Graphite Creek Project

NI 43-101 Technical Report and Feasibility Study

Seward Peninsula, Alaska

Effective Date: March 25, 2025

Submitted by:
Barr Engineering Co.
170 South Main Street, Suite 500
Salt Lake City, UT 84101

Prepared for:
Graphite One Inc.
777 Hornby Street, Suite 600
Vancouver, BC V6Z 1S4

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Graphite One

HATCH

Alaska Earth Sciences

Important Notice

This Report was prepared for Graphite One, Inc. by the qualified persons (QPs) identified in the Report's Date and Signature Page.

This Report contains estimates, projections, and conclusions that are forward-looking information within the meaning of applicable securities laws. Forward-looking statements are based upon the responsible QPs opinion at the time that they are made but, in most cases, involve significant risk and uncertainty.

Although each of the responsible QPs has attempted to identify factors that could cause actual events or results to differ materially from those described in this Report, there may be other factors that cause events or results to not be as anticipated, estimated or projected. None of the QPs undertake any obligation to update the forward-looking information.

As permitted by Item 3 of Form 43-101F1, the QPs have, in the preparation of this Report, relied upon certain reports, opinions and statements of certain experts. These reports, opinions, and statements, the makers of each such report, opinion, or statement and the extent of reliance are described in Chapter 3 of this report. Each of the QPs hereby disclaims liability for such reports, opinions, and statements to the extent that they have been relied upon in the preparation of this Report, as described in Chapter 3.

This Report is intended to be used by Graphite One, Inc., subject to the terms and conditions of its contracts with each of the QPs. Except for the purposes legislated under Canadian provincial and territorial securities law, any use of, or reliance on, this Report by any third party is at that party's sole risk.

Date and Signature Page

This technical report and feasibility study is effective as of the 25th day of March, 2025.

Original signed and sealed on file	April 22, 2025
Jason Todd, QP Barr Engineering Co.	Date
Original signed and sealed on file	April 22, 2025
Chotipong Somrit, QP Barr Engineering Co.	Date
Original signed and sealed on file	April 22, 2025
Jedediah Greenwood, PE Barr Engineering Co.	Date
Original signed and sealed on file	April 22, 2025
Scott Phillips, PE Barr Engineering Co.	Date
Original signed and sealed on file	April 22, 2025
Daniel R. Palo, PE Barr Engineering Co.	Date
Original signed and sealed on file	April 22, 2025
Jon Godwin, P. Eng. Hatch Ltd.	Date
Original signed and sealed on file	April 22, 2025
Arlene P. Dixon, PE Hatch Ltd.	Date
Original signed and sealed on file	April 22, 2025
Robert M. Retherford, QP Alaska Earth Sciences, Inc.	Date

Certificate of Qualified Person

Jason N. Todd, QP

This certificate applies to the NI 43-101 technical report titled, *“Graphite Creek Project Feasibility Study”* (the “Technical Report”), that has an effective date of March 25, 2025 (the “Effective Date”).

I, Jason N. Todd, QP, do hereby certify that:

1. I am a Senior Mining Engineer with Barr Engineering Co., 170 S. Main St., Suite 500, Salt Lake City, Utah, 84111 USA.
2. I attended Montana Tech of the University of Montana where I earned a Bachelor of Science degree in Mining Engineering in 1998.
3. I am a Qualified Professional Member of the Mining and Metallurgical Society of America, Member No. 1414QP. I am a “qualified person” for the purposes of National Instrument 43-101.
4. I have worked continuously as a mining engineer for 28 years, since graduating from college/university, for mining companies and as a consultant specializing in multiple commodities including industrial minerals, base and precious metals, critical minerals and coal.
5. I have read the definition of “qualified person” set out in the National Instrument 43-101 – Standards of Disclosure for Mineral Projects (“NI 43-101”) and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, in my opinion, I fulfill the requirements to be a “qualified person” for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101
7. I am responsible for preparing Chapters 2, 3, 4, 5, and 23. I am also co-author and responsible for Chapters 1, 19, 20, 24, 25, 26, and 27.
8. I personally inspected the Graphite Creek Project site on August 12th, 13th, and 14th of 2024.
9. I have had no prior involvement with the Graphite Creek Project.
10. I have read NI 43-101 and the Technical Report, in my opinion, has been prepared in compliance with the instrument.
11. As of the effective date of the Technical Report, to the best of my knowledge, information, and belief, the sections of the Technical Report for which I am responsible contain all the scientific and technical information that is required to be disclosed, to make the portions of the Technical Report for which I am responsible, not misleading.

Signed and sealed this 22 day of April 2025.

“ORIGINAL SIGNED AND SEALED BY AUTHOR AND ON FILE”

Jason N. Todd, QP

Senior Mining Engineer, Barr Engineering Co.

BARR

Certificate of Qualified Person

Chotipong Somrit, QP

This certificate applies to the NI 43-101 technical report titled, *“Graphite Creek Project Feasibility Study”* (the “Technical Report”), that has an effective date of March 25, 2025 (the “Effective Date”).

I, Chotipong Somrit, QP, do hereby certify that:

1. I am a Senior Mining Engineer with Barr Engineering Co., 170 S. Main St., Suite 500, Salt Lake City, Utah, 84111 USA.
2. I attended Chiang Mai University where I earned a Bachelor of Engineering degree in Mining Engineering in 1998.
3. I attended Colorado School of Mines where I earned a Master of Science degree in Mining and Earth Systems Engineering in 2006 and a Doctor of Philosophy degree in Mining and Earth Systems Engineering in 2011.
4. I am a Qualified Professional Member of the Mining and Metallurgical Society of America, Member No. 04152149. I am a “qualified person” for the purposes of National Instrument 43-101.
5. I have worked continuously as a mining engineer for 25 years, since graduating from college/university, for public sector and mining companies and as a consultant specializing in multiple commodities including industrial minerals, base and precious metals, critical minerals and coal.
6. I have read the definition of “qualified person” set out in the National Instrument 43-101 – Standards of Disclosure for Mineral Projects (“NI 43-101”) and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, in my opinion, I fulfill the requirements to be a “qualified person” for the purposes of NI 43-101.
7. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101
8. I am responsible for preparing Chapters 15, 16 (except Sections 16.4 and 16.5), 21, and 22.
9. I personally inspected the Graphite Creek Project site on August 12th, 13th, and 14th of 2024.
10. I have had no prior involvement with the Graphite Creek Project.
11. I have read NI 43-101 and the Technical Report, in my opinion, has been prepared in compliance with the instrument.
12. As of the effective date of the Technical Report, to the best of my knowledge, information, and belief, the sections of the Technical Report for which I am responsible contain all the scientific and technical information that is required to be disclosed, to make the portions of the Technical Report for which I am responsible, not misleading.

Signed and sealed this 22 day of April 2025.

“ORIGINAL SIGNED AND SEALED BY AUTHOR AND ON FILE”

Chotipong Somrit, QP

Senior Mining Engineer, Barr Engineering Co.

Certificate of Qualified Person

Daniel R. Palo, PhD, P.Eng., PE

This certificate applies to the NI 43-101 technical report titled, *"Graphite Creek Project Feasibility Study"* (the "Technical Report"), that has an effective date of March 25, 2025 (the "Effective Date").

I, Daniel R. Palo, PE, do hereby certify that:

1. I am a Senior Process Engineer with Barr Engineering Co., 170 S. Main St., Suite 500, Salt Lake City, Utah, 84101, USA.
2. I attended the University of Minnesota where I earned a Bachelor of Science degree in Chemical Engineering in 1994; and the University of Connecticut where I earned a PhD in Chemical Engineering in 1999.
3. I am a Professional Chemical Engineer in 16 US states, including Minnesota License No. 52715, and two Canadian provinces, and work predominantly in mining. I am a "qualified person" for the purposes of National Instrument 43-101.
4. I have worked continuously as a chemical engineer for 25 years, since graduating from college/university, predominantly in mineral and chemical processing specializing in multiple commodities including industrial minerals, base and precious metals, critical minerals, and coal.
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, in my opinion, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101
7. I am responsible for preparing Chapter 13 and Section 17.1.
8. I personally inspected the Graphite Creek Project site on August 12, 13, and 14 of 2024.
9. I have had no prior involvement with the Graphite Creek Project.
10. I have read NI 43-101 and the Technical Report, in my opinion, has been prepared in compliance with the instrument.
11. As of the effective date of the Technical Report, to the best of my knowledge, information, and belief, the sections of the Technical Report for which I am responsible contain all the scientific and technical information that is required to be disclosed, to make the portions of the Technical Report for which I am responsible, not misleading.

Signed and sealed this 22 day of April 2025.

"ORIGINAL SIGNED AND SEALED BY AUTHOR AND ON FILE"

Daniel R. Palo, PhD, P.Eng., PE

Senior Process Engineer, Barr Engineering Co.

Certificate of Qualified Person

Jedediah D. Greenwood, PE

This certificate applies to the NI 43-101 technical report titled, *"Graphite Creek Project Feasibility Study"* (the "Technical Report"), that has an effective date of March 25, 2025 (the "Effective Date").

I, Jedediah D. Greenwood, PE, do hereby certify that:

1. I am a Senior Geotechnical Engineer with Barr Engineering Co., 4300 MarketPointe Blvd, Suite 200, Minneapolis, MN, 55435 USA.
2. I attended the University of Minnesota-Twin Cities where I earned a Bachelor of Engineering degree in Geological Engineering in 2001.
3. I attended Massachusetts Institute of Technology where I earned a Master of Engineering degree in Civil Engineering (Geotechnical) in 2003.
4. I am licensed as a Professional Engineer in the state of Alaska, PE No. AELC12848. I am a "qualified person" for the purposes of National Instrument 43-101.
5. I have worked continuously as a geotechnical engineer for 21 years, since graduating from college/university, as a consultant for open pit mines and tailings storage facilities for multiple commodities including industrial minerals, base and precious metals, critical minerals and coal.
6. I have read the definition of "qualified person" set out in the National Instrument 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, licensure, and past relevant work experience, in my opinion, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
7. I am independent of the issuer applying all of the tests in Section 1.5 of NI 43-101
8. I am responsible for preparing Sections 16.4, 16.5, 18.1.7.1, and 18.1.9.
9. I personally inspected the Graphite Creek Project site on September 21st, 2023, and June 13th-22nd, 2024.
10. I have had no prior involvement with the Graphite Creek Project.
11. I have read NI 43-101 and the Technical Report, in my opinion, has been prepared in compliance with the instrument.
12. As of the effective date of the Technical Report, to the best of my knowledge, information, and belief, the sections of the Technical Report for which I am responsible contain all the scientific and technical information that is required to be disclosed, to make the portions of the Technical Report for which I am responsible, not misleading.

Signed and sealed this 22 day of April 2025.

"ORIGINAL SIGNED AND SEALED BY AUTHOR AND ON FILE"

Jedediah D. Greenwood, PE

Senior Geotechnical Engineer, Barr Engineering Co.

BARR

Certificate of Qualified Person

Scott A Phillips, PE

This certificate applies to the NI 43-101 technical report titled, *"Graphite Creek Project Feasibility Study"* (the "Technical Report"), that has an effective date of March 25, 2025 (the "Effective Date").

I, Scott Phillips, PE, do hereby certify that:

1. I am a Senior Civil Engineer with Barr Engineering Co., 170 S. Main St., Suite 500, Salt Lake City, Utah, 84111 USA.
2. I attended California Polytechnic University where I earned a Bachelor of Science degree in Environmental Engineering in December of 1995, and a Master of Engineering Management in 1999.
3. I am a Professional Civil Engineer in 5 western states, including Utah, License No. 14210430-2202 and work predominantly in mining. I am a "qualified person" for the purposes of National Instrument 43-101.
4. I have worked continuously as a Civil and Environmental engineer for 30 years, predominantly in mining and water management. I have worked on water and infrastructure design, facility infrastructure design, environmental regulation, and directly in mine facility operations over the last 15 years, specializing in multiple commodities including industrial minerals, base and precious metals, critical minerals, and coal.
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, in my opinion, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101
7. I am responsible for preparing Section 18.1, except for sections 18.1.7.1 and 18.1.9.
8. I personally inspected the Graphite Creek Project site on August 12th, 13th, and 14th of 2024.
9. I have had no prior involvement with the Graphite Creek Project.
10. I have read NI 43-101 and the Technical Report, in my opinion, has been prepared in compliance with the instrument.
11. As of the effective date of the Technical Report, to the best of my knowledge, information, and belief, the sections of the Technical Report for which I am responsible contain all the scientific and technical information that is required to be disclosed, to make the portions of the Technical Report for which I am responsible, not misleading.

Signed and sealed this 22 day of April 2025.

"ORIGINAL SIGNED AND SEALED BY AUTHOR AND ON FILE"

Scott A Phillips, PE

Senior Civil Engineer, Barr Engineering Co.

HATCH

Certificate of Qualified Person

Arlene P. Dixon, PE

This certificate applies to the NI 43-101 technical report titled, *"Graphite Creek Project Feasibility Study"* (the "Technical Report"), that has an effective date of March 25, 2025 (the "Effective Date").

I, Arlene P. Dixon, hereby certify that:

1. I am an Engineering Manager with Hatch Ltd, 3611 Queen Palm Blvd, Sabal VI Suite 100, Tampa, Florida 33619 USA.
2. I attended the University of the West Indies where I earned a Bachelor of Science degree in Mechanical Engineering in 2001.
3. I am a Registered Professional Engineer with the Florida Board of Professional Engineers (FBPE), License # PE 87452. I am a "qualified person" for the purposes of National Instrument 43-101.
4. I have worked as a Mechanical Engineer with increasing in level of responsibility to Engineering Manager for over 23 years. I have worked in the mining and extracted minerals industries, with 20 years in EPCM consulting in multiple commodities including bauxite, alumina and industrial minerals.
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, in my opinion I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101
7. I am responsible for the Secondary Treatment Plant (STP) Section 18.2 of the Technical Report.
8. I have had no prior involvement with the Graphite Creek Project.
9. I have read NI 43-101 and the Secondary Treatment Plant (STP) Section of Technical Report in my opinion has been prepared in compliance with the instrument.
10. As of the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Secondary Treatment Plant (STP) Section of the Technical Report for which I am responsible contain all technical information that is required to be disclosed, to make the portions of the Secondary Treatment Plant (STP) Section of the Technical Report for which I am responsible, not misleading.

Signed and sealed this 22 day of April 2025.

"ORIGINAL SIGNED AND SEALED BY AUTHOR AND ON FILE"

Arlene P. Dixon, PE*

Engineering Manager, Hatch Ltd.

*Florida Board of Professional Engineers (FBPE)

HATCH

Certificate of Qualified Person

Jon Godwin, P.Eng.

This certificate applies to the NI 43-101 technical report titled, *"Graphite Creek Project Feasibility Study"* (the "Technical Report"), that has an effective date of March 25, 2025 (the "Effective Date").

I, Jon Godwin, hereby certify that:

1. I am a Senior Process Engineer with Hatch Ltd, 201-121 Research Drive, Saskatoon, Saskatchewan, Canada S7N 1K2.
2. I attended the University of Saskatchewan where I earned a Bachelor of Science degree in Chemical Engineering in 2009 and a Master of Science degree in Chemical Engineering in 2011.
3. I am a Registered Professional Engineer with the Association of Professional Engineers and Geoscientists of Saskatchewan (APEGS), License #24010. I am a "qualified person" for the purposes of National Instrument 43-101.
4. I have worked continuously as a Chemical Process Engineer with increasing in level of responsibility for over 13 years. I have worked in the mining and extracted minerals industries, with 13 years in EPCM consulting in multiple commodities including potash, uranium, and other minerals.
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, in my opinion I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101
7. I am responsible for the Secondary Treatment Plant (STP) Section 17.2 of the Technical Report.
8. I have had no prior involvement with the Graphite Creek Project.
9. I have read NI 43-101 and the Secondary Treatment Plant (STP) Section of the Technical Report in my opinion has been prepared in compliance with the instrument.
10. As of the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Secondary Treatment Plant (STP) Section of the Technical Report for which I am responsible contain all technical information that is required to be disclosed, to make the portions of the Secondary Treatment Plant (STP) Section of the Technical Report for which I am responsible, not misleading.

Signed and sealed this 22 day of April 2025.

"ORIGINAL SIGNED AND SEALED BY AUTHOR AND ON FILE"

Jon Godwin, P.Eng.*

Senior Process Engineer, Hatch Ltd.

* Association of Professional Engineers and Geoscientists of Saskatchewan (APEGS)

ALASKA EARTH SCIENCES, INC.

Certificate of Qualified Person

Robert M. Retherford, QP

This certificate applies to the NI 43-101 technical report titled, *"Graphite Creek Project Feasibility Study"* (the "Technical Report"), that has an effective date of March 25, 2025 (the "Effective Date").

I, Robert M. Retherford, QP, do hereby certify that:

1. I am a Senior Geologist with Alaska Earth Sciences, Inc., 12100 Industry Way, Unit P-9, Anchorage, Alaska 99515, USA.
2. I attended the University of Colorado where I earned a Bachelor of Arts and Master of Science degree in Geology in 1970 and 1972 respectively.
3. I am a Qualified Professional as a Member of the American Institute of Professional Geologists (CPG # 10903). I am a "qualified person" for the purposes of National Instrument 43-101.
4. I have worked continuously as an exploration geologist for 55 years, since graduating from the University of Colorado in 1970. This has included engineering and exploration companies, regional Alaska Native Corporations and for my own company, Alaska Earth Sciences, Inc since 1985.
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, in my opinion, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101
7. I am responsible for preparing Chapters 6, 7, 8, 9, 10, 11, 12, and 14.
8. I personally inspected the Graphite Creek Project sites on August 5th – August 8th of 2024.
9. I have had no prior involvement with the Graphite Creek Project.
10. I have read NI 43-101 and the Technical Report, in my opinion, has been prepared in compliance with the instrument.
11. As of the effective date of the Technical Report, to the best of my knowledge, information, and belief, the sections of the Technical Report for which I am responsible contain all the scientific and technical information that is required to be disclosed, to make the portions of the Technical Report for which I am responsible, not misleading.

Signed and sealed this 22 day of April 2025.

"ORIGINAL SIGNED AND SEALED BY AUTHOR AND ON FILE"
Robert M. Retherford,, QP

Senior Geologist, Alaska Earth Sciences, Inc.

Graphite Creek Project
NI 43-101 Technical Report and Feasibility Study

April 2025

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Figures

Abbreviations

”	seconds of angle or inches
~	approximately
’	minutes of angle
°	degrees of angle
°C	degrees Celsius
°F	degrees Fahrenheit
µm	microns
2D	two dimensional
A	amperes
a	annum (year)
AACE	Association for the Advancement of Cost Engineering
AAM	active anode material
AASHTO	American Association of State of Highway Traffic Officials
ac	acres
ActLabs	Activation Laboratories Ltd.
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOT	Alaska Department of Transportation and Public Facilities
AES	Alaska Earth Sciences Inc.
Ai	abrasion index
AK	Alaska
AMSL	above mean sea level
ANFO	ammonium nitrate & fuel oil
APDES	Alaska Pollutant Discharge Elimination System
APEX	APEX Geoscience Ltd.
AQC	Air Quality Control
ARD	acid rock drainage
ATV	acoustic televiewer
Barr	Barr Engineering Co.
Benchmark	Benchmark Minerals Intelligence
BFD	block flow diagram
BLM	U.S. Bureau of Land Management
BMR	borehole magnetic resonance
BOM	bill of materials
BQS	biotite-quartz schist
BTS	Brazilian indirect tensile strength
BWi	ball mill work index
C(t)	total carbon
cfm	cubic feet per minute
Cg	graphitic carbon
Chenyu	Hunan Chenyu Fuji New Energy Technology Co. Ltd.
CHP	combined heat and power
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
CO_2	carbon dioxide
COG	cut-off grades
CRM	certified reference materials
D or d	day
DB	design basis

DEM	digital elevation model
DGGS	Alaska Division of Geological and Geophysical Surveys
DoD	U.S. Department of Defense
DSHA	deterministic seismic hazard analysis
DTC	digital temperature cables
DTM	digital terrain model
EA	environmental assessment
EIA	Energy Information Administration
EIS	environmental impact statement
EPA	Environmental Protection Agency
EPCM	engineering, procurement and construction management
ESA	Endangered Species Act
ESSA	effective stress stability analysis
EV	electric vehicle
FEOC	Federal Executive Order Compliance
FONSI	Finding of No Significant Impact
FoS	factor of safety
FS	feasibility study
ft	feet
g	gram
G&A	general and administrative
g/L	grams per Liter
g/t	grams per tonne
G1	Graphite One Inc.
gal	gallons
gal/day	gallons per day
gal/yr	gallons per year
GC	Graphite Creek
GCG	Graphite Creek graphite
GMMs	ground motion models
GOH	Gross operating hours
GPa	GigaPascal
gpm	gallons per minute
GPS	Global Positioning System
ha	hectares
Hatch	Hatch Ltd.
Hazen	Hazen Research
HDPE	high-density polyethylene
HDS	high-density sludge
hp	horsepower
HPGR	high-pressure grinding roll
HVAC	Heating, Ventilation, and Air Conditioning
IDW2	inverse-distance weighted squared
in	inches
INF	felsic intrusive
INM	mafic intrusive
IRR	Internal Rate of Return
Jade	Jade North, LLC.
JDS	JDS Energy & Mining Inc.
JRC	joint roughness coefficient
kg	kilograms
kL	kiloliters
km	kilometers

KP	kilometer post
kPa	kilopascal
kt	kilotonne
kV	kilovolts
kW	kilowatts
kWh	kilowatt-hours
L	Liter
LCT	Locked cycle tests
Lettis	Lettis Consultants International, Inc.
lidar	Light Detection and Ranging
Li-ion	lithium-ion
LIQ	liquefied undrained strength stability analysis
LLDPE	linear low-density polyethylene
LMPP	large mine permitting process
LOM	Life of mine
LPG	Liquified Petroleum Gas
LTO	lithium-titanate
m	meters
M	Million
M&EB	mass and energy balance
Ma	mega-annum
MC	modified California
MEL	mechanical equipment list
MIBC	methyl isobutyl carbinol
mill	multi-location mining and processing operation at Graphite Creek, AK
mm	millimeters
Mm^3	million cubic meters
MSHA	Mine Safety and Health Administration
Mt	million tonnes
MTO	material takeoff
Mtpa	million tonnes per annum
MW	megawatts
NAAQS	National Ambient Air Quality Standards
NAD	North American Datum
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NEPA	National Environmental Protection Act
NG	natural graphite
NHPA	National Historic Preservation Act
NI 43-101	Canadian National Instrument 43-101
NOAA	National Oceanic and Atmospheric Administration
NOH	Net operating hours
NPV	net present value
NRCS	Natural Resource Conservation Service
NSR	net smelter return
NWI	National Wetland Inventory
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OH	Ohio
OMC	optimum moisture content
OPMP	ADNR Office of Project Management and Permitting
OSHA	Occupational Safety and Health Administration
OTS	Oriented Targeting Solutions

OTV	optical televiewer
P&IDs	piping and instrumentation diagram
PAG	potentially acid generating
PDC	process design criteria
PFD	process flow diagram
PFS	preliminary feasibility study
pH	potential of hydrogen
Pocock	Pocock Industrial
PoF	probability of failure
PP	process pond
Project	Graphite One Project (includes all activities in Alaska and Ohio)
PSD	Prevention of Significant Deterioration
PSHA	probabilistic seismic hazard analysis
PTIO	Permit to install/operate
QA/QC	quality assurance / quality control
QBGS	quartz biotite garnet schist
QBGSS	quartz biotite garnet sillimanite schist
QBS	quartz biotite schist
QBSS	quartz biotite sillimanite schist
QDIO	quartz diorite
QP	qualified person
R&D	Research and Development
Recon	Recon, LLC
RICE	reciprocating internal combustion engine
RMR	rock mass rating
ROM	run-of-mine
RQD	rock quality designation
RTK	real-time kinematic
SAC	Subsistence Advisory Committee
SAG	semi-autogenous grinding
sec	seconds
SG	specific gravity
SGS	SGS Minerals Inc.
SHPO	Alaska State Historic Preservation Office
SI	International System of Units
SiC	silicon carbide
SLS	solid-liquid separation
SMC	SAG mill comminution
SMM	stirred media milling
SMR	small modular reactor
SPT	standard penetration test
SRK	SRK Consulting
STP	secondary treatment plant
t	metric tonne(s)
TCS	triaxial compressive strength
TDS	total dissolved solids
TIMA	Tescan Integrated Mineral Analyzer
TMF	tailings management facility
tpa	tonnes per annum
tpd	tonnes per day
Tundra	Tundra Consulting Inc.
U.S. or US	United States
UCS	unconfined compressive strength

UHS	uniform hazard spectra
UPUS	unrestricted portable use standards
USACE	United States Army Corps of Engineers
USAMS	Uncle Sam Alaska Mining Syndicate
USD	United States dollar
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
USSA	undrained strength stability analysis
UTM	universal transverse mercator
V	volts
VAC	volts alternating current
VWP	vibrating wire piezometer
W	watts
WBS	work breakdown structure
WMF	waste management facility
WMP	water management pond
WTP	water treatment plant
WWTP	wastewater (sewage) treatment plant
Y or y	year(s)

1 Summary

1.1 Introduction

This technical report has been prepared for Graphite One Inc. (GPH: TSX-V; GPHOF: OTCQX) (Graphite One or the Company) with its address at Suite 600, 777 Hornby St., Vancouver, BC, for the purpose of disclosing the results of a feasibility study (FS) for the Graphite One Project (the Project). The Company's objective is to become a vertically integrated 100% U.S.-based manufacturer of graphite products with an operating mine near Nome, Alaska, and an operating secondary treatment plant (STP) in Niles, Ohio, which are modeled in this report. This technical report was prepared by Barr Engineering Co. (Barr) at the request of Graphite One. The results of the FS were disclosed to the public by Graphite One in a press release on March 25, 2025, the effective date of the technical report.

In Alaska (AK), the graphite will be mined from the company-owned deposit, then crushed, ground, and concentrated in a flotation mill to enrich the graphite content to approximately 95%. Next, it will be dried to ~1.0 wt% moisture content for shipment. Lastly, the bulk concentrate will be loaded into 20-foot-long, lined shipping containers and transported to the STP in Niles, Ohio.

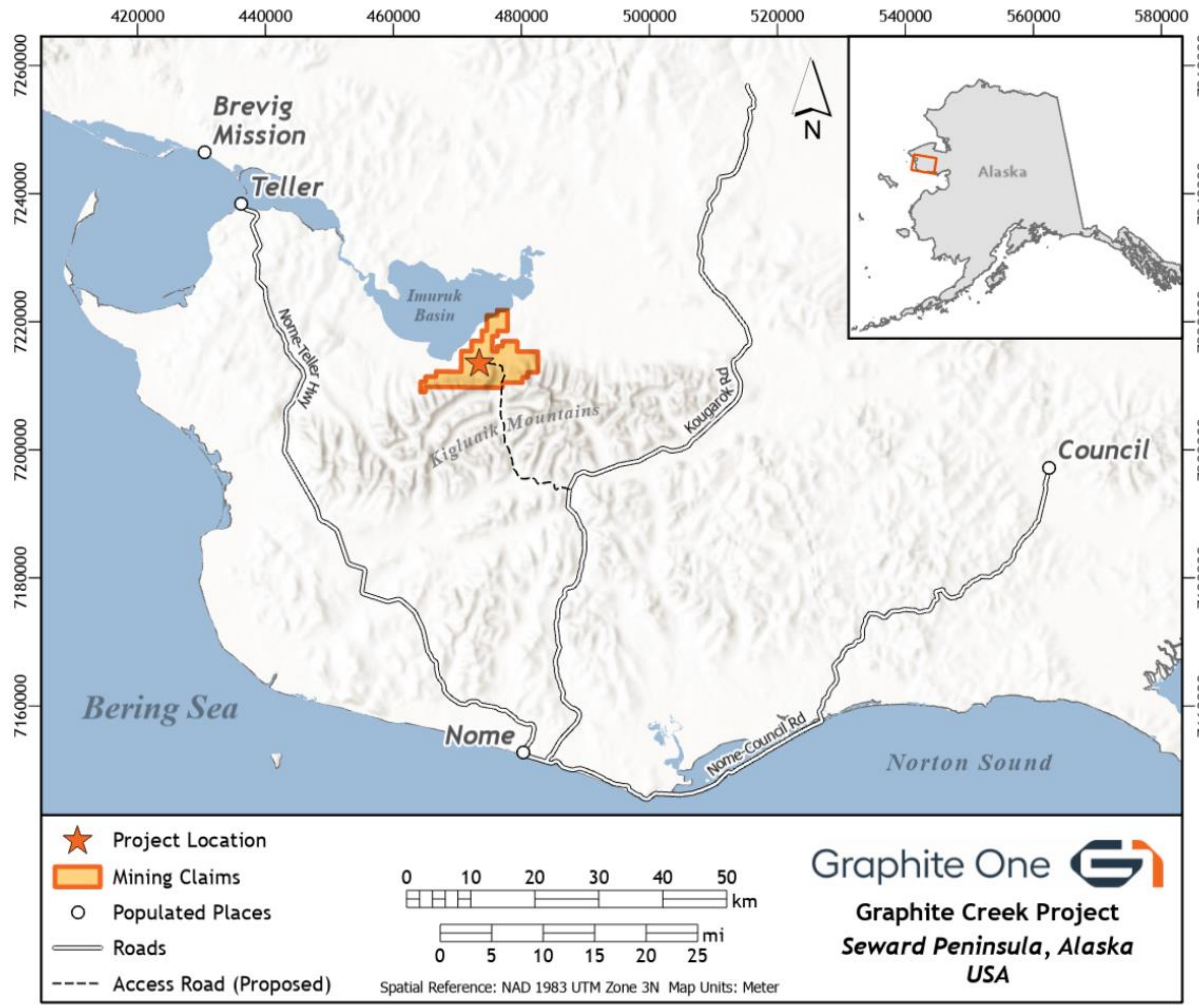
The city of Nome has a seasonal shipping window, and as such, stockpiling and bulk shipping of the concentrate will be required. This will result in a considerable lag between the milling of the mined graphite ore and the realization of revenue from the final product.

The company intends to construct the STP prior to the mine so that the concentrate produced at the mine can be shipped directly to the STP and treated. As the time required to develop the mine is longer than that required to construct the STP, the company intends to commission the STP with graphite purchased on the open market (open market graphite or OMG) and operate it continuously while the Graphite Creek graphite (GCG) is permitted, mined, processed, and shipped.

1.2 Location and Tenure

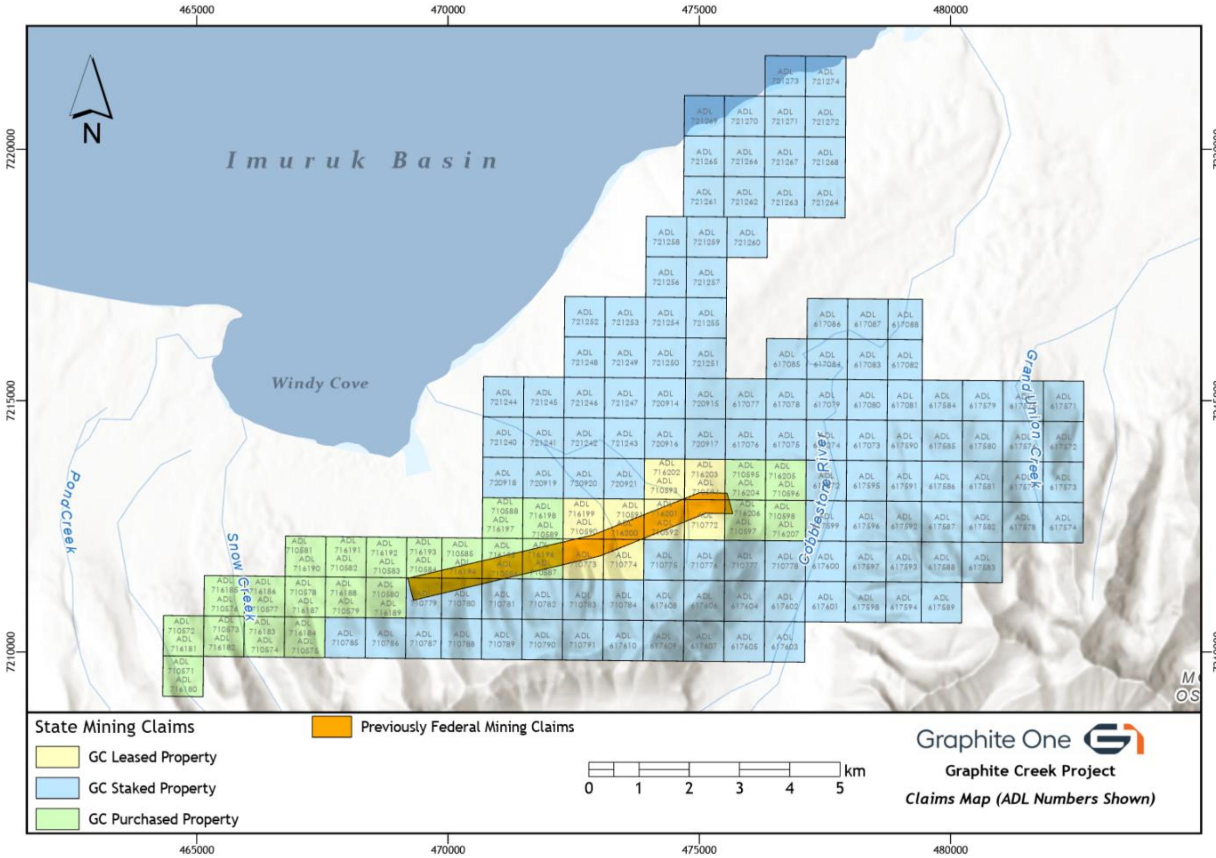
1.2.1 The Property

The Graphite Creek Property (the Property) is on the Seward Peninsula, approximately 60 kilometers (km) (37 miles) north of Nome, Alaska (Figure 1-1). The Property comprises 9,583 hectares (ha) (23,680 acres (ac)) and consists of 176 active state of Alaska 65 ha (160 ac) (1/4 section) mining claims, with 28 of those claims overlying more senior claims within the claim block (Figure 1-2). The claims are on the Teller A2 and A1 quadrangles, and the deposit's plan projection is centered on Universal Transverse Mercator (UTM) coordinates 474,600 E and 7,212,200 N (NAD 83, Zone 3N). The corresponding geographic coordinates are -165.540990W, 65.038424N. The proposed mining footprint is well within the Property boundaries.



