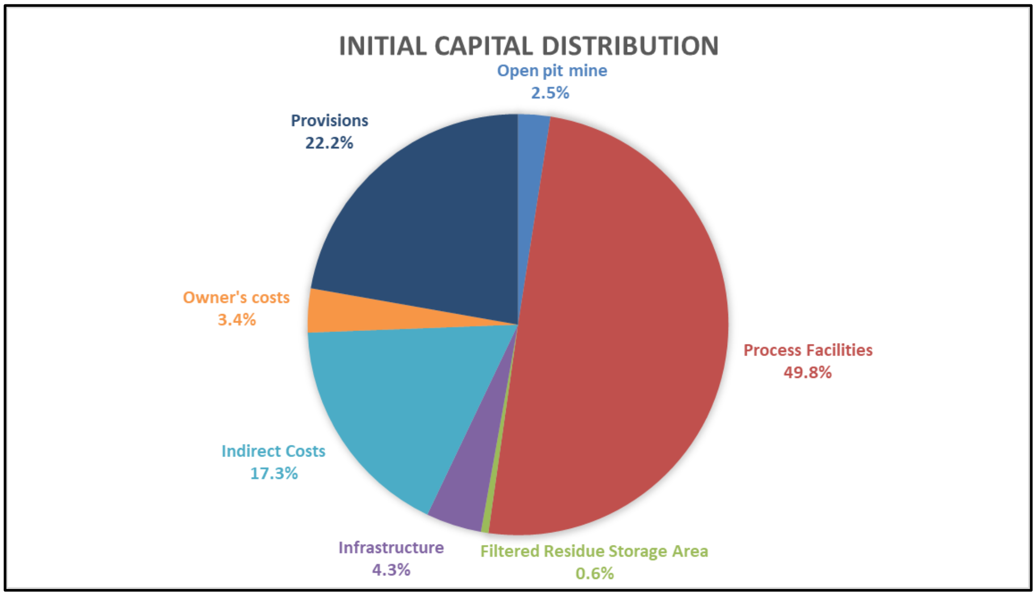
Mine Site	Year Incurred	Amount (US$M)
Total Closure Cost	PP2	4.87

Note: PP2 – pre-production Year -2

22.3.11 Capital Costs

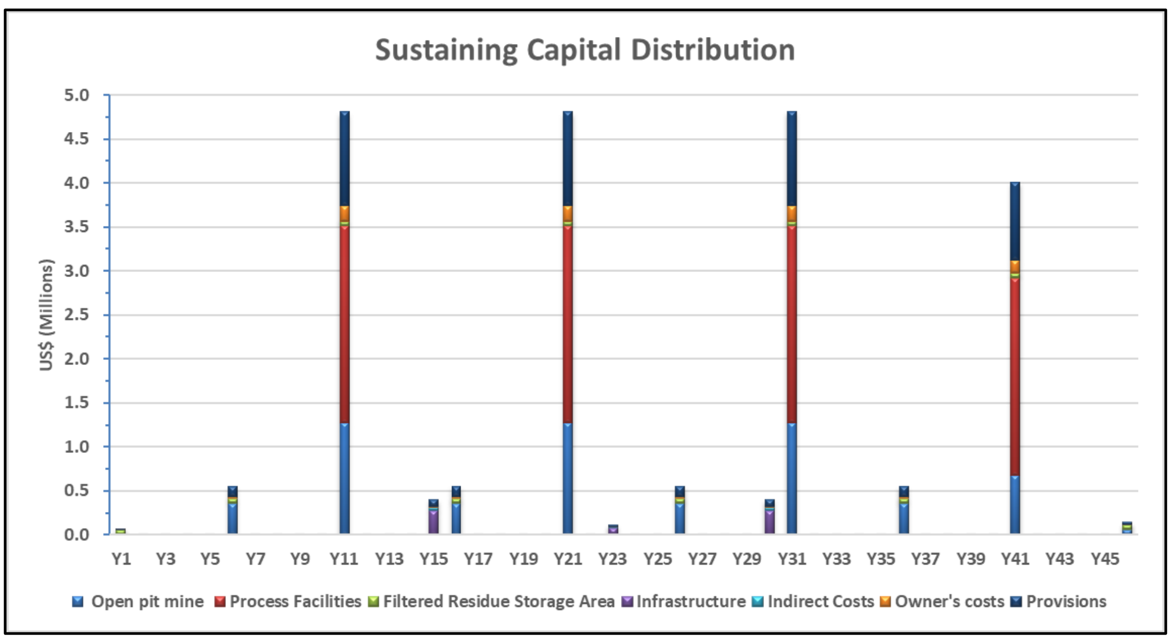
Total Project capital is US$372 million as described in Section 21. Of the total amount, US$350 million is attributable to initial capital and US$22 million to sustaining capital, exclusive of closure costs. Figure 22-1 shows the distribution of initial capital spend and Figure 22-2 shows the sustaining capital over the LOM.

Figure 22-1: Initial Capital Distribution



Source: prepared by Wood, dated 2022

Figure 22-2: Sustaining Capital Distribution



Source: prepared by Wood, dated 2022

22.3.12 Operating Costs

Operating costs have been applied as described in Section 21.

22.3.13 Salvage Value

No salvage value is applied within the financial model.

22.3.14 Inflation

No escalation or inflation are applied. All amounts expressed in constant real first-quarter 2022 terms.

22.4 Financial Results

The cashflow forecast on an annual basis using Mineral Resources within the PEA mine plan are shown in Table 22-3. Based on the economic analysis, the Project generates positive before- and after-tax discounted cashflows. The after-tax NPV_{10} for the Project is US$486 million. Figure 22-3 shows the distribution of after-tax cashflows and NPV_{10}.

Table 22-4 and Table 22-5 show the before- and after-tax financial statistics, respectively.

Table 22-3: Financial Model

				Years																
Cashflow	**Unit**	**NPV**	**Total/Average**	**PP2**	**PP1**	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**	**Y8**	**Y9**	**Y10**	**Y11**	**Y12**	**Y13**	**Y14**	**Y15**
MINE PRODUCTION SCHEDULE																				
Mining																				
Direct Feed to Mill	kt		**12,228**	-	-	365	187	313	365	326	339	365	265	308	248	270	241	237	229	303
Mill Feed Stockpile	kt		**4,761**	-	-	319	404	254	206	179	192	163	171	179	166	155	88	78	98	91
Waste	kt		**22,876**	-	158	316	409	433	429	495	469	472	564	513	586	575	671	685	673	606
Total	**kt**		**39,865**	**-**	**-**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**
Strip Ratio	W:O		**1.35**	-	-	0.46	0.69	0.76	0.75	0.98	0.88	0.90	1.29	1.05	1.42	1.35	2.04	2.17	2.05	1.54
Processing																				
Direct Feed	kt		**12,228**	-	-	365	187	313	365	326	339	365	265	308	248	270	241	237	229	303
Direct Grade	% Mn		**8.58**	-	-	10.44	9.50	9.41	10.32	8.78	9.12	9.45	9.54	8.84	8.84	8.68	8.66	7.77	7.97	7.83
Reclaim Feed	kt		**4,761**	-	-	-	178	52	-	39	26	-	100	57	117	95	124	128	136	62
Reclaim Grade	% Mn		**5.35**	-	-	-	9.08	7.54	-	7.25	7.02	-	7.04	6.77	6.78	6.74	6.64	5.11	5.09	5.09
Total Feed	kt		**16,990**	-	-	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365
Total Grade	% Mn		**7.67**	-	-	10.44	9.30	9.14	10.32	8.62	8.97	9.45	8.86	8.52	8.18	8.17	7.97	6.84	6.90	7.37
Total Contained Mn	Mn kt		**1,304**	-	-	38	34	33	38	31	33	34	32	31	30	30	29	25	25	27
Recovery	%		**78.0**	-	-	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0
HPMSM	kt		**3,178**	-	-	93	83	81	92	77	80	84	79	76	73	73	71	61	61	66
Total Recovered Mn	Mn kt		**1,017**	-	-	30	26	26	29	25	26	27	25	24	23	23	23	19	20	21
Tailings	kt wet		**16,574**	-	-	327	339	340	328	346	342	337	343	347	351	351	353	365	364	359
CASHFLOW																				
Mn Selling Price	$/t Mn			-	-	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063
Sales																				
HPMSM Sales	US$M		**9,217.03**	-	-	269.45	239.89	235.77	266.15	222.36	231.49	243.87	228.56	219.80	211.12	210.87	205.68	176.49	178.06	190.14
Sales Costs																				
Transport Cost	US$M		**155.74**	-	-	4.55	4.05	3.98	4.50	3.76	3.91	4.12	3.86	3.71	3.57	3.56	3.48	2.98	3.01	3.21
Selling Costs	US$M		**460.85**	-	-	13.47	11.99	11.79	13.31	11.12	11.57	12.19	11.43	10.99	10.56	10.54	10.28	8.82	8.90	9.51
Total Sales Costs	**US$M**		616.59	**-**	**-**	**18.03**	**16.05**	**15.77**	**17.80**	**14.88**	**15.49**	**16.31**	**15.29**	**14.70**	**14.12**	**14.11**	**13.76**	**11.81**	**11.91**	**12.72**
Royalty																				
Battery Hill Royalties	US$M		**276.51**	-	-	8.08	7.20	7.07	7.98	6.67	6.94	7.32	6.86	6.59	6.33	6.33	6.17	5.29	5.34	5.70
Revenue																				
Mn Revenue	US$M		**8,323.93**	-	-	243.34	216.64	212.93	240.36	200.81	209.06	220.24	206.41	198.50	190.66	190.44	185.75	159.39	160.81	171.72

				Years																
Cashflow	**Unit**	**NPV**	**Total/Average**	**PP2**	**PP1**	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**	**Y8**	**Y9**	**Y10**	**Y11**	**Y12**	**Y13**	**Y14**	**Y15**
Operating Costs																				
Mining	US$M		**313.01**	-	-	7.58	7.60	7.59	7.59	7.59	7.61	7.61	7.59	7.60	7.62	7.60	7.58	7.58	7.59	7.51
Processing	US$M		**1,587.64**	-	-	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11
Filtered Residue Storage	US$M		**72.71**	-	-	1.34	1.33	1.33	1.33	1.34	1.33	1.33	1.33	1.34	1.33	1.33	1.33	1.34	1.33	1.33
G&A	US$M		**104.32**	-	-	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24
Total Operating Costs	**US$M**		**2,077.69**	**-**	**-**	**45.27**	**45.29**	**45.27**	**45.28**	**45.27**	**45.30**	**45.29**	**45.27**	**45.29**	**45.30**	**45.28**	**45.26**	**45.27**	**45.27**	**45.19**
Total Production Costs																				
Total Operating Costs	US$M		**2,077.69**	-	-	45.27	45.29	45.27	45.28	45.27	45.30	45.29	45.27	45.29	45.30	45.28	45.26	45.27	45.27	45.19
Lease Payment	US$M		**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bond Cost on Balance	US$M		**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Production Costs	**US$M**		**2,077.69**	**-**	**-**	**45.27**	**45.29**	**45.27**	**45.28**	**45.27**	**45.30**	**45.29**	**45.27**	**45.29**	**45.30**	**45.28**	**45.26**	**45.27**	**45.27**	**45.19**
Income from Operations																				
Net Revenue	US$M		**8,323.93**	-	-	243.34	216.64	212.93	240.36	200.81	209.06	220.24	206.41	198.50	190.66	190.44	185.75	159.39	160.81	171.72
Production Costs	US$M		**2,077.69**	-	-	45.27	45.29	45.27	45.28	45.27	45.30	45.29	45.27	45.29	45.30	45.28	45.26	45.27	45.27	45.19
Net Income Before Taxes	**US$M**		**6,246.25**	**-**	**-**	**198.08**	**171.36**	**167.65**	**195.08**	**155.54**	**163.77**	**174.95**	**161.14**	**153.22**	**145.36**	**145.16**	**140.49**	**114.12**	**115.54**	**126.53**
Taxes																				
New Brunswick Mining Tax	US$M		**1,077.95**	-	-	20.14	19.14	24.49	31.02	24.91	27.13	29.72	27.61	26.47	25.27	25.24	24.58	19.94	20.32	22.39
New Brunswick Income Tax	US$M		**670.29**	-	-	8.99	10.98	12.81	17.91	14.75	16.64	18.58	17.47	16.88	16.21	16.28	15.78	12.87	13.10	14.41
Canada Income Tax	US$M		**718.17**	-	-	9.63	11.77	13.73	19.19	15.80	17.83	19.91	18.71	18.09	17.37	17.45	16.91	13.79	14.04	15.44
Net Income After Taxes	**US$M**		**3,779.84**	**-**	**-**	**159.32**	**129.47**	**116.62**	**126.97**	**100.09**	**102.17**	**106.74**	**97.35**	**91.77**	**86.52**	**86.19**	**83.21**	**67.53**	**68.08**	**74.29**
Capital Cost																				
Initial & Sustaining	US$M		**372.19**	349.43	0.97	0.07	-	-	-	-	0.55	-	-	-	-	4.81	-	-	-	0.40
Reclamation & Closure	US$M		**4.87**	4.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salvage Value	US$M		**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Cost	**US$M**		**377.06**	**354.30**	**0.97**	**0.07**	**-**	**-**	**-**	**-**	**0.55**	**-**	**-**	**-**	**-**	**4.81**	**-**	**-**	**-**	**0.40**
Working Capital																				
Working Capital	US$M		**-**	-	-	34.33	(4.30)	(0.61)	4.51	(6.58)	1.43	1.84	(2.27)	(1.38)	(1.22)	(0.03)	(0.77)	(4.39)	0.29	1.80

				Years																
Cashflow	**Unit**	**NPV**	**Total/Average**	**PP2**	**PP1**	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**	**Y8**	**Y9**	**Y10**	**Y11**	**Y12**	**Y13**	**Y14**	**Y15**
Cashflow Before Tax			**5,869.19**	(354.30)	(0.97)	163.68	175.66	168.26	190.58	162.12	161.79	173.11	163.41	154.59	146.58	140.38	141.26	118.51	115.25	124.32
Cumulative Before-Tax Cashflow	US$M			(354.30)	(355.27)	(191.59)	(15.94)	152.33	342.90	505.02	666.81	839.91	1,003.33	1,157.92	1,304.50	1,444.88	1,586.14	1,704.65	1,819.90	1,944.23
NPV_8	US$M	8%	**1,244.69**	(328.06)	(0.83)	129.91	129.08	114.49	120.07	94.55	87.37	86.56	75.66	66.26	58.17	51.59	48.06	37.33	33.61	33.57
NPV_{10}	US$M	10%	**933.03**	(322.09)	(0.80)	122.94	119.94	104.45	107.55	83.15	75.43	73.38	62.97	54.14	46.67	40.63	37.17	28.34	25.06	24.57
NPV_{12}	US$M	12%	**714.61**	(316.34)	(0.77)	116.47	111.60	95.45	96.52	73.29	65.30	62.39	52.58	44.40	37.59	32.14	28.88	21.62	18.78	18.08
IRR	%		**35.0**																	
Cashflow After Tax			**3,402.78**	(354.30)	(0.97)	124.92	133.76	117.23	122.46	106.66	100.18	104.91	99.62	93.15	87.73	81.42	83.98	71.92	67.79	72.08
Cumulative After-Tax Cashflow	US$M			(354.30)	(355.27)	(230.35)	(96.59)	20.64	143.10	249.76	349.95	454.85	554.47	647.62	735.35	816.77	900.75	972.67	1,040.46	1,112.54
NPV_8	US$M	8%	**672.54**	(328.06)	(0.83)	99.14	98.30	79.77	77.15	62.21	54.10	52.46	46.12	39.92	34.82	29.92	28.57	22.65	19.77	19.47
NPV_{10}	US$M	10%	**486.04**	(322.09)	(0.80)	93.83	91.34	72.77	69.11	54.71	46.71	44.47	38.39	32.62	27.93	23.57	22.10	17.20	14.74	14.25
NPV_{12}	US$M	12%	**354.65**	(316.34)	(0.77)	88.89	84.98	66.50	62.02	48.22	40.44	37.81	32.06	26.75	22.50	18.64	17.17	13.12	11.04	10.49
IRR	%		**25.3**																	

Table 22-3 Continued (Year16 to Year 32)

			Years																
Cashflow	**Unit**	**NPV**	**Y16**	**Y17**	**Y18**	**Y19**	**Y20**	**Y21**	**Y22**	**Y23**	**Y24**	**Y25**	**Y26**	**Y27**	**Y28**	**Y29**	**Y30**	**Y31**	**Y32**
MINE PRODUCTION SCHEDULE																			
Mining																			
Direct Feed to Mill	kt		299	358	365	365	365	365	365	365	364	310	365	365	365	365	363	323	197
Mill Feed Stockpile	kt		104	79	116	143	120	168	208	141	153	100	72	175	105	287	-	18	-
Waste	kt		597	563	519	492	515	467	427	494	482	590	563	460	530	348	637	660	803
Total	**kt**		**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**
Strip Ratio	W:O		1.48	1.29	1.08	0.97	1.06	0.88	0.75	0.98	0.93	1.44	1.29	0.85	1.13	0.53	1.75	1.94	4.07
Processing																			
Direct Feed	kt		299	358	365	365	365	365	365	365	364	310	365	365	365	365	363	323	197
Direct Grade	% Mn		7.45	6.97	7.33	7.78	7.92	7.58	7.96	8.59	8.54	8.50	7.84	8.62	8.46	9.13	8.93	9.50	9.00
Reclaim Feed	kt		66	7	-	-	-	-	-	-	1	55	-	-	-	-	2	42	168
Reclaim Grade	% Mn		5.09	5.08	-	-	-	-	-	-	6.94	6.03	-	-	-	-	8.42	7.10	6.91
Total Feed	kt		365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365
Total Grade	% Mn		7.02	6.93	7.33	7.78	7.92	7.58	7.96	8.59	8.53	8.12	7.84	8.62	8.46	9.13	8.93	9.22	8.04
Total Contained Mn	Mn kt		26	25	27	28	29	28	29	31	31	30	29	31	31	33	33	34	29
Recovery	%		78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0
HPMSM	kt		62	62	65	69	70	67	71	76	76	72	70	77	75	81	79	82	72
Total Recovered Mn	Mn kt		20	20	21	22	23	22	23	24	24	23	22	25	24	26	25	26	23
Tailings	kt wet		363	364	360	355	353	357	353	346	347	351	354	346	348	340	343	340	352
CASHFLOW																			
Mn Selling Price	$/t Mn		9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063
Sales																			
HPMSM Sales	US$M		181.24	178.85	189.16	200.70	204.42	195.47	205.50	221.66	220.20	209.62	202.36	222.43	218.37	235.67	230.46	237.86	207.36
Sales Costs																			
Transport Cost	US$M		3.06	3.02	3.20	3.39	3.45	3.30	3.47	3.75	3.72	3.54	3.42	3.76	3.69	3.98	3.89	4.02	3.50
Selling Costs	US$M		9.06	8.94	9.46	10.04	10.22	9.77	10.28	11.08	11.01	10.48	10.12	11.12	10.92	11.78	11.52	11.89	10.37
Total Sales Costs	**US$M**		**12.12**	**11.96**	**12.65**	**13.43**	**13.67**	**13.08**	**13.75**	**14.83**	**14.73**	**14.02**	**13.54**	**14.88**	**14.61**	**15.77**	**15.42**	**15.91**	**13.87**
Royalty																			
Battery Hill Royalties	US$M		5.44	5.37	5.67	6.02	6.13	5.86	6.17	6.65	6.61	6.29	6.07	6.67	6.55	7.07	6.91	7.14	6.22
Revenue																			
Mn Revenue	US$M		163.68	161.52	170.83	181.26	184.61	176.53	185.59	200.18	198.86	189.31	182.75	200.88	197.21	212.83	208.13	214.81	187.27