Source: Graphite One, 2024

Figure 1-1 Project Location Map



Source: Graphite One, 2024

Figure 1-2 Project Mining Claims Map

1.2.2 The Secondary Treatment Plant (STP)

The STP is designed to produce lithium-ion (Li-ion) battery anode materials on a commercial scale for the U.S. domestic market using natural graphite and other materials. It is expected to start operation and continue for an estimated period of up to four years by processing purchased graphite while the Graphite Creek (GC) mine progresses through permitting and construction. GCG is expected to be phased in as soon as it is available. At full capacity, the STP is expected to require about 89 ha (220 ac) of land, consisting of approximately 88 buildings. The facility would initially process 50,000 tonnes (t) of natural graphite. At full capacity, the STP aims to process 175,000 t of natural graphite and produce 256,000 t of manufactured graphite products annually. The products are grouped into battery anode materials, specialty purified graphite products, and traditional unpurified graphite products. The products are manufactured from natural graphite concentrate, artificial graphite precursors, coke, and pitch. Key components of the manufacturing process are the purification of natural graphite and the graphitization of artificial graphite precursors in high-temperature, electrically heated furnaces. The STP is expected to be located in Niles, Ohio (OH), to access both its relatively lower power rates and its skilled workforce.

1.3 History

During the early 1900s, at least two companies mined in the area. The first known claims were staked in 1900 by Uncle Sam Alaska Mining Syndicate (USAMS) near Graphite Bay, now known as Windy Cove (Harrington, 1919). In 1912, USAMS shipped 120 t of graphite to Seattle and the San Francisco Bay area, and by 1916 had stockpiled another 275 t (Mertie, 1918). The Alaska Graphite Mining Co. staked claims in 1905 and added additional claims in 1915 and 1916 (Mertie, 1918; Harrington, 1919). A total of 32 t of graphite was mined from talus in 1907 (Coats, 1944). Employing about seven people, 90 t of graphite was mined in 1916 (Mertie, 1918). This production was hauled a short distance overland to Windy Cove, from there to Teller by boat, then shipped to Seattle and San Francisco (Harrington, 1919).

1.4 Geological Setting and Mineralization

1.4.1 Regional Geology

The Graphite Creek deposit lies within the Kigluaik Mountains on the Seward Peninsula (Figure 1-1). The Kigluaik Mountains are a gneiss dome composed of Kigluaik Group amphibolite and granulite facies metamorphic rocks and are one of a group of Cretaceous gneiss domes on the southern Seward Peninsula and in eastern Chukotka, Russia. Nome Group Cambrian to Devonian platform rocks recording blueschist metamorphism and retrograde greenschist metamorphism surround the Kigluaik Group. These are all parts of the Arctic Alaska Chukotka microplate (Till, 2016).

The Kigluaik metamorphic complex consists of a 15 km-thick structural section of amphibolite and granulite facies metamorphic rocks surrounding a gneiss dome. Amphibolite-grade rocks are exposed on the southern flanks of the Kigluaik mountain range, while granulite-grade schist and gneiss are exposed on the north flank of the mountains. These highest-grade rocks have no direct counterparts in the adjacent mountain ranges and are believed to represent the deepest crustal rocks exposed in northwestern Alaska (Amato & Miller, 1994). These metamorphic rocks comprise coarse marble, quartzofeldspathic gneiss, schist and gneiss of mafic and ultramafic composition, graphite-rich schist, and garnet lherzolite. All the formations of the Kigluaik Mountains are cut by intrusive rocks—the most common of which is granite. These intrusions are more abundant in the higher-grade part of the group. Besides granite intrusions, dikes, and sills of diorite, diabase, and pegmatite are present.

The depositional age of the protoliths is broadly constrained by regional igneous and detrital zircon U–Pb ages from the Kigluaik metamorphic complex and Nome Complex, which span the Neoproterozoic to Pennsylvanian (Till et al., 2014). Monazite petrochronology data constrain peak metamorphic grade in the area to the Middle Cretaceous (96 Ma), followed by exhumation and retrograde overprint by ca 85 Ma (Case et al., 2023).

The Graphite One Property area is underlain by the high-grade granulite facies metamorphic rocks of the Kigluaik metamorphic complex. The Kigluaik Fault is a regional-scale, normal fault dipping to the north that defines the boundary between the uplifted Kigluaik Mountains to the south and the sediment-filled Imuruk Basin to the north. Bedrock is either exposed or covered minimally by surficial overburden material throughout most of the Property area, particularly in the incised creek valleys and/or relatively steep slopes adjacent to the Kigluaik Fault. Surficial quaternary deposits dominate the area north of the Kigluaik Fault. The surficial deposits include glacially deposited sand, gravel, and boulders; fluvial gravel and sand; marine and fluvial terrace deposits; and wetlands (Till et al., 2011).

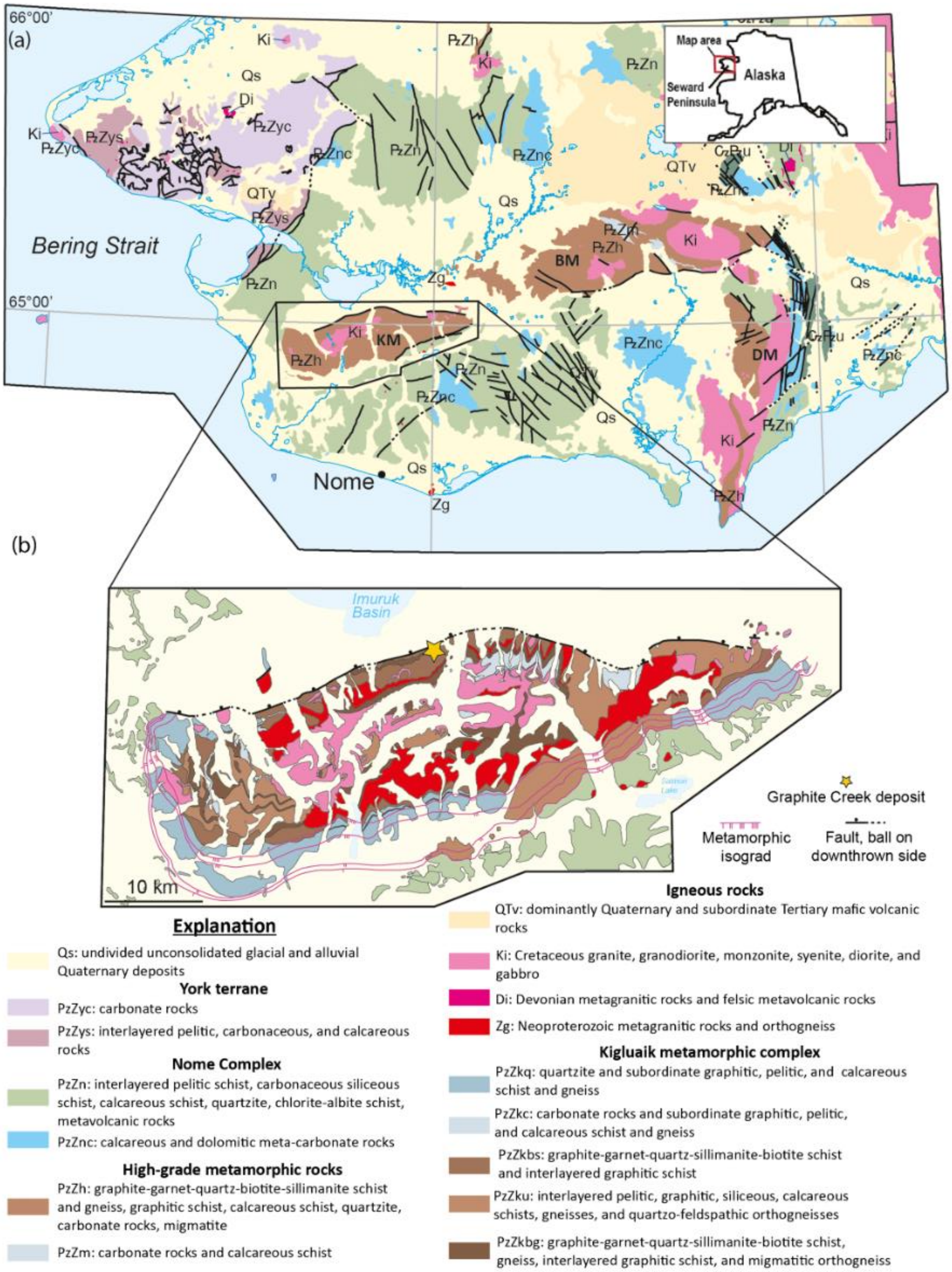


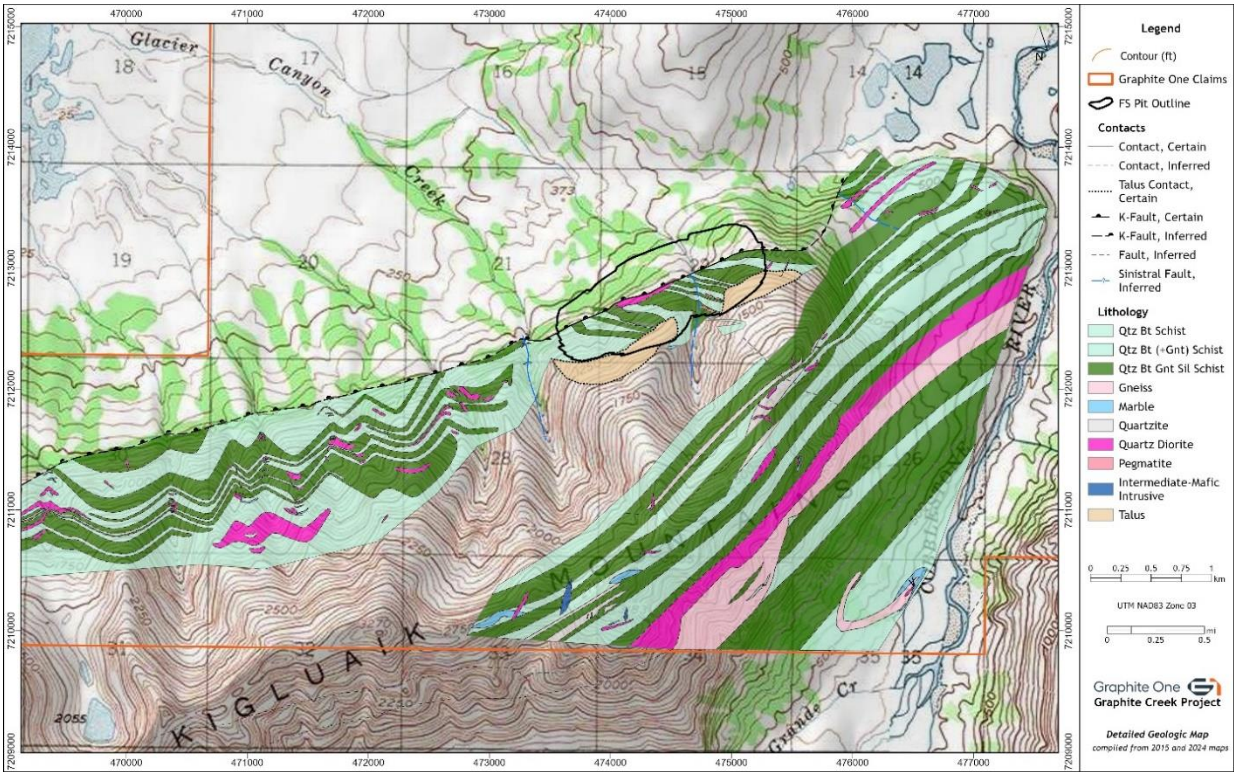
Figure 1-3 Regional Geology of the Graphite Creek Property Area from Case et al. (2023) a) Simplified Geologic Map of the Seward Peninsula from Till et al. (2011) b) Simplified Geologic Map of the Kigluaik Mountains Modified from Amato & Miller (2004)

1.4.2 Property Geology

The Graphite Creek deposit is on the north slope of the Kigluaik Mountains in granulite facies metamorphic rocks of sedimentary marine origin. Graphite occurs as high-grade massive to semi-massive segregations and disseminations within amphibolite to granulite facies metasedimentary rocks, primarily biotite-quartz schist with zones of sillimanite-garnet-biotite-quartz schist. Carbon isotopes indicate an organic carbon origin of the graphite (Case et al., 2023). The graphite-bearing schist units strike subparallel to the mountain front and dip north to northeast between 40° and 75°.

The deposit is on the southern footwall side of the Kigluaik Fault. The fault strikes at an approximate azimuth of 250° and dips ~45°, as measured in drillholes within the proposed pit area, and extends over a strike length of approximately 35 km. Contemporary movement on this fault has uplifted the Kigluaik Mountains to the south and downthrown the lowlands of the Imuruk Basin to the north (Hudson & Plafker, 1978). The fault is a boundary between bedrock mineralization and sedimentary overburden. Surficial Quaternary deposits cover the area to the north of the Kigluaik Fault on the Graphite One Property. The surficial deposits include glacially deposited sand, gravel, and boulders; fluvial gravel and sand; marine and fluvial terrace deposits; and wetlands (Till et al., 2011).

Bedrock is either exposed or covered minimally by surficial overburden material throughout most of the Property area south of the Kigluaik Fault, particularly in the incised creek valleys and/or relatively steep slopes adjacent to the Kigluaik Fault (Figure 1-4).

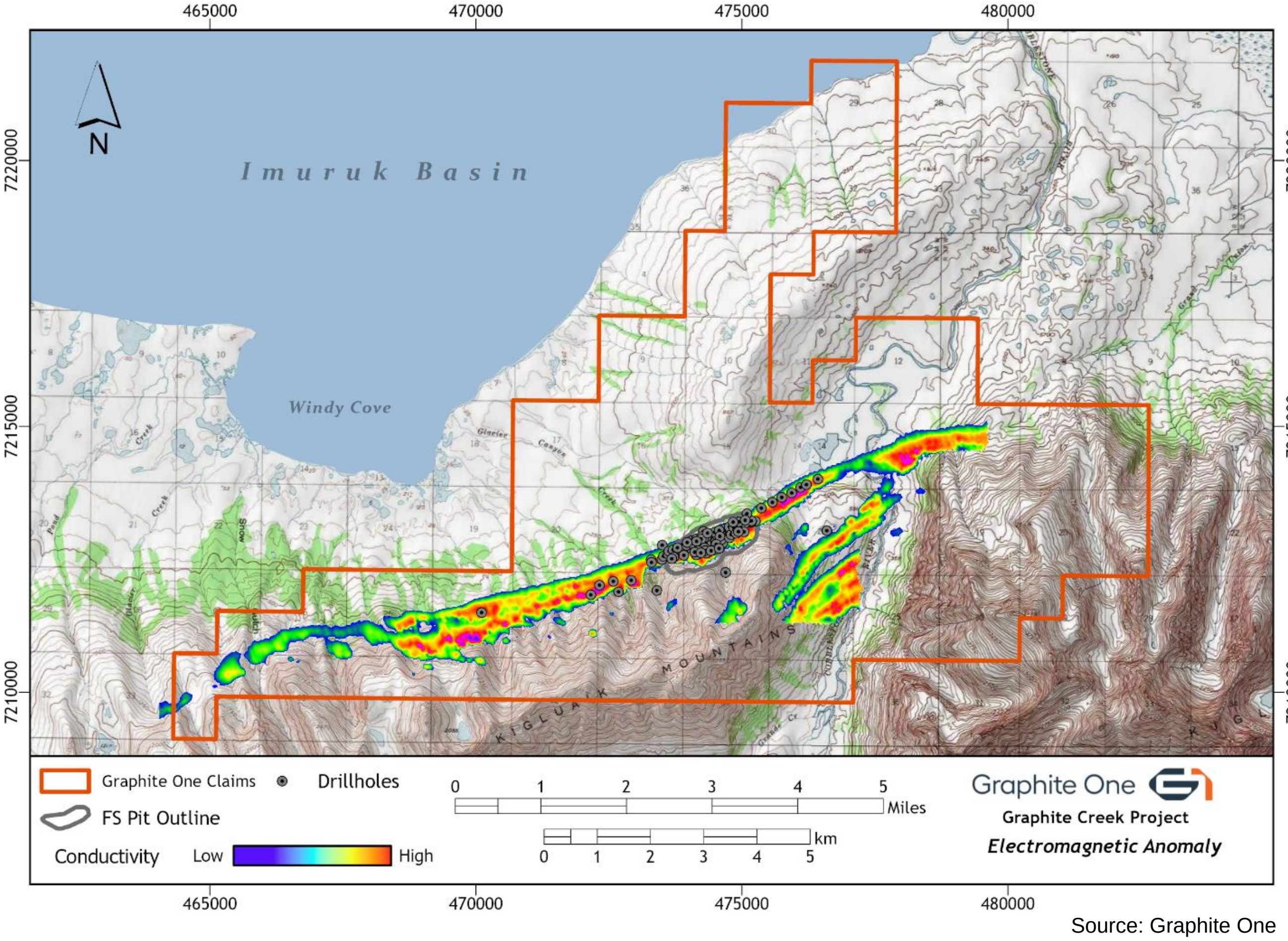


Source: Graphite One

Figure 1-4 Detailed Geologic Map of the Proposed Pit Area Within the Graphite Creek Property

The 2012 and 2024 geological mapping programs confirmed historical observations of recurring high-grade massive to semi-massive segregated and disseminated graphite in sillimanite-quartz-feldspar-biotite-graphite-garnet schist and disseminated graphite in biotite-quartz (±garnet) schist along the range front. A total of 591 rock grab samples collected from throughout the Graphite Creek Property during 2012 were analyzed for specific gravity and graphitic carbon (Cg). Of the 591 samples, 11 samples yielded >45% Cg (up to 80.9% Cg), 47 samples had >10% Cg, and 137 samples had >3% Cg.

A 1,523.5 line-km time-domain, helicopter-borne, magnetic, and electromagnetic survey over the Graphite One Property shows that bands of continuous high-electromagnetic anomalies follow historical and 2012 geological mapping of high-grade graphitic units in the Property area. The high-electromagnetic bands also correlate well with the 2012-2024 drill results. A 2023 drillhole testing a high-conductivity zone in the aerial geophysics over 4 km west of the proposed pit area intersected with high-grade graphite (Figure 1-5). Interpretation of the electromagnetic data provides evidence that the high-grade graphite layers extend along the strike in a north-easterly direction for approximately 18 km. The map pattern of the electromagnetic anomaly suggests a low-angle northeast-plunging fold geometry at mountain scale. This is consistent with downhole structural and mapping data.



Source: Graphite One

Figure 1-5 Locations of Drillholes Testing the Electromagnetic Anomaly in the Graphite Creek Property

1.4.3 Mineralization

Two main graphite-bearing lithologies are identified in logging at Graphite Creek. One is sillimanite-garnet-biotite-quartz schist (QBGSS) that contains disseminations of graphite and very high-grade lenses (up to 60% graphite) of coarse-grained, semi-massive and massive graphite segregations (Figure 1-6). The other is biotite-quartz schist (QBS), which typically contains disseminated, and occasionally massive, graphite. The QBGSS is the principal host to higher-grade graphite and appears in outcrop as two distinctive layers in the metasedimentary sequence along the north flank of the Kigluaik Mountains. A third potential horizon is defined by ‘pods’ of sillimanite-quartz-biotite-garnet gneiss. Within the proposed pit area, the QBGSS and QBS layers strike obliquely to the mountain front and dip north to northeast at 40° to 80°.

The QBGSS typically is fine- to coarse-grained, weathers grey, has a wavy and crenulated schistosity, has garnet porphyroblasts (up to 2 cm across), and has augen-shaped quartz segregations. Discontinuous segregations (lenses and streaks) of high-grade graphite from centimeters to a few meters thick are common. These high-grade graphite lenses in the QBGSS have up to 60% coarse crystalline graphite at 1 m scale sample lengths in the drill core. Disseminated flakes of graphite up to 1 millimeter (mm) or more across make up several percent of the rock.

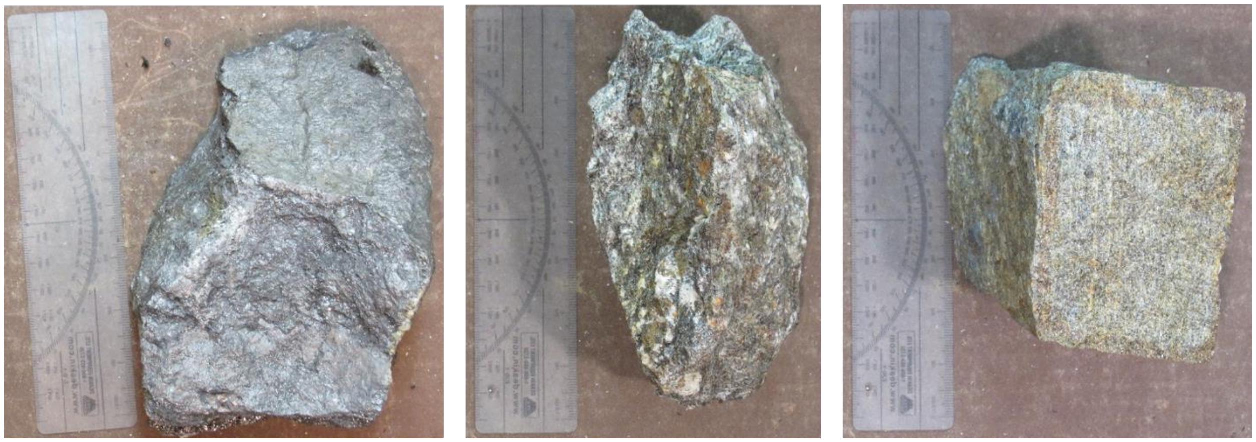


Figure 1-6 Hand Samples of Main Graphite-Bearing Rock Units at Graphite Creek. Left: Semi-Massive Graphite. Center: Sillimanite-Garnet-Biotite-Quartz Schist (QBGSS) Right: Biotite-Quartz Schist (QBS)

The QBS is fine-grained, weathers a rusty ochre color, and has regular subplanar layering with individual layers commonly 3 to 10 cm thick. Graphite occurs as disseminated flakes up to about 1 mm across and can make up several percent of the rock. Higher-grade graphite-rich layers, varying from 3 to 25 cm in width, are present but are not as common as in the QBGSS.

The other logged schist units at Graphite Creek, garnet-biotite-quartz schist (QBGS) and sillimanite-biotite-quartz schist (QBSS), are usually poorly mineralized. Graphite is observed in at least trace amounts in all lithologies other than quartz diorite (QDIO) and mafic intrusive (INM).

1.5 Exploration

1.5.1 Early Exploration

After initial production in the early 1900s, the Graphite Creek deposits lay dormant until 1943 when United States Geologic Survey (USGS) geologist Robert Coats visited the area. His field crew sampled material from several sorted piles of previously mined graphite and from several high-grade graphitic lenses on the Property (Coats, 1944). Three specific areas underwent surface excavation work and were named by Coats as Christophosen Creek, Ruby Creek, and Graphite Creek. Coats (1944) reported that exposed high-grade lenses in these three areas varied from a few centimeters to a meter in thickness with lengths that were ten to fifteen times their width and contained up to 60% graphite.

The last known exploration company interest in the area was in 1981 when a brief field examination of the showings was conducted by the Anaconda Copper Company when several samples were taken for analysis during a one-day visit (Hudson, 1981; Wolgemuth, 1982). The Alaska Division of Geological and Geophysical Surveys (DGGS) and researchers at Stanford University completed mapping in the area in 1992. Minor data collection, sample analysis, and report writing were completed at the request of the claim-holding Tweet family in 1994 and 1998 by Jim Adler of Online Exploration Services and Tom Bundtzen of Pacific Rim Geological Consulting.

1.5.2 Graphite One Exploration

Exploration work done for Graphite One began in 2011 and has continued with some gap years through 2024. Exploration activities commissioned by Graphite One have largely relied on contractors to execute the work. Cedar Mountain Exploration Inc. executed a program in 2011 with On-line Exploration Services, APEX Geoscience Ltd. (APEX) from 2012 to 2014, and Alaska Earth Sciences in 2018 and 2019. Graphite One executed field programs in 2021-2024 with contracting support from Alaska Earth Sciences.

Drilling, mapping, rock and core sampling, and an aerial geophysical survey were executed during these program years, the details of which are reported in Nelson (2011), Adler & Bundtzen (2011), Duplessis et al. (2013), Eccles and Nicolls (2014), Eccles et al. (2015), King et al. (2019), and Gierymski et al. (2022). The program details are summarized by year in this report's Exploration and Drilling sections.

1.6 Drilling

Drilling campaigns began at Graphite Creek in 2012. A total of 188 holes have been drilled within Graphite One claims. Most drillholes (143 of 188) are located within the proposed pit area arranged in a grid at 50 m spacing. Many of these holes have been utilized for multiple purposes, including resource assays, geotechnical or hydrologic data acquisition, or metallurgy sampling. Drillholes used for resource assay sampling were predominantly drilled HQ size but also included PQ and NQ sizes. Sixteen drillholes exclusively intersect overburden in the lowlands north of the deposit and were designed as geotechnical holes for mine infrastructure and water modeling. Six holes were drilled along the Cobblestone River access road corridor to assess potential road material sites. Exploration drillholes span 6.7 km along the northern slope of the Kigluaik Mountains.

1.7 Sample Preparation, Analyses, Security

The sample preparation, analysis, and security procedures and protocols followed during the various exploration phases carried out on the Property are presented in the previous technical reports issued by Graphite One. Qualified personnel supervised all sample handling, preparation, and analysis phases. For detailed descriptions and analyses of the various protocols followed, refer to Duplessis et al. (2013), Eccles & Nicholls (2014), Eccles et al. (2015), King et al. (2019), and Gierymski et al. (2022).

During drill seasons from 2012 to 2024, core and rock samples were transported from the field to camp by helicopter, where they were palletized, loaded onto a flatbed truck, and driven to Graphite One's warehouse in Nome for processing. Geotechnical logging, geological core logging, core photography, core splitting/cutting, and core sampling were conducted at the Nome facility.

The sample preparation lab in Nome is owned by Graphite One but managed and operated by Activation Laboratories Ltd. (ActLabs). Activities conducted in the Nome preparation lab consisted of drying, crushing, splitting, pulverizing, and packaging all drill core samples for shipping from Nome to the ActLabs facility in Ancaster, Ontario, Canada for analysis. Samples were shipped via a commercial carrier with package tracking. To complete the chain of custody, individual samples with the same sample numbers originally recorded in the field remained consistent to delivery at ActLabs.

Graphitic carbon analyses were conducted at ActLabs. ActLabs is ISO 17025 and ISO 9001 certified. Pulp samples that arrived at ActLabs were visually inspected to ensure sample integrity and cross-checked with the shipping manifest to ensure accuracy. All samples were analyzed with a LECO CR-412 Carbon Analyzer following standard procedures. A representative 0.5 g sample was removed from each sample packet, digested with hydrochloric and perchloric acids, and treated in a multi-stage furnace to eliminate all forms of carbon other than graphite. The remaining material was combusted and quantified in a LECO analyzer to determine % Cg.

The quality assurance / quality control (QA/QC) procedures and protocols used by Graphite One's geological and geophysical consultants and contractors follow the industry best practices. Data verification included inserting standards, blanks, and duplicates within the primary sample stream. The frequency and type of standards, blanks, and duplicates varied over the years based on recommendations from ActLabs and Hobbie Consulting. Hobbie Consulting was tasked with ensuring QA/QC compliance met requirements prior to incorporation into the database. Details of the results of previous years' QA/QC programs can be found in Chapter 11 of this study.

1.8 Mineral Processing and Metallurgical Testing

Two metallurgical testwork campaigns were conducted for Graphite One's Graphite Creek deposit in Alaska. Both were conducted at SGS Mineral Services in Lakefield, Ontario, on samples from the Graphite Creek deposit. The first campaign was conducted on drill samples representing the pre-feasibility study (PFS) pit in 2020. As part of the FS study in 2023, additional drilling was performed to expand the reserve, and a second metallurgical program was conducted to verify that the additional ore in the FS pit would be compatible with the PFS flowsheet, optimize the flowsheet, and determine the expected variability with different ore zones and grades.

The PFS flowsheet was used as the starting point for testing the 2023-2024 drilling samples and developing the FS flowsheet. The FS program targeted 95% graphite grade with greater than 90% graphite recovery. The FS testwork confirmed that the PFS flowsheet was the preferred flowsheet with some minor changes.

The 2023 three-dimensional Graphite Creek ore model was used to select cores from the 2023 drilling campaign that would be representative of the expanded FS pit for metallurgical testing. The objective was to optimize the PFS flowsheet on a representative composite sample and determine the performance of the newly optimized flowsheet on highly variable samples that would be encountered in the orebody. Samples were selected for the composite sample to include the different ore types, grades, and spatial representations in the proposed FS pit. The final composite consisted of horizons from 13 different drill cores across the proposed pit area (SGS 17658-03, SGS Canada Inc, 2024a).

Variability samples (SGS 17658-04, SGS Canada Inc, 2025a) were chosen to show how samples would perform independently and determine if any specific ore type, grade, or pit area would have throughput or recovery issues. Various horizons from 16 different drill cores were used to develop variability samples with carbon grades ranging from 3.0% up to 18.8%. Table 1-1 summarizes the metallurgical testwork conducted during the FS.

Table 1-1 Testwork Conducted During FS

Category	Testing Company	
	SGS	Pocock
Types of Testing	Whole Rock	Settling – Static And Dynamic – Tails And Con
	Flotation Parametric Testing	Vacuum Filtration – Tails And Con
	Hardness	Pressure Filtration – Tails And Con
	Abrasion	
FS Testing Reference Reports	SGS 17658-03: Flowsheet Optimization on a Master Composite (SGS Canada Inc, 2024a)	Pocock 2446: Solid Liquid Separation Testing (Pocock Industrial, Inc., 2024a, 2024b, 2024c)
	SGS 17658-04: Variability Testing on Eighteen Composites (SGS Canada Inc, 2025a)	
	SGS 17658-05: Graphite Creek Concentrate Production Pilot Plant (SGS Canada Inc, 2024b)	
	SGS 17658-06: The Grindability and Flotation Characteristics of a Master Composite Sample (HPGR testwork) (SGS Canada Inc, 2025b)	

The composite testwork (SGS 17658-03, SGS Canada Inc., 2024a) informed key process design changes from the PFS flowsheet. In particular, regrinding of flotation products and recycled tailings was found to be highly impactful on the final product grade. In testing that did not achieve proper grinding targets, product grades often failed to reach the 95% Cg grade target. However, in similar tests with finer grinds, product grades regularly met or exceeded the 95% Cg mark. Tailings regrind and recycle paths were established to promote maximum graphite liberation and support adequate recoveries above 90%.

1.9 Mineral Resources and Reserves

1.9.1 Mineral Resources

The maiden Graphite Creek mineral resource was released in 2013. As drilling has progressed, numerous updates have been released since then in 43-101 reports. Notable major updates were in the 2016 PEA and 2022 PFS.

The Graphite Creek resource estimate has been classified in accordance with guidelines established by Canadian Institute of Mining, Metallurgy and Petroleum's (CIM) "Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines" dated November 23, 2003, and CIM's "Definition Standards for Mineral Resources and Mineral Reserves" dated November 27, 2010.

According to the CIM definition standards, the Graphite Creek resource estimate has been classified as Indicated and Inferred. The classification was based on geological confidence, data quality, and grade continuity. The most relevant factors used in the classification process were:

- Drillhole spacing; density
- Level of confidence in the geological interpretation where the observed stratigraphic horizons are easily identifiable along strike and across the deposit, which provides confidence in the geological and mineralization continuity
- Estimation parameters (i.e., continuity of mineralization)

The parameters of each estimation pass were determined by the factors listed above, so the estimation pass guided the classification of resources (Table 1-2). The single box search pass and Pass 1 are considered to have a high level of confidence. Thus, they are unlikely to be drilled again and are placed within the Measured category. Pass 2 used a range within 80% of the maximum sill variance with at least two drillholes and is considered to be the next highest level of confidence, the Indicated category. All remaining blocks estimated are considered within the Inferred category, which includes blocks estimated in passes 3-7. The updated Graphite Creek resource numbers for Inferred, Indicated, and Measured resources are summarized in Table 1-3.

Table 1-2 Resource Classification Criteria

	Pass	Nominal Search Distance	Min. Number of Composites	Min. # Of Drillholes
Measured	BOX	1 x 1 x 1	1	1
	1	30 x 20 x 8	3	2
Indicated	2	92 x 63 x 8	3	2
Inferred	3	175 x 125 x 8	3	2
	4	87 x 62.5 x 8	2	1
	5	300 x 150 x 8	3	2
	6	150 x 75 x 8	2	1
	7	1500 x 500 x 500	2	1

Table 1-3 February 2025 Graphite Creek Updated Resource with Inferred, Indicated, and Measured Resources

Mineral Resource Classification	Cut-Off Grade (% Cg)	Tonnage (Mt)	Graphite Grade (% Cg)	Contained Graphite (t)
Inferred	2	268.10	4.31%	11,567,844
Indicated	2	99.57	4.54%	4,523,443
Measured	2	5.11	5.33%	272,249
Measured + Indicated	**4**	**104.68**	**4.58%**	**4,795,692**

The dip and location of the Kigluaik Fault that trends parallel and is adjacent to the deposit's mineralization are controlling factors of the graphite resource. The fault surface has been updated in 2019, 2020, 2022, and 2024. The updates in 2018 and 2019 resulted in resources being truncated by the fault surface. New drilling in 2021 indicated a shallow dip to the fault, resulting in minimal to no truncation of resources. Further drilling since 2021 confirms the shallow dip; however, drill intercepts outside the main resource area are minimal. Continued drilling is required to confirm the fault interpretation to the southwest and northeast. Observed graphite mineralization continues to show remarkable consistency along the strike with little deviation, which provides confidence in the geological and mineralization continuity.