			Years																
Cashflow	**Unit**	**NPV**	**Y16**	**Y17**	**Y18**	**Y19**	**Y20**	**Y21**	**Y22**	**Y23**	**Y24**	**Y25**	**Y26**	**Y27**	**Y28**	**Y29**	**Y30**	**Y31**	**Y32**
Operating Costs																			
Mining	US$M		7.51	7.51	7.54	7.53	7.61	7.63	7.67	7.59	7.11	7.09	7.11	7.11	7.10	7.21	7.10	7.09	7.08
Processing	US$M		34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11
Filtered Residue Storage	US$M		1.33	1.34	1.33	1.33	1.69	1.69	1.69	1.69	1.69	1.70	1.69	1.69	1.69	1.70	1.69	1.69	1.69
G&A	US$M		2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24
Total Operating Costs	**US$M**		**45.20**	**45.20**	**45.22**	**45.22**	**45.65**	**45.67**	**45.70**	**45.64**	**45.15**	**45.13**	**45.15**	**45.16**	**45.14**	**45.26**	**45.14**	**45.13**	**45.12**
Total Production Costs																			
Total Operating Costs	US$M		45.20	45.20	45.22	45.22	45.65	45.67	45.70	45.64	45.15	45.13	45.15	45.16	45.14	45.26	45.14	45.13	45.12
Lease Payment	US$M		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bond Cost on Balance	US$M		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Production Costs	**US$M**		**45.20**	**45.20**	**45.22**	**45.22**	**45.65**	**45.67**	**45.70**	**45.64**	**45.15**	**45.13**	**45.15**	**45.16**	**45.14**	**45.26**	**45.14**	**45.13**	**45.12**
Income from Operations																			
Net Revenue	US$M		163.68	161.52	170.83	181.26	184.61	176.53	185.59	200.18	198.86	189.31	182.75	200.88	197.21	212.83	208.13	214.81	187.27
Production Costs	US$M		45.20	45.20	45.22	45.22	45.65	45.67	45.70	45.64	45.15	45.13	45.15	45.16	45.14	45.26	45.14	45.13	45.12
Net Income Before Taxes	**US$M**		**118.48**	**116.32**	**125.61**	**136.04**	**138.96**	**130.86**	**139.89**	**154.54**	**153.71**	**144.17**	**137.60**	**155.72**	**152.06**	**167.57**	**162.99**	**169.67**	**142.15**
Taxes																			
New Brunswick Mining Tax	US$M		20.99	20.69	22.45	24.41	25.01	23.41	25.15	27.87	27.77	26.09	24.90	28.24	27.61	30.47	29.63	30.71	25.78
New Brunswick Income Tax	US$M		13.51	13.28	14.36	15.57	15.91	14.93	15.89	17.60	17.53	16.46	15.71	17.79	17.38	19.16	18.64	19.34	16.12
Canada Income Tax	US$M		14.47	14.23	15.39	16.68	17.05	15.99	17.03	18.86	18.79	17.63	16.84	19.06	18.62	20.53	19.97	20.72	17.27
Net Income After Taxes	**US$M**		**69.51**	**68.13**	**73.41**	**79.38**	**81.00**	**76.53**	**81.82**	**90.20**	**89.62**	**84.00**	**80.15**	**90.63**	**88.45**	**97.41**	**94.74**	**98.90**	**82.98**
Capital Cost																			
Initial & Sustaining	US$M		0.55	-	-	-	-	4.81	-	0.12	-	-	0.55	-	-	-	0.40	4.81	-
Reclamation & Closure	US$M		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salvage Value	US$M		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Cost	**US$M**		**0.55**	**-**	**-**	**-**	**-**	**4.81**	**-**	**0.12**	**-**	**-**	**0.55**	**-**	**-**	**-**	**0.40**	**4.81**	**-**
Working Capital																			
Working Capital	US$M		(1.32)	(0.41)	1.59	1.71	0.50	(1.39)	1.55	2.41	(0.16)	(1.64)	(1.01)	2.98	(0.60)	2.47	(0.68)	1.10	(4.53)

			Years																
Cashflow	**Unit**	**NPV**	**Y16**	**Y17**	**Y18**	**Y19**	**Y20**	**Y21**	**Y22**	**Y23**	**Y24**	**Y25**	**Y26**	**Y27**	**Y28**	**Y29**	**Y30**	**Y31**	**Y32**
Cashflow Before Tax			119.25	116.73	124.03	134.33	138.46	127.45	138.34	152.02	153.87	145.81	138.06	152.74	152.66	165.10	163.26	163.76	146.68
Cumulative Before-Tax Cashflow	US$M		2,063.47	2,180.21	2,304.23	2,438.56	2,577.02	2,704.47	2,842.81	2,994.83	3,148.70	3,294.51	3,432.57	3,585.31	3,737.97	3,903.07	4,066.33	4,230.10	4,376.77
NPV_8	US$M	8%	29.82	27.02	26.58	26.66	25.44	21.68	21.79	22.17	20.78	18.23	15.98	16.37	15.15	15.17	13.89	12.90	10.70
NPV_{10}	US$M	10%	21.43	19.06	18.41	18.13	16.99	14.21	14.02	14.01	12.89	11.10	9.56	9.61	8.73	8.58	7.72	7.04	5.73
NPV_{12}	US$M	12%	15.49	13.53	12.84	12.41	11.43	9.39	9.10	8.93	8.07	6.82	5.77	5.70	5.08	4.91	4.33	3.88	3.10
IRR																			
Cashflow After Tax			70.27	68.54	71.83	77.67	80.50	73.12	80.27	87.68	89.78	85.63	80.61	87.65	89.05	94.94	95.02	92.99	87.50
Cumulative After-Tax Cashflow	US$M		1,182.82	1,251.36	1,323.19	1,400.85	1,481.35	1,554.47	1,634.74	1,722.42	1,812.20	1,897.83	1,978.43	2,066.09	2,155.14	2,250.08	2,345.10	2,438.09	2,525.59
NPV_8	US$M	8%	17.57	15.86	15.39	15.41	14.79	12.44	12.64	12.79	12.12	10.70	9.33	9.39	8.84	8.72	8.08	7.32	6.38
NPV_{10}	US$M	10%	12.63	11.19	10.66	10.48	9.88	8.15	8.14	8.08	7.52	6.52	5.58	5.52	5.09	4.94	4.49	4.00	3.42
NPV_{12}	US$M	12%	9.13	7.95	7.43	7.18	6.64	5.39	5.28	5.15	4.71	4.01	3.37	3.27	2.97	2.82	2.52	2.20	1.85
IRR																			

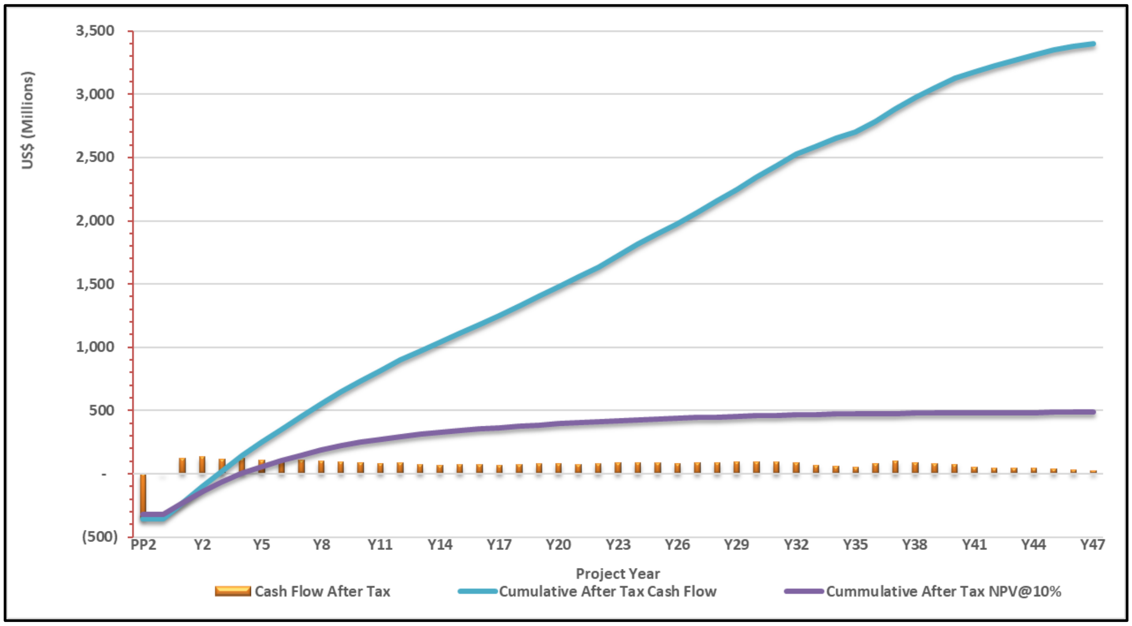
Table 22-3 Continued (Year 33 to Year 47)

			Years														
Cashflow	**Unit**	**NPV**	**Y33**	**Y34**	**Y35**	**Y36**	**Y37**	**Y38**	**Y39**	**Y40**	**Y41**	**Y42**	**Y43**	**Y44**	**Y45**	**Y46**	**Y47**
MINE PRODUCTION SCHEDULE																	
Mining																	
Direct Feed to Mill	kt		142	132	39	365	365	327	272	361	-	-	-	-	-	-	-
Mill Feed Stockpile	kt		-	4	-	6	2	6	0	12	-	-	-	-	-	-	-
Waste	kt		858	864	961	629	633	668	727	492	-	-	-	-	-	-	-
Total	**kt**		**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**865**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Strip Ratio	W:O		6.06	6.36	24.86	1.69	1.73	2.01	2.67	1.32	-	-	-	-	-	-	-
Processing																	
Direct Feed	kt		142	132	39	365	365	327	272	361	-	-	-	-	-	-	-
Direct Grade	% Mn		8.23	8.38	6.36	9.18	9.46	8.43	8.38	7.58	-	-	-	-	-	-	-
Reclaim Feed	kt		223	233	326	-	-	38	93	4	365	365	365	365	365	365	200
Reclaim Grade	% Mn		5.28	5.23	5.11	-	-	5.52	5.10	5.10	5.08	4.99	4.91	4.89	4.75	3.70	3.51
Total Feed	kt		365	365	365	365	365	365	365	365	365	365	365	365	365	365	200
Total Grade	% Mn		6.42	6.38	5.24	9.18	9.46	8.13	7.55	7.55	5.08	4.99	4.91	4.89	4.75	3.70	3.51
Total Contained Mn	Mn kt		23	23	19	34	35	30	28	28	19	18	18	18	17	13	7
Recovery	%		78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0
HPMSM	kt		57	57	47	82	84	72	67	67	45	44	44	43	42	33	17
Total Recovered Mn	Mn kt		18	18	15	26	27	23	21	22	14	14	14	14	14	11	5
Tailings	kt wet		369	370	382	340	337	351	357	357	384	385	386	386	387	399	219
CASHFLOW																	
Mn Selling Price	$/t Mn		9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063	9,063
Sales																	
HPMSM Sales	US$M		165.72	164.49	135.17	236.95	244.19	209.72	194.71	194.92	131.14	128.64	126.65	126.11	122.62	95.42	49.56
Sales Costs																	
Transport Cost	US$M		2.80	2.78	2.28	4.00	4.13	3.54	3.29	3.29	2.22	2.17	2.14	2.13	2.07	1.61	0.84
Selling Costs	US$M		8.29	8.22	6.76	11.85	12.21	10.49	9.74	9.75	6.56	6.43	6.33	6.31	6.13	4.77	2.48
Total Sales Costs	**US$M**		**11.09**	**11.00**	**9.04**	**15.85**	**16.34**	**14.03**	**13.03**	**13.04**	**8.77**	**8.61**	**8.47**	**8.44**	**8.20**	**6.38**	**3.32**
Royalty																	
Battery Hill Royalties	US$M		4.97	4.93	4.06	7.11	7.33	6.29	5.84	5.85	3.93	3.86	3.80	3.78	3.68	2.86	1.49
Revenue																	
Mn Revenue	US$M		149.67	148.55	122.07	213.99	220.53	189.40	175.84	176.04	118.43	116.18	114.37	113.89	110.74	86.18	44.75

			Years														
Cashflow	**Unit**	**NPV**	**Y33**	**Y34**	**Y35**	**Y36**	**Y37**	**Y38**	**Y39**	**Y40**	**Y41**	**Y42**	**Y43**	**Y44**	**Y45**	**Y46**	**Y47**
Operating Costs																	
Mining	US$M		7.09	7.46	7.42	7.12	7.12	7.12	7.12	7.05	2.44	2.45	2.44	2.44	2.44	2.45	2.44
Processing	US$M		34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	34.11	18.65
Filtered Residue Storage	US$M		1.67	1.67	1.69	1.69	1.70	1.69	1.69	1.69	1.69	1.70	1.69	1.69	1.69	1.70	1.69
G&A	US$M		2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	1.23
Total Operating Costs	**US$M**		**45.11**	**45.48**	**45.47**	**45.16**	**45.16**	**45.17**	**45.16**	**45.09**	**40.48**	**40.49**	**40.48**	**40.48**	**40.48**	**40.49**	**24.01**
Total Production Costs																	
Total Operating Costs	US$M		45.11	45.48	45.47	45.16	45.16	45.17	45.16	45.09	40.48	40.49	40.48	40.48	40.48	40.49	24.01
Lease Payment	US$M		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bond Cost on Balance	US$M		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Production Costs	**US$M**		**45.11**	**45.48**	**45.47**	**45.16**	**45.16**	**45.17**	**45.16**	**45.09**	**40.48**	**40.49**	**40.48**	**40.48**	**40.48**	**40.49**	**24.01**
Income from Operations																	
Net Revenue	US$M		149.67	148.55	122.07	213.99	220.53	189.40	175.84	176.04	118.43	116.18	114.37	113.89	110.74	86.18	44.75
Production Costs	US$M		45.11	45.48	45.47	45.16	45.16	45.17	45.16	45.09	40.48	40.49	40.48	40.48	40.48	40.49	24.01
Net Income Before Taxes	**US$M**		**104.56**	**103.08**	**76.61**	**168.83**	**175.36**	**144.23**	**130.68**	**130.94**	**77.95**	**75.69**	**73.89**	**73.40**	**70.26**	**45.69**	**20.75**
Taxes																	
New Brunswick Mining Tax	US$M		19.00	18.78	14.00	30.75	31.97	26.34	23.89	23.96	14.11	13.74	13.45	13.39	12.83	8.37	3.81
New Brunswick Income Tax	US$M		11.85	11.71	8.69	19.27	20.02	16.46	14.92	14.95	8.85	8.54	8.36	8.33	7.98	5.18	2.33
Canada Income Tax	US$M		12.70	12.54	9.31	20.64	21.45	17.64	15.98	16.02	9.48	9.15	8.96	8.92	8.55	5.55	2.50
Net Income After Taxes	**US$M**		**61.01**	**60.05**	**44.60**	**98.16**	**101.93**	**83.80**	**75.89**	**76.01**	**45.51**	**44.26**	**43.13**	**42.77**	**40.89**	**26.59**	**12.10**
Capital Cost																	
Initial & Sustaining	US$M		-	-	-	0.55	-	-	-	-	4.01	-	-	-	-	0.15	-
Reclamation & Closure	US$M		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salvage Value	US$M		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Cost	**US$M**		**-**	**-**	**-**	**0.55**	**-**	**-**	**-**	**-**	**4.01**	**-**	**-**	**-**	**-**	**0.15**	**-**
Working Capital																	
Working Capital	US$M		(6.23)	(0.18)	(4.35)	15.15	0.99	(5.03)	(2.23)	0.04	(8.94)	(0.33)	(0.30)	(0.08)	(0.55)	(4.00)	(9.17)

			Years														
Cashflow	**Unit**	**NPV**	**Y33**	**Y34**	**Y35**	**Y36**	**Y37**	**Y38**	**Y39**	**Y40**	**Y41**	**Y42**	**Y43**	**Y44**	**Y45**	**Y46**	**Y47**
Cashflow Before Tax			110.79	103.25	80.96	153.13	174.37	149.27	132.91	130.90	82.88	76.02	74.19	73.48	70.81	49.54	29.92
Cumulative Before-Tax Cashflow	US$M		4,487.56	4,590.81	4,671.77	4,824.90	4,999.27	5,148.54	5,281.44	5,412.35	5,495.23	5,571.25	5,645.43	5,718.92	5,789.73	5,839.27	5,869.19
NPV_8	US$M	8%	7.48	6.45	4.69	8.21	8.65	6.86	5.65	5.16	3.02	2.57	2.32	2.13	1.90	1.23	0.69
NPV_{10}	US$M	10%	3.93	3.33	2.38	4.08	4.23	3.29	2.66	2.38	1.37	1.14	1.01	0.91	0.80	0.51	0.28
NPV_{12}	US$M	12%	2.09	1.74	1.22	2.06	2.09	1.60	1.27	1.12	0.63	0.52	0.45	0.40	0.34	0.21	0.12
IRR	%		35.0														
Cashflow After Tax			67.24	60.22	48.95	82.46	100.93	88.83	78.11	75.97	50.44	44.59	43.42	42.85	41.44	30.44	21.28
Cumulative After-Tax Cashflow	US$M		2,592.83	2,653.05	2,702.00	2,784.46	2,885.40	2,974.23	3,052.34	3,128.31	3,178.75	3,223.35	3,266.77	3,309.62	3,351.06	3,381.51	3,402.78
NPV_8	US$M	8%	4.54	3.76	2.83	4.42	5.01	4.08	3.32	2.99	1.84	1.51	1.36	1.24	1.11	0.76	0.49
NPV_{10}	US$M	10%	2.39	1.94	1.44	2.20	2.45	1.96	1.56	1.38	0.83	0.67	0.59	0.53	0.47	0.31	0.20
NPV_{12}	US$M	12%	1.27	1.02	0.74	1.11	1.21	0.95	0.75	0.65	0.38	0.30	0.26	0.23	0.20	0.13	0.08
IRR	%		25.3														