It should also be noted that as additional drilling occurs, the variogram ranges are updated, potentially creating variations in resource classification. The variations have a minimal impact on the total resource but rather impact the category to which they are applied. Further domain refinement based on geologic units or more dynamic grade shells can help mitigate this effect.

Mineral resources are not mineral reserves and do not have demonstrated economic viability. The above tabulation is unconstrained by mining volumes. Values have been rounded and may not sum as a result. There is no guarantee that all or any part of the mineral resource will be converted into a mineral reserve. Based on the current stages of exploration, the above resource analysis indicates that the Graphite Creek Property currently contains sufficient grade and tonnage to continue feasibility studies. The Property includes excellent potential to increase the size of the resource

1.9.2 Mineral Reserves

To convert mineral resources into a mineral reserve, estimates of commodity prices, mining dilution, process recovery, refining and transport costs, royalties, mining costs, processing, and general and administration costs were used to estimate cut-off grades (COG). These input parameters, along with geotechnical slope recommendations, formed the basis for the selection of economic mining blocks.

The economic mining blocks were identified using the Lerchs-Grossmann or Pseudoflow pit optimization algorithm in the Maptek Vulcan software package, which produced a series of optimized open-pit shapes. The QPs selected the optimum shape and completed a detailed design, which was used to quantify the mineral reserves at the determined COG within the final pit design.

A summary of the mineral reserves for the project is shown in Table 1-4 within the designed final pit for the Graphite Creek deposit. In the detailed mine production schedule, the COG has been raised variably over the life of the project to 3.0% Cg. Any resources below the raised COG have been wasted.

The QPs have not identified any known legal, political, environmental, or other risks that would materially affect the potential development of the mineral reserves, except for the risk of not being able to secure the necessary permits from the government for the development and operation of the project; however, the QPs are not aware of any unique characteristics of the project that would prevent permitting.

Table 1-4 Proven and Probable Mineral Reserve Estimate

Class	Diluted Tonnes (kt)	Diluted Grade (% Cg)	Contained Graphite (kt)
Proven	4,099	5.80	238
Probable	67,120	5.18	3,480
Total Proven and Probable	**71,219**	**5.22**	**3,717**

Notes:
1. Mineral reserves follow CIM definitions and are effective as of 25 March 2025.
2. The mineral reserves are inclusive of mining dilution and ore loss.
3. Mineral reserves are estimated using a raised variable cut-off of 2.0% Cg – 3.0% Cg which is required to maximize secondary treatment production. The economic value is calculated based on a net average Graphite Price of $1,200/t (including transport and treatment charges), 3.5% - 8.0% royalty, and a mill recovery of 90%.
4. The final pit design contains an additional 17.4 Mt of Measured and Indicated resources between the raised COG (3.0% Cg) and the economic COG (2.0% Cg) at an average grade of 2.4% Cg. These resources have been treated as waste in the final mine production schedule.
5. The final pit design contains an additional 40.4 Mt of Inferred resources above the economic COG (2.0% Cg) at an average grade of 3.9% Cg. Inferred mineral resources are considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as mineral reserves, and there is no certainty that any part of the Inferred resources could be converted into mineral reserves.
6. Tonnages are rounded to the nearest 1,000 t, and graphite grades are rounded to two decimal places. Tonnage measurements are in metric units.
7. Totals may not sum due to rounding.

1.10 Mining Methods

Open-pit mining was selected as the mining method for the Graphite Creek deposit due to its relatively low cost (versus underground mining methods) and the near-surface nature of the deposit. The ultimate pit design was split into five pushbacks to aid construction activities and help smooth production rates during operations. The approximate pushback shapes were selected from the generated pit shells as part of the pit optimization process, which provides a sequence based on overall value. The design parameters include a ramp width of 30 m, road grades of 10%, bench height of 8 m, variable slope angles by rock type, and a minimum mining width of 30 m. Final walls will be benched to a height of 32 m to satisfy an overall slope angle of 42.4° or flatter. The geotechnical design parameters were based on the 2024 geotechnical field and laboratory testing programs carried out to update the structural, geotechnical, and hydrogeologic models.

The mine schedule is developed and reported monthly for the pre-production period and the first two years of production, quarterly from Year 3 to Year 5, and annually thereafter. The scheduling constraints utilize a maximum mining capacity of 17 million tonnes (Mt) per year and the maximum number of benches mined per year at ten in each phase.

The production schedule includes the mill ramp-up which considers the normal inefficiencies related to the start of operations and includes the tonnage processed as well as the associated recoveries, which increases the design capacity during the second quarter of operation. The mine requires one year of pre-production before the start of operations in the mill. After the pre-production period and the first year, mining is expected to be able to maintain a relatively low strip ratio of 2:1 (waste:ore) for the next five years. Stripping requirements will increase after the first phase is mined. The current expected mine life is 21 years.

Ore production rate was determined based on STP capacity of 175,000 tonnes per year (tpa). To achieve this, the mill production capacity was set to be at 3,600,000 tpa over the life-of-mine (LOM), and the mine COG was raised to be between 2% and 3%. Due to these raised COG, approximately 17.4 Mt of low-grade resources with an average grade of 2.4% are considered waste. Stockpiling and reclaiming strategies were used to optimize the production schedule. After finishing the first mining phase in Year 7, stockpile inventory reaches 2.6 Mt. Stockpile reclaim begins in Year 9 and continues throughout the end-of-mine life.

Mining activities will be self-performed using conventional mining techniques (drill, blast, load, and haul). The mining fleet will consist of a hydraulic mining shovel, front-end loader, 141-t haul trucks, and 171 mm (6.75 inch (in)) diameter drills. Given the overall scale of operations and equipment requirements, the entire fleet will be diesel-powered. The mine will operate 365 days per year, allowing 13 non-operating days due to weather delays, and 24 hours a day, seven days a week. It will utilize four rotating crews working two 12-hour shifts.

Blasting at this mine will primarily use gassed-emulsion explosives, which will be manufactured on-site. A contractor is assumed to produce and deliver explosives and blasting accessories. Loading the holes and blasting will be a joint effort between the mine employees and the explosives contractor.

A total of 230 Mt of waste material will be mined over the mine life. It has been assumed that all non-overburden waste materials will be potentially acid generating (PAG) and will be contained in the waste management facility (WMF) along with tailings material. The WMF is located north of the open pit, approximately 100 m away from the pit crest. The facility is designed to store approximately 307 Mt of filtered tailings and waste rock, equivalent to a storage volume of approximately 139 Mm^3.

The WMF design includes a high-density polyethylene (HDPE) basin liner and a stabilizing buttress. The buttress will be constructed with waste material from the pit. The tailings and waste rock will then be co-mingled and placed in the WMF. The objective of the co-mingling strategy is to create a blended, compacted, low-permeability material. Waste rock or processed material may also be placed in select locations in the WMF to promote internal drainage of the filtered tailings. The WMF will be constructed in three stages to accelerate contemporaneous closure activities.

After mining operations conclude, the site will transition into final reclamation and closure activities. All reclamation activities will be self-performed utilizing the equipment fleet that supported the mining operation. The demolition and most reclamation activities will be completed in approximately one year. All facilities will be demolished and removed. The debris will be disposed of in the final pit and covered in accordance with Alaska mining regulations. The haul roads, access roads, and facility pads will be dismantled and regraded to approximate original contours. Topsoil material that was salvaged during operations will be spread on the regraded areas where suitable and reseeded according to permit requirements. The last phase of the WMF will also be regraded and closed at this time. Final reclamation monitoring and maintenance are included in the operating cost estimate for a ten-year period following the completion of reclamation activities.

1.11 Recovery Methods

1.11.1 Graphite Creek Facility

The project envisages a multi-location mining and processing operation consisting of producing 175,000 tpa of graphite concentrate (95 wt%) at Graphite Creek, Alaska (mill); shipping the concentrate to Niles, Ohio; and refining 175,000 tpa of natural graphite concentrate into AAM and other graphitic byproducts at the Niles, Ohio, STP.

The facility at Graphite Creek consists of an open-pit mine feeding approximately 10,000 tonnes per day (tpd) of run-of-mine (ROM) ore to the mill. The mill operations consist of primary crushing, crushed ore stockpile and reclaim, semi-autogenous grinding (SAG) milling, flash and rougher flotation, and seven stages of cleaner flotation supported by three stages of regrind. The tailings will be thickened, filtered, and loaded out to the WMF. The concentrate will be thickened, filtered, dried, and loaded into 20-foot containers for transport to Niles, Ohio.

The mill will operate two shifts per day, 365 days per year, with an overall availability of 90%. The design basis further assumes 90% graphite recovery in the mill with a final concentrate moisture content of 1.0 wt.% or less.

The plant design capacity is based on producing 175,000 tpa of 95% graphite concentrate with a 90% recovery rate from approximately 10,000 tpd of ROM material containing 5.3 wt% Cg. An operating schedule of 365 days per year, 2 x 12-hour shifts per day, was assumed for the grinding circuit and downstream operations. The crushing plant operation feeding the crushed ore stockpile is based on 1 x 12-hour shift per day.

Plant design consists of the following major processing steps:

- The comminution circuit will include a jaw crusher (P80 of 125 mm) followed by a SAG mill in closed circuit (P80 of 350 µm). A coarse ore stockpile between the crusher and mill will decouple the crushing and grinding operations and provide approximately 48 hours of plant feed storage capacity.
- The grinding circuit will include an internal flash flotation step, and rougher flotation operating on SAG mill discharge.
- Rougher and flash flotation concentrates will combine and be reduced in a closed-circuit ball mill (P80 of 240 µm). The subsequent seven stages of cleaner flotation will include regrind after the second and fourth cleaner stages (170 µm and 140 µm, respectively).
- The graphite concentrate will be dewatered and dried through a combination of high-rate thickener, plate and frame filter press, and diesel-fired dryer.
- Dried product will report to storage silos and ultimately to 20-foot shipping containers. Shipping containers stored onsite will provide additional product storage ahead of truck shipment to Nome.

- Combined plant tailings will be dewatered with a high-rate thickener and vacuum belt filters to produce filter cake, which will be stockpiled and hauled to the WMF. Tailings will be comingled with waste rock in the WMF.

A plot plan of the primary processing plant is shown in Figure 1-7.

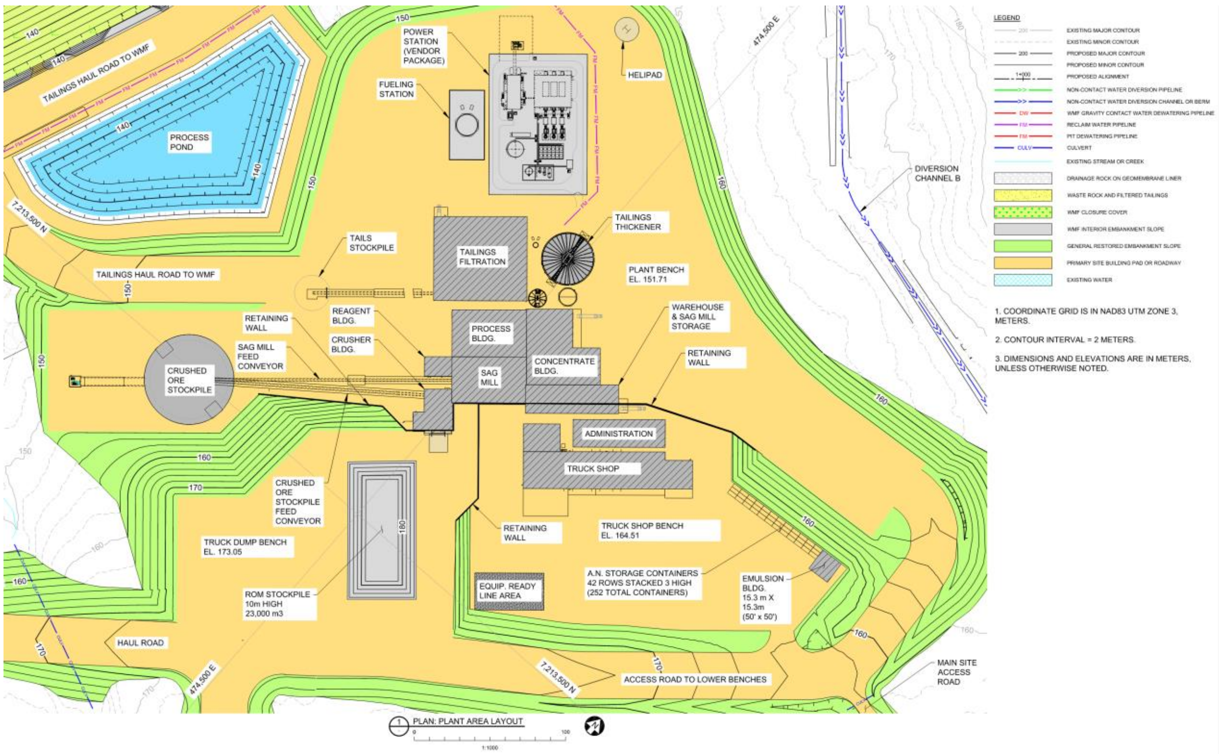


Figure 1-7 Graphite One Plot Plan

1.12 Concentrate Transport Logistics

The transport of graphite concentrate from the project to the STP involves a multi-modal approach. Dried graphite concentrate in reusable 20-foot shipping containers will be transported by truck to Nome multiple times daily throughout the year. Due to seasonal port availability, concentrate containers will be stored in Nome adjacent to the port until the spring thaw. In early June, the containers will be loaded onto a self-loading (geared) container ship in exchange for empty containers returning from the STP. The ship will travel to Prince Rupert, British Columbia, Canada, where full containers will be transferred to temporary storage, where they will await transfer to unit trains. Empty containers will be loaded back onto the ship for the return trip to Nome. Trains will then transport the full containers to the STP and return with empty ones. The entire journey covers approximately 8,000 km and accounts for the coordination and storage required at each transfer point along the route. Further details on the concentrate transport logistics can be found in Section 18.1.14.

1.13 Secondary Treatment Plant (Ohio, USA)

The STP in Niles, Ohio, aims to process natural graphite (NG) sourced from the Graphite Creek Property in Alaska to produce active anode materials (AAM) for the Li-ion battery market and other graphite products. The key products envisioned from this plant are listed in Table 1-5 (25 ktpa) and Table 1-6 (175 ktpa) below.

The STP will be constructed over five years, building seven modules during that time. Each module is expected to process approximately 25,000 tpa (27,558 short tpa) of graphite concentrate, along with other additives such as coke, pitch, and anode precursor material to produce a total estimated 36,850 tpa (40,620 short tpa) of products, including 24,371 tpa (26,864 short tpa) of anode material products for the Li-ion battery application along with 3,608 tpa (3,977 short tpa) of purified and 8,871 tpa (9,779 short tpa) of unpurified products for the graphite market.

The STP is expected to require approximately 89 ha (220 ac) of land and consists of 88 buildings.

The manufacturing processes are envisioned to utilize electrically heated, high-temperature furnaces for the purification and graphitization processes. The project site is anticipated to be in Niles, Trumbull County, Ohio, and has access to railroad tracks and paved roadways.

After the STP is designed and permitted, construction of the first two 25,000 tpa modules is expected to take approximately 22 months before being turned over to pre-operational testing and commissioning, and it will take an additional 40 months to reach 175,000 tpa of NG capacity.

Graphite One appointed Hatch to perform the required preliminary engineering activities for the chosen site, including process drawings and process mass balances based on the manufacturing process design by Graphite One. The process layout and buildings were based on the process requirements provided by Andrew Tan of Graphite One. The facility has been designed for 25,000 tpa modules with seven modules required for 175,000 tpa of NG capacity.

A plot plan of the STP site showing one 25,000 tpa module is shown in Figure 1-8.

Table 1-5 STP Products and Production Rate for 25 ktpa

Category	Description	Purity (% Cg)	Nominal Flowrate (tpa)	Total (tpa)
Anode Material	Secondary Particle NG Anode 'A'	99.95	1,749	24,372
	Secondary Particle Composite Anode 'A'	99.95	6,024	
	Single Particle Pure NG Anode 'B'	99.95	5,714	
	Single Particle Blended Anode 'B'	99.95	10,884	
Purified	+32 Mesh Purified Graphite Product	>99	55	3,608
	+50 Mesh Purified Graphite Product	>99	502	
	+80 Mesh Purified Graphite Product	>99	557	
	+100 Mesh Purified Graphite Product	>99	929	
	Battery Conductor Product	99.9	660	
	Synthetic Diamond Product	99.99	905	
Unpurified	+32 Mesh Unpurified Graphite Flake	>95	90	8,872
	+50 Mesh Unpurified Graphite Flake	>95	810	
	+80 Mesh Unpurified Graphite Flake	>95	900	
	+100 Mesh Unpurified Graphite Flake	>95	1,500	
	Rejected Coke	>95	1,149	
	Carbon Raisers Lubricants Product	>95	4,423	
Total				**36,852**

Table 1-6 STP Products and Production Rate for 175 ktpa

Category	Description	Purity (% Ct)	Nominal Flowrate (tpa)	Total (tpa)
Anode Material	Secondary Particle NG Anode 'A'	99.95	12,160	169,386
	Secondary Particle Composite Anode 'A'	99.95	42,085	
	Single Particle Pure NG Anode 'B'	99.95	39,639	
	Single Particle Blended Anode 'B'	99.95	75,502	
Purified	+32 Mesh Purified Graphite Product	>99	386	25,035
	+50 Mesh Purified Graphite Product	>99	3,480	
	+80 Mesh Purified Graphite Product	>99	3,866	
	+100 Mesh Purified Graphite Product	>99	6,446	
	Battery Conductor Product	99.9	4,579	
	Synthetic Diamond Product	99.99	6,278	
Unpurified	+32 Mesh Unpurified Graphite Flake	>95	630	62,090
	+50 Mesh Unpurified Graphite Flake	>95	5,670	
	+80 Mesh Unpurified Graphite Flake	>95	6,297	
	+100 Mesh Unpurified Graphite Flake	>95	10,502	
	Rejected Coke	>95	8,043	
	Carbon Raisers Lubricants Product	>95	30,949	
Total				**256,510**

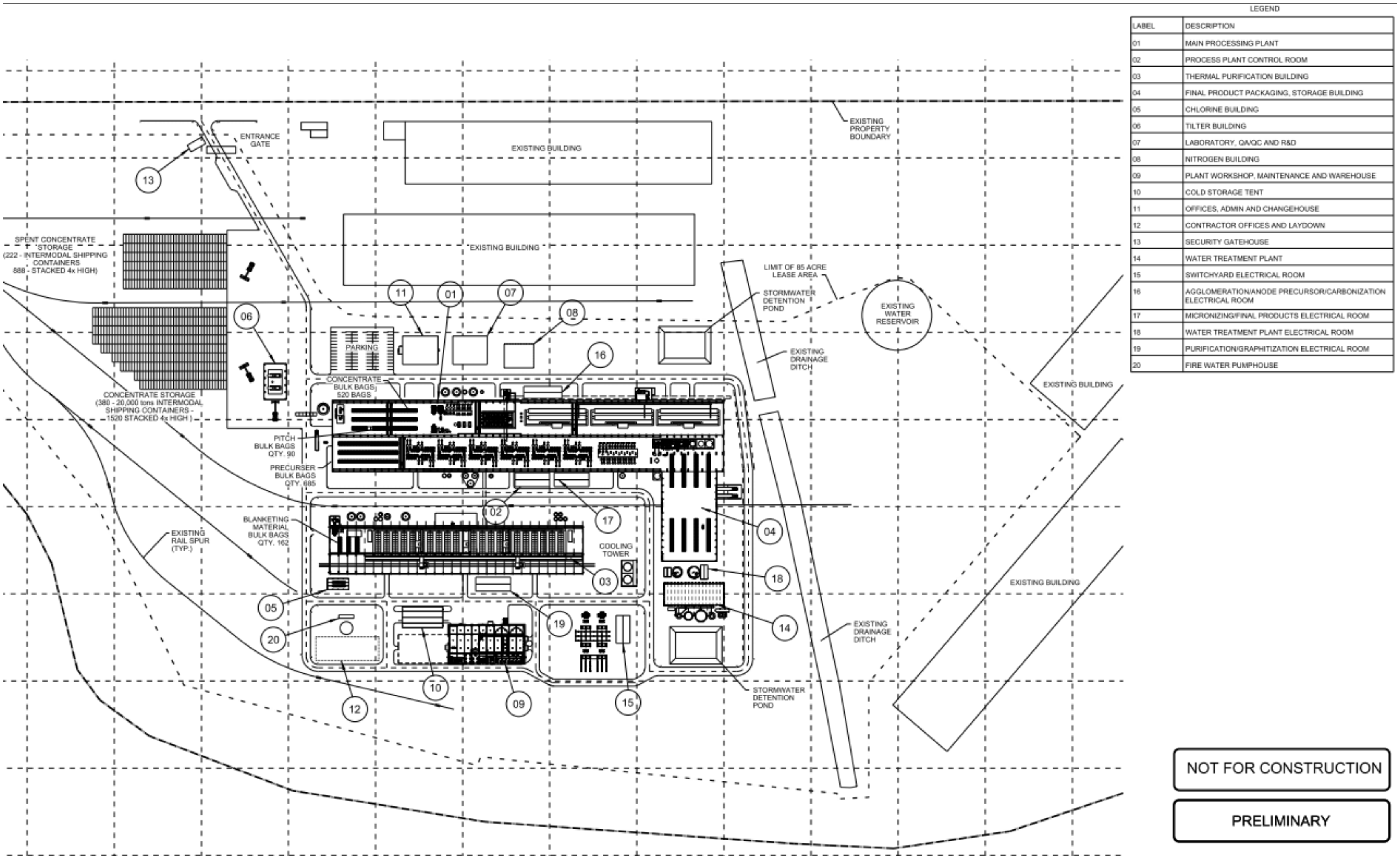


Figure 1-8 Secondary Treatment Plant Plot Plan

1.14 Project Infrastructure

Project infrastructure and facilities will be required for both the Alaska site and STP.

1.14.1 Alaskan Site

The Alaskan project site is a remote, greenfield site with no existing infrastructure.

1.14.1.1 Project Infrastructure

Project infrastructure includes the main access road, site roads, site electrical power generation and distribution, fuel storage and dispensing, explosives and emulsion storage, mine WMF, water treatment facilities, and a helipad. Enclosed buildings are provided for administration offices, warehousing, metallurgical lab, crusher, SAG mill, mill, tailings filtration and thickening, concentrate loading, truck shop, parts storage, and emergency response. Crushed ore feeding the mill will also be stored in a covered stockpile. Accommodation facilities for both the construction and permanent workforce will be in Nome.

1.14.1.2 Water Management Plan

The water management plan for the mining facility is designed to manage water resources throughout the life of the mine, ensuring maximum reuse and minimal environmental impact. The plan segregates contact water from non-contact water and re-employs diversion of upstream sources around mine operations.

The plan involves managing contact water generated from precipitation on the mill infrastructure, pit, WMF, and main haul roads. The water management pond (WMP) is designed to collect contact water generated from the increasing footprint of the mine facilities and store it for treatment before discharge. A smaller process pond (PP) will support operational needs at the mill and capture runoff from the mill area. These two ponds will be linked hydraulically to maintain the balance between reuse and treatment.

After the mine pit extends to Graphite Creek, an upstream diversion structure will be constructed to mitigate pit infiltration and reduce dewatering needs. This diversion will redirect creek flows around the pit and all operational areas into Glacier Canyon Creek to the west. Intercept berms and channels will prevent other non-contact water from running on and route it around operational areas, minimizing the volume of water requiring treatment.

All infrastructure will be removed at closure, and active water management will cease. Graphite Creek diversion structure will remain in perpetuity and require intermittent maintenance. Direct precipitation to the pit will exceed seepage loss to groundwater until an equilibrium elevation well below the pit spill elevation is reached. This elevation is modeled to be well below the pit spill elevation. Post-closure water management will likely require some level of in-pit water treatment to mitigate changes in collected water chemistry over the long term.

1.14.1.3 Waste Management Facility

The WMF is designed to store filtered tailings and waste rock produced from mine and mill operations. Since the geochemical characterization of the mine site reveals potential for acid generation and metal leaching, the filtered tailings and waste rock are planned to be co-disposed within a single-lined storage facility. The WMF is not intended to provide water storage. The primary water storage facility to manage process and meteoric contact water is the WMP.

The WMF designed geometry (height, slopes, etc.) was developed from a two-dimensional (2D) slope stability analysis using GeoStudio and FLAC software programs to evaluate long-term stability conditions under the ultimate WMF geometry. The geometry uses an exterior slope of 2.5H:1V and a maximum height of approximately 105 m, though the average maximum height thickness is closer to 85 m. The WMF design uses a waste rock perimeter embankment surrounding the co-mingled tailings and waste material.

Two cross sections selected at the maximum WMF height and along the primary topographic grades were evaluated with respect to drained, yield undrained, and post-liquefaction undrained-shear-strength conditions. Modeling was also performed to assess the saturation of the tailings over time during operation as a function of the initial placed moisture content and the resulting susceptibility of the tailings to liquefaction, both seismic and static. Static and seismic deformation analyses were performed in FLAC. Using the advanced PM4Sand constitutive model and an earthquake with a return period of 2,475 years, the maximum displacement magnitudes were on the order of 0.4 m, suggesting slumping as the dominant failure mechanism at the downstream toe of the waste rock perimeter embankment with no triggering of flow liquefaction. The comingled material was modeled overlying a polyethylene liner placed on native foundation material. The liner was incorporated into the stability analysis as it was the leading option at the time of this study. The waste-liner interface is a controlling feature in the global stability assessment.

1.14.2 Secondary Treatment Plant

The STP is expected to be in an area of Trumbull County, Ohio, where existing infrastructure will be utilized to meet project needs. The site is bounded to the east by the existing Norfolk Southern Railroad tracks. The proposed site is accessible by paved roadways and contains usable rail spurs. Grid electric power, natural gas, and raw water are all currently available at the site boundary or within the site. The STP project will incorporate and build on this existing infrastructure.

1.15 Markets and Contracts

1.15.1 Graphite Uses

Natural and synthetic graphites are used to make products for many applications that can generally be grouped into the following categories:

- **Energy storage**: anode materials for Li-ion batteries for electric vehicles (EV) and electrical grid storage applications, and Li-ion and other batteries for consumer, communications, aerospace, medical and military applications
- **Thermal management**: applications requiring graphite’s properties as a thermal conductor or insulator, including refractories, crucibles, steel and foundry additives, hot-metal toppings, and geothermal grouting systems

- **Engineering products**: products manufactured using graphite powder additives such as fire retardants, powder metallurgy, foils, friction materials (brake linings, clutch facings), carbon brushes, and synthetic diamonds
- **Lubricants**: applications relying on graphite's natural lubricity such as lubricants (wet, dry, rail, nuclear grade, aerospace, agriculture, MIL-SPEC, food grade), drilling fluids, coatings, and dispersions
- **Plastics and polymers**: applications using graphite's properties in plastics and polymers to make gaskets, seals, anti-static materials, and coatings

In some cases, only synthetic (also known as artificial) or only natural graphite can be used to make a particular product. In others, the two are used as a blend or processed together, depending on the product's goals.

- China is and will continue to be the dominant global producer of advanced graphite products. It has abundant natural graphite resources, synthetic graphite production capacity, coated spherical graphite production capacity, advanced anode production capacity, related technology and experience, and the capital to expand.
- All types of graphite used in all applications are forecast to increase to 9.2 million tonnes per year (Mtpa) in 2050 from about 2.85 Mtpa in 2020. Of this, synthetic increases to 5.9 Mtpa from about 1.8 Mtpa and natural to 3.35 Mtpa from about 1.0 Mtpa.
- Flake graphite in battery use is forecast to peak at 2.41 Mtpa in 2043, increasing from 0.28 Mtpa in 2020 and gradually dropping to 2.17 Mtpa in 2050.
- An increase in demand, for natural flake graphite for batteries, of over 2 Mtpa by 2043 requires existing operations to reach their maximum capacities and new projects to commence production.

1.15.2 Natural Graphite

Natural graphite occurs in three types of mineral deposits: microcrystalline (amorphous), macrocrystalline (flake), and vein (crystalline vein or lump).

Natural flake graphite is mined, crushed, ground, milled, and screened, then separated from non-graphitic material in a froth flotation process. The resulting graphite concentrate, depending on its source, is about 95% Cg and has a characteristic particle-size distribution. The concentrate is used in many traditional applications (refractories, etc.) or further purified and processed into higher-value products for use in advanced applications (fire retardants, battery anode materials, etc.).

Over the last decade, flake graphite has become increasingly important as a substitute for or an additive with synthetic graphite in Li-ion battery anodes. Anode producers look to optimize costs and battery performance with various blends of materials. To be used in a Li-ion battery anode, flake of the correct sizing (typically minus 100 mesh) is spheronized, purified (to at least 99.95% Cg), coated with a carbon coating, and carbonized for consistent quality and optimal conductive properties. The resulting coated spherical graphite is an ingredient in a battery anode. A cell producer will combine the anode material with the other battery components in the casing of choice to produce a battery cell. The cell can be in either a cylindrical, prismatic, or pouch configuration. The OEM will then purchase the cells from the battery producer for use in its various powered applications.

1.15.2.1 Natural Graphite Demand

The battery anode market is the largest consumer of graphite, accounting for 49% (0.55 Mt) of graphite demand in 2023. This is projected to increase to 78.3% (2.25 Mt) by 2030 and 90.3% (7.23 Mt) by 2040.

While flake graphite demand is expected to increase, use in non-battery products is expected to remain steady in terms of the amounts of product required. Still, it will represent a much lower percentage of the total flake graphite demand as the Li-ion battery market increases year-on-year.

1.15.2.2 Natural Graphite Supply

China continues to dominate flake graphite supply by increasing production from 1.1 Mt in 2023 to 1.6 Mt in 2030 and 1.7 Mt annually by 2040. Despite an increase in forecast production, China's market share is expected to decrease from 77% in 2024 to 62% by 2030 as African countries increase their market share from 11% in 2023 to 24% in 2030. Africa's supply is forecast to increase production from 161 kilotonne (kt) in 2023 to 634 kt in 2030 and 596 kt by 2040. South American production, fully from Brazil, will increase from 105 kt in 2023 to 121 kt in 2030, then down to 97 kt by 2040. Benchmark Minerals Intelligence (Benchmark) forecasts North American production to increase from 4.4 kt in 2023 to 106 kt in 2030, and 108 kt by 2040. The North American forecast includes Canadian operations only, so the Graphite Creek project contribution, as defined in this feasibility study, is not included.

1.15.3 Synthetic Graphite

Synthetic graphite is produced by graphitizing a precursor material in high-temperature furnaces (2,800°C to 3,000°C). The precursor is made from needle coke and pitches that are first milled and mixed, then carbonized. Synthetic graphite powders are used in various applications, including making Li-ion battery anode materials.

1.15.3.1 Synthetic Graphite Demand

Synthetic graphite has two primary uses—battery anode material and electrodes for the steel industry. Global demand for these two products was 2 Mt in 2023, with battery anode material accounting for 34% (692 kt) and electrodes accounting for 66% (1.3 Mt). Battery demand is forecast to drive a 228% increase in demand over 2023 for synthetic battery anode material by 2030 and 437% by 2040. This will increase demand for synthetic graphite battery anode material to 2.5 Mt in 2030 and 3.7 Mt by 2040. The electrode market is forecast to see demand for 1.45 Mt and 1.75 Mt in the same years. Supply is expected to be in surplus until 2033, when demand will exceed supply.

1.15.3.2 Synthetic Graphite Supply

China is expected to continue its industry dominance with production increasing from 2.4 Mt in 2023 to 3.6 Mt by 2030 and 3.7 Mt in 2040. India is expected to maintain its position as the second largest producer of synthetic graphite by increasing production from 155 kt in 2023, 219 kt in 2030, and 232 kt by 2040.

1.15.4 Battery Market

Driven by the EV sector, demand for AAM is expected to reach 6.3 Mt by 2030 and 7.5 Mt by 2040, a 249% increase and 630% increase verses. 2023, respectively. Although energy storage systems and portable batteries will continue to see demand increase, their market share is expected to diminish as EVs dominate demand.

The demand for natural graphite for battery anode materials is expected to grow with a forecast demand of 1.1 Mt in 2030 and 3.0 Mt required by 2040. Demand for synthetic graphite is expected to grow at even faster rates with demand forecasts of 2.3 Mt in 2030 and 3.7 Mt by 2040.

1.15.5 Refined Product Pricing

Graphite One has used the industry forecasts from Benchmark to provide category pricing at representative qualities, and a $250/t ocean freight to the United States has been included. A discrete 48.7% and 20% allowance has been applied to account for U.S. tariffs on Chinese artificial graphite products and refined natural graphite, respectively, in effect as of March 2025. Other consultants with direct industry marketing experience have been used to get an understanding of the potential variations within product categories due to quality parameters, potential contract quantities, and shipping and packaging requirements for commercial-scale production.

The weighted average price of all refined product categories is $7,843/t.

1.15.6 Contracts

Unlike most mined commodities, there are limited open markets for graphite products, and such contracts will need to be negotiated to sell all products generated by the STP. While Graphite One has had preliminary discussions with several potential customers under confidentiality agreements, the only supply agreement currently in place is a non-binding AAM supply agreement with U.S.-based electric car manufacturer, Lucid Motors.

Graphite One signed technology license and consulting agreements with Hunan Chenyu Fuji New Energy Technology Co. Ltd. (Chenyu), a Chinese-headquartered AAM manufacturer, to support the design, construction, and operation of the Ohio STP.

1.16 Environmental and Permitting

The following are summarized below for both the Graphite Creek Project in Alaska and the STP facility in Ohio.