Figure 22-3: Distribution of After-Tax Cashflows



Source: prepared by Wood, dated 2022

Table 22-4: Before-Tax Financial Results

Before-Tax Valuation Indicators	Unit	Value
Undiscounted cumulative cashflow	US$M	5,869
NPV_{10}	**US$M**	**933**
NPV_8	US$M	1,245
NPV_{12}	US$M	715
Payback period (from start of operations)	years	2.1
IRR before tax	%	35

Note: Base case is bolded.

Table 22-5: After-Tax Financial Results

After Tax Valuation Indicators	Unit	Value
Undiscounted cumulative cashflow	US$M	3,403
NPV_{10}	**US$M**	**486**
NPV_8	US$M	673
NPV_{12}	US$M	355
Payback period (from start of operations)	years	2.8
IRR	%	25

Note: Base case is bolded.

The PEA is preliminary in nature, and a portion of the Mineral Resources in the mine plan, production schedule, and cashflow include Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the PEA will be realized. Due to the conceptual nature of the PEA, none of the Mineral Resources in the PEA have been converted to Mineral Reserves and therefore do not have demonstrated economic viability.

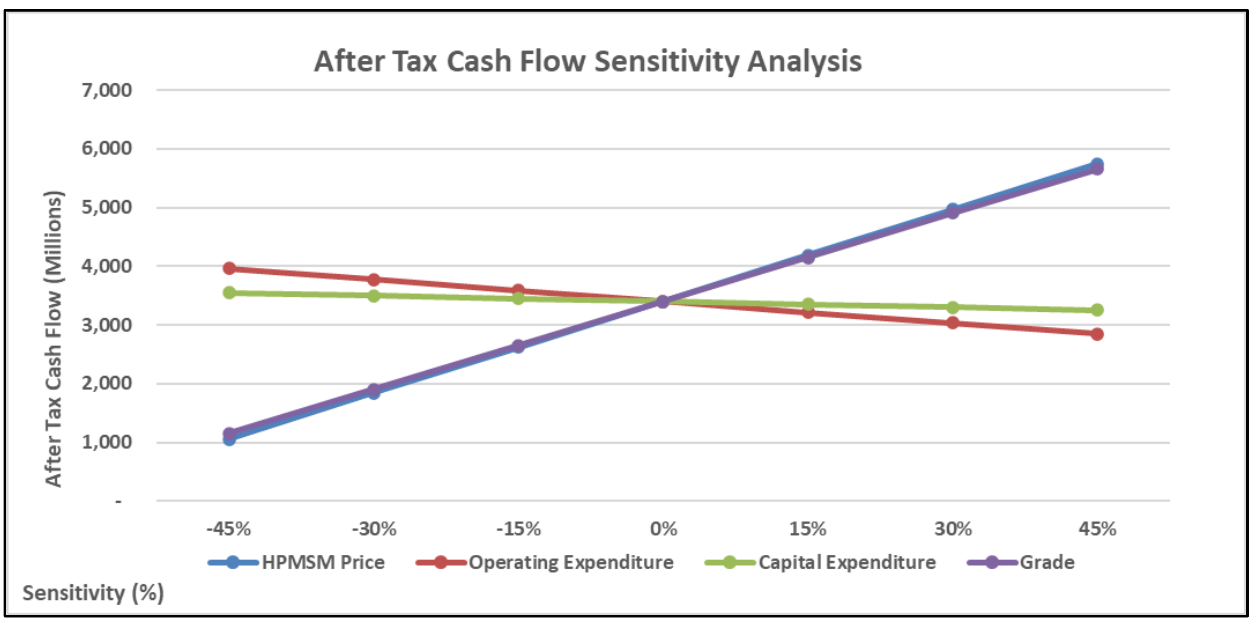
22.5 Sensitivity Analysis

A sensitivity analysis was completed for the Project's cashflow, NPV_{10}, and IRR over the ranges of ±45% for HPMSM selling price, grade, total capital, and operating cost and shown in the spider graphs in Figure 22-4, Figure 22-5, and Figure 22-6.

The Project is most sensitive to changes in manganese feed grade and HPMSM selling price, followed by changes to total capital costs and operating costs.

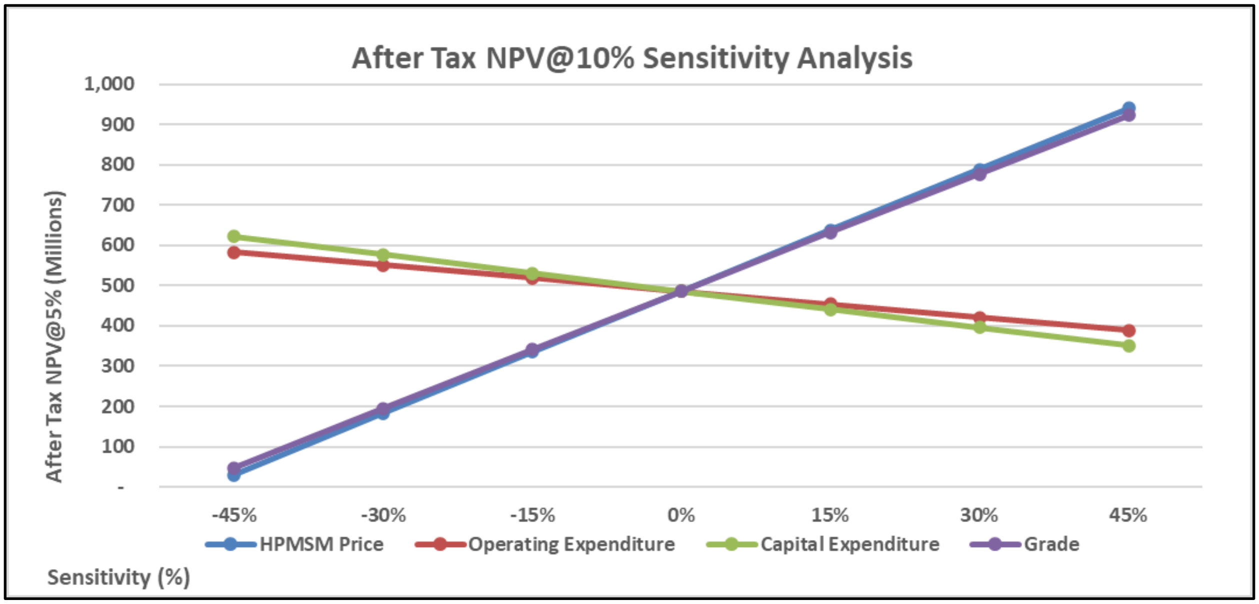
HPMSM prices have trended upward during 2021 and into 2022 and are a nascent industry with limited historical supporting data. As such, alternate pricing scenarios both above and below the base case HPMSM price are presented in Table 22-6.

Figure 22-4: After-Tax Cashflow Sensitivity



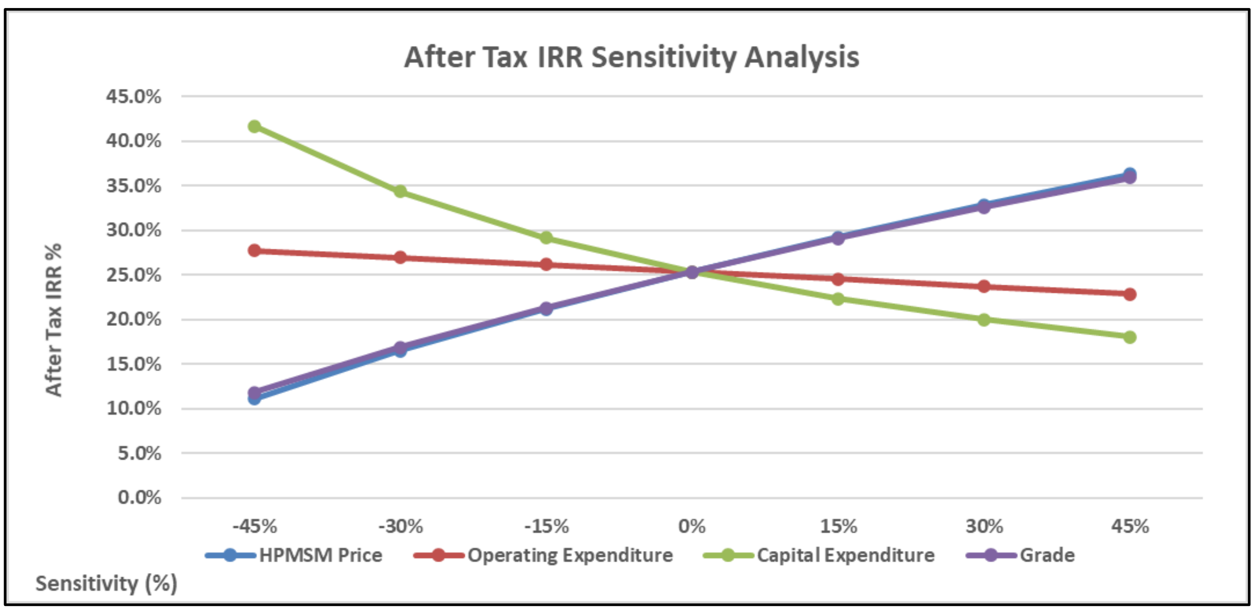
Source: prepared by Wood, dated 2022

Figure 22-5: After-Tax NPV_{10} Sensitivity



Source: prepared by Wood, dated 2022

Figure 22-6: After-Tax IRR Sensitivity



Source: prepared by Wood, dated 2022

Table 22-6: Alternate Metal Pricing Scenarios

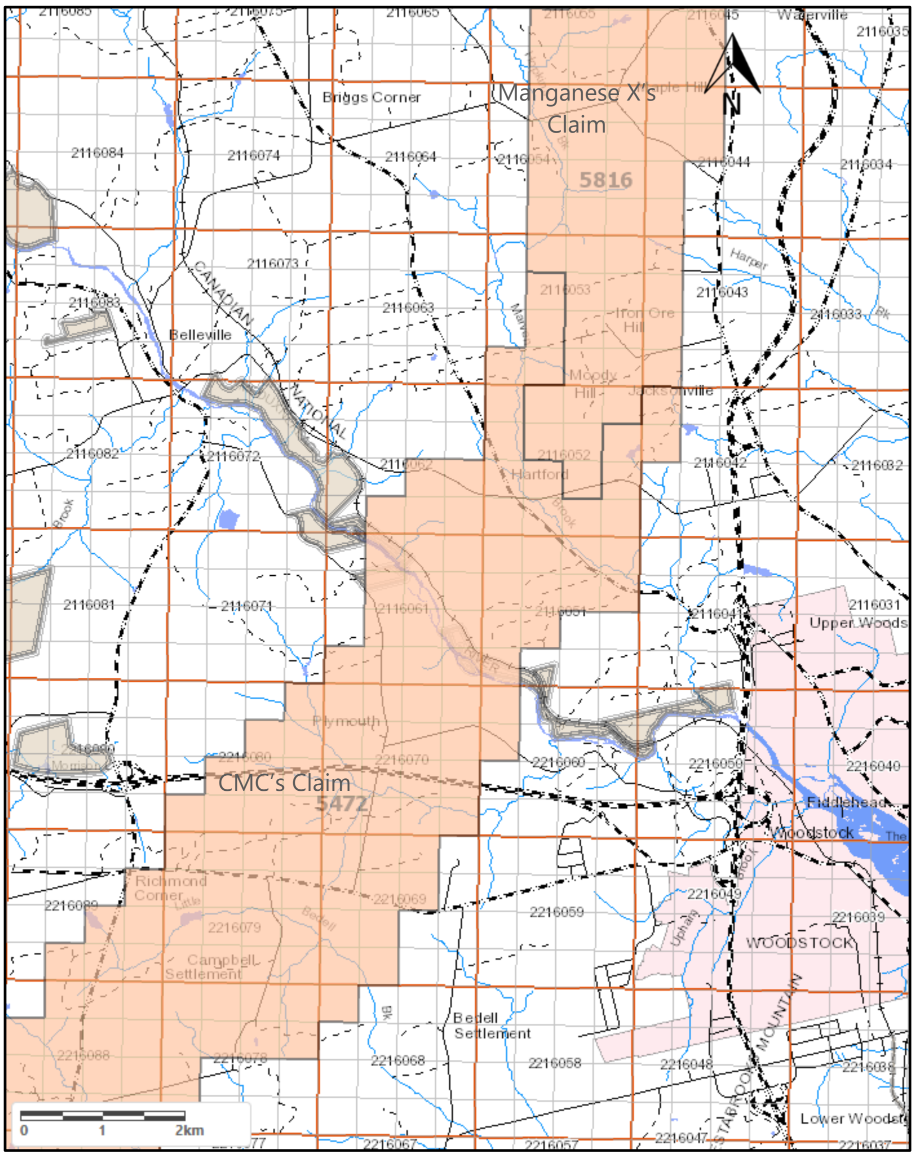
		HPMSM Price (US$/t)							
Metrics	**Unit**	**$1,400**	**$1,900**	**$2,400**	**$2,900 – Base Case[1]**	**$3,400**	**$3,900**	**$4,400**	**$4,200[2]**
Before-Tax Metrics									
Undiscounted Cashflow	US$M	1,483	2,945	4,407	**5,869**	7,331	8,793	10,255	9,670
NVP_8	US$M	168	527	886	**1,245**	1,604	1,963	2,322	2,178
NVP_{10}	US$M	77	363	648	**933**	1,218	1,503	1,789	1,675
NVP_{12}	US$M	14	248	481	**715**	948	1,181	1,415	1,321
IRR	%	13%	21%	28%	**35%**	41%	47%	52%	50%
Payback Period	years	6.2	3.7	2.7	**2.1**	1.7	1.5	1.3	1.4
After-Tax Metrics									
Undiscounted Cashflow	US$M	849	1,702	2,552	**3,403**	4,254	5,104	5,955	5,615
NVP_8	US$M	45	257	465	**673**	880	1,088	1,296	1,212
NVP_{10}	US$M	(13)	156	321	**486**	651	815	980	914
NVP_{12}	US$M	(54)	85	220	**355**	489	624	759	705
IRR	%	10%	16%	21%	**25%**	30%	34%	37%	36%
Payback Period	years	7.2	4.5	3.4	**2.8**	2.4	2.1	1.9	1.9

Note: (1) Base case $2,900/t HPMSM price is a risk managed price used for the PEA study.
(2) $4,200/t HPMSM represents long-term market price estimate from CPM.

23.0 ADJACENT PROPERTIES

The Project is located directly adjacent to CMC's Woodstock Manganese property comprising Mineral Claim 5472 sharing Mineral Claim borders to the south of Manganese X's Mineral Claim 5816 (Figure 23-1). According to the PEA reported in their 2014 technical report (Kesavanathan et al., 2014) Mineral Claim 5472 consists of 232 mineral claims and includes the Plymouth deposit and most of the Hartford manganese-iron deposit.