- Environmental baseline studies
- Major environmental resources within the respective areas
- Environmental permitting requirements

1.16.1 Environmental Permitting Requirements

1.16.1.1 Wetlands

Due to wetlands impacts at the Graphite Creek Project, it will be necessary to obtain a U.S. Army Corps of Engineers (USACE) permit under Section 404 of the Clean Water Act (CWA). This critical authorization is the only major federal authorization necessary for the Project and will trigger a National Environmental Protection Act (NEPA) review.

Wetlands and water body mapping have been completed in sufficient detail for the USACE to make a Jurisdictional Determination, which is necessary for the USACE to decide on the CWA Section 404 Permit. 6,349.5 ha (15,690 ac) around the proposed mine site and access road corridor have undergone wetlands delineation mapping.

Results of the mapping and analysis show that 1.4 ha (3.4 ac) of the total 640 ha (1,581.5 ac) Graphite Creek Project area is identified as a jurisdictional wetland or waterbody (i.e., <1%).

No Section 404 permit is anticipated for the STP facility in Ohio. Two aquatic resources are mapped within the anticipated site area on the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI). One mapped resource is likely a stormwater facility and is not regulated under the CWA. The other is a tributary to the Mahoning River, which is not proposed to be impacted by the development of the site. The U.S. Department of Agriculture (USDA)–Natural Resource Conservation Service (NRCS) has classified the manufacturing facility site area as urban land. Based on preliminary studies, the site soils/sediments are composed of weathered slag fill ranging in depth from ten feet to thirty feet deep. No natural wetlands are mapped by the NWI, and mapped soils, vegetation, and lack of hydrology do not indicate wetlands are present.

1.16.1.2 Surface Water Hydrology and Quality

Understanding the baseline hydrology, water quality, and the potential impacts of the proposed activity to water in the project areas are fundamental parts of the NEPA analysis.

Alaska

Graphite One has conducted baseline water quality sampling of streams in the Graphite Creek area since 2014. Ten monitoring sites in six streams have been sampled for most of this period. Two sites were added on a seventh stream in 2024. Water quality sampling indicates that streams in the project area have elevated acidity (lower potential of hydrogen (pH)) and elevated content of some metals, including Al, Cd, Fe, and Ni. Some streams, including Graphite Creek have naturally occurring aluminum sulfate precipitate in their upper reaches and iron oxide/hydroxide precipitate in their mid-reaches.

Streamflow measurements have been taken at five gauging stations: two on Glacier Canyon Creek, two on Graphite Creek, and one on the Cobblestone River.

Baseline studies to understand the salinity, bathymetry, and current flow of the Imuruk Basin and Tuksuk Channel began in 2024

Ohio

Before vacating the site in 2012, the U.S. Department of Defense (DoD) performed a Voluntary Action Program assessment and cleanup project to receive "No Further Action" and "Covenant Not to Sue" letters from the Ohio Environmental Protection Agency (OEPA). The Recorded Covenant Not to Sue for NFA Letter No. 14NFA596 indicates: "No surface water or sediments are present on the property".

According to the 2024 Integrated Report, which fulfills Ohio's reporting obligations under Section 305(b) (33 U.S.C. 1315) and Section 303(d) (33 U.S.C. 1313) of the Federal Clean Water Act, the Mahoning River segment (Mahoning River Mainstem–Eagle Creek to Pennsylvania Border; Assessment Unit ID: OHLR050301039001) adjacent to the manufacturing facility site is a CWA Section 303(d) listed, impaired waters (Category 5). Category 5 refers to the list of impaired waters that require the development of a Total Maximum Daily Load. The Aquatic Life–Warmwater Habitat parameter includes the following impairments: flow regime modification, habitat alterations, organic enrichment, pollutants in urban stormwater, sedimentation/siltation, and cause unknown. The Human Health–Fish Consumption parameter is impaired for polychlorinated biphenyls in fish tissue. The Recreation–Primary Contact parameter is impaired for Escherichia Coli.

1.16.1.3 Groundwater Hydrogeology and Quality

Alaska

Groundwater studies (hydrogeology) have been conducted to quantify baseline conditions, predict impacts to surface water resources during and after mining, and provide input to operational considerations, such as water handling and treatment. A minimal program was accomplished in 2019, with more comprehensive ongoing studies since 2021.

Hydrogeologic studies indicated that bedrock in the deposit area has very low primary permeability and that most of the groundwater is in faults and fractures. Relatively small quantities of groundwater are expected to enter the pit during mining. Studies and modeling indicate that the majority of the water that will need to be removed from the pit will be from rain and snow melt.

A pit lake is expected to form post-mining. Modeling indicates that the pit lake will reach a maximum depth in 15 to 20 years and not overflow.

The groundwater in the deposit area has elevated acidity (low pH), Al, Fe, Ni, sulfate, and total dissolved solids (TDS). The concentration of these constituents rapidly decreases north of the mountain front; the groundwater in the lowlands north of the pit area has background levels of these constituents.

Ohio

No known groundwater quality concerns exist at the manufacturing facility site. Before vacating the site in 2012, the DoD performed a voluntary action program (VAP) assessment and cleanup project to receive "No Further Action" and "Covenant Not to Sue" letters from the OEPA. According to the VAP Property Summary: "The uppermost water-bearing zone typically ranged from 10 to 20 feet below ground surface, was part of the Site Assessment. Potential chemicals of interest in uppermost water-bearing zone meet unrestricted potable use standards (UPUS)."

1.16.1.4 Air Quality

Alaska

Air quality may be impacted by power plant emissions (diesel generating set) and fugitive dust control. The Alaska Department of Environmental Conservation (ADEC) requires a year of baseline meteorological data before applying for a minor air permit or a Prevention of Significant Deterioration (PSD) permit. A PSD permit also requires data on background air pollutants in the area. In addition to baseline data collection, modeling and permit preparation can require another six months, and ADEC can require roughly a year to process a PSD application. The air quality information required for ADEC should be adequate for NEPA. A meteorological tower was installed in the project area in October of 2024. The instrument package on the tower will continue to measure a number of parameters necessary for modeling. The location of the tower and the instrument package were both approved by ADEC.

Ohio

In the U.S. Environmental Protection Agency's (EPA) Ohio Eight-Hour Ozone Nonattainment Areas map, Trumbull County, the air quality control region where the manufacturing facility site is located, is in attainment (maintenance area). Air emissions from the facility would require an Air Pollution Control Permit–Permit to Install/Operate (PTIO) from the OEPA for new emissions. The PTIO process covers various types of air permits, but a PSD permit is anticipated for the manufacturing facility site. Meteorological data is available through various Ohio sources to support the background air pollutant data requirements of the permit process. Similar to Alaska, the modeling and permit preparation would require roughly three to six months, with the processing through the OEPA requiring up to another twelve months.

1.16.1.5 Aquatic Resources

Alaska

Graphite One has completed aerial fish reconnaissance surveys of the Project area streams since 2018. Ongoing aquatic baseline data collection started in 2019 to establish baseline conditions of aquatic communities and water quality while quantifying the natural variability of both, and to evaluate the overall health and productivity of the drainage.

The sampling program has included establishing long-term biomonitoring sites and conducting aerial and ground-based fish surveys. The goal of the aquatic baseline study is to collect data to establish the aquatic resource baseline, support NEPA evaluation, Federal permitting, and Alaska Department of Fish and Game (ADFG) Fish Habitat Permit review and issuance. Biomonitoring sites were sampled for water quality, periphyton standing crop, aquatic macroinvertebrates (invertebrates), and juvenile fish for abundance and whole-body elemental analysis.

To evaluate aquatic resources in the project area and aid in road design and alignment, all potential road crossings of area streams have been investigated. Most small streams with potential fish habitat are not used by fish, and those that are used primarily by slimy sculpin, and/or juvenile Dolly Varden and coho salmon.

Ohio

No unique aquatic habitat is known to exist at the manufacturing facility site as no natural waterways or wetlands are located on site.

1.16.1.6 Marine Environment

Alaska

The project area is within five miles of Imuruk Basin, a body of tidally influenced water. Imuruk Basin is connected to Grantley Harbor to the west by the narrow 10-mile-long Tuksuk Channel. Numerous freshwater rivers flow into Imuruk Basin, including the Kusitrin, Kaviruk, Aqiapuk, Cobblestone Rivers, and Graphite Creek. All rivers and streams proximal to the mine site flow into Imuruk Basin.

To characterize the existing water quality in the Imuruk Basin, in-situ water conditions were measured at various depths at 12 sites. Monitoring indicates that the basin water is slightly brackish, and a more saline layer is occasionally seen at the bottom near the outlet.

Fish sampling was instituted in 2022, focusing on the southern shore of the Basin between the western edge of Windy Cove to near the mouth of the Cobblestone River.

Sampling results indicate a mixed assemblage of freshwater and marine/brackish water fish species use the southern shores of Imuruk Basin throughout the season, likely based on salinity fluctuations and fish life history.

Ohio

No marine environments exist in the vicinity of the manufacturing facility site.

1.16.1.7 Wildlife

Alaska

Though the project site may not be in a particularly sensitive area for wildlife, the project's impact on wildlife may be an important issue because local residents rely on subsistence resources.

There are three species listed as ‘threatened’ under the Endangered Species Act (ESA) that are known to use coastal habitats in the vicinity of the project area: polar bear, Steller’s eider, and spectacled eider. Polar bear critical habitat technically includes Imuruk Basin, but their use of this inland estuary is expected to be very unlikely. Steller’s and spectacled eiders are known to use coastal habitats in Port Clarence during spring and fall migrations but do not breed on the Seward Peninsula. The lead permitting agency, USACE, will determine whether it is necessary to conduct Section 7 ESA consultation on these species.

Since 2022, annual raptor nest surveys have been conducted in the project area and have identified several nests, including those of golden eagles. Construction activities will be required to comply with timing restrictions for vegetation clearing during migration and nesting season.

Ohio

No significant wildlife concerns exist at the manufacturing facility site. Based on the USFWS Information for Planning and Consultation tool results for the manufacturing facility site, Indiana bats, eastern Massasauga rattlesnakes, eastern hellbenders, and monarch butterflies may exist in the general vicinity; however, none are anticipated to occur due to the lack of suitable habitat within the previously developed industrial site. Additionally, no critical habitats are located within the manufacturing facility site boundary. Limited building demolition may require presence/absence surveys for Indiana bats; however, if any Indiana bats are present, they can be excluded from buildings during periods specified by the Ohio Department of Natural Resources (ODNR) prior to demolition.

1.16.1.8 Cultural Resources

Alaska

Pedestrian and aerial cultural resources surveys were conducted in 2023 and 2024 around the project site and along the access road corridor. The survey crew, led by a Secretary of the Interior-qualified archaeologist, documented a number of historic and prehistoric sites. Additional background research and cultural resource surveys of the project area, particularly within areas to be disturbed by the project, will need to be conducted. As the Project falls on Alaska state land, it is subject to compliance with the Alaska State Historic Preservation Act.

Once a CWA Section 404 permit is applied for, USACE will initiate the Section 106 consultation process. As the lead federal permitting agency, USACE, in consultation with the State Historic Preservation Office (SHPO), will determine whether the cultural resources surveys performed meet a reasonable and good faith effort, which is required under Section 106 of the National Historic Preservation Act (NHPA). USACE will identify parties that should be consulted for their input on the cultural resource information collected, determine whether any sites in the project area are eligible for listing under the National Register of Historic Places, and determine whether any of these sites would be affected by the project. Efforts should be made to avoid or minimize impacts to eligible sites, where possible. Where avoidance and minimization are not possible, mitigation may be required to complete the Section 106 process.

Ohio

No previously recorded archaeological sites, historic resources, cemeteries, or National Register of Historic Places properties or districts are located within the proposed manufacturing facility site. The following are located within one mile of the Property:

- Two previously recorded archaeological sites
- Two previously recorded cultural resources surveys
- One state-listed historic property known as the Austin J. Fulk House
- Two cemeteries

If NEPA is required for the manufacturing facility site, then consultation under Section 106 of the NHPA will be required.

1.16.1.9 Visual Resources

Alaska

The project is located in a remote part of the state with few anthropogenic visual features other than the two communities and related infrastructure (such as roads and transmission lines). When constructed, portions of the operation may be visible from near the two communities, especially during dark periods. A visual resource assessment, including visual simulations from key observation points may be needed to provide detail on potential visual impacts and potential mitigation measures.

Ohio

The manufacturing facility site will be located on a previously developed industrial site. Except for the presence of the Mahoning River on the western boundary of the site parcel, there are no scenic vistas within the site or in the immediate vicinity. The site is surrounded by mature trees that obscure the view of the site from adjacent properties. There is no existing aesthetic landscaping at this site.

1.16.1.10 Noise

Alaska

The project is located in a remote part of the state characterized by relatively low ambient sound levels. Noise impacts from the operation are not anticipated for the community of Nome, as it is too far away. However, the two nearby communities, Teller and Brevig Mission, may experience some level of noise impact from the operation.

Federal agencies may require baseline acoustic measurements to characterize the existing environment at important locations. It is not clear that these would be required for the project, as baseline data collected on National Park Service lands could be used, if deemed appropriate. Impacts are estimated through a variety of existing sound propagation models.

Ohio

The manufacturing facility site is located in an industrial zone. Minor noise impacts to residential areas within Niles and Warren, Ohio, are anticipated to result from site development and facility operations; however, noise levels are anticipated to be consistent with previous land use, zoning ordinances, and Occupational Safety and Health Administration (OSHA) standards.

1.16.1.11 Land Use and Recreation

Alaska

The project area is located primarily on lands owned by the state of Alaska and managed by Alaska Department of Natural Resources (ADNR). There are no federal lands within the project area. The area where the mine and mill are envisioned is classified for mineral development in ADNRs land-use plan for the area, the Northwest Area Plan. Subunit S-05 in the plan has the primary designation of Minerals and Dispersed Public Recreation. This designation indicates that ADNR expects mineral development but also indicates it should be managed in a manner that minimizes harm to dispersed public recreation.

Nome residents use the Mosquito Pass area for some limited recreational purposes, and sport fishermen fly to the Cobblestone River occasionally.

Ohio

The manufacturing facility site is located on a previously developed industrial site. No recreation potential exists at this location, and the proposed facility is congruous with existing zoning. No adjacent recreational facilities are expected to be affected by the redevelopment of the site.

1.16.2 Environmental Authorizations and Permits

1.16.2.1 Existing Permits and Authorizations

The Graphite Creek Project currently holds the following authorizations and permits:

- ADNR Miscellaneous Land Use Permit, which authorizes hard rock exploration activities on the project site.
- Four ADNR Temporary Water Use Authorizations which authorize water removal from surface waterbodies for exploration activities.
- Three ADNR Land Use Permits, which authorize the use of two staging areas along the Kougarok Highway, the placement of a communications repeater and a meteorological station, and geotechnical drilling along the proposed access corridor.
- An ADEC Alaska Pollutant Discharge Elimination System (APDES) General Permit for Stormwater Discharges for Multi-Sector General Permit Activity.

1.16.2.2 Additional Permits and Authorizations

Alaska

The following additional permits and authorizations will be required for the construction and operations of the Graphite Creek Project:

- ADNR Plan of Operations Approval stipulating how the Project will be operated to protect the State's public resources.
- An ADNR Reclamation Plan Approval describing site reclamation stipulations and bonding requirements.
- AN ADNR Millsite Lease establishing a surface authorization for mine facilities that are not located on the upland mining lease or mining claim.
- ADEC Air Quality Permit to ensure the mine complies with both State and Federal air emissions standards.
- ADEC APDES Permit to authorize the effluent discharge to receiving waters.
- AEC Solid Waste Management permit, which authorizes the disposal of tailings and waste rock.

- USACE Wetlands Permit under Section 404 of the CWA, which authorizes the discharge of fill into waters of the United States, including wetlands. This is the only Federal permit required for the Graphite Creek Project.
- ADNR Right of Way for the site access road.
- ADNR Water Right or Temporary Water Use Authorization for the use of water
- ADNR Materials Sales Agreements for the use of sand and gravel from State lands outside of the mining claims.
- ADNR Mining Lease to consolidate the mining claims to a single lease.
- ADEC Stormwater Plan to define how the project will manage and discharge stormwater runoff.
- Fish Habitat Permit # FH22-III-0125, which authorizes activities in fish bearing waters, primarily for water withdrawal structures. This authorization is issued by ADFGs Habitat Division and expires on 12/31/2026.
- ADF&G Fish Passage permits for the access road bridge crossings and culvert locations.
- National Oceanic and Atmospheric Administration (NOAA) Fisheries Essential Fish Habitat to protect "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."
- USFWS Bald and Golden Eagle Protection Act, Migratory Bird Treaty, and Threatened and Endangered Species Act clearances.
- Cultural Resources authorizations to protect both State and Federal cultural resources such as archaeological artifacts. ADNRs SHPO makes such authorizations or activities on State lands, while the USACE has authority over federal and state lands.
- ADNR Dam Safety Permit which provides authority to construct and operate tailings storage dams and water supply dams.

Ohio

The following OEPA permits and authorizations will be required for the STP site:

- Hazardous Waste Permit that regulates the generation, transportation, treatment, storage, and disposal of hazardous waste.
- NPDES Stormwater Permits that authorize the site's management of stormwater and wastewater prior to release. Both a Construction Stormwater General Permit and an Industrial Stormwater Permit will be required.
- Air pollution control permits under the Clean Air Act to regulate various air emissions sources such as material handling activities, carbonization and graphitization processes, cooling towers, cyclonic separators, scrubbers, emergency generators, and natural gas combustion sources.

A variety of other county and municipal rights-of-way and building permits will be required by Trumbull County and the Weathersfield Township Zoning Commission.

A Railroad Track Encroachment Permit is anticipated to be required through Norfolk Southern Railway for work within the railroad right-of-way for utility connections.

1.17 Capital and Operating Costs

1.17.1 Capital Cost

Capital cost estimates were prepared for initial, sustaining, and closure capital at Graphite Creek, and as a capital program for the STP bringing seven 25 ktpa modules online in quick succession over the course of five years.

The total estimated initial capital cost for the design, construction, installation, and commissioning of all facilities and equipment for the Graphite Creek Mine is $949.4 M, including a contingency of $94.4 M (11.2%). After the initial capital phase, sustaining capital costs will be expended on the order of $101.6 M. Closure costs of $74.5 M have been estimated.

The initial capital for the phased construction of the STP (175,000 tpa total production capacity) is estimated at $3,919.4 M, including a contingency of $783.9 M (25%). Sustaining capital is included as 5% of the operating maintenance costs. No closure capital costs are called out for the STP.

These capital costs are expressed in U.S. dollars (USD) (Q1 2025) with no escalation or inflation unless stated otherwise.

The Project capital costs total $5,044.9 M, consisting of the elements listed in Table 1-7.

Table 1-7 Project Capital Costs

Capital Costs	Initial Capex ($M)	Sustaining and Closure ($M)	Total ($M)
Mining	128.0	33.2	161.2
Milling	221.1	0.0	221.1
Waste Management Facility	71.2	133.2	205.3
Infrastructure	211.5	9.7	221.2
Indirect Costs	136.7	0.0	136.7
Owners Costs	85.5	0.0	85.5
Contingency	94.4	0.0	94.4
Subtotal Graphite Creek	**949.4**	**176.1**	**1,125.6**
Secondary Treatment Plant (STP)	2,389.7	0.0	2,389.7
STP Indirect Costs	745.8	0.0	745.8
STP Contingency	783.9	0.0	783.9
Total Capital Costs	**4,868.8**	**176.1**	**5,044.9**

1.17.1.1 Alaska Mine and Processing Plant

Initial capital costs include all costs to develop the Property for operations. They total $949.4 M and are expended over a 30-month pre-production period on engineering, construction, and commissioning activities.

Sustaining capital costs include all costs related to the acquisition, replacement, or major overhaul of assets during the mine life required to sustain operations. Sustaining capital costs total $176.1 M and are expended in the first year of operations at the Alaska mine site and carry through 20 years of operations, plus additional years associated with closure and reclamation.

Sustaining capital costs include $74.5 M of costs related to the closure, reclamation, and post-operations. Closure costs start in Year 21, the final year of operations, and include costs that will occur for an extended period in the post-closure phase. Costs occurring for an extended period have been included at the current value in Year 22.

1.17.1.2 Secondary Treatment Plant

Initial STP capital costs include the cost to construct seven full-scale 25 ktpa facilities in the state of Ohio, which upgrades the natural graphite concentrate into final products for distribution. These full-scale facilities are based on the 25 ktpa modular unit and factored to a full capacity of 175 ktpa (7 x 25 ktpa modules). The capital costs total $3,919.4 M and include all costs to develop the property to an operating treatment plant facility. Initial capital costs are expended over seven years, with two 25 ktpa modules operating in Year 2.

1.17.2 Operating Cost

The operating costs were developed using data collected from in-house databases, vendors, contractors, reliable publicly available sources, and operational experiences. These costs encompass mining, tailings handling, ore processing in Alaska, concurrent reclamation, civil earthwork throughout the LOM, concentrate transportation, concentrate processing at the STP, and general and administrative costs.

The operating costs estimate is broken into five major sections.

- Mining
- Milling
- STP Processing
- Transportation
- General & Administrative

The operating costs are presented in 2024 USD on a calendar year basis. No escalation or inflation is included.

The total operating cost for the mine equates to $610/t of graphite concentrate. The cost of shipping graphite concentrate from the mine to the STP is $372/t graphite concentrate. The 175,000 tpa of graphite concentrate is combined with other feedstocks at the STP to produce a total of 256,510 tpa graphite and carbon products, detailed in Table 1-6. The total operating cost of the STP plant equates to $2,119/t of STP product. The total cost of the STP product including mining and shipping costs of the graphite concentrate is $2,804/t of STP product (multiple products). Summaries of the operating costs are provided in Table 1-8 (Alaska) and Table 1-9 (Ohio).

Table 1-8 Operating Costs-Alaska

Operating Costs - Alaska	$/t Concentrate	LOM Total ($M)
Mining	239	840.1
Milling	288	1014.0
G&A	84	294.4
Total Mined Graphite Conc	**610**	**2148.5**
Transportation to Ohio	372	1,311.5
Total	**982**	**3,460.0**

Table 1-9 Operating Costs-Ohio

Operating Costs - Ohio	$/t Production	LOM Total ($M)
Secondary Treatment Plant	2,119	11,804.3
Purchased Graphite Conc	64	354.4
Mined Graphite Conc and Shipping	621	3,460.0
Total	**2,804**	**15,618.7**

1.18 Economic Analysis

An engineering economic model was developed to estimate the Project’s annual cash flows and sensitivities. Pre-tax estimates of the project values were prepared for comparative purposes, while after-tax estimates were developed and are likely to approximate the true investment value. It must be noted, however, that tax estimates involve many complex variables that can only be accurately calculated during operations, and, as such, the after-tax results are only approximations.

Variations in refined product prices, operating costs, and capital costs were subject to univariate sensitivity analyses to determine their relative importance as Project value drivers.

This technical report contains forward-looking information regarding projected mine production rates, construction schedules, and forecasts of resulting cash flows as part of this study. The mill head grades are based on sufficient sampling that is reasonably expected to be representative of the realized grades from actual mining operations. Factors such as the ability to obtain permits to construct and operate a mine, or to obtain major equipment, or skilled labor on a timely basis, to achieve the assumed mine production rates at the assumed grades, may cause actual results to differ materially from those presented in this economic analysis.

The reader is cautioned that the refined product prices used in this study are only estimates. There is no guarantee that they will be realized if the Project is taken into production. The price of refined graphite products is based on many complex factors, and there are no reliable methods of predicting the long-term price.

1.18.1 Main Assumptions

Table 1-10 provides the product pricing for the varied refined products that are used in the analysis.

Table 1-10 Product Pricing for Varied Refined Products

Product	Sale Price ($/t)
CPN: Coated, Spherical NG	8,424
BAN: Blended AG and NG	11,563
SPN: Secondary Particle NG	10,971
SPC: Secondary Particle Composite	10,971
+'32 Mesh Purified 99%	4,569
+'50 Mesh Purified 99%	3,884
+'80 Mesh Purified 99%	3,066
+'100 Mesh Purified 99%	2,547
Battery Conductor, -320 Mesh 99%	5,357
Synthetic Diamond RM, -320 Mesh 99%	5,974
+32 Mesh Unpurified	1,683
+50 Mesh Unpurified	1,683
+80 Mesh Unpurified	1,564
+'100 Mesh Unpurified	1,256
Carbon Raisers Lubricants	2,122
Rejected Coke Product	610
Weighted Average	**7,843**

STP revenue is derived from the sale of refined graphite products in the international marketplace. No contractual arrangements for production currently exist, and mine production is assumed to be sold to the STP. Table 1-11 indicates the net smelter return (NSR) parameters that were used in the economic analysis.

Table 1-11 NSR Parameters

Parameter	Unit	Value
Graphite Recovery (Mine Site)	%	95
Graphite Products Payable	%	100
Graphite Creek LOM Avg Royalties	%	3.57

The Project has been evaluated on an after-tax basis to provide a more indicative but approximate value of the potential Project economics. A tax model was prepared by Mining Tax Planners, an independent tax consultant, and reviewed by Graphite One personnel. Current tax pools were used in the analysis. The tax model contains the following assumptions:

- Federal Income Tax: 21%
- Alaska State Income Tax: 9.4%
- Alaska Mining License Tax: 7.0%
- Alaska Production Royalty Tax: 3%
- Ohio Property Tax 6.21%
- Ohio Commercial Activity Tax 0.26%
- Advanced Manufacturing Production Tax Credit as applicable
- Total taxes for the Project amount to $4,549.1 M of the Project life

1.18.2 Results

The economic results for the Project, based on the assumptions outlined above, are presented in Table 1-12.

Table 1-12 Economic Results

Summary of Results of Integrated Project	Unit	Value
Total Revenue, Net of Royalties	$M	43,561.3
Total Operating Costs	$M	15,618.7
Initial Capital Costs	$M	4,868.8
Sustaining Capital Costs	$M	101.6
Mine Rehabilitation & Reclamation	$M	74.5
Total Pre-Tax Cash Flow	$M	22,897.7
Pre-Tax NPV @ 6%	$M	8,677.0
Pre-Tax NPV @ 8%	$M	6,396.7
Pre-Tax NPV @ 10%	$M	4,740.0
Pre-Tax IRR	%	29.8
Pre-Tax Payback Period	Years	7.3
After-Tax Cash Flow	$M	18,348.6
Post-Tax NPV @ 6%	$M	6,876.0
Post-Tax NPV @ 8%	$M	5,029.7
Post-Tax NPV @ 10%	$M	3,686.6
Post-Tax IRR	%	26.8
Post-Tax Payback Period	Years	7.5

NPV = net present value
IRR = internal rate of return

1.18.3 Sensitivities

A univariate sensitivity analysis was performed to examine which factors most affect the Project economics when acting independently of all other cost and revenue factors. Each variable evaluated was tested using the same percentage range of variation, from -30% to +30%, although some variables may actually experience significantly larger or smaller percentage fluctuations over the LOM. For instance, the product prices were evaluated at a ±30% range to the base case, while the capital costs and all other variables remained constant. This may not truly represent market scenarios, as commodity prices may not fluctuate in a similar trend. The variables examined in this analysis are those commonly considered in similar studies–their selection for examination does not reflect any particular uncertainty.

Notwithstanding the above-noted limitations to the sensitivity analysis, which are common to studies of this sort, the analysis revealed that the Project is most sensitive to Product pricing. Figure 1-9 and Figure 1-10 show the results of the post-tax sensitivity tests for net present value (NPV)(8) and internal rate of return (IRR), respectively.

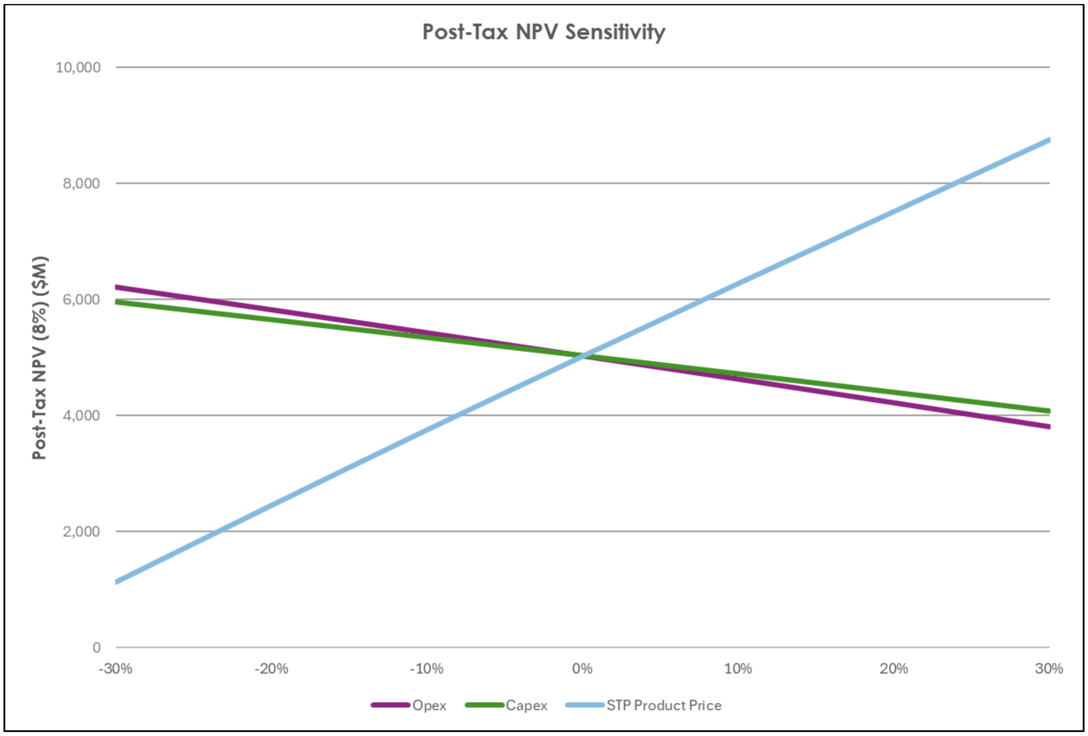


Figure 1-9 Post-Tax NPV Sensitivity (8%)

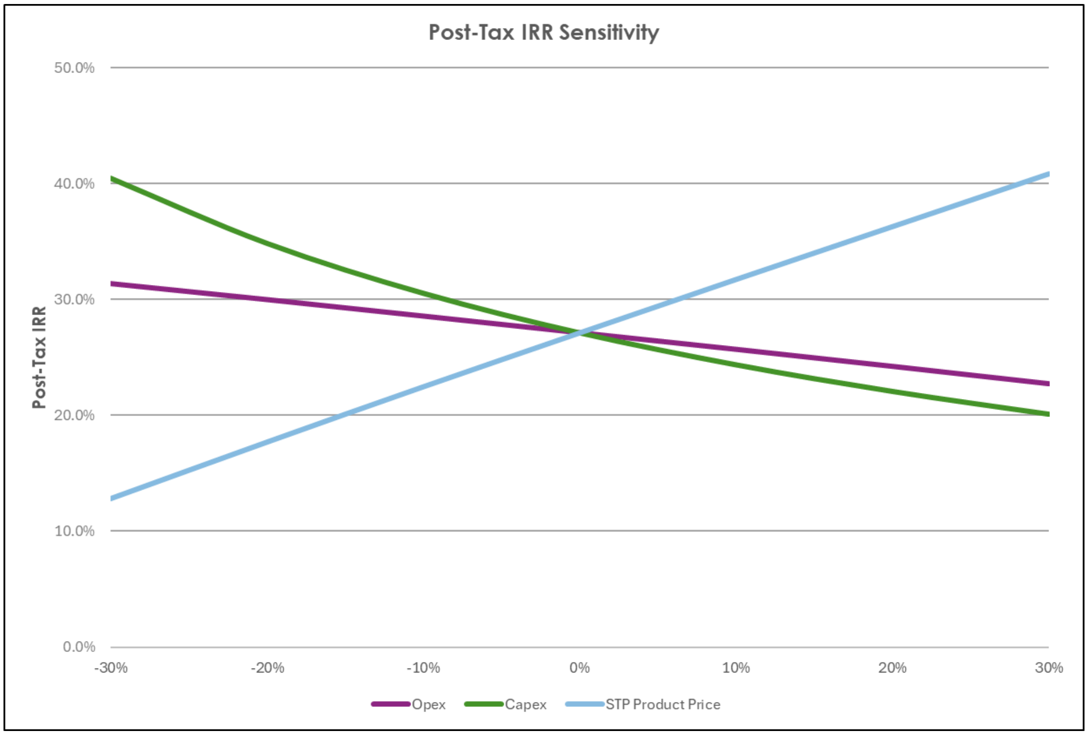


Figure 1-10 Post-Tax IRR Sensitivity

1.19 Other Relevant Data and Information

1.19.1 Alaska Site

Construction of the Alaskan facilities is expected to require approximately 30 months following approval of required permits. The mine requires nominally two years of pre-strip operations, tailings management facility (TMF) pre-development, and water management facilities development before mine production can commence. Construction of the site access road, mill, and support facilities is expected to commence as soon as practicable following permit approvals. Equipment and materials needed for the mine site activities are planned to be pre-positioned at a staging area near the mine site location during the shipping season prior to pioneering the access road into the site.

Commissioning of the Alaskan facilities is expected to occur over several phases. Nome construction-support facilities will need to be commissioned as early as possible following project authorization and receipt of necessary permits. The main site access road from Kougarok Road to the mine site is expected to be commissioned in two phases. The milling facilities, WTP, and site infrastructure will be commissioned as each reaches substantial completion during construction. The WMF will be commissioned during the latter stage of mine pre-development activities before commencing mine production.