Figure 23-1: Claim Boundaries

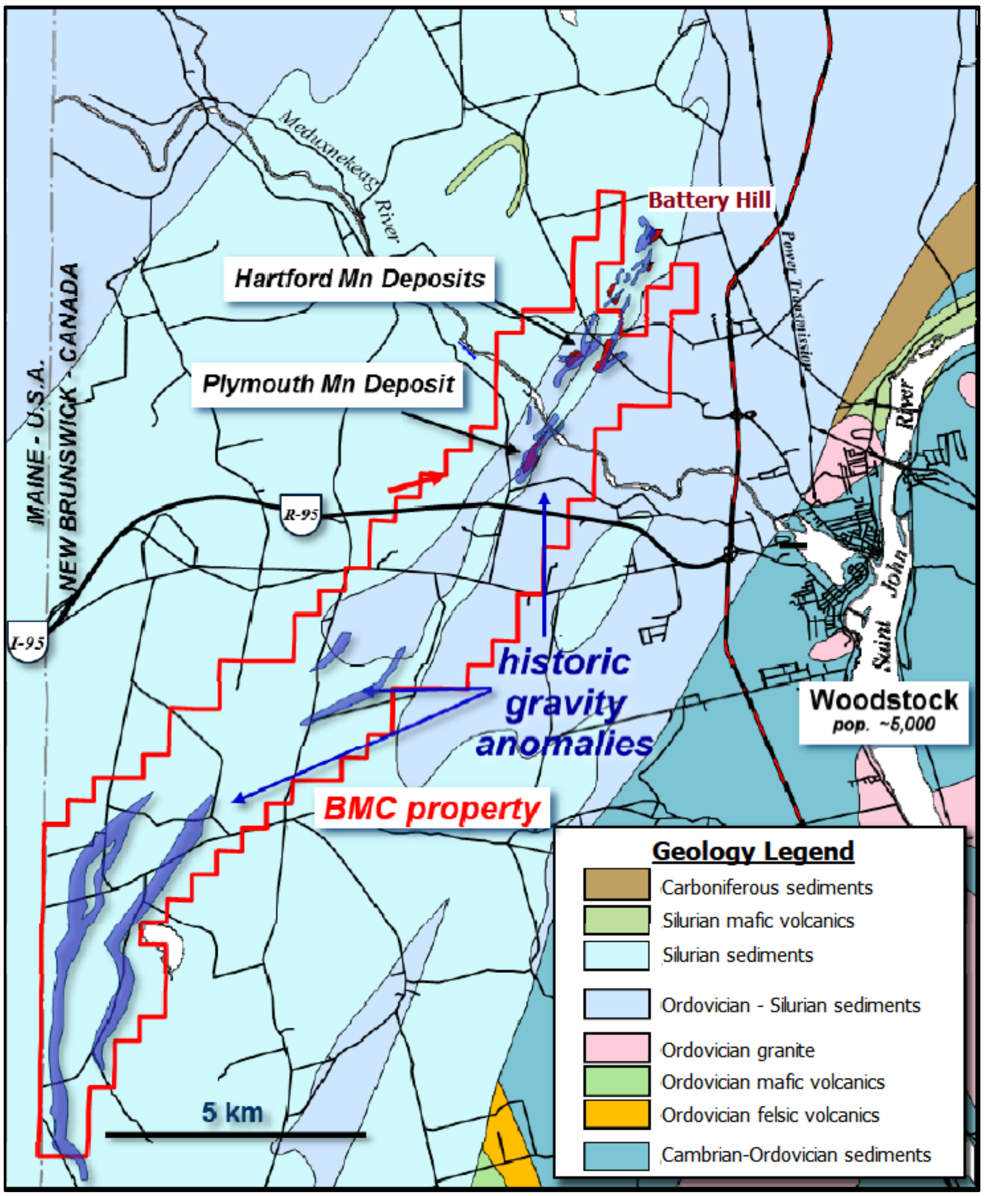


Source: modified after nbeclaims.gnb.ca, 2022

23.1 Geological Characteristics

CMC's Plymouth deposit for which the 2014 PEA is based is located approximately 4 km south of Manganese X's Mineral Claim 5816 as demonstrated by Figure 23-2. The qualified person has been unable to verify the information and that the information is not necessarily indicative of the mineralization on the Battery Hill property that is the subject of this Report.

Figure 23-2: Woodstock Property Claims



Source: after Kesavanathan et al., 2014

24.0 OTHER RELEVANT DATE AND INFORMATION

This section is not relevant to this Report.

25.0 INTERPRETATIONS AND CONCLUSIONS

25.1 Summary

The QPs note the following interpretations and conclusions in their respective areas of expertise, based on the review of data available for this Report.

25.2 Mineral Tenure, Surface Rights, Royalties

Manganese X has provided expert information pertaining to the mineral tenure and property agreements that supports the assumptions used in this Report.

25.3 Geology and Mineralization

The Project covers the northern portion of a belt of Silurian, stratiform manganese-iron mineralization hosted by the Smyrna Mills Formation, as well as a small portion of the belt's southern extent. Three principal host rocks characterize the mineralization, these being brick-red to maroon-coloured siltstones, green-grey to black siltstones, and a banded mix of the red and grey siltstones. These three types of mineralized siltstones have been termed Red, Grey, and Mixed for current purposes and are directly comparable to similar mineralized sequences that have been described in detail with respect to the CMC's Plymouth manganese-iron deposit, located approximately 5 km south of the Battery Hill deposit on the adjacent exploration property.

25.4 Data Collection in Support of Mineral Resource Estimation

Exploration to date has delineated mineral occurrences on the property including Moody Hill, Sharpe Farm, Iron Ore Hill (Battery Hill deposit), and Maple and Wakefield to the north. A total of 55 diamond drill holes (10,056 m) have been completed on the Battery Hill deposit with drilling procedures consistent with industry standards.

Sampling, logging, core recovery and collar and downhole survey data collected are consistent with industry standards and adequately support Mineral Resource estimation.

Independent, accredited laboratories prepared samples and conducted analytical methods for manganese and iron. The QP authors found the quality of the analytical results sufficiently reliable to support their use in the Mineral Resource estimation.

As part of site visits conducted in 2020 and 2021, QP author P. Ténière confirmed the presence of manganese mineralization in drill core and that it is accurately reflected in drill logs, that the

Manganese X core logging and storage facility is well organized with proper QAQC procedures in place and collected independent witness samples for check sampling. The QP authors confirm that the drill hole database is acceptable for Mineral Resource estimation.

25.5 Mineral Resources

The Mineral Resource estimate for the Battery Hill deposit is based on validated results of 55 diamond drill holes totaling 10,056 m of drilling.

The Mineral Resources were estimated in conformity with CIM Estimation of Mineral Resource and Mineral Reserves Best Practices Guidelines and are reported in accordance with NI 43-101. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.

Mineral Resources are reported using a 1.5% Mn cut-off grade, metallurgical recovery and long-range HPMSM price, operating costs, including mining, processing, G&A costs, stockpile reclaim costs, closure costs, shipping costs and royalties.

Factors that may materially impact the Project Mineral Resource include, but are not limited to, the following:

- Changes to the long-term HPMSM price assumptions including unforeseen long-term negative market pricing trends and changes to the CA$:US$ exchange rate
- Changes to the deposit scale interpretations of mineralization geometry and continuity
- Variance associated with density assignment assumptions and/or changes to the density values applied
- Inaccuracies of deposit modelling and grade estimation programs with respect to actual metal grades and tonnages contained within the deposit
- Changes to the input values for mining, processing, and G&A costs to constrain the Mineral Resource
- Changes to metallurgical recovery assumptions including metallurgical recoveries that fall outside economically acceptable ranges
- Variations in geotechnical, hydrological, and mining assumptions
- Changes in the assumptions of marketability of the final product
- Issues with respect to mineral tenure, land access, land ownership, environmental conditions, permitting, and social license.

25.6 Metallurgical Testwork and Mineral Processing

Aspects of the process flowsheet for the Project are novel, although individual process unit operations are well established. The metallurgical testwork performed to-date and the preliminary simulation of the process supports the current flowsheet. Further bench scale and pilot plant testwork is necessary to refine the flowsheet, develop design data for the respective unit operations and demonstrate that HPMSM can be produced at a consistent quality and in sufficient quantities for testing by prospective end users.

For material represented by the Moody Central composite, testwork to-date has identified practical and reagent efficient conditions for leaching and product purification. For other resource materials the database is small. For resource definition, additional variability testwork is required on samples that represent the mineralization included in the current mine plan, with emphasis on the mineralization that will be mined in the early years of production.

25.7 Mine Plan

The PEA mine plan has been partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves and there is no certainty that the PEA based on these Mineral Resources will be realized.

Material will be mined from six pits, two each from Moody Hill, Sharpe Farm and Iron Ore Hill using contract mining over a 40-year mine production life with a two-year pre-production period and seven years of stockpile reclaim feed. Approximately 28% of the mill feed tonnage and 30% of the manganese contained metal tonnage is in the Inferred category.

25.8 Infrastructure

The site requires the development of infrastructure including an access road from Highway 560 to the east, a crushing facility, process plant, process and mine ancillary buildings, ROM stockpile, WRSFs, FRSA, collection ditches and sedimentation ponds. It is anticipated that water supply needs can be obtained by drilling wells onsite and from in-pit dewatering. Offsite infrastructure will include approximately 2 km extension off NBPower’s 69 kV transmission line located just east of the Trans Canada Highway.

25.9 Markets and Contracts

A current commodity market research report on high purity manganese including HPMSM was obtained by an independent research and consultancy company recognized as an expert in generating commodity reports of this nature. The analysis provided a long-term price forecast based on supplying North American and European markets. Further, a risk managed base case price was provided and used for establishing the Mineral Resource statement, the mine plan and the economic analysis for this PEA. The research indicated a world supply-demand deficit of high purity manganese beginning in 2023 and increasing substantially by 2035 showing the market capacity will be able to absorb the planned production from Battery Hill.

The QP has reviewed the current marketing studies and analyses, and directly engaged with the lead author of the commodity research reports. As a result, the QP considers the information as an acceptable basis for the HPMSM price assumptions used in the PEA and the basis for gaining a share of HPMSM market to place Battery Hill's mine production.

25.10 Capital and Operating Costs

The Project's pre-production capital cost estimate is $438 million with sustaining costs totalling $27.2 million over the LOM. The total Project capital inclusive of initial and sustaining is estimated at $465.2 million.

The operating costs over the LOM are estimated at $2,597.1 million, equivalent to $152.86/t.

25.11 Economic Analysis

The PEA study represents forward-looking information, including the Mineral Resource estimates in the PEA mine plan and the cash flows derived from them, HPMSM prices used, capital and operating cost estimates, estimated HPMSM production, and payback period. Actual results may vary from the forward-looking information with the Mineral Resource estimates, costs, HPMSM prices, metallurgical recoveries, and taxes being different from what was assumed for the PEA.

Under the assumptions presented in this Report, the Project generates positive after-tax results. The after-tax NPV_{10} is $486 million with an IRR of 25% and an after-tax payback of 2.8 years.

The Project is most sensitive to changes in manganese feed grade and HPMSM selling price, followed by changes to total capital costs and operating costs.

25.12 Environmental, Permitting and Social Considerations

The project is located on private land within a mixed landscape including mature forest, rural residences, and agricultural land. Access to transportation routes is good.

About six major permits will be required prior to construction and operations.

Initial environmental surveys have been conducted by GHD limited to broadly characterize the mining claim area and commence surface water quality monitoring. Additional environmental studies are required to support multiple permit applications. The study requirements will be verified following the development of a detailed design footprint and project description. Some studies can be planned based on the conceptual design and may be conducted imminently.

One environmental concern has been identified; the possible presence of Butternut, a species at risk protected by federal regulation. Its presence or absence must be field verified and, if present, appropriate mitigation is required. No other key environmental concerns have been identified at this stage.

Post mining land use objectives will need to meet landowner and regulatory expectations, meaning mainly "safe and stable" site conditions.