1.19.2 Secondary Treatment Plant

Construction of the STP is expected to require approximately 22 months for the first two modules to be built before being turned over to pre-operational testing and commissioning. Subsequent modules are expected to take less time due to lessons learned and workforce efficiency. Construction is scheduled to be performed in two phases: demolition and early works followed by main construction works. The contracting strategy is expected to consider three specific phases: site preparation, bulk earthworks, and plant construction. Construction-driven planning is expected to utilize advanced work packages that break down the installation into construction work packages to identify and prioritize necessary engineering deliverables required to support the construction schedule. Construction of all seven modules is expected to be continuous after the first two modules' groundbreaking and will require approximately 60 months.

Commissioning of the STP is expected to require approximately six months for the first two modules before being turned over to operations. Subsequent modules are expected to take less time due to lessons learned and workforce efficiency. The commissioning team involves the combined effort and cooperation of many parties. It is expected to comprise the owner's construction group and commissioning teams, the owner's maintenance/operating teams, and equipment suppliers. Planning for the training of the owner's operators and maintenance personnel is expected to begin after the final selection of equipment and conclude prior to the start of commissioning.

1.20 Conclusions and Recommendations

1.20.1 Alaska Site Recommendations

There are several recommendations and opportunities for the Alaskan site. Many of these recommendations are highlighted below:

- Detailed mapping and geologic modeling of the resource and pit area
- Further drill testing of the geophysical data to identify and delineate shallow zones of particularly high-grade ore
- Analysis of Measured and Indicated resources between the raised cut-off grade (3.0% Cg) and the economic cut-off grade (2.0% Cg) to determine if this material could be stockpiled and processed profitably after mining is completed.
- Additional mineral processing investigations:
    - Composite samples representing several mining time frames should be tested for ore hardness and flotation response
    - Flotation collector tests, with cold weather additives to the fuel oil, to determine the impact on flotation kinetics
    - HPGR (high-pressure grinding roll) testing on two samples along with a revisiting of the tradeoff between HPGR and SAG milling
    - Ore hardness and flotation testing to correlate performance to the different ore types

  - An examination of the responses of coarse and fine tailings to other dewatering methods
  - Pilot scale testing of an ore sample representative of the first three years of mine production
- Close ground temperature monitoring and modeling of climate trends
- Validation of the water balance model with data from the site weather station
- Conduct bench and pilot water treatability testing using surrogate water spiked to influent design water quality during mine life
- Validate post-closure pit lake treatment strategy based on updated precipitation data and on further drilling results
- Additional geotechnical drilling within the open pit, WMF and mill site areas
- Supplemental geotechnical drilling in the open pit area prior to mine development
- Further assessment of both construction and operational staffing requirements to better define accommodation needs
- A full-scale, dynamic, supply-chain study for transportation of concentrate from Nome, Alaska, to Niles, Ohio

1.20.2 Alaska Site Conclusions

- Mineral reserves for the project are based on a 21-year mine life and 71.2 Mt of Proven and Probable mineral resources at an average diluted grade of 5.22% Cg
- The mine will utilize conventional truck and shovel mining techniques to extract ore and waste material from the open pit
- Multiple metallurgical testing programs have demonstrated that the Graphite Creek ore will produce a 95% Cg concentrate at 90% recovery

1.20.3 Secondary Treatment Plant Recommendations

There are several recommendations and opportunities for the STP. A few are highlighted below.

- Performing testwork to investigate material handling characteristics and verify the design criteria outlined in the process design criteria
- Establish pilot programs to test, evaluate, and adapt the technology prior to its full-scale deployment
- Performing geotechnical investigation at the planned site location is recommended. Results from the drilling will provide input into the structural, foundation, roadway pavement design, and mitigate schedule risk in the proceeding phase

- Establishing an environmental permitting plan to be developed and executed at the beginning of the next phase. To mitigate schedule risk, pre-consultation and pre-application meetings with the responsible regulatory agencies should be initiated
- Developing a diversified supply chain strategy and/or strategic partnerships to reduce dependency on any single region or supplier for material critical to the process (e.g., crucibles)

The aforementioned recommendations should be integrated as part of the proceeding design phase with an emphasis on preparing critical path equipment packages to a “ready for award” state and also sufficient engineering definition and preparation of a package for early work construction to “ready for award” status.

1.20.4 Secondary Treatment Plant Conclusions

A preliminary design was completed for a 25 ktpa module. The module was then scaled and factored to estimate the requirements for a 175 ktpa (7-module) facility. The design requires further optimization, which is recommended to be completed either prior to or during the next phase of engineering. This includes additional testwork to close gaps in the process design criteria, site investigations to close gaps and assumptions in the discipline design criteria, trade-off studies to optimize the process flowsheet, layout optimization particularly in respects to the expansion strategy to 175 ktpa production, review of the major project risks to ascertain mitigation options in an attempt to reduce overall project risk. In addition, geotechnical investigations at the project site should be completed.

2 Introduction

2.1 Overview and Terms of Reference

Barr has prepared this report to summarize and present the results of a FS performed for the Graphite Creek Project. The study was commissioned by Graphite One Inc. (GPH: TSX-V; GPHOF: OTCQX), headquartered at Suite 600, 777 Hornby St., Vancouver, BC. The study outlines the Project and Graphite One's plan to establish a vertically integrated approach to ultimately produce high-grade anode material to support the EV battery market, energy storage systems, and additional production for different value-added graphite applications.

The Project encompasses two primary sites—the Graphite Creek Project, a surface mining and milling operation near Nome, Alaska, and an STP near Niles, Ohio. Graphite One's subsidiary, Graphite One (Alaska) Inc., owns and will operate the Graphite Creek Project, where graphite ore will be mined, processed, and concentrated to approximately 95% purity. The concentrate will be transported via ship and then rail to the STP in Niles, Ohio, for final refinement. The STP will be owned and operated by a Graphite One subsidiary company, Graphite One Manufacturing (Ohio), Inc.

Graphite One intends to expedite the construction of both facilities. Given a longer development timeline for the Alaska site, the company plans to initiate operations at the STP using graphite sourced from the open market. This strategy will allow for continuous STP operation while graphite from the Graphite Creek project is produced.

The FS results were publicly disclosed by Graphite One on March 25, 2025, which serves as the effective date of this technical report.

There has been no material change to the Project between the effective date and the signature date of this technical report. Barr understands that this technical report will support the public disclosure requirements of Graphite One and will be filed on SEDAR as required under NI 43-101 disclosure regulations.

2.2 Qualified Persons

2.2.1 Areas of Responsibility

Several firms and consultants worked on the FS and contributed to the creation of this technical report. The list below briefly summarizes the areas of responsibility.

Barr:

- Study management
- Mineral reserve determination
- Mine engineering
- Geotechnical engineering

- Mineral processing and mill design
- Water management and treatment design
- Civil and site engineering
- Mechanical and structural engineering
- Logistics and supply chain
- Preparation of operating and capital cost estimates and the economic model

Hatch Ltd. (Hatch):

- STP plant design (*Graphite One's specialist, Andrew Tan supplied the STP process design.)
- Preparation of operating and capital cost estimates for the STP

Alaska Earth Sciences (AES):

- Site geology, regional geology, and mineral resource determination

Tundra Consulting, LLC (Tundra):

- Regional groundwater modeling

Jade North, LLC (Jade):

- Permitting and environmental

HDR:

- Permitting and environmental

SRK Consulting (SRK):

- Geochemical characterization
- Water quality predictions

Recon, LLC (Recon):

- Site access road design

Phase Canada Consulting:

- Capital cost estimation

2.2.2 Qualifications and Responsibilities

The results of this FS are not dependent upon any prior agreements concerning the conclusions to be reached, nor are there any undisclosed understandings concerning any future business dealings between Graphite One and the qualified person (QP). The QPs are being paid a fee for their work in accordance with normal professional consulting practice.

The following individuals—by virtue of their education, experience, and professional association—are considered QPs as defined in the NI 43-101 and are members in good standing of appropriate professional institutions/associations. The QPs are responsible for the specific report chapters as follows in Table 2-1.

Table 2-1 QP Responsibilities

Chapter	Description	QP	Company	Comments and Exceptions
1	Summary	Jason Todd, QP	Barr	Contributions from all
2	Introduction	Jason Todd, QP	Barr	
3	Reliance on Other Experts	Jason Todd, QP	Barr	
4	Project Property Description & Location	Jason Todd, QP	Barr	
5	Accessibility, Climate, Local Resources, Infrastructure & Physiography	Jason Todd, QP	Barr	
6	History	Robert Retherford, CPG	AES	
7	Geological Setting & Mineralization	Robert Retherford, CPG	AES	
8	Deposit Types	Robert Retherford, CPG	AES	
9	Exploration	Robert Retherford, CPG	AES	
10	Drilling	Robert Retherford, CPG	AES	
11	Sample Preparation, Analyses & Security	Robert Retherford, CPG	AES	
12	Data Verification	Robert Retherford, CPG	AES	
13	Mineral Processing & Metallurgical Testing	Daniel R. Palo, PE	Barr	
14	Mineral Resource Estimates	Robert Retherford, CPG	AES	
15	Mineral Reserve Estimates	Chotipong Somrit, QP	Barr	
16	Mining Methods - (All sections except 16.4 & 16.5)	Chotipong Somrit, QP	Barr	
	Mining Methods - (16.4 & 16.5)	Jedediah Greenwood, PE	Barr	
17	Recovery Methods - (17.1)	Daniel R. Palo, PE	Barr	
	Recovery Methods - (17.2)	Jon Godwin, P.Eng.	Hatch	
18	Project Infrastructure - (18.1, except 18.1.7.1 & 18.1.9)	Scott Phillips, PE	Barr	
	Project Infrastructure - (18.1.7.1 & 18.1.9)	Jedediah Greenwood, PE	Barr	
	Project Infrastructure - (18.2)	Arlene P. Dixon. PE	Hatch	
19	Market Studies and Contracts	Jason Todd, QP	Barr	
20	Environmental Studies, Permitting & Social or Community Impact	Jason Todd, QP	Barr	
21	Capital and Operating Costs	Chotipong Somrit, QP	Barr	

Chapter	Description	QP	Company	Comments and Exceptions
22	Economic Analysis	Chotipong Somrit, QP	Barr	
23	Adjacent Properties	Jason Todd, QP	Barr	
24	Other Relevant Data and Information	Jason Todd, QP	Barr	Contributions from all
25	Interpretation and Conclusions	Jason Todd, QP	Barr	Contributions from all
26	Recommendations	Jason Todd, QP	Barr	Contributions from all
27	References	Jason Todd, QP	Barr	Contributions from all

2.3 Sources of Information

This report is based on information collected by Barr and other contributing professionals during various site visits, as described in Table 2-2. Other information was obtained from the public domain. Additionally, information was provided by Graphite One throughout the course of the study. Barr has no reason to doubt the reliability of the information supplied by Graphite One. This technical report is based on the following sources of information:

- Discussions with Graphite One personnel
- Inspection of the Graphite Creek project area, including outcrop and drill core, planned mining area, facilities areas, access road, and local infrastructure (state highways, port of Nome, etc.)
- Review of exploration data collected by Graphite One, including down hole geophysics performed by DGI Geoscience
- Review of down hole geophysics collected by DGI Geoscience for geotechnical characterization of drillholes in the proposed pit area
- Metallurgical and process laboratory testwork and associated reports provided by SGS Lakefield and Pocock Industrial
- Geotechnical testwork by Soil Engineering Testing, Inc., TerraSense Geotechnical Laboratory, Advanced Terra Testing, and Northern Geotechnical Engineering, Inc. d.b.a. Terra Firma Testing
- Additional information from public domain sources

2.4 Site Visit

In accordance with National Instrument 43-101 guidelines, several QPs have visited the Graphite One project site, as detailed in Table 2-2.

Table 2-2 QP Site Visits

Qualified Person	Company	Date	Description of Inspection
Robert M. Retherford	AES	8/24	Inspection of drilling in progress. Inspection of core logging procedures and facility. Review of QA/QC protocols.
Jedediah Greenwood	Barr	9/23 & 6/24	Exploration activities, mine geotechnical drilling, WMF and facilities geotechnical drilling,
Jason Todd	Barr	8/24	Exploration activities, planned mining area, facilities geotechnical drilling, site layout, access road location, local infrastructure, etc.
Chotipong Somrit	Barr	8/24	Exploration activities, planned mining area, facilities geotechnical drilling, site layout, access road location, local infrastructure, etc.
Scott Phillips	Barr	8/24	Exploration activities, planned mining area, facilities geotechnical drilling, site layout, access road location, local infrastructure, etc.
Daniel R. Palo	Barr	8/24	Exploration activities, planned mining area, facilities geotechnical drilling, site layout, access road location, local infrastructure, etc.

2.5 List of Previous Relevant Technical Reports

The most recent technical report for the property and the most recent economic evaluation of the Graphite Creek project was “2022 NI 43-101 Preliminary Feasibility Study Technical Report, Graphite One Project Alaska, USA” prepared by JDS Energy & Mining Inc. The report has an effective date of 29 August 2022 and report date of 13 October 2022.

The most recent mineral resource estimation for the Graphite Creek project was in the press release "2022 Drilling Program Results Increase Graphite One Measured and Indicated Resource by 15.5%" published on the Graphite One website on 13 March 2023.

2.6 Units, Currency, and Rounding

The units of measure used in this report are as per the International System of Units (SI) or metric.

Unless otherwise noted, all dollar figures quoted in this report refer to United States dollars (US$, USD, or $).

Frequently used abbreviations and acronyms can be found near the beginning of the report. This report includes technical information that required subsequent calculations to derive subtotals, totals, and weighted averages. Such calculations inherently involve a degree of rounding and, consequently, introduce a margin of error. Where these instances occur, the QPs do not consider them material.

3 Reliance on Other Experts

3.1 Introduction

This technical report has been specifically prepared for Graphite One Inc. In preparing the report, the authors have relied upon certain data, reports, opinions, and statements from other experts. The authors consider reliance on these experts, as described below, as being reasonable based on their expertise and qualifications. The QPs that authored this report disclaim responsibility for the other experts' content used in preparing this report in the following areas.

3.2 Mineral Tenure, Property Agreements, Surface Rights, and Royalties

No separate, independent review or validation of mineral tenure, property agreements, surface rights, or royalties were performed by the QPs. The authors have solely relied upon Graphite One and the legal experts retained by Graphite One for legal due diligence. This information applies to Chapters 4, 14, 15 and 22.

3.3 Mineral Resources

QPs relied on sample processing and Cg assay analyses from ActLabs, Ancaster, Ontario, Canada; Chris Valorose (Valorose Consulting, Inc.) for mineral resource estimation; and Penny Hobbie (P. Hobbie Consulting) for sample QA/QC analysis and database management. Geologic interpretations were provided by Graphite One geologic staff and Alaska Earth Sciences geologic staff.

3.4 Metallurgical Testing

QPs relied on metallurgical test results obtained from SGS Mineral Services (Ontario, Canada) and Pocock Industrial, Inc. (Utah, USA) to inform the flowsheet and design basis for the mill facility at the Alaska site. This information applies to Chapters 13 and 17.

3.5 STP

QPs relied on Valley Property Investments LTD (Cleveland, Ohio) via Graphite One for providing information pertaining to the 'brownfield' Ohio site, such as existing site drawings including, but not limited to, plot plans, utility surveys, structural engineering drawings, and environmental site assessments. In addition to this, where Graphite One or third-party project partners did not provide specific data, public data was relied upon to close information gaps, for instance relating to site data such as geotechnical, topography, and hydrology. These inputs were used to inform the preliminary process and civil, structural, mechanical, piping, and electrical designs. This information applies to Chapters 17 and 18.

QPs relied on ASHRAE Climatic Design Conditions 2024 (Youngstown-Warren Airport Weather Station) and NOAA climate tool (2024). This information was used to establish the Ohio site's climatic conditions, which informed the process and mechanical design criteria. This information applies to Chapter 17 and 18.

QPs relied on CJL Engineering (Youngstown, Ohio) to determine the required incoming power supply characteristics and modifications necessary to the electrical infrastructure to implement the STP at the Ohio site, including equipment costs and lead times for critical equipment (e.g., substation). This information applies to Chapters 18 and 21.

QPs relied on reputable equipment vendors to provide technical data and budgetary quotations for critical equipment. The results of these inquiries were used to inform the STP design, capital cost estimate, and operating cost estimate. This information applies to Chapters 17, 18, and 21.

QPs relied on Graphite One and equipment vendors for the base design of the STP process required to convert natural graphite concentrate into saleable final products. This included the desired production capacity, product specifications, and characterization of the input materials.

QPs relied on Graphite One to provide capital costs and vendor data for the purification furnaces. In addition, Graphite One provided vendor selection directives for key process equipment such as kilns, agglomerators, mills, etc. This information was used to inform the process design, layout, capital and operating costs and applies to Chapters 17, 18, and 21.

QPs relied on Graphite One and equipment vendors for the base design of the STP process required to convert natural graphite concentrate into saleable final products, including the desired production capacity, product specifications, and characterization of the input materials. This information applies to Chapter 17.

QPs relied on Graphite One and reputable equipment vendors to provide some inputs to the operational cost estimate, for instance, labor salaries, utility prices, consumable unit rate costs, consumptions of consumables and utilities related to vendor packages, and waste/effluent management costs. This information applies to Chapter 21.

In respect to utility input and output connections, such as natural gas, water, sewage, and treated effluent, the characteristics of input utilities and connection requirements for inputs and outputs were provided by others, namely Meander Water Supply, survey data from Valley Property Investments LTD., and public domain information. This information applies to Chapters 17 and 18.

QPs were not able to complete a site visit to any of the facilities to witness testwork, as no testwork pertaining to the STP was performed in this phase. The testwork results would be an input into the pneumatic conveyance design e.g., material flowability. As a result, a conservative conveyance design (e.g., fluidizers added at silos) was implemented. This information applies to Chapters 17, 18, and 21.

3.6 Geotechnical Testing and Analysis

QPs relied on geotechnical testing performed by Soil Engineering Testing, Inc. (Minnesota, USA), TerraSense Geotechnical Laboratory (New Jersey, USA), Advanced Terra Testing (Colorado, USA), and Northern Geotechnical Engineering, Inc. d.b.a. Terra Firma Testing (Alaska, USA). QPs also relied on seismic hazard analysis performed by Lettis Consultants International, Inc. (California, USA) and seismic deformation modeling review by Beaty Engineering, LLC (Oregon, USA). This information was used to develop input parameters for the analysis of pit highwall stability, WMF performance, and facility foundations. This information applies to Chapters 15, 16, and 18.

3.7 Access Road

QPs relied on access road design information supplied by Recon, LLC (Alaska, USA) for road alignment and material quantities. This information applies to Chapters 18 and 21.

3.8 Avalanche Hazards

QPs relied on an avalanche hazard assessment completed by Alpine Solutions (Vancouver, BC, Canada) to inform infrastructure layout, placement, and mitigation strategies. This information applies to Chapter 18.

3.9 Snow Survey

QPs relied on snow survey results from Kuna Engineering (Alaska, USA) to inform the water balance analysis used for the project. This information applies to Chapter 18.

3.10 Markets

The QPs have relied on graphite marketing and product sales price information supplied by Graphite One. The information used in this study was prepared by Benchmark Minerals Intelligence and is based on past, present, and forecast market data. Lone Star Tech Minerals USA provided current and historical pricing for graphite byproduct applications. This information is utilized in Chapters 19 and 22.

3.11 Environmental, Permitting, Closure, Social, and Community Impacts

The QPs have relied upon the work and experience of Jade North (Alaska, USA) to define the environmental permitting requirements for the Alaska site project. The QPs have relied on HDR (Alaska, USA) to define the environmental baseline status and the permitting requirements for the project at both the Alaska and Ohio sites. This information applies to Chapter 20.

3.12 Hydrogeology, Permafrost Characterization, Precipitation, and Groundwater Modeling

QPs relied on information sourced from various studies performed by Tundra Consulting (Alaska, USA). The information was used to assist with pit highwall designs, infrastructure placement, water balance modeling, and groundwater interactions and applies to Chapters 16 and 18.

3.13 Water Quality Predictions and Acid/Base Determination

QPs relied on a geochemical water model and humidity cell test results produced by SRK Consulting (Vancouver, BC, Canada). This information was used to inform operational water treatment requirements, long-term pit water management, and the suitability of various off-site construction materials. This information is applicable to Chapter 18.

3.14 Cost and Economic Analysis

QPs relied on Phase Canada Consulting to generate certain portions of the capital cost estimate pertaining to the Alaska site (mine, mill, facilities, etc.).

QPs relied on Hatch Ltd. to generate the portions of the capital and operating cost estimates pertaining to the STP.

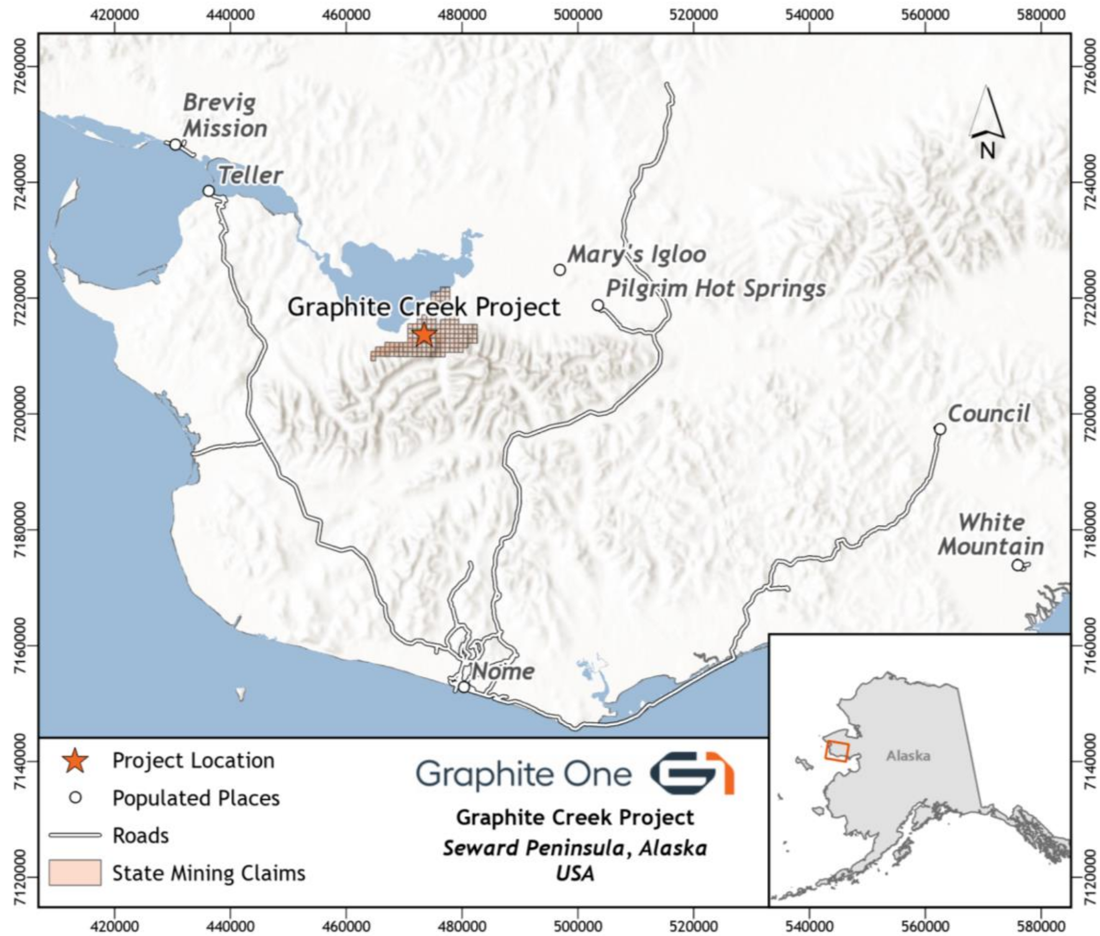
QPs relied on Mining Tax Plan LLC (Colorado, USA) to provide guidance on the state of Alaska, state of Ohio, and federal tax inputs to the economic model, which applies to Chapter 22.

4 Property Description and Location

4.1 Graphite Creek Property Location

The property comprises 9,583 ha (23,680 ac) of state of Alaska mining claims. The claim block consists of 176 active 65 ha (160-acre) (1/4 section) claims with 28 of those claims staked as duplicates over other claims within the claim block. Of the 176 total claims, 163 are wholly owned by Graphite One (Alaska) Inc., and 13 are leased to Graphite One (Alaska), Inc. by Kougarok, LLC. The claims are on the Teller A2 and A1 quadrangles. The property is located on the north flank of the Kigluaik Mountains and on the alluvial plain to the north. The northern end of the claim block abuts intertidal waters of the Imuruk Basin. The Kigluaiks are a rugged, glacially carved mountain range with a maximum elevation at Mt. Osborne of 1437 m. See Figure 4-1.

The closest significant port and industrial/population center is Nome, which is situated approximately 59 km to the south. There is currently no road access to the property; the closest seasonal road is 20 km to the southeast (the Nome-Taylor Highway).



Source: Graphite One (2024)

Figure 4-1 Graphite Creek Project Location, Seward Peninsula, Alaska

4.2 Graphite Creek Mineral Tenure

The project's mineral tenure consists of 176 state mining claims categorized as three groups based primarily upon the way the interests in the claims were acquired by Graphite One (Alaska) Inc. The three groups are nominally referred to as:

1. The GC Leased Property
2. The GC Staked Property
3. The GC Purchased Property

The claims constituting the three groups are depicted in Figure 4-2. The first group, the GC Leased Property, consists of 13 state mining claims, shaded yellow in Figure 4-2, which partially overlap the 24 former federal mining claims shaded orange in Figure 4-2. Five of the claims in the GC Leased Property are duplicate claims such that the GC Leased Property appears in Figure 4-2 to consist of eight separate mining claims. The second group, the GC Staked Property, consists of 117 state mining claims shaded blue in Figure 4-2. The third group, the GC Purchased Property, consists of 46 state mining claims, including 23 duplicate claims shaded green in Figure 4-2. These three groups form a contiguous block of Alaska state mining claims. Each group is described further in the following sections and summarized in Table 4-1, Table 4-2, and Table 4-4, respectively.

Readers are cautioned that the summaries do not constitute full disclosure, and that each agreement has not been referenced to confirm the status and application of any of the royalty or lease agreement payments. The QP did not establish the legal status of the mineral claims and has relied upon the guidance of Graphite One Inc. in describing the property groups and the agreements with involved parties. The QP has no knowledge of further encumbrances beyond what has been described that would impact the mining claims.

4.2.1 The GC Leased Property

Graphite One (Alaska) Inc. originally leased the former federal claims from Kougarok, LLC. When the federal claims were relinquished and the lands conveyed to the state of Alaska, the state mining claims that comprise the GC Leased Property were transferred to Kougarok, LLC and committed to the lease in place of the former federal claims via a quitclaim deed with confirmatory grant, recorded on May 8, 2015, in the Cape Nome Recording District. A restated version of the lease with Kougarok, LLC had been executed in 2015 with an initial term of twenty (20) years commencing January 1, 2014, and may be extended for so long as the production of minerals continues from anywhere on the GC Leased Property. Three of the state mining claims making up the GC Leased Property were originally staked by Graphite One (Alaska) Inc. The remaining ten state mining claims that comprise the GC Leased Property were purchased by Graphite One (Alaska) Inc. Those ten claims consist of two sets of five, duplicate, state mining claims which completely overlap one another. The payments and production royalties due under the lease are as follows:

1. An advance royalty of $30,000 was paid to the lessor (Kougarok, LLC) upon execution of the lease agreement

2. Annual advance royalty payments of $30,000 paid on January 1 of each year through 2019, then increasing by $10,000/yr until production begins

3. Production royalties:

   a) 5% from lands within the 4 former federal claims staked in 1943
   b) 2.5% from lands within the other 20 former federal claims
   c) Except as provided in 3b above, 5% from lands within the claims staked by Graphite One (Alaska) Inc
   d) Except as provided in 3a above, 2.5% from lands within the claims purchased by Graphite One (Alaska) Inc

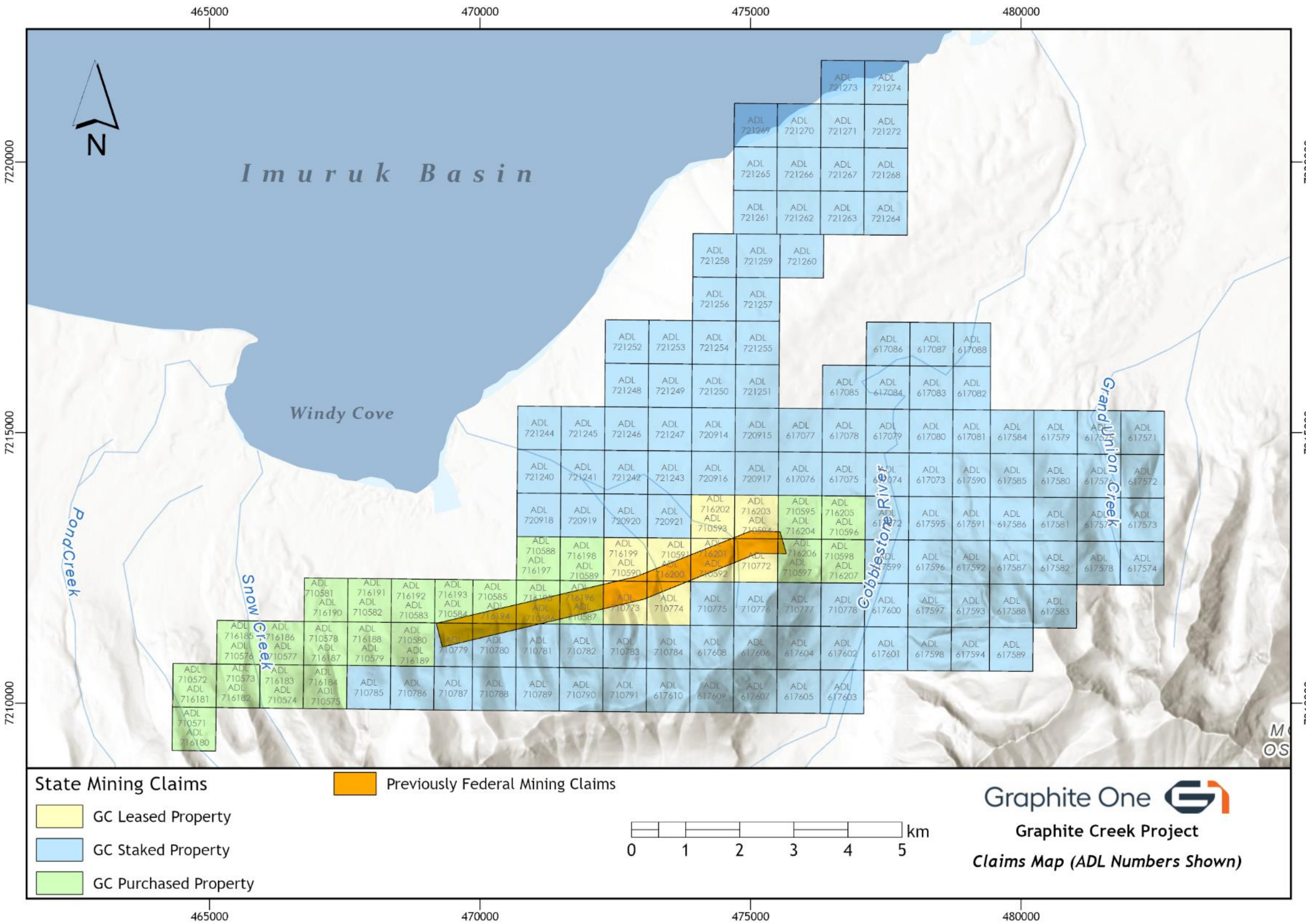
4. Graphite One (Alaska) Inc. has the option to reduce all production royalties due under the lease by up to 2% by paying $2,000,000 for each 1% reduction of the royalties

5. All advance royalties may be recouped from production royalties

Table 4-1 GC Leased Property: Alaska State Mining Claims

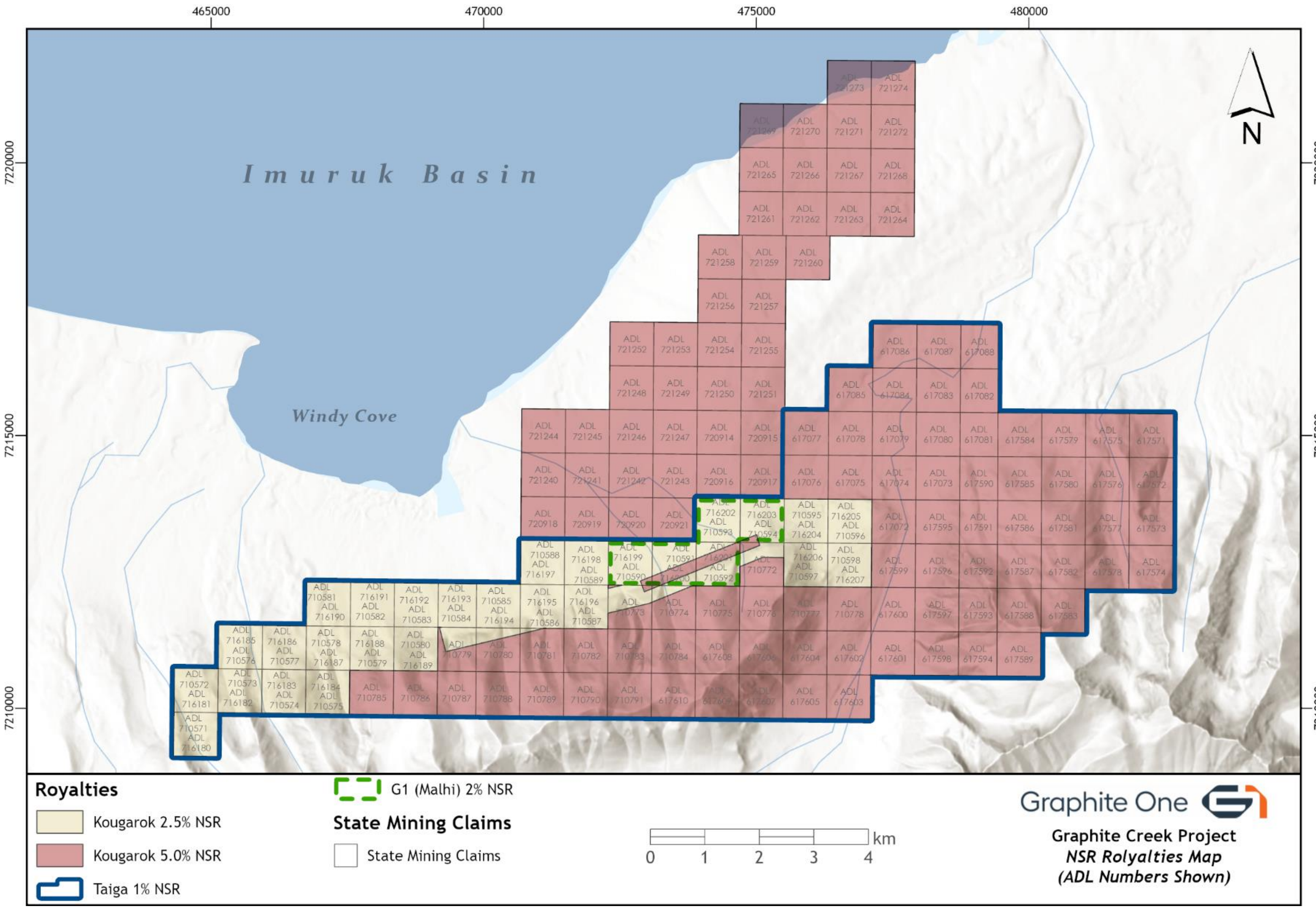
Claim Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 710772	Kougarok LLC	GC 001	22-Nov-11	K 005S 034W 22SE
ADL 710773	Kougarok LLC	GC 002	22-Nov-11	K 005S 034W 28NW
ADL 710774	Kougarok LLC	GC 003	22-Nov-11	K 005S 034W 28NE
ADL 710590	Kougarok LLC	Graphite Creek 20	29-Oct-11	K 005S 034W 21SW
ADL 710591	Kougarok LLC	Graphite Creek 21	29-OCT-11	K 005S 034W 21SE
ADL 710592	Kougarok LLC	Graphite Creek 22	29-OCT-11	K 005S 034W 22SW
ADL 710593	Kougarok LLC	Graphite Creek 23	29-OCT-11	K 005S 034W 22NW
ADL 710594	Kougarok LLC	Graphite Creek 24	29-OCT-11	K 005S 034W 22NE
ADL 716199	Kougarok LLC	GPH 20	04-OCT-12	K 005S 034W 21SW
ADL 716200	Kougarok LLC	GPH 21	04-OCT-12	K 005S 034W 21SE
ADL 716201	Kougarok LLC	GPH 22	06-OCT-12	K 005S 034W 22SW
ADL 716202	Kougarok LLC	GPH 23	03-OCT-12	K 005S 034W 22NW
ADL 716203	Kougarok LLC	GPH 24	03-OCT-12	K 005S 034W 22NE

Source: Graphite One (2024)
Note: All claims are a full ¼ section [64.7 ha (160 ac)]



Source: Graphite One (2024)

Figure 4-2 Claims Map of Graphite Creek Property (ADL Numbers Shown)



Source: Graphite One (2024)

Figure 4-3 Royalties Map

4.2.2 The GC Staked Property

The GC Staked Properties consist of 117 Alaska state mining claims located by Graphite One (Alaska) Inc., a wholly owned subsidiary of Graphite One Inc. (shown in blue in Figure 4-2).