A public and stakeholder consultation program will be required as part of the EIA process, including a public open house, letters to potentially effected landowners, and First Nations engagement. All stakeholder concerns will be recorded, with responses, for the regulator.

25.13 Opportunities

Opportunities have been identified that have the potential to significantly improve project economics.

- Alternative acid generation options have been identified. These options should be explored as there is a potential to significantly reduce capital costs.
- The results from previous beneficiation testing suggests that this area should be re-evaluated, magnetic separation in particular. There is a potential to reduce reagent costs significantly from a relatively moderate capital investment.
- With detailed waste rock storage planning, the footprint of the WRSFs could be reduced.
- By geotechnically characterizing the leach residue and considering ways to compact the placed leach residue to increase its dry density, the volume of the FRSA could be reduced.
- Should mining of Moody Hill Pit 2 be accelerated, placement of leach residue could commence sooner and thus reducing the footprint of the FRSA.

25.14 Risks

- Community engagement is at an early stage and there is uncertainty regarding what is necessary for obtaining a social license to develop a mine.
- Footprint for establishing the project infrastructure will require agreements from local landowners and adjacent mineral title holder, which is at an early stage of assessment.
- Interpretation of the property agreements may be different to what has been assumed for the study.
- Assumptions regarding supply demand forecasts for HPMSM, market entry strategy and HPMSM price may not be realized because of supply chain constraints.
- The geological interpretation and assumptions on grade continuity based on limited drilling may change with more detailed drilling.
- There may be unrecognized metallurgical variability that could change the mine plan, metallurgical recoveries and/or process costs.
- The degree of saturation of leach residue is currently based on the mineralization’s specific gravity and residue moisture content and is close to 90% which may pose problems in placement and movement of equipment in the FRSA.
- Should mining of Moody Hill Pit 2 not be completed by Year 24, the capacity of the FRSA would require enhancement by raising the perimeter waste rock buttress and increased costs.
- The potential presence of species at risk Butternut trees in the project footprint could be an issue of high concern to regulators and stakeholders. The existing survey was limited to the Moody Hill ESA. Should a more exhaustive survey uncover the presence of Butternut trees, the path to permitting is uncertain and could be a cause of delay and/or require design modifications to mitigate impacts. Avoidance is the first preference. Other forms of mitigation (such as transplantation) would need to be negotiated with regulators.

26.0 RECOMMENDATIONS

26.1 Summary

Recommendations have been broken into two phases with Phase 1 addressing items such as drilling, testwork and studies required to complete Phase 2, a pre-feasibility study. Phase 1 recommendations have been estimated to cost $3.7 million while Phase 2 (pre-feasibility study) has been estimated to cost $1.7 million.

26.2 Royalty Obligations

It is recommended that the parties to the Option Agreement seek a definitive third-party interpretation of the GMR or otherwise renegotiate Section 5.4 of the Option Agreement to resolve the significant ambiguity that exists regarding the calculation and payment of the GMR as well as any other ambiguous terms.

Total estimated cost is $50,000.

26.3 Geology and Mineral Resources

The following activities are recommended to improve confidence in the geological interpretation and definition of Mineral Resources:

- An infill core drilling program of 3,500 m directed towards upgrading Inferred Mineral Resources located in the Moody Hill, Sharpe Farm, and Iron Ore Hill areas to the Indicated and Measured categories
- Developing custom representative CRM samples based on mineralized samples from the property by a commercial laboratory for use in future diamond drilling programs. This should help reduce the large variability in CRM assay results noted in the previous diamond drilling programs.
- Collecting representative pulp duplicates or coarse rejects from the 2017 and 2020 drill program for testing at an umpire laboratory (third-party testing) for duplicate analysis and check sampling purposes. This method should be incorporated into the QAQC protocol and utilized for all future drilling programs on the Project.
- An updated Mineral Resource estimate for the Project inclusive of the recommended drill program results.

Total estimated cost is $750,000.

26.4 Mining

The following mining studies are recommended for the next phase of study:

- A labour and housing survey to determine availability to attract and house employees in the area compared to sourcing employees from surrounding areas. This may affect mine shift schedules and should feed into a trade-off study for contract mining versus Owner mining.
- Drill and blast study to determine optimal blast pattern to achieve the size distribution for the primary crusher's product
- A study to evaluate the potential to reduce waste rock facility storage and/or filtered residue by reviewing backfill scheduling
- Geotechnical characterization of Battery Hill rock mass quality to refine pit slopes recommendations
- Targeting study incorporating multiple financial model scenarios to evaluate increased production tonnage and processing capacity operating scenarios.

Total estimated cost is $250,000.

26.5 Metallurgical

For resource definition, additional variability testwork is required on samples that represent the mineralization included in the current mine plan, with emphasis on the mineralization that will be mined in the early years of production.

Regarding further process development, key areas for ongoing testwork are considered to include:

- A repeat beneficiation program followed by leach a test of beneficiated products to determine reagent requirements. A review of previously reported results suggests that costs savings associated with magnetic separation are potentially significant.
- Further evaluation and refinement of leaching parameters to improve recovery and increase manganese concentrations in leach liquor
- Further definition of leach solution purification, starting with the neutralization which may be optimized for both recovery and impurity rejection.
- Crystallization optimization will be critical for product purity and recovery. Many variables remain to be investigated

- Solid-liquid separation testing to provide a database for definition of the most suitable technologies for each unit operation
- Locked-cycle testing on leach and neutralization, purification, crystallization and bleed processing
- Bulk sample comprising of six drill holes totalling 850 m
- Pilot plant testing to demonstrate the process and generate sufficiently large HPMSM samples for end-user testing.

Total estimated cost is $1,450,000.

26.6 Rock Mechanics

The following activities are recommended for further development of the open pit design:

- Additional core drilling totalling 300 m at strategic locations around the proposed pit to obtain a better understanding of the structural features that could affect slope stability
- Structural joint analysis and rock mass characterization with the completion of oriented core logging, geo-mechanical logging and starter pit mapping
- Laboratory testing to support open pit slope design including unconfined compression strength tests, confined triaxial tests, tensile test by the Brazilian indirect methods and direct shear strength tests.

Total estimated cost is $250,000.

26.7 Hydrogeology

The following activities are recommended to gain preliminary insight on the hydrogeological regime for the proposed mine site:

- Drilling of test holes to determine groundwater levels near the proposed pits and near the closest residential wells
- Carry out a pumping test to determine potential quantities of groundwater available for a water supply
- Assess the changes in groundwater levels during the pumping test to advance dewatering requirements.

Total estimated cost is: $150,000.

26.8 Geotechnical

The following tasks are recommended to advance the design of the FRSA:

- Completion of laboratory tests on representative samples of the leach residue including specific gravity, gradation envelopes, optimum moisture content and maximum dry density and shear strength
- Geotechnical investigations involving drill holes, trial pits, monitoring instrumentation, sampling and laboratory testing to understand the soil stratigraphy, index properties, groundwater levels/seasonal variations and potential for foundation soil liquefaction.

Total estimated cost is $230,000.

26.9 Water Management

The following information will be required prior to the development of the detailed water management design:

- Identification of depth to bedrock in general site area for ditching purposes
- Generation of site contour to latest Lidar mapping
- Collection of site-specific rainfall data.

Total estimated cost is $30,000.

26.10 Environmental, Permitting and Social and Community Impact

Further onsite surveys and studies will be required to complete applications like the EIA registration and other permit applications. As part of the next phase of project development typical study requirements are recommended below that will gather baseline information:

- Air/noise baseline monitoring (should consider multiple monitoring events to capture several seasons)
- Aquatic habitat surveys (may include fish population study – electrofishing)
- Wetland delineation
- Vegetation surveys (1 spring and 1 summer) for rare plants and general habitat
- Archaeological background study (desktop research). This requires a site-specific license, plus a separate “license report” directly to the regulator when the report has been completed. Report will include recommendations for a follow-up field program.
- Supplementary bird/bat monitoring (recording devices)

- First Nations engagement to identify Indigenous community concerns and current use of traditional lands or areas of cultural significance.

The ultimate EIA scope is subject to regulatory consultation so there is some uncertainty what they will consider is needed. The surface water monitoring (by GHD) seems adequate, but the other environmental studies are linked to the Project footprint which currently extends beyond the site investigations conducted by GHD to date, particularly extremities outside the mining claim area.

It should be noted that these recommended surveys should be planned based on a relatively final project design and footprint. The current design is a preliminary conceptual project description, and any changes can have a significant effect on the cost of various field investigations (higher or lower) or fall short of ultimate project requirements. In light of this potential for inaccuracy, it is recommended that the field program be conducted in 2023, following the early planning phase of the project and finalization of the general scope (production rate, approach to facility layout, etc.) and refinement of the Project footprint to a level of high confidence.

Total estimated cost is $70,000.

26.11 Summary of Costs

Estimated costs for completing work recommended in this section is summarized in Table 26-1.

Table 26-1: Estimated Costs for Recommended Work Programs

Item	Cost ($000s)
Phase 1	
Royalty obligations	50
Geology and Mineral Resources	750
Mining	250
Metallurgical	1,450
Rock mechanics	250
Hydrogeology	150
Geotechnical	230
Water management	30
Environmental	70
Contingency (15%)	485
Total Phase 1	**3,715**
Phase 2	
Pre-feasibility study	1,500
Contingency (15%)	225
Total Phase 2	**1,725**
Grand Total	**5,440**

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