Table 4-2 GC Staked Property: Alaska State Mining Claims

Claim Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 710775	Graphite One (Alaska) Inc.	GC 004	22-Nov-11	K 005S 034W 27NW
ADL 710776	Graphite One (Alaska) Inc.	GC 005	22-Nov-11	K 005S 034W 27NE
ADL 710777	Graphite One (Alaska) Inc.	GC 006	22-Nov-11	K 005S 034W 26NW
ADL 710778	Graphite One (Alaska) Inc.	GC 007	22-Nov-11	K 005S 034W 26NE
ADL 710779	Graphite One (Alaska) Inc.	GC 008	22-Nov-11	K 005S 034W 30SW
ADL 710780	Graphite One (Alaska) Inc.	GC 009	22-Nov-11	K 005S 034W 30SE
ADL 710781	Graphite One (Alaska) Inc.	GC 010	22-Nov-11	K 005S 034W 29SW
ADL 710782	Graphite One (Alaska) Inc.	GC 011	22-Nov-11	K 005S 034W 29SE
ADL 710783	Graphite One (Alaska) Inc.	GC 012	22-Nov-11	K 005S 034W 28SW
ADL 710784	Graphite One (Alaska) Inc.	GC 013	22-Nov-11	K 005S 034W 28SE
ADL 710785	Graphite One (Alaska) Inc.	GC 014	22-Nov-11	K 005S 035W 36NW
ADL 710786	Graphite One (Alaska) Inc.	GC 015	22-Nov-11	K 005S 035W 36NE
ADL 710787	Graphite One (Alaska) Inc.	GC 016	22-Nov-11	K 005S 034W 31NW
ADL 710788	Graphite One (Alaska) Inc.	GC 017	22-Nov-11	K 005S 034W 31NE
ADL 710789	Graphite One (Alaska) Inc.	GC 018	22-Nov-11	K 005S 034W 32NW
ADL 710790	Graphite One (Alaska) Inc.	GC 019	22-Nov-11	K 005S 034W 32NE
ADL 710791	Graphite One (Alaska) Inc.	GC 020	22-Nov-11	K 005S 034W 33NW
ADL 617072	Graphite One (Alaska) Inc.	GCX-01	04-Jun-12	K 005S 034W 24NW
ADL 617073	Graphite One (Alaska) Inc.	GCX-02	04-Jun-12	K 005S 034W 13SE
ADL 617074	Graphite One (Alaska) Inc.	GCX-03	04-Jun-12	K 005S 034W 13SW
ADL 617075	Graphite One (Alaska) Inc.	GCX-04	04-Jun-12	K 005S 034W 14SE
ADL 617076	Graphite One (Alaska) Inc.	GCX-05	04-Jun-12	K 005S 034W 14SW
ADL 617077	Graphite One (Alaska) Inc.	GCX-06	04-Jun-12	K 005S 034W 14NW
ADL 617078	Graphite One (Alaska) Inc.	GCX-07	04-Jun-12	K 005S 034W 14NE
ADL 617079	Graphite One (Alaska) Inc.	GCX-08	04-Jun-12	K 005S 034W 13NW
ADL 617080	Graphite One (Alaska) Inc.	GCX-09	04-Jun-12	K 005S 034W 13NE
ADL 617595	Graphite One (Alaska) Inc.	GCX-52	29-Aug-12	K 005S 034W 24NE
ADL 617596	Graphite One (Alaska) Inc.	GCX-53	29-Aug-12	K 005S 034W 24SE
ADL 617599	Graphite One (Alaska) Inc.	GCX-57	29-Aug-12	K 005S 034W 24SW
ADL 617602	Graphite One (Alaska) Inc.	GCX-61	29-Aug-12	K 005S 034W 26SE
ADL 617604	Graphite One (Alaska) Inc.	GCX-63	29-Aug-12	K 005S 034W 26SW
ADL 617606	Graphite One (Alaska) Inc.	GCX-65	29-Aug-12	K 005S 034W 27SE
ADL 617608	Graphite One (Alaska) Inc.	GCX-67	29-Aug-12	K 005S 034W 27SW
ADL 617081	Graphite One (Alaska) Inc.	GCX-10	04-Jun-12	K 005S 033W 18NW
ADL 617082	Graphite One (Alaska) Inc.	GCX-11	04-Jun-12	K 005S 033W 07SW
ADL 617083	Graphite One (Alaska) Inc.	GCX-12	04-Jun-12	K 005S 034W 12SE
ADL 617084	Graphite One (Alaska) Inc.	GCX-13	04-Jun-12	K 005S 034W 12SW
ADL 617085	Graphite One (Alaska) Inc.	GCX-14	04-Jun-12	K 005S 034W 11SE
ADL 617086	Graphite One (Alaska) Inc.	GCX-15	04-Jun-12	K 005S 034W 12NW
ADL 617087	Graphite One (Alaska) Inc.	GCX-16	04-Jun-12	K 005S 034W 12NE
ADL 617088	Graphite One (Alaska) Inc.	GCX-17	04-Jun-12	K 005S 033W 07NW
ADL 617571	Graphite One (Alaska) Inc.	GCX-18	29-Aug-12	K 005S 033W 16NW
ADL 617572	Graphite One (Alaska) Inc.	GCX-19	29-Aug-12	K 005S 033W 16SW
ADL 617573	Graphite One (Alaska) Inc.	GCX-20	29-Aug-12	K 005S 033W 21NW
ADL 617574	Graphite One (Alaska) Inc.	GCX-21	08-Sep-12	K 005S 033W 21SW

Claim Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 617575	Graphite One (Alaska) Inc.	GCX-25	29-Aug-12	K 005S 033W 17NE
ADL 617576	Graphite One (Alaska) Inc.	GCX-26	29-Aug-12	K 005S 033W 17SE
ADL 617577	Graphite One (Alaska) Inc.	GCX-27	29-Aug-12	K 005S 033W 20NE
ADL 617578	Graphite One (Alaska) Inc.	GCX-28	08-Sep-12	K 005S 033W 20SE
ADL 617579	Graphite One (Alaska) Inc.	GCX-32	29-Aug-12	K 005S 033W 17NW
ADL 617580	Graphite One (Alaska) Inc.	GCX-33	29-Aug-12	K 005S 033W 17SW
ADL 617581	Graphite One (Alaska) Inc.	GCX-34	29-Aug-12	K 005S 033W 20NW
ADL 617582	Graphite One (Alaska) Inc.	GCX-35	08-Sep-12	K 005S 033W 20SW
ADL 617583	Graphite One (Alaska) Inc.	GCX-36	08-Sep-12	K 005S 033W 29NW
ADL 617584	Graphite One (Alaska) Inc.	GCX-39	29-Aug-12	K 005S 033W 18NE
ADL 617585	Graphite One (Alaska) Inc.	GCX-40	29-Aug-12	K 005S 033W 18SE
ADL 617586	Graphite One (Alaska) Inc.	GCX-41	29-Aug-12	K 005S 033W 19NE
ADL 617587	Graphite One (Alaska) Inc.	GCX-42	08-Sep-12	K 005S 033W 19SE
ADL 617588	Graphite One (Alaska) Inc.	GCX-43	08-Sep-12	K 005S 033W 30NE
ADL 617589	Graphite One (Alaska) Inc.	GCX-44	08-Sep-12	K 005S 033W 30SE
ADL 617590	Graphite One (Alaska) Inc.	GCX-46	29-Aug-12	K 005S 033W 18SW
ADL 617591	Graphite One (Alaska) Inc.	GCX-47	29-Aug-12	K 005S 033W 19NW
ADL 617592	Graphite One (Alaska) Inc.	GCX-48	08-Sep-12	K 005S 033W 19SW
ADL 617593	Graphite One (Alaska) Inc.	GCX-49	08-Sep-12	K 005S 033W 30NW
ADL 617594	Graphite One (Alaska) Inc.	GCX-50	08-Sep-12	K 005S 033W 30SW
ADL 617597	Graphite One (Alaska) Inc.	GCX-54	29-Aug-12	K 005S 034W 25NE
ADL 617598	Graphite One (Alaska) Inc.	GCX-55	29-Aug-12	K 005S 034W 25SE
ADL 617600	Graphite One (Alaska) Inc.	GCX-58	29-Aug-12	K 005S 034W 25NW
ADL 617601	Graphite One (Alaska) Inc.	GCX-59	29-Aug-12	K 005S 034W 25SW
ADL 617603	Graphite One (Alaska) Inc.	GCX-62	29-Aug-12	K 005S 034W 35NE
ADL 617605	Graphite One (Alaska) Inc.	GCX-64	29-Aug-12	K 005S 034W 35NW
ADL 617607	Graphite One (Alaska) Inc.	GCX-66	29-Aug-12	K 005S 034W 34NE
ADL 617609	Graphite One (Alaska) Inc.	GCX-68	29-Aug-12	K 005S 034W 34NW
ADL 617610	Graphite One (Alaska) Inc.	GCX-69	29-Aug-12	K 005S 034W 33NE
ADL 720914	Graphite One (Alaska) Inc.	GCN 001	11-Jun-15	K 005S 034W 15NW
ADL 720915	Graphite One (Alaska) Inc.	GCN 002	11-Jun-15	K 005S 034W 15NE
ADL 720916	Graphite One (Alaska) Inc.	GCN 003	11-Jun-15	K 005S 034W 15SW
ADL 720917	Graphite One (Alaska) Inc.	GCN 004	11-Jun-15	K 005S 034W 15SE
ADL 720918	Graphite One (Alaska) Inc.	GCN 005	11-Jun-15	K 005S 034W 20NW
ADL 720919	Graphite One (Alaska) Inc.	GCN 006	11-Jun-15	K 005S 034W 20NE
ADL 720920	Graphite One (Alaska) Inc.	GCN 007	11-Jun-15	K 005S 034W 21NW
ADL 720921	Graphite One (Alaska) Inc.	GCN 008	11-Jun-15	K 005S 034W 21NE
ADL 721240	Graphite One (Alaska) Inc.	GCN 009	20-Nov-15	K 005S 034W 17SW
ADL 721241	Graphite One (Alaska) Inc.	GCN 010	20-Nov-15	K 005S 034W 17SE
ADL 721242	Graphite One (Alaska) Inc.	GCN 011	20-Nov-15	K 005S 034W 16SW
ADL 721243	Graphite One (Alaska) Inc.	GCN-012	20-Nov-15	K 005S 034W 16SE
ADL 721244	Graphite One (Alaska) Inc.	GCN 013	20-Nov-15	K 005S 034W 17NW
ADL 721245	Graphite One (Alaska) Inc.	GCN 014	20-Nov-15	K 005S 034W 17NE
ADL 721246	Graphite One (Alaska) Inc.	GCN 015	20-Nov-15	K 005S 034W 16NW
ADL 721247	Graphite One (Alaska) Inc.	GCN 016	20-Nov-15	K 005S 034W 16NE
ADL 721248	Graphite One (Alaska) Inc.	GCN 017	20-Nov-15	K 005S 034W 09SW
ADL 721249	Graphite One (Alaska) Inc.	GCN 018	20-Nov-15	K 005S 034W 09SE
ADL 721250	Graphite One (Alaska) Inc.	GCN 019	20-Nov-15	K 005S 034W 10SW
ADL 721251	Graphite One (Alaska) Inc.	GCN 020	20-Nov-15	K 005S 034W 10SE
ADL 721252	Graphite One (Alaska) Inc.	GCN 021	20-Nov-15	K 005S 034W 09NW
ADL 721253	Graphite One (Alaska) Inc.	GCN 022	20-Nov-15	K 005S 034W 09NE
ADL 721254	Graphite One (Alaska) Inc.	GCN 023	20-Nov-15	K 005S 034W 10NW

Claim Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 721255	Graphite One (Alaska) Inc.	GCN 024	20-Nov-15	K 005S 034W 10NE
ADL 721256	Graphite One (Alaska) Inc.	GCN 025	20-Nov-15	K 005S 034W 03SW
ADL 721257	Graphite One (Alaska) Inc.	GCN 026	20-Nov-15	K 005S 034W 03SE
ADL 721258	Graphite One (Alaska) Inc.	GCN 027	20-Nov-15	K 005S 034W 03NW
ADL 721259	Graphite One (Alaska) Inc.	GCN 028	20-Nov-15	K 005S 034W 03NE
ADL 721260	Graphite One (Alaska) Inc.	GCN 029	20-Nov-15	K 005S 034W 02NW
ADL 721261	Graphite One (Alaska) Inc.	GCN 030	20-Nov-15	K 004S 033W 31SW
ADL 721262	Graphite One (Alaska) Inc.	GCN 031	20-Nov-15	K 004S 033W 31SE
ADL 721263	Graphite One (Alaska) Inc.	GCN 032	20-Nov-15	K 004S 033W 32SW
ADL 721264	Graphite One (Alaska) Inc.	GCN 033	20-Nov-15	K 004S 033W 32SE
ADL 721265	Graphite One (Alaska) Inc.	GCN 034	20-Nov-15	K 004S 033W 31NW
ADL 721266	Graphite One (Alaska) Inc.	GCN 035	20-Nov-15	K 004S 033W 31NE
ADL 721267	Graphite One (Alaska) Inc.	GCN 036	20-Nov-15	K 004S 033W 32NW
ADL 721268	Graphite One (Alaska) Inc.	GCN 037	20-Nov-15	K 004S 033W 32NE
ADL 721269	Graphite One (Alaska) Inc.	GCN 038	20-Nov-15	K 004S 033W 30SW
ADL 721270	Graphite One (Alaska) Inc.	GCN 039	20-Nov-15	K 004S 033W 30SE
ADL 721271	Graphite One (Alaska) Inc.	GCN 040	20-Nov-15	K 004S 033W 29SW
ADL 721272	Graphite One (Alaska) Inc.	GCN 041	20-Nov-15	K 004S 033W 29SE
ADL 721273	Graphite One (Alaska) Inc.	GCN 042	20-Nov-15	K 004S 033W 29NW
ADL 721274	Graphite One (Alaska) Inc.	GCN 043	20-Nov-15	K 004S 033W 29NE

Source: Graphite One (2024)
Note: All claims are a full ¼ section [64.7 ha (160 ac)]

4.2.3 The GC Purchased Properties

Graphite One (Alaska) Inc. purchased the GC Purchased Property in two transactions. In each transaction, Graphite One (Alaska) Inc. acquired 28 Alaska state mining claims. Each set of 28 claims is classified into two of the nominal groups with five claims in each set included in GC Leased Properties and the other 23 claims in each set included in GC Purchased Properties. The two sets of 23 claims classified as GC Purchased Properties are duplicate claims which completely overlap one another and partially surround the GC Leased Property. The first group of 28 claims was purchased in 2012 for $20,000, and the seller was granted a 2% production royalty on future production from the particular claims. Graphite One (Alaska) Inc. purchased the 2% production royalty in 2020. The production royalty merged with Graphite One (Alaska) Inc.'s ownership of the claims such that the 23 claims are no longer burdened by the 2% production royalty. The five remaining claims to which the 2% Graphite One (formerly Malhi) royalty applies are listed in Table 4-3 and shown in Figure 4-3 above.

Table 4-3 Graphite One 2% Royalty Claims

Claim Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 710590	Kougarok LLC	GRAPHITE CREEK 20	29-Oct-11	K 005S 034W SW21
ADL 710591	Kougarok LLC	GRAPHITE CREEK 21	29-Oct-11	K 005S 034W SE21
ADL 710592	Kougarok LLC	GRAPHITE CREEK 22	29-Oct-11	K 005S 034W SW22
ADL 710593	Kougarok LLC	GRAPHITE CREEK 23	29-Oct-11	K 005S 034W NW22
ADL 710594	Kougarok LLC	GRAPHITE CREEK 24	29-Oct-11	K 005S 034W NE22

Source: Graphite One (2024)

The second group of 28 claims was purchased in 2015 for $50,000, the issuance of 3 million common shares of Graphite One Resources Inc., and a royalty interest equal to 1% of the Net Smelter Returns received by Graphite One (Alaska) Inc. on production from the acquired claims. Graphite One (Alaska) Inc. has the right to purchase the royalty for $500,000 on or before the earlier of (i) the third anniversary of the commencement of production of the particular claims or (ii) June 1, 2035. The royalty interest remains a burden on all 28 claims, 23 of which are part of the GC Purchased Property and five of which are part of the GC Leased Property. Graphite One (Alaska) Inc. later conveyed 10 claims, five from each of the two acquisitions to Kougarok, LLC. As discussed above, those 10 claims now comprise the GC Leased Property.

Table 4-4 GC Purchased Property: Alaska State Mining Claims

Claim Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 710571	Graphite One (Alaska) Inc.	Graphite Creek 1	29-OCT-11	K 005S 035W 34SW
ADL 710572	Graphite One (Alaska) Inc.	Graphite Creek 2	29-OCT-11	K 005S 035W 34NW
ADL 710573	Graphite One (Alaska) Inc.	Graphite Creek 3	29-OCT-11	K 005S 035W 34NE
ADL 710574	Graphite One (Alaska) Inc.	Graphite Creek 4	29-OCT-11	K 005S 035W 35NW
ADL 710575	Graphite One (Alaska) Inc.	Graphite Creek 5	29-OCT-11	K 005S 035W 35NE
ADL 710576	Graphite One (Alaska) Inc.	Graphite Creek 6	29-OCT-11	K 005S 035W 27SE
ADL 710577	Graphite One (Alaska) Inc.	Graphite Creek 7	29-OCT-11	K 005S 035W 26SW
ADL 710578	Graphite One (Alaska) Inc.	Graphite Creek 8	29-OCT-11	K 005S 035W 26SE
ADL 710579	Graphite One (Alaska) Inc.	Graphite Creek 9	29-OCT-11	K 005S 035W 25SW
ADL 710580	Graphite One (Alaska) Inc.	Graphite Creek 10	29-OCT-11	K 005S 035W 25SE
ADL 710581	Graphite One (Alaska) Inc.	Graphite Creek 11	29-OCT-11	K 005S 035W 26NE
ADL 710582	Graphite One (Alaska) Inc.	Graphite Creek 12	29-OCT-11	K 005S 035W 25NW
ADL 710583	Graphite One (Alaska) Inc.	Graphite Creek 13	29-OCT-11	K 005S 035W 25NE
ADL 710584	Graphite One (Alaska) Inc.	Graphite Creek 14	29-OCT-11	K 005S 034W 30NW
ADL 710585	Graphite One (Alaska) Inc.	Graphite Creek 15	29-OCT-11	K 005S 034W 30NE
ADL 710586	Graphite One (Alaska) Inc.	Graphite Creek 16	29-OCT-11	K 005S 034W 29NW
ADL 710587	Graphite One (Alaska) Inc.	Graphite Creek 17	29-OCT-11	K 005S 034W 29NE
ADL 710588	Graphite One (Alaska) Inc.	Graphite Creek 18	29-OCT-11	K 005S 034W 20SW
ADL 710589	Graphite One (Alaska) Inc.	Graphite Creek 19	29-OCT-11	K 005S 034W 20SE
ADL 710595	Graphite One (Alaska) Inc.	Graphite Creek 25	29-OCT-11	K 005S 034W 23NW
ADL 710596	Graphite One (Alaska) Inc.	Graphite Creek 26	29-OCT-11	K 005S 034W 23NE
ADL 710597	Graphite One (Alaska) Inc.	Graphite Creek 27	29-OCT-11	K 005S 034W 23SW
ADL 710598	Graphite One (Alaska) Inc.	Graphite Creek 28	29-OCT-11	K 005S 034W 23SE
ADL 716180	Graphite One (Alaska) Inc.	GPH 01	08-OCT-12	K 005S 035W 34SW
ADL 716181	Graphite One (Alaska) Inc.	GPH 02	07-OCT-12	K 005S 035W 34NW
ADL 716182	Graphite One (Alaska) Inc.	GPH 03	07-OCT-12	K 005S 035W 34NE
ADL 716183	Graphite One (Alaska) Inc.	GPH 04	08-OCT-12	K 005S 035W 35NW
ADL 716184	Graphite One (Alaska) Inc.	GPH 05	08-OCT-12	K 005S 035W 35NE
ADL 716185	Graphite One (Alaska) Inc.	GPH 06	06-OCT-12	K 005S 035W 27SE
ADL 716186	Graphite One (Alaska) Inc.	GPH 07	06-OCT-12	K 005S 035W 26SW
ADL 716187	Graphite One (Alaska) Inc.	GPH 08	06-OCT-12	K 005S 035W 26SE
ADL 716188	Graphite One (Alaska) Inc.	GPH 09	07-OCT-12	K 005S 035W 25SW
ADL 716189	Graphite One (Alaska) Inc.	GPH 10	06-OCT-12	K 005S 035W 25SE
ADL 716190	Graphite One (Alaska) Inc.	GPH 11	06-OCT-12	K 005S 035W 26NE
ADL 716191	Graphite One (Alaska) Inc.	GPH 12	06-OCT-12	K 005S 035W 25NW
ADL 716192	Graphite One (Alaska) Inc.	GPH 13	06-OCT-12	K 005S 035W 25NE
ADL 716193	Graphite One (Alaska) Inc.	GPH 14	06-OCT-12	K 005S 034W 30NW
ADL 716194	Graphite One (Alaska) Inc.	GPH 15	06-OCT-12	K 005S 034W 30NE
ADL 716195	Graphite One (Alaska) Inc.	GPH 16	06-OCT-12	K 005S 034W 29NW
ADL 716196	Graphite One (Alaska) Inc.	GPH 17	06-OCT-12	K 005S 034W 29NE
ADL 716197	Graphite One (Alaska) Inc.	GPH 18	04-OCT-12	K 005S 034W 20SW

Claim Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 716198	Graphite One (Alaska) Inc.	GPH 19	04-OCT-12	K 005S 034W 20SE
ADL 716204	Graphite One (Alaska) Inc.	GPH 25	04-OCT-12	K 005S 034W 23NW
ADL 716205	Graphite One (Alaska) Inc.	GPH 26	04-OCT-12	K 005S 034W 23NE
ADL 716206	Graphite One (Alaska) Inc.	GPH 27	04-OCT-12	K 005S 034W 23SW
ADL 716207	Graphite One (Alaska) Inc.	GPH 28	03-OCT-12	K 005S 034W 23SE

Source: Graphite One (2024)
Note: All claims are a full ¼ section [64.7 ha (160 ac)]

4.2.4 Taiga Royalty

In 2023, Graphite One sold a 1% NSR Royalty on 133 claims (Table 4-5) to Taiga Mining Company, Inc. The claims to which the Taiga Royalty applies is a mix of 56 purchased and 77 located claims. Although 28 of the applicable claims overlap each other, the royalty payment will be calculated as if only one set of claims exist. For those lands with duplicate claims, the royalty is not duplicated. The boundary outline of the applicable claims is shown in Figure 4-3.

Table 4-5 Taiga 1% NSR Royalty Claims

ADL Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 617072	Graphite One (Alaska) Inc.	GCX-01	04-Jun-12	K 005S 034W NW24
ADL 617073	Graphite One (Alaska) Inc.	GCX-02	04-Jun-12	K 005S 034W SE13
ADL 617074	Graphite One (Alaska) Inc.	GCX-03	04-Jun-12	K 005S 034W SW13
ADL 617075	Graphite One (Alaska) Inc.	GCX-04	04-Jun-12	K 005S 034W SE14
ADL 617076	Graphite One (Alaska) Inc.	GCX-05	04-Jun-12	K 005S 034W SW14
ADL 617077	Graphite One (Alaska) Inc.	GCX-06	04-Jun-12	K 005S 034W NW14
ADL 617078	Graphite One (Alaska) Inc.	GCX-07	04-Jun-12	K 005S 034W NE14
ADL 617079	Graphite One (Alaska) Inc.	GCX-08	04-Jun-12	K 005S 034W NW13
ADL 617080	Graphite One (Alaska) Inc.	GCX-09	04-Jun-12	K 005S 034W NE13
ADL 617081	Graphite One (Alaska) Inc.	GCX-10	04-Jun-12	K 005S 033W NW18
ADL 617082	Graphite One (Alaska) Inc.	GCX-11	04-Jun-12	K 005S 033W SW07
ADL 617083	Graphite One (Alaska) Inc.	GCX-12	04-Jun-12	K 005S 034W SE12
ADL 617084	Graphite One (Alaska) Inc.	GCX-13	04-Jun-12	K 005S 034W SW12
ADL 617085	Graphite One (Alaska) Inc.	GCX-14	04-Jun-12	K 005S 034W SE11
ADL 617086	Graphite One (Alaska) Inc.	GCX-15	04-Jun-12	K 005S 034W NW12
ADL 617087	Graphite One (Alaska) Inc.	GCX-16	04-Jun-12	K 005S 034W NE12
ADL 617088	Graphite One (Alaska) Inc.	GCX-17	04-Jun-12	K 005S 033W NW07
ADL 617571	Graphite One (Alaska) Inc.	GCX-18	29-Aug-12	K 005S 033W NW16
ADL 617572	Graphite One (Alaska) Inc.	GCX-19	29-Aug-12	K 005S 033W SW16
ADL 617573	Graphite One (Alaska) Inc.	GCX-20	29-Aug-12	K 005S 033W NW21
ADL 617574	Graphite One (Alaska) Inc.	GCX-21	08-Sep-12	K 005S 033W SW21
ADL 617575	Graphite One (Alaska) Inc.	GCX-25	29-Aug-12	K 005S 033W NE17
ADL 617576	Graphite One (Alaska) Inc.	GCX-26	29-Aug-12	K 005S 033W SE17
ADL 617577	Graphite One (Alaska) Inc.	GCX-27	29-Aug-12	K 005S 033W NE20
ADL 617578	Graphite One (Alaska) Inc.	GCX-28	08-Sep-12	K 005S 033W SE20
ADL 617579	Graphite One (Alaska) Inc.	GCX-32	29-Aug-12	K 005S 033W NW17
ADL 617580	Graphite One (Alaska) Inc.	GCX-33	29-Aug-12	K 005S 033W SW17
ADL 617581	Graphite One (Alaska) Inc.	GCX-34	29-Aug-12	K 005S 033W NW20

ADL Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 617582	Graphite One (Alaska) Inc.	GCX-35	08-Sep-12	K 005S 033W SW20
ADL 617583	Graphite One (Alaska) Inc.	GCX-36	08-Sep-12	K 005S 033W NW29
ADL 617584	Graphite One (Alaska) Inc.	GCX-39	29-Aug-12	K 005S 033W NE18
ADL 617585	Graphite One (Alaska) Inc.	GCX-40	29-Aug-12	K 005S 033W SE18
ADL 617586	Graphite One (Alaska) Inc.	GCX-41	29-Aug-12	K 005S 033W NE19
ADL 617587	Graphite One (Alaska) Inc.	GCX-42	08-Sep-12	K 005S 033W SE19
ADL 617588	Graphite One (Alaska) Inc.	GCX-43	08-Sep-12	K 005S 033W NE30
ADL 617589	Graphite One (Alaska) Inc.	GCX-44	08-Sep-12	K 005S 033W SE30
ADL 617590	Graphite One (Alaska) Inc.	GCX-46	29-Aug-12	K 005S 033W SW18
ADL 617591	Graphite One (Alaska) Inc.	GCX-47	29-Aug-12	K 005S 033W NW19
ADL 617592	Graphite One (Alaska) Inc.	GCX-48	08-Sep-12	K 005S 033W SW19
ADL 617593	Graphite One (Alaska) Inc.	GCX-49	08-Sep-12	K 005S 033W NW30
ADL 617594	Graphite One (Alaska) Inc.	GCX-50	08-Sep-12	K 005S 033W SW30
ADL 617595	Graphite One (Alaska) Inc.	GCX-52	29-Aug-12	K 005S 034W NE24
ADL 617596	Graphite One (Alaska) Inc.	GCX-53	29-Aug-12	K 005S 034W SE24
ADL 617597	Graphite One (Alaska) Inc.	GCX-54	29-Aug-12	K 005S 034W NE25
ADL 617598	Graphite One (Alaska) Inc.	GCX-55	29-Aug-12	K 005S 034W SE25
ADL 617599	Graphite One (Alaska) Inc.	GCX-57	29-Aug-12	K 005S 034W SW24
ADL 617600	Graphite One (Alaska) Inc.	GCX-58	29-Aug-12	K 005S 034W NW25
ADL 617601	Graphite One (Alaska) Inc.	GCX-59	29-Aug-12	K 005S 034W SW25
ADL 617602	Graphite One (Alaska) Inc.	GCX-61	29-Aug-12	K 005S 034W SE26
ADL 617603	Graphite One (Alaska) Inc.	GCX-62	29-Aug-12	K 005S 034W NE35
ADL 617604	Graphite One (Alaska) Inc.	GCX-63	29-Aug-12	K 005S 034W SW26
ADL 617605	Graphite One (Alaska) Inc.	GCX-64	29-Aug-12	K 005S 034W NW35
ADL 617606	Graphite One (Alaska) Inc.	GCX-65	29-Aug-12	K 005S 034W SE27
ADL 617607	Graphite One (Alaska) Inc.	GCX-66	29-Aug-12	K 005S 034W NE34
ADL 617608	Graphite One (Alaska) Inc.	GCX-67	29-Aug-12	K 005S 034W SW27
ADL 617609	Graphite One (Alaska) Inc.	GCX-68	29-Aug-12	K 005S 034W NW34
ADL 617610	Graphite One (Alaska) Inc.	GCX-69	29-Aug-12	K 005S 034W NE33
ADL 710571	Graphite One (Alaska) Inc.	Graphite Creek 1	29-Oct-11	K 005S 035W SW34
ADL 710572	Graphite One (Alaska) Inc.	Graphite Creek 2	29-Oct-11	K 005S 035W NW34
ADL 710573	Graphite One (Alaska) Inc.	Graphite Creek 3	29-Oct-11	K 005S 035W NE34
ADL 710574	Graphite One (Alaska) Inc.	Graphite Creek 4	29-Oct-11	K 005S 035W NW35
ADL 710575	Graphite One (Alaska) Inc.	Graphite Creek 5	29-Oct-11	K 005S 035W NE35
ADL 710576	Graphite One (Alaska) Inc.	Graphite Creek 6	29-Oct-11	K 005S 035W SE27
ADL 710577	Graphite One (Alaska) Inc.	Graphite Creek 7	29-Oct-11	K 005S 035W SW26
ADL 710578	Graphite One (Alaska) Inc.	Graphite Creek 8	29-Oct-11	K 005S 035W SE26
ADL 710579	Graphite One (Alaska) Inc.	Graphite Creek 9	29-Oct-11	K 005S 035W SW25
ADL 710580	Graphite One (Alaska) Inc.	Graphite Creek 10	29-Oct-11	K 005S 035W SE25
ADL 710581	Graphite One (Alaska) Inc.	Graphite Creek 11	29-Oct-11	K 005S 035W NE26
ADL 710582	Graphite One (Alaska) Inc.	Graphite Creek 12	29-Oct-11	K 005S 035W NW25
ADL 710583	Graphite One (Alaska) Inc.	Graphite Creek 13	29-Oct-11	K 005S 035W NE25
ADL 710584	Graphite One (Alaska) Inc.	Graphite Creek 14	29-Oct-11	K 005S 034W NW30
ADL 710585	Graphite One (Alaska) Inc.	Graphite Creek 15	29-Oct-11	K 005S 034W NE30
ADL 710586	Graphite One (Alaska) Inc.	Graphite Creek 16	29-Oct-11	K 005S 034W NW29
ADL 710587	Graphite One (Alaska) Inc.	Graphite Creek 17	29-Oct-11	K 005S 034W NE29
ADL 710588	Graphite One (Alaska) Inc.	Graphite Creek 18	29-Oct-11	K 005S 034W SW20

ADL Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 710589	Graphite One (Alaska) Inc.	Graphite Creek 19	29-Oct-11	K 005S 034W SE20
ADL 710590	Kougarok LLC	Graphite Creek 20	29-Oct-11	K 005S 034W SW21
ADL 710591	Kougarok LLC	Graphite Creek 21	29-Oct-11	K 005S 034W SE21
ADL 710592	Kougarok LLC	Graphite Creek 22	29-Oct-11	K 005S 034W SW22
ADL 710593	Kougarok LLC	Graphite Creek 23	29-Oct-11	K 005S 034W NW22
ADL 710594	Kougarok LLC	Graphite Creek 24	29-Oct-11	K 005S 034W NE22
ADL 710595	Graphite One (Alaska) Inc.	Graphite Creek 25	29-Oct-11	K 005S 034W NW23
ADL 710596	Graphite One (Alaska) Inc.	Graphite Creek 26	29-Oct-11	K 005S 034W NE23
ADL 710597	Graphite One (Alaska) Inc.	Graphite Creek 27	29-Oct-11	K 005S 034W SW23
ADL 710598	Graphite One (Alaska) Inc.	Graphite Creek 28	29-Oct-11	K 005S 034W SE23
ADL 710772	Kougarok LLC	GC 001	22-Nov-11	K 005S 034W SE22
ADL 710773	Kougarok LLC	GC 002	22-Nov-11	K 005S 034W NW28
ADL 710774	Kougarok LLC	GC 003	22-Nov-11	K 005S 034W NE28
ADL 710775	Graphite One (Alaska) Inc.	GC 004	22-Nov-11	K 005S 034W NW27
ADL 710776	Graphite One (Alaska) Inc.	GC 005	22-Nov-11	K 005S 034W NE27
ADL 710777	Graphite One (Alaska) Inc.	GC 006	22-Nov-11	K 005S 034W NW26
ADL 710778	Graphite One (Alaska) Inc.	GC 007	22-Nov-11	K 005S 034W NE26
ADL 710779	Graphite One (Alaska) Inc.	GC 008	22-Nov-11	K 005S 034W SW30
ADL 710780	Graphite One (Alaska) Inc.	GC 009	22-Nov-11	K 005S 034W SE30
ADL 710781	Graphite One (Alaska) Inc.	GC 010	22-Nov-11	K 005S 034W SW29
ADL 710782	Graphite One (Alaska) Inc.	GC 011	22-Nov-11	K 005S 034W SE29
ADL 710783	Graphite One (Alaska) Inc.	GC 012	22-Nov-11	K 005S 034W SW28
ADL 710784	Graphite One (Alaska) Inc.	GC 013	22-Nov-11	K 005S 034W SE28
ADL 710785	Graphite One (Alaska) Inc.	GC 014	22-Nov-11	K 005S 035W NW36
ADL 710786	Graphite One (Alaska) Inc.	GC 015	22-Nov-11	K 005S 035W NE36
ADL 710787	Graphite One (Alaska) Inc.	GC 016	22-Nov-11	K 005S 034W NW31
ADL 710788	Graphite One (Alaska) Inc.	GC 017	22-Nov-11	K 005S 034W NE31
ADL 710789	Graphite One (Alaska) Inc.	GC 018	22-Nov-11	K 005S 034W NW32
ADL 710790	Graphite One (Alaska) Inc.	GC 019	22-Nov-11	K 005S 034W NE32
ADL 710791	Graphite One (Alaska) Inc.	GC 020	22-Nov-11	K 005S 034W NW33
ADL 716180	Graphite One (Alaska) Inc.	GPH 01	08-Oct-12	K 005S 035W SW34
ADL 716181	Graphite One (Alaska) Inc.	GPH 02	07-Oct-12	K 005S 035W NW34
ADL 716182	Graphite One (Alaska) Inc.	GPH 03	07-Oct-12	K 005S 035W NE34
ADL 716183	Graphite One (Alaska) Inc.	GPH 04	08-Oct-12	K 005S 035W NW35
ADL 716184	Graphite One (Alaska) Inc.	GPH 05	08-Oct-12	K 005S 035W NE35
ADL 716185	Graphite One (Alaska) Inc.	GPH 06	06-Oct-12	K 005S 035W SE27
ADL 716186	Graphite One (Alaska) Inc.	GPH 07	06-Oct-12	K 005S 035W SW26
ADL 716187	Graphite One (Alaska) Inc.	GPH 08	06-Oct-12	K 005S 035W SE26
ADL 716188	Graphite One (Alaska) Inc.	GPH 09	07-Oct-12	K 005S 035W SW25
ADL 716189	Graphite One (Alaska) Inc.	GPH 10	06-Oct-12	K 005S 035W SE25
ADL 716190	Graphite One (Alaska) Inc.	GPH 11	06-Oct-12	K 005S 035W NE26
ADL 716191	Graphite One (Alaska) Inc.	GPH 12	06-Oct-12	K 005S 035W NW25
ADL 716192	Graphite One (Alaska) Inc.	GPH 13	06-Oct-12	K 005S 035W NE25
ADL 716193	Graphite One (Alaska) Inc.	GPH 14	06-Oct-12	K 005S 034W NW30
ADL 716194	Graphite One (Alaska) Inc.	GPH 15	06-Oct-12	K 005S 034W NE30
ADL 716195	Graphite One (Alaska) Inc.	GPH 16	06-Oct-12	K 005S 034W NW29
ADL 716196	Graphite One (Alaska) Inc.	GPH 17	06-Oct-12	K 005S 034W NE29

ADL Number	Claim Owner	Claim Name	Location Date	Township Location
ADL 716197	Graphite One (Alaska) Inc.	GPH 18	04-Oct-12	K 005S 034W SW20
ADL 716198	Graphite One (Alaska) Inc.	GPH 19	04-Oct-12	K 005S 034W SE20
ADL 716199	Kougarok LLC	GPH 20	04-Oct-12	K 005S 034W SW21
ADL 716200	Kougarok LLC	GPH 21	04-Oct-12	K 005S 034W SE21
ADL 716201	Kougarok LLC	GPH 22	06-Oct-12	K 005S 034W SW22
ADL 716202	Kougarok LLC	GPH 23	03-Oct-12	K 005S 034W NW22
ADL 716203	Kougarok LLC	GPH 24	03-Oct-12	K 005S 034W NE22
ADL 716204	Graphite One (Alaska) Inc.	GPH 25	04-Oct-12	K 005S 034W NW23
ADL 716205	Graphite One (Alaska) Inc.	GPH 26	04-Oct-12	K 005S 034W NE23
ADL 716206	Graphite One (Alaska) Inc.	GPH 27	04-Oct-12	K 005S 034W SW23
ADL 716207	Graphite One (Alaska) Inc.	GPH 28	03-Oct-12	K 005S 034W SE23

Source: Graphite One, 2024

4.2.5 Surface Rights and Permitting

For Alaska state mining claims, surface rights remain with the state while surface uses that are necessary for the prospecting for, extraction of, or basic processing of minerals are allowed, subject to reasonable concurrent uses. The permits required to establish a mining operation are more fully outlined in Chapter 20 of this assessment, but as a minimum, the following are expected to be required:

- U.S. Army Corps of Engineers: Section 404 Wetlands Dredge and Fill Permit
- Alaska Department of Natural Resources: Plan of Operations Approval
- Alaska Department of Environmental Conservation: Alaska Pollution Discharge Elimination Permit
- Alaska Department of Environmental Conservation: Waste Management Permit

To the knowledge of the QP, there are no outstanding environmental liabilities to which any portion of the project is subject.

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

5.1 Topography, Elevation, and Vegetation

The property is in the Seward Peninsula in Alaska, located approximately 60 km north of Nome, the closest major center. The northern edge of the property borders the Imuruk Basin, a shallow tidal body of water that flows through the Tuksuk Channel out to Grantley Harbor, then on to Port Clarence and the Bering Sea. The property's elevation gently rises from the basin to the Kigluaik Mountains, which reach some 1190 m AMSL. The proposed mine site would be located between 100 and 500 m in elevation along the base of the Kigluaik Mountain range, front adjacent to Graphite Creek, a small drainage descending from the mountain’s west-facing slopes.

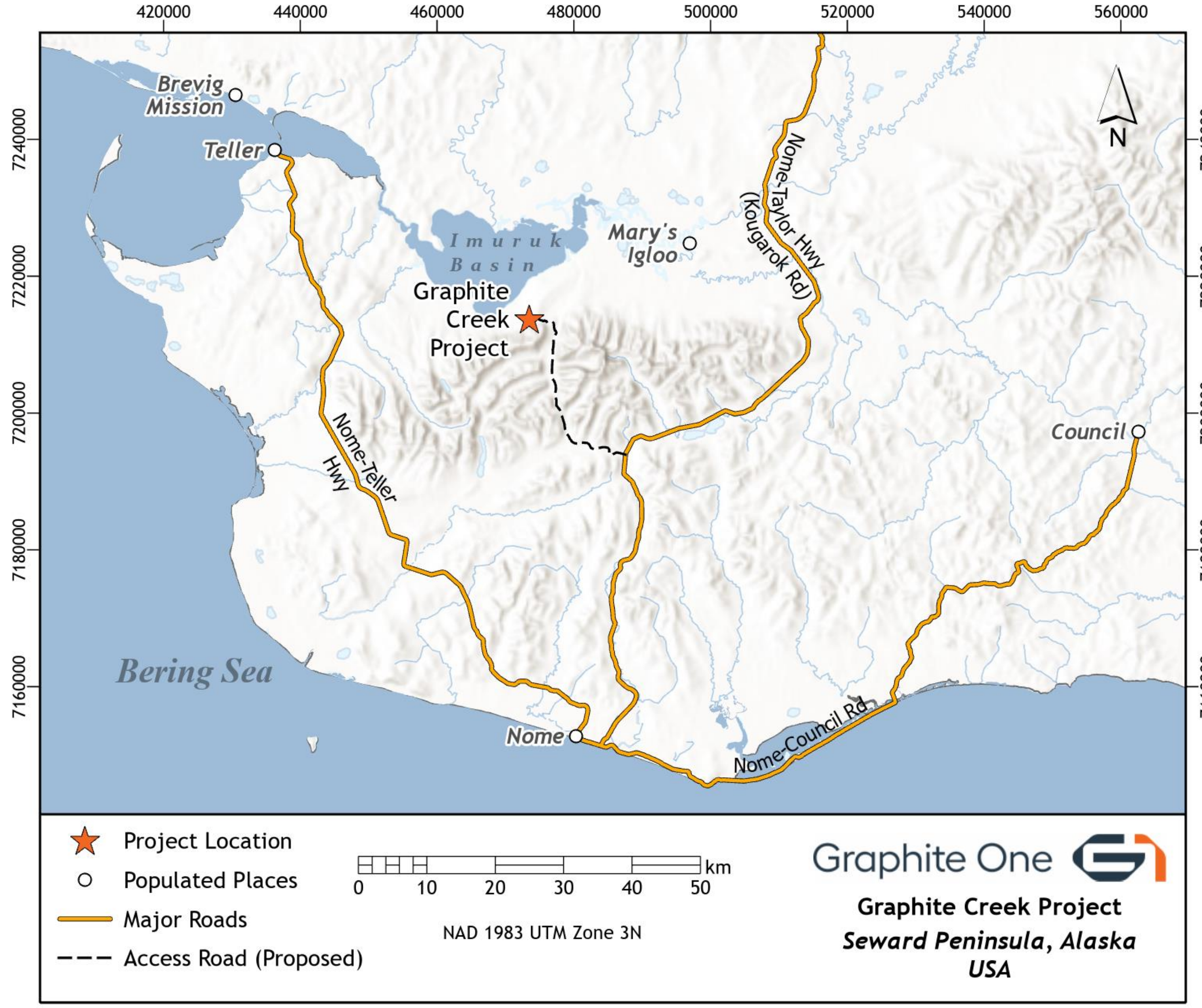
Vegetation on the property is characteristic of the Arctic tundra biome, where vegetation is low and dominated by shrubs, sedges, perennial forbs, grasses, mosses, and lichens. Additionally, a layer of discontinuous permafrost is present (Eccles et al., 2015).

5.2 Accessibility

With the major urban center, Nome, to the south, the closest village to the property is the Inupiat village of Teller (2020 population of 249 persons), located 42 km northwest. There is no road access to the property at present. The roads closest to the site are marked in Figure 5-1. The Nome-Teller Highway (Bob Blodgett Highway) passes the western periphery of the Kigluaik Mountain chain approximately 30 km west of the property and ends at Teller, Alaska. The Nome-Taylor Highway, known locally and throughout this report as the Kougarok Road, circumvents the eastern part of the mountain range along its southern flank 20 km southeast of the project area and ends at the Kougarok River Bridge. A road spur leading off the Kougarok Road leads to Pilgrim Hot Springs, just north of the eastern flank of the Kigluaik Mountain range. Both highways are well-maintained gravel roads, but neither highway is entirely maintained during winter months (October to May) beyond milepost 13 for the Kougarok Road and milepost 8 for the Nome-Teller Highway. The highways are typically closed after the first snow accumulation of the season.

Although the local community of Brevig Mission (2022 population of 625) is located only 9.7 km northwest of Teller, there is no road connection between the two.

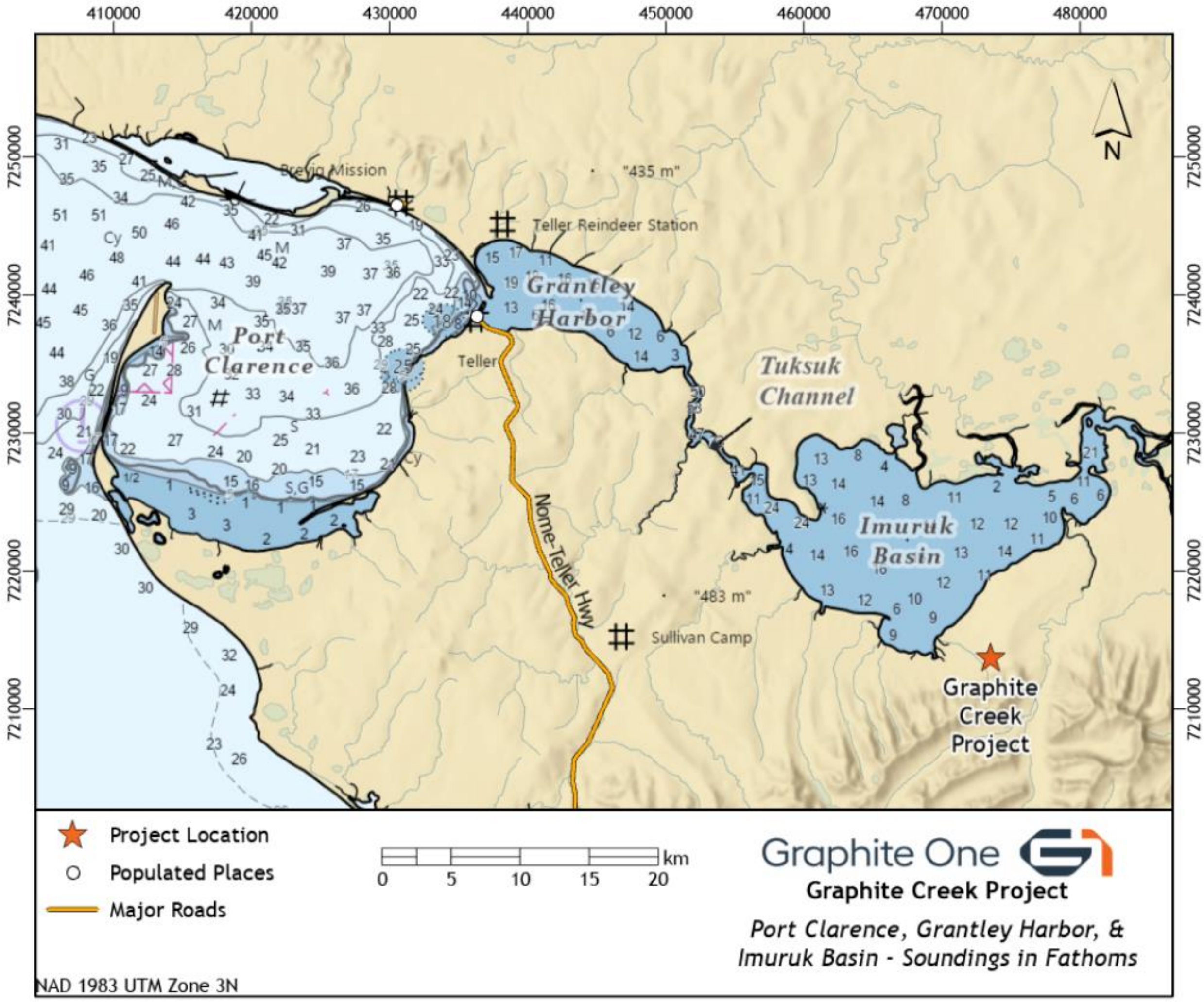
During the 2021 and 2022 field exploration programs, a temporary exploration camp at the Graphite Creek site was established, and access to the property was achieved by helicopter. A proposed overland route connecting the mine site to the Kougarok Road will support future mining operations.



Source: Graphite One (2024)

Figure 5-1 Nome Area Major Road Routes

The Seward Peninsula lacks rivers of adequate depth for commercial transport and navigation to be commonplace. The navigational route from the property on the Imuruk Basin at Windy Cove through the Tuksuk Channel to Grantley Harbor and on to Port Clarence would have to be assessed for larger bulk transport of material at the proposed scale of operation, as shown in Figure 5-2. The use of the abandoned U.S. Coast Guard facilities at Port Clarence has not been considered in this study due to a lack of access when the surrounding waterways freeze. Imuruk Basin is a shallow lagoon with recorded depths of 1.8 to 2.7 m (1 to 2 fathoms) in most places. Employment of a port facility on the Imuruk Basin is not the primary focus for a transport option due to a combination of factors, including difficult passage through the Tuksuk Channel, uncertain water depths, the need to identify an appropriate/passable route, the presence of two threatened seal species, and concerns regarding potential Alaska Natives' fishing and hunting sustenance constraints. As such, a year-round road connected to the Kougarok Road is presently considered to be the most suitable and practical transport option. The proposed road length and location are presented in more detail in Chapter 18 of this report.



Source: Graphite One (2024)

Figure 5-2 Port Clarence, Grantly Harbor, and Imuruk Basin Depth Soundings in Feet

5.3 Local Resources and Infrastructure

5.3.1 Energy Supply

There are presently no large, interconnected grids of power transmission and distribution lines in the Seward Peninsula. The only intra-state grid network is found in the more populated areas of eastern Alaska, running the corridor from Fairbanks to Anchorage.

Most power in the Seward Peninsula is generated by consumer-owned electric cooperatives near the serviced communities. Teller, Brevig Mission, and Nome generate electricity via diesel-fired power plants with respective electrical generating capacities of 1,050 kilowatt (kW) (approximately 1 megawatt (MW)) and 20.4 MW. In general, the project area and western Alaska are far from the eastern oil-producing regions, the Alaska oil pipeline, and access to the intra-state electrical grid. However, the Tuksuk Channel that links Imuruk Basin to Grantley Harbor has been identified as a potential site for hydroelectric power generation on maps by the Alaska Energy Authority and was evaluated in a 1980 study on Alaskan hydroelectric resources to have a potential generating capacity of 66 MW.

There are various options for electric power generation on-site, ranging from diesel generation, which is more likely, to liquid natural gas and wind (Nome has local experience in setting up arctic-grade wind generation systems) to some geothermal generation from Unaatuq LLC’s Pilgrim Hot Springs project. None of these are currently commercially viable, but Graphite One continues monitoring them as they mature. Further information on this is included in Chapter 18.

5.4 Transportation

5.4.1 Ports

The nearest port is the Port of Nome which is located 60 km south of the project. Shipments in and out of the port are limited to the ice-free portions of the year, typically between early June and early October each year. The port is currently serviced by four scheduled freight barges annually during this season. These barges originate their northbound journeys in Seattle, Washington, before stopping in Anchorage, Alaska, and several coastal Alaskan villages before reaching Nome. Fuels such as diesel, gasoline, and jet-A fuel are delivered by separate dedicated barges during the same season. The existing, regularly scheduled services do not have the capacity to serve the Graphite Creek project, so dedicated barges and/or ships will be required to support the project.

Through a partnership with the USACE, the city of Nome has started a port modification project designed to alleviate existing vessel restrictions resulting from shallow channel depths and limited harbor space. Components include enlarging the outer basin and creating a new deep-water basin with a depth of minus 40 feet, which will be accomplished by dredging and constructing new rock causeways. At the time of this report, the Port of Nome expansion project has been delayed while USACE evaluates a less expensive, phased approach to the project. This study assumes that the Port of Nome expansion project is completed such that deeper draft-geared container ships can be used for concentrate transportation.

Source: City of Nome (2024)

Figure 5-3 Aerial View of the Port of Nome (Facing East)

5.4.2 Air Transportation

Air travel and freight transportation to the project area is via the Nome Airport, a state-owned public-use airport. The Nome Airport is currently serviced by two commercial jet flights to and from Anchorage daily. Several carriers also fly freight between Anchorage and Nome in 737 and C-130 model aircraft. A small local carrier offers regular service between Nome and the surrounding villages.

The Nome Airport has two asphalt runways—one 6,009 ft x 150 ft and one 6,176 ft x 150 ft.

No runway is planned for the Graphite Creek project, but a local helicopter charter provider is available if needed.

5.4.3 Railroads

There is no rail service near the project. The only rail line in the state is owned by the Alaska Railroad, a state of Alaska-owned Class II line that operates freight and seasonal passenger service linking Seward, Whittier, Anchorage, and Fairbanks. There are no rail lines leading out of the state; however, the Alaska Railroad is able to load a small number of rail cars onto specialty “rail barges” that sail between Whittier and Seattle.

After barging to a port in the Pacific Northwest, graphite concentrates will be transported by rail to the secondary treatment plant. Further information on this supply chain route can be found in Chapter 18 of this report.

5.5 Surface Ownership

The project site and access road are fully on state of Alaska lands. State of Alaska mining claims allow for surface usage through the permitting process. A right-of-way from the state of Alaska is required for the construction of the mine access road.

Surface rights for Nome facilities, such as the concentrate container storage yard, will be purchased or leased from private landowners and/or the city of Nome.

Surface rights for the secondary treatment facility in Ohio are already secured through a lease agreement with the property owner.

5.6 Water Resources

The Graphite Creek project area includes surface water streams, the Cobblestone River, ample groundwater, and the nearby brackish Imuruk Basin.

Surface water resources (Figure 5-4) include several small streams and two main creeks crossing the site from southeast to northwest. Surface water sampling has been conducted at ten established sites on small project-area streams, including Cobblestone River, Graphite Creek, Ptarmigan Creek, Ruby Creek, and Trail Creek. Graphite Creek, the easternmost creek within the project boundary and the one most affected by the project, flows through the areas designated for the pit and WMF. The flows of Graphite Creek average around 5,000 m^3/day but vary greatly between winter and summer. Current monitoring indicates that this creek flows throughout the year, with a minimum recorded flow in March. Glacier Canyon Creek flows parallel to Graphite Creek and to the west of planned operations. Both major creeks have been monitored for quality and quantity since 2022 (Brailey Hydrologic Consultants & Tundra Consulting, LLC, 2023). Both Graphite and Glacier Canyon Creek are considered non-fish-bearing streams with pH values below six and high levels of aluminum, iron, nickel, and zinc that frequently exceed Alaska water quality standards. Graphite Creek also shows naturally increased sulfate and dissolved solids from June to September during the seasonal thaw (Forster & Seigle, 2023). These two creeks converge as Glacier Canyon Creek immediately downstream of the project boundary before flowing 2.7 km north and west to discharge into the Imuruk Basin.

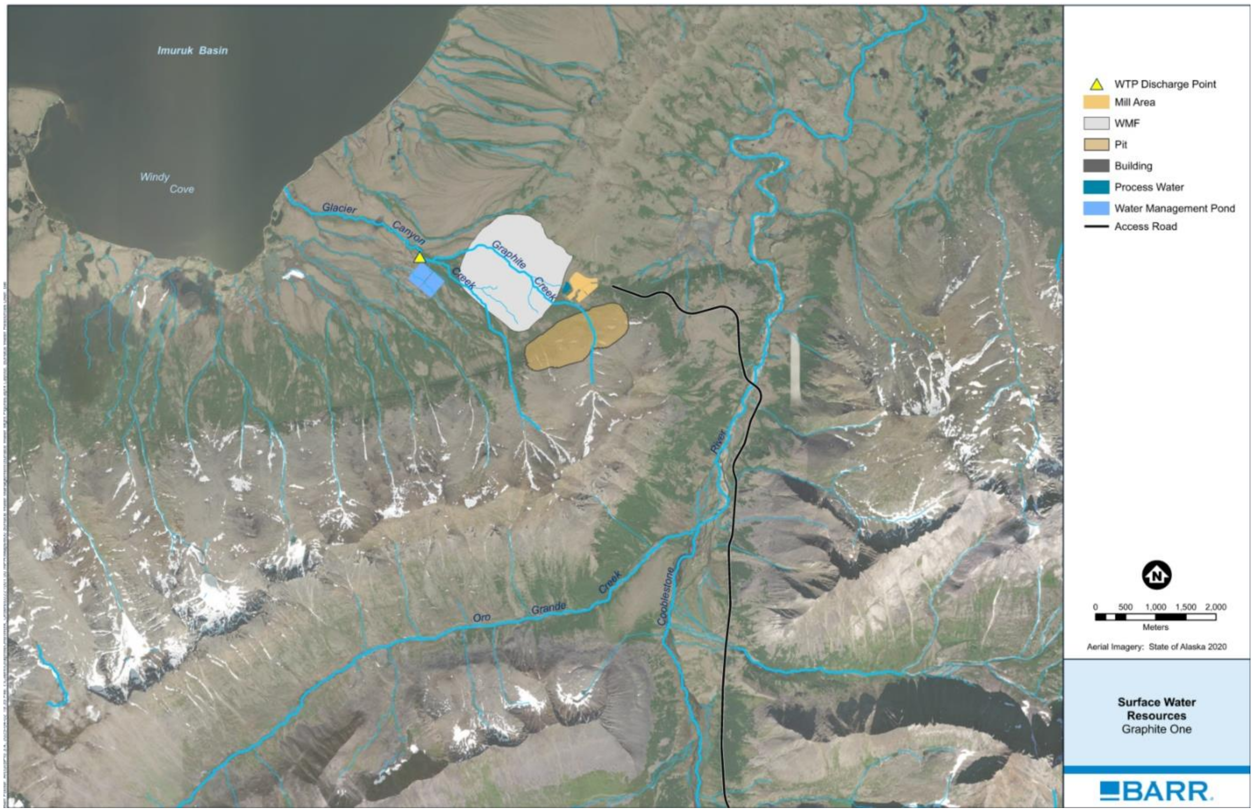


Figure 5-4 Surface Water Resources

Several smaller creeks have also been identified across the project property; however, they either go subsurface into the coarse sediments of the lowlands or are tributary to the Graphite or Glacier Canyon Creeks.

Approximately 2 km to the east of the project site, the Cobblestone River flows south to north. Its annual flow varies greatly between winter and summer, with an annualized average flow of 615,000 m^3/day (Tundra Consulting, LLC, 2024). This river will remain undisturbed from the Graphite Creek project aside from the single mine access road bridge crossing. The Cobblestone River has been monitored for quality and biodiversity since 2023.

The project area also encompasses two distinct groundwater systems separated by the Kigluaik Fault: a bedrock aquifer system in the highlands to the south and an unconsolidated sediment aquifer system in the lowlands to the north. The bedrock system exhibits artesian conditions near the fault and shows similar hydrograph patterns across different elevations. The unconsolidated sediment system displays downward vertical gradients and larger annual fluctuations in deeper wells. Both systems follow an annual hydrologic cycle with declining levels through winter, reaching lows in late May/early June, followed by a rapid rise to summer high levels during spring break up, and sustained high levels through summer until early October. Groundwater temperatures show little variation.

There are sufficient water sources on or available at the property to support mining operations. Natural water quality varies but is determined to be sufficient to support mining activities. A site for a process water pond has been identified adjacent to the mill, and a site for a larger WMP downstream of all operations will be established to retain any contact water generated during construction and operation. Contact water containment will be managed between the PP and the WMP to maintain sufficient quantity for milling and containment capacity for storm event runoff with the option for volume balancing between the two. All mill process water will be taken from the PP, which will be primarily fed by surface water from Graphite Creek with additional contributions from mill site contact water runoff and snow harvesting. Additional source water wells are accounted for in the study; however, they would only be used to augment surface water during unlikely deficit periods. All contact water will be treated to meet applicable water quality limits prior to discharge to the Glacier Canyon Creek watershed downstream of the project. A detailed evaluation of water management can be found in Chapter 18 of this report.

6 History

6.1 Overview

Historical graphite excavations and occurrences as well as other mineral commodities around the property are shown on Figure 6-1. The only areas of historic graphite mining in the region occur within the property boundary. Other undeveloped graphite occurrences are documented at Christophosen Creek to the west and at Windy Creek about 8-10 km southeast of the property.

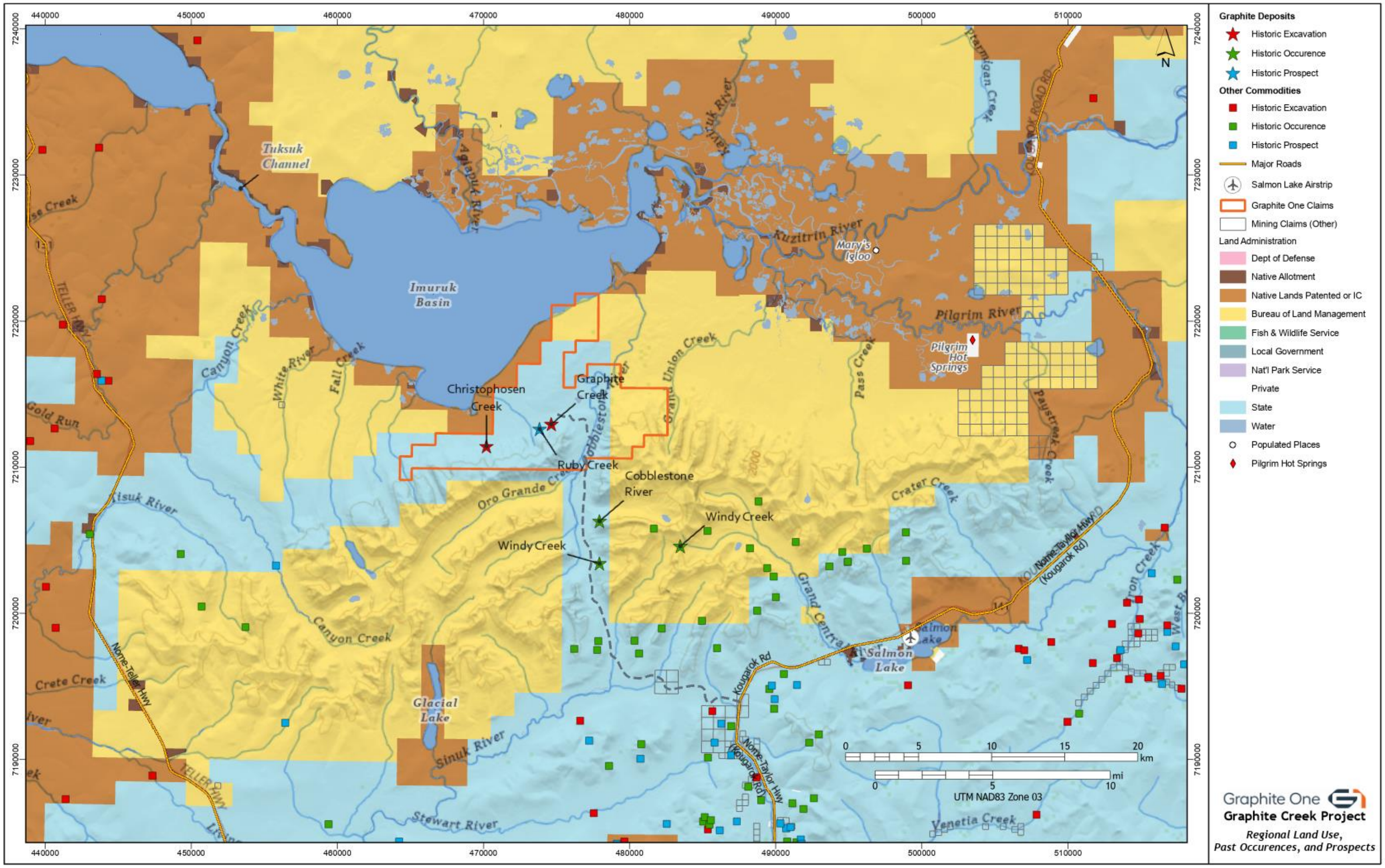
No work has been completed by Graphite One, Inc. or by any other QP on the area's historic mining, historically reported deposits, or mineral inventory. Therefore, those deposits and resources are not considered modern mineral resources or mineral reserves. The QP has solely relied on NI 43-101 resource estimates published by Graphite One, Inc. in 2013, 2014, 2015, 2019, 2022, and 2023.

Graphitic bedrock was first documented on the north side of the Kigluaik Mountains in the early twentieth century (Moffit, 1913). The graphite occurrences are known to crop out in incised creek valleys on the north side of the Kigluaik Mountains, and it is from these exposures that the graphite occurrences have been described by various authors (e.g., Mertie, 1918; Coats, 1944; Cobb, 1972; Cobb & Sainsbury, 1972; Sainsbury, 1972; Weiss, 1973; Cobb, 1975; Hudson & Plafker, 1978; Hudson, 1981, 1998; Swainbank et al., 1995; Adler & Bundtzen, 2011; Nelson, 2011). From west to east, these creek exposures include Christophosen Creek, Hot Springs Creek, Trail Creek, Glacier Canyon Creek, Ruby Creek, and Graphite Creek. A general historical overview of each of the historical graphite occurrences is described in Duplessis et al. (2013). The USGS reports Graphite Creek as the largest known flake graphite deposit in the U.S. and among the largest in the world (Case et al., 2023).

6.2 Historical Mining

Historic mining production and resource estimates were originally published in imperial units. All values have been converted to metric units for clarity and convenience.

During the early 1900s, at least two companies mined in the area. The first known claims were staked in 1900 by USAMS in Graphite Bay, now known as Windy Cove (Harrington, 1919). In 1912, USAMS shipped 120 t of graphite to Seattle and the San Francisco Bay area, and by 1916, it had stockpiled another 275 t (Mertie, 1918). The Alaska Graphite Mining Co. staked claims in 1905 and added additional claims in 1915 and 1916 (Mertie, 1918; Harrington, 1919). A total of 32 t of graphite was mined from talus in 1907 (Coats, 1944). Employing about seven people, 90 t of graphite was mined in 1916 (Mertie, 1918). This production was hauled a short distance overland to Windy Cove, then to Teller by boat, and then shipped to Seattle and San Francisco (Harrington, 1919).



Source: Graphite One (2024)

Figure 6-1 Property Location, Historic Deposits, Occurrences, and Land Disposition in the Property Area

6.3 Prior Exploration

After initial production in the early 1900s, the properties lay dormant until 1943 when USGS geologist Robert Coats visited the area. His field crew sampled material from several sorted piles of previously mined graphite and from several high-grade graphitic lenses on the property (Coats, 1944). Three specific areas underwent surface excavation work and were named by Coats as Christophosen Creek, Ruby Creek, and Graphite Creek (Figure 6-1). Coats (1944) reported that exposed high-grade lenses in these three areas varied from a few centimeters to a meter in thickness with lengths that are 10 to 15 times their width and contained up to 59.7% graphite.

The last known exploration interest in the area was in 1981 when a brief field examination of the showings was conducted by the Anaconda Copper Company and several samples were taken for analysis during a one-day visit (Hudson, 1981; Wolgemuth, 1982).

The historical work, which includes inferences to middle 1910s ‘mining’ by way of hand-sorting high-grade graphite material from small (<10 m) excavations into outcrop, is superseded by recent investigations conducted by Graphite One.

Exploration work performed by Graphite One from 2011 to 2024 consisted of a variety of programs, the details of which are reported by Duplessis et al. (2013), Eccles & Nicolls (2014), Eccles et al. (2015), King et al. (2018), Messler (2019), and Gierymski et al. (2022). Those programs are summarized in Chapter 9 (Exploration).

7 Geological Setting and Mineralization

7.1 Regional Geology

The following synopsis of the regional geology of the property area is derived from previous technical reports issued for the property, academic mapping publications, and a peer-reviewed journal article authored by the USGS (Amato & Miller, 2004; Amato et al., 2009; Till et al., 2011; Duplessis et al., 2013; Eccles & Nicholls, 2014; Eccles et al., 2015; King et al., 2019; Case et al., 2023). The QP, Robert M. Retherford, considers this description to be current and applicable.

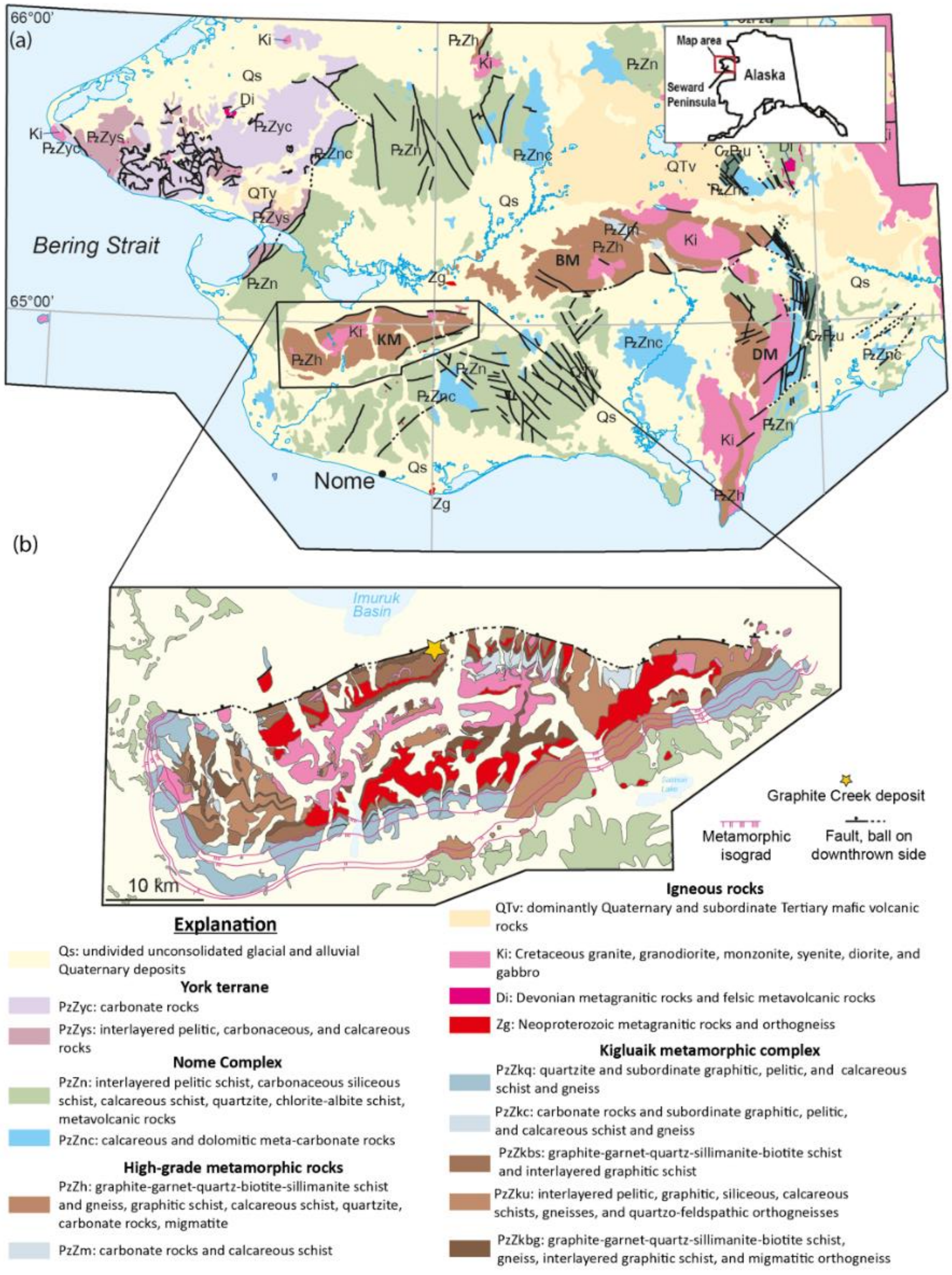
The Graphite Creek deposit lies within the Kigluaik Mountains on the Seward Peninsula. Tectonically, this lies within the Arctic Alaska-Chukotka microplate, which extends to Chukotka in Russia and the Brooks Range in northern Alaska. During the late Devonian period to the early Jurassic period, this region was marine in a passive margin depositional environment. Due to the onset of the Brookian orogeny, these rocks were subjected to crustal imbrication and thickening during the Jurassic period and widespread plutonic activity in mid-Cretaceous to late Cretaceous time (Sainsbury, 1972, 1975; Bunker et al., 1979; Miller & Richter, 1994; Till & Dumoulin, 1994; Armstrong et al., 1986; Amato & Wright, 1998; Till et al., 2011). As a result, Seward Peninsula rocks exhibit a record of blueschist facies metamorphism, subsequent decompression, greenschist facies metamorphism, and overprinting by Barrovian metamorphism related to the formation of the Kigluaik gneiss dome (Amato & Miller, 2004).

The rocks of the Seward Peninsula are divided into two map units that consist of a blueschist-greenschist facies unit and a greenschist-amphibolite-granulite facies unit exposed mainly in the Kigluaik, Bendeleben, and Darby Mountains (Case et al., 2023). Amato & Miller (2004) and Till et al. (2011) assigned the blueschist-greenschist facies rocks on the south side of the Seward Peninsula to the Nome Complex (Figure 7-1) while Moffit (1913) designated the higher grade amphibolite-granulite-facies rocks comprising the Kigluaik Mountains as the Kigluaik Group and referred to informally as the Kigluaik metamorphic complex by Amato & Miller (2004) and Case et al. (2023).

The Kigluaik metamorphic complex consists of a 15 km-thick structural section of amphibolite and granulite facies metamorphic rocks surrounding a gneiss dome. Amphibolite-grade rocks are exposed on the southern flanks of the Kigluaik mountain range, while granulite-grade schist and gneiss are exposed on the north flank of the mountains. These highest-grade rocks have no direct counterparts in the adjacent mountain ranges and are believed to represent the deepest crustal rocks exposed in northwestern Alaska (Amato & Miller, 1994). These metamorphic rocks comprise coarse marble, quartzo-feldspathic gneiss, schist and gneiss of mafic and ultramafic composition, graphite-rich schist, and garnet lherzolite. All of the formations of the Kigluaik Mountains are cut by intrusive rocks—the most common of which is granite—these intrusions are more abundant in the higher-grade part of the group. Besides granite intrusions, dikes and sills of diorite, diabase, and pegmatite are present.

The depositional age of the protoliths is broadly constrained by regional igneous and detrital zircon U–Pb ages from the Kigluaik metamorphic complex and Nome Complex that span the Neoproterozoic to Pennsylvanian (Amato et al., 2009, Figure 11a; Till et al., 2014). Monazite petrochronology data constrain peak metamorphic grade in the area to the Middle Cretaceous (96 Ma), followed by exhumation and retrograde overprint by circa 85 Ma (Case et al., 2023).

The Graphite One property area is underlain by the high-grade granulite facies metamorphic rocks of the Kigluaik metamorphic complex. The Kigluaik Fault is a regional-scale, normal fault dipping to the north that defines the boundary between the uplifted Kigluaik Mountains to the south and the sediment-filled Imuruk Basin to the north. Bedrock is either exposed or covered minimally by surficial overburden material throughout most of the property area, particularly in the incised creek valleys and/or relatively steep slopes adjacent to the Kigluaik Fault. Surficial quaternary deposits dominate the area north of the Kigluaik Fault (Figure 7-1). The surficial deposits include glacially deposited sand, gravel, and boulders; fluvial gravel and sand; marine and fluvial terrace deposits; and wetlands (Till et al., 2011).



Source: Case et al. (2023)

Figure 7-1 Regional Geology of the Graphite Creek Property Area From Case et al. (2023) A) Simplified Geologic Map of the Seward Peninsula From Till et al. (2011) B) Simplified Geologic Map of the Kigluaik Mountains Modified From Amato & Miller (2004)

7.2 Property Geology

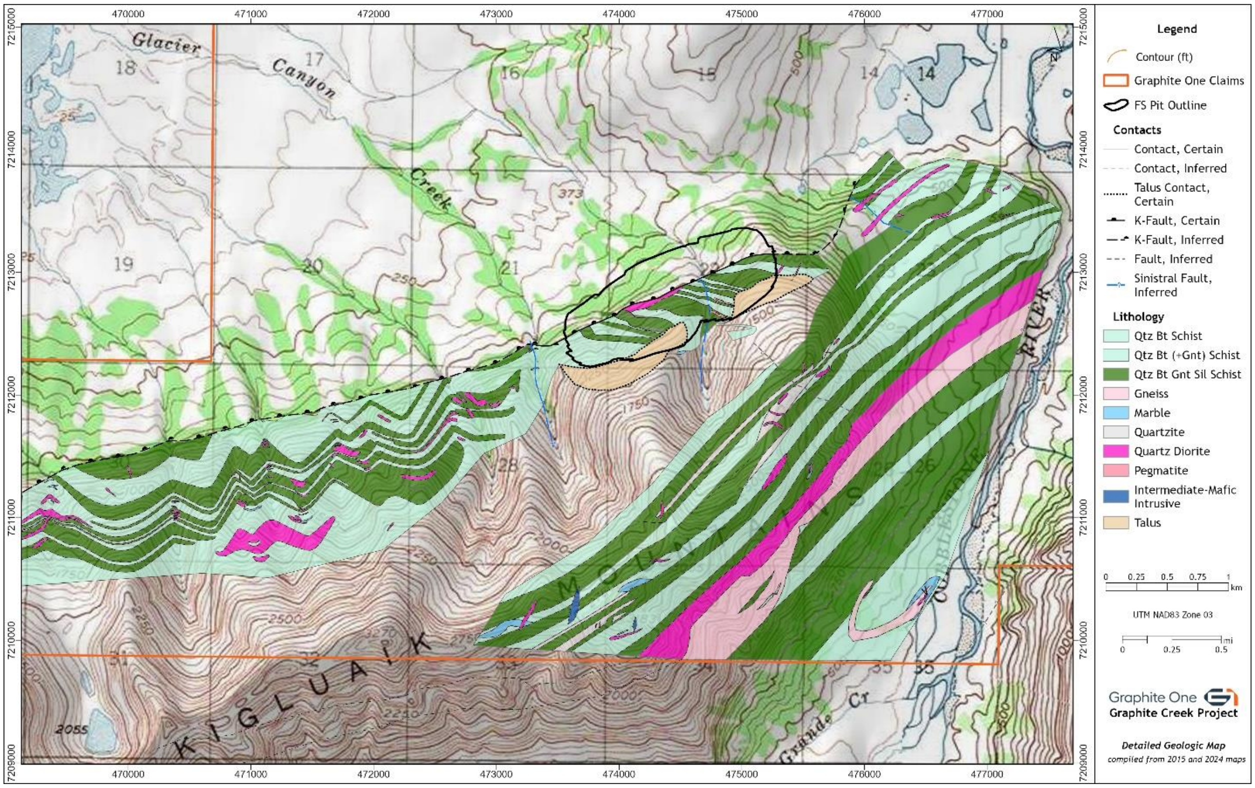
The property-scale geology in the Graphite One project area has been described in previous technical reports issued for the property. The following property-scale description of the Graphite Creek area geology is derived from Eccles et al. (2015), results from the 2021-2024 exploration programs, and a peer-reviewed journal article on the graphite deposit by the USGS in 2023. Local mapping of the pit and facility areas was conducted in 2024 and resulted in updates to the interpreted surficial geology and bedrock map. The QP, Robert M. Retherford, has reviewed these and considers this a fair and accurate description of the property geology.

The Graphite Creek graphite deposit is located on the north side of the Kigluaik Mountains (at about 230 m elevation). The graphite-bearing units occur in the upslope and footwall block of the Kigluaik normal fault. The Kigluaik Fault generally strikes at an azimuth of 250° and defines the boundary between the uplifted Kigluaik Mountains to the south and the sediment-filled Imuruk Basin to the north. The location of the hanging wall block of the Kigluaik Fault is presently unknown. The dip of the fault has been previously estimated at 75° along the range front, but drilling has constrained the fault dip to ~45° within the pit area (Gierymski et al., 2022). The Kigluaik Fault is generally parallel to the graphitic schist at the range-front scale, but it is not directly parallel to the bedding/foliation of the schist with the pit area. A well-indurated and massive unit of quartz diorite has been logged as the uppermost bedrock unit beneath the Kigluaik Fault in many of the drillholes within the pit area.

Graphite occurs as high-grade massive to semi-massive segregations and disseminations hosted within two distinct schistose to migmatic paragneiss units. Carbon isotopes indicate an organic carbon origin of the graphite (Case et al., 2023). One unit is a strongly foliated sillimanite-quartz-feldspar-biotite-graphite-garnet schist (QBGSS), locally gneissic, containing intervals (10-20 cm thick) of dense garnet porphyroblasts. The second unit is a quartz-feldspar-biotite schist (QBS) with minor pyrrhotite and very little garnet or sillimanite and appears massive or banded. The QBS unit also contains local calcareous layers and intervals of calc-silicate rock. Sillimanite- and graphite-bearing leucosomes, biotite-rich melanosomes, and pegmatitic granite are abundant in both units and indicate partial melting took place. Intervals of concentrated sillimanite, garnet, and biotite that contain little quartz are consistent with restite and strongly suggest the loss of some of this melt. Silicate melt loss and the resulting concentration of remaining rock constituents (including carbon) have been proposed as a primary mechanism for the formation of the observed graphite segregations (Case et al., 2023).

The 2012 and 2024 geological mapping programs confirmed historical observations of recurring high-grade massive to semi-massive segregated and disseminated graphite in sillimanite-quartz-feldspar-biotite-graphite-garnet schist and disseminated graphite in biotite-quartz schist (±garnet) along the range front. A total of 591 rock grab samples were collected from throughout the Graphite Creek property during 2012 and were analyzed for specific gravity and Cg. Of the 591 samples, 11 samples yielded >45% Cg (up to 80.9% Cg), 47 samples had >10% Cg, and 137 samples had >3% Cg.

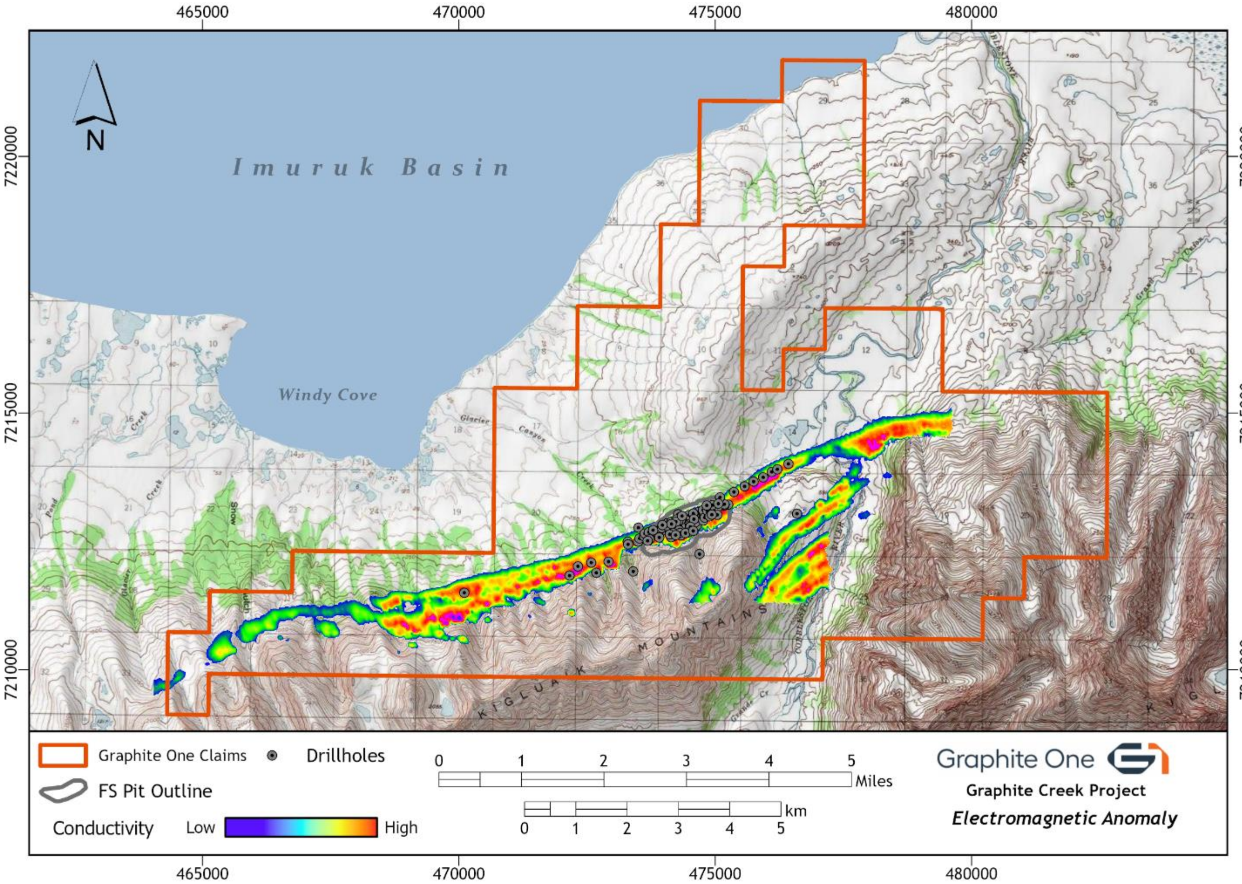
The 2024 mapping program obtained surface structural measurements of unit contacts and foliation in roadcut outcrops throughout the proposed pit area. The graphite-bearing QBGSS and QBS units repeat across the deposit, with units generally dipping north and northeast. Folding has been observed in the outcrop and drill core on the sub-meter to meter scale. Interpretation of the oriented core data by Oriented Targeting Solutions (OTS) also suggests an F1 low-angle northeast plunging fold pattern. Repetition of the primary host units at the surface and down hole is consistent with the regionally interpreted imbrication and thickening. Figure 7-2 below presents a detailed geologic map of the Graphite Creek property.



Source: Graphite One (2024)

Figure 7-2 Detailed Geologic Map of the Proposed Pit Area Within the Graphite Creek Property

A 1,523.5 line-km, time-domain, helicopter-borne, magnetic and electromagnetic survey over the Graphite One property shows that bands of continuous high-electromagnetic anomalies follow historical and 2012 geological mapping of high-grade graphitic units in the property area. The high-electromagnetic bands also correlate well with the 2012-2024 drill results. A 2023 drillhole testing a high-conductivity zone in the aerial geophysics over 4 km west of the proposed pit area intersected high-grade graphite (Figure 7-3). Interpretation of the electromagnetic data provides evidence that the high-grade graphite layers extend along the strike in a north-easterly direction for approximately 18 km. The map pattern of the electromagnetic anomaly suggests a low-angled northeast-plunging fold geometry at mountain scale. This is consistent with down hole structural and mapping data.



Source: Graphite One (2024)

Figure 7-3 Locations of Drillholes Testing the Electromagnetic Anomaly in the Graphite Creek Property

7.3 Mineralization

The mineralization in the property area has been described in previous technical reports issued for the property. The following synopsis of the mineralization on the Graphite Creek property is quoted from Eccles et al. (2015). New studies of the mineralization have begun since this synopsis was published, and the QP, Robert M. Retherford, considers this is still a fair and accurate description of the mineralization.

There are two distinctive graphite-bearing schist intervals at Graphite Creek. The first is sillimanite-garnet-biotite-quartz schist (QBGSS), that contains coarse, semi-massive, and massive graphite segregations and disseminated graphite (Figure 7-4). The other interval unit is biotite-quartz schist (BQS), that typically contains disseminated graphite. The QBGSS is the principal host to higher-grade graphite and makes up two distinctive layers in the metasedimentary sequence along the north flank of the Kigluaik Mountains. A third potential horizon is defined by 'pods' of sillimanite-quartz-biotite-garnet gneiss. The QBGSS and QBS layers strike obliquely to the mountain front and dip north to northeast at 40° to 78°.

The QBGSS typically is fine- to coarse-grained, weathers grey, has a wavy and crenulated schistosity, has garnet porphyroblasts (up to 2 cm across), and has augen-shaped quartz segregations. Discontinuous segregations (lenses and streaks) of high-grade graphite from centimeters to a few meters thick are common. These high-grade graphite lenses in the QBGSS have up to 60% coarse crystalline graphite and were likely the sources of hand-sorted graphite produced in the early 1900s. Disseminated flakes of graphite up to 1 mm or more across, account for several percent of the rock.

The BQS is fine-grained, weathers rusty ochre, and has regular subplanar layering with individual layers commonly 3 to 10 cm thick. Graphite occurs as disseminated flakes up to about 1 mm across and can account for several percent of the rock. Higher-grade graphite-rich layers varying from 3 to 25 cm in width are present but are not as common as in the QBGSS.

The other logged schist units at Graphite Creek, garnet-biotite-quartz schist (QBGS) and sillimanite-biotite-quartz schist (QBSS), are usually not well mineralized. Graphite is observed in at least trace amounts in all lithologies other than quartz diorite (QDIO) and INM.

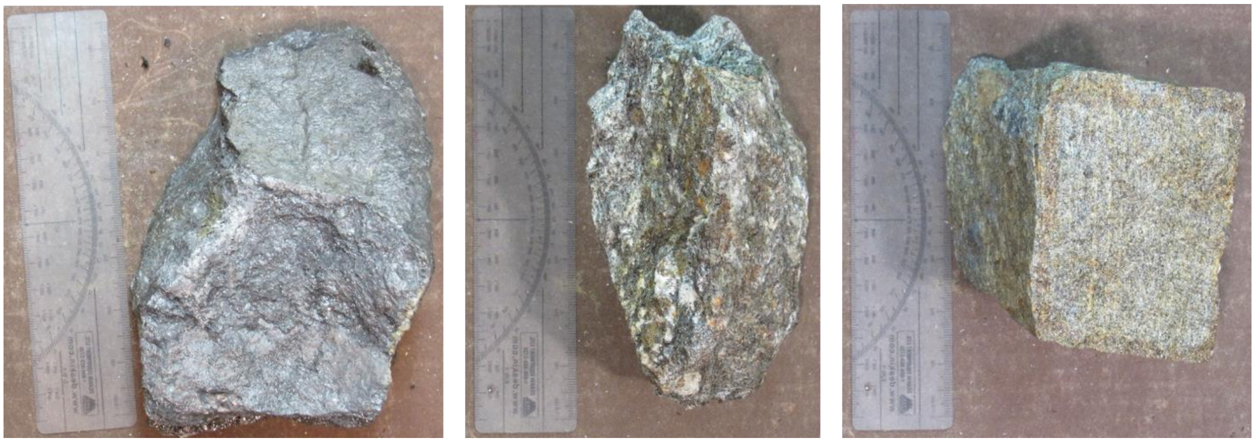


Figure 7-4 Hand Samples of Main Graphite-Bearing Rock Units at Graphite Creek. Left: Semi-Massive Graphite. Center: Sillimanite-Garnet-Biotite-Quartz Schist (QBGSS) Right: Biotite-Quartz Schist (BQS)

8 Deposit Types

Graphitic carbon deposit types have been described in previous technical reports issued for the property. The following synopsis of graphitic-carbon deposits is quoted from Eccles et al. (2015). The QP, Robert M. Retherford, is not aware of any research published subsequent to the 2019 technical report which would render the observations and conclusions invalid. The QP, Robert M. Retherford, considers this a fair and accurate description of the various deposit types around the world.

Graphite deposits of commercial interest occur widely in regionally or thermally metamorphosed sedimentary rocks and in hydrothermal and metasomatic deposits. Harben & Kužvart (1997) identified five deposit types.

- Deposits formed by concentration and crystallization of carbon (from coal or carbonaceous sedimentary rocks) during regional or contact metamorphism (Cameron & Weiss, 1960; Graffin, 1975; Krauss et al., 1988; Sutphin et al., 1991; Weiss, 1973; Weiss & Salas, 1978)
- Vein deposits, where graphite is thought to form epigenetically from carbon-rich hydrothermal or pneumatolytic solutions as interlocking aggregates of coarse graphite crystals in veins containing 75-100% carbon (Cameron & Weiss, 1960; Harben & Bates, 1984; Krauss et al., 1988; Rumble et al., 1986; Sutphin et al., 1991; Weiss, 1973)
- Contact metasomatic (skarn) deposits resulting from a concentration of preexisting carbon in sediments (Bugge, 1978) that could include calc-silicate hornfelses or reaction skarns (Evans, 1993)
- Residual deposits that may be concentrated in deposits formed through weathering/leaching of graphitic gneiss and schist because of the unreactive nature of graphite (Dill, 2009; Murdoch, 1967; Fogg & Boyle, 1987)
- Early magmatic deposits (rare) such as peraluminous dacite and gabbro (Tsuchiya et al., 1991; Kanaris-Sotiriou, 1997), and alkaline pegmatite (Jaszczak et al., 2007; Satish-Kumar & Santosh, 1998)

Most economic deposits of graphite occur as flake graphite in high-grade metamorphic rock (i.e., granulite facies) forming under pressures of 1 GigaPascal (GPa) and 750°C. Disseminated flake graphite deposits develop syngenetically from carbonaceous material in sedimentary rocks that have been subjected to garnet-grade or higher regional metamorphism (Cameron & Weiss, 1960; Harben & Bates, 1984; Krauss et al., 1988; Sutphin et al., 1991). Since graphite is a form of carbon, and all carbon oxidizes at high temperatures in the presence of oxygen, graphite must have a reducing environment in order to be stable at high temperature.

Flake graphite deposits may be any age but are commonly from Archean to late Proterozoic eons. Host rocks typically consist of metasedimentary rocks, such as quartz-mica schist, gneiss, micaceous quartzite, micaceous-feldspathic quartzite and marble. Associated rocks are pegmatite, aplite, and granite intrusives. Gangue mineralogy may include quartz, calcite, biotite, muscovite, feldspars, garnet, and sometimes amphibole, pyrrhotite, pyrite, and magnetite. A typical rock type where flake graphite may be found is sulfidic biotite-quartz-feldspar gneiss, such is the rock type of the Mesoproterozoic graphite deposits in the Highlands region of New Jersey, USA (Volkert et al., 2000).

Deposits are usually stratabound and consist of individual beds or lenses in gneiss, schist, and marble that are richer in graphite than associated beds. Deposits are typically up to 35 m thick and several kilometers or more long. Concurrent, intense large-scale folding of the metasedimentary sequences is common and graphite deposits commonly occur on the limbs of such folds. Deposits tend to occur in metamorphosed continental margin or intercratonic basinal sediments. Regional depositional environments include regional metamorphism and large-scale deformation of carbon-rich sedimentary sequences. Rarely, graphite veins may be associated with disseminated flake graphite deposits.

Most of the world's production of flake graphite comes from deposits of disseminated graphite in areas characterized by regionally metamorphosed rocks. Large deposits of flake graphite are known and/or have been mined in the United States, Central America, South America, Canada, Africa, India, Germany, Ukraine, Russia, Madagascar, and China. Small, localized deposits of flake or flake-like graphite are known from literally hundreds of other localities. Mined flake graphite deposits commonly have grades of 10% to 12% graphite. Mexico and South Korea are significant sources of amorphous, or microcrystalline, graphite. Sri Lanka is home to the largest known deposits of crystalline vein graphite. Contact metasomatic or hydrothermal graphite deposits were mined in Canada and the United States, but these deposits are generally small and of relatively low grade.

Landis (1971) tentatively concluded that graphite formation is primarily dependent upon metamorphic temperature and forms above 400°C with pressure and variation in starting material constituting secondary controls.

Since the Graphite One project graphite deposit occurs in a quartz-granite-biotite-sillimanite schist, which is a high-grade metamorphic rock, the Graphite Creek mineralization is considered to be of a flake-graphite-type mineralization.

Characterization testwork executed by TRU Group, a graphite-graphene engineering consultant based in Tucson, Arizona, at an independent graphite laboratory, confirmed graphite flake characteristics along with unique, naturally occurring morphologies in mineralized samples in drill core segments taken from seven drillholes. Graphite characterization and morphologies identified at Graphite Creek are discussed in greater detail in Chapter 13.

9 Exploration

Graphite One's exploration work at the Graphite Creek property began in 2011 and the exploration programs that ran through 2024 are summarized below. Exploration activities included:

- A time-domain, helicopter-borne electromagnetic survey
- Geological mapping; surface grab, channel, and bulk-pit sampling
- Diamond drilling programs in 2012, 2013, 2014, 2018, 2019, 2021, 2022, 2023, and 2024
- Flake-size distribution analysis
- Graphite beneficiation tests
- Down hole geophysical surveys

For greater detail on the 2012, 2013, and 2014 exploration programs, refer to Duplessis et al. (2013), Eccles & Nicholls (2014), and Eccles et al. (2015). For greater detail on the 2018, 2019, and 2021 exploration programs, refer to King et al. (2019) and Gierymski et al. (2022).

9.1 2011 Exploration

In 2011, a helicopter-supported mapping and sampling program was completed on behalf of Graphite One. The distribution of graphite-bearing meta-sediments along the north-central slope of the Kigluaik Mountains was identified and mapped during this program (Nelson, 2011). Graphite-rich host rocks were reported across a continuous strike length in excess of 5 km.

During the 2011 field season, three 15 kilogram (kg) composite samples were collected from the outcrop (Hudson, 2011). The samples were characterized as high-grade, mixed-grade, and mixed/disseminated-grade and submitted for petrographic and laboratory screen analysis.

The high-grade, mixed-grade, and disseminated-grade graphite samples contained 56.9, 14.5, and 8.2 percent graphite, respectively. Screening analyses of the samples that were crushed to -10 mesh (<2 mm) determined that they contained 84.3%, 93.6%, and 76.5% large-flake graphite. A large flake is defined as a flake size greater than 80 mesh in one dimension (Hudson, 2011). Graphite flakes varied between a few microns to about 1.5 mm in its longest direction, averaging 150-250 µm. The graphite was described as consisting of lath-shaped particles with deformed or foliated texture, liberated crystals, and intergrowths with other constituents.

9.2 2012 Exploration

An ambitious exploration program was carried out over the property during the summer of 2012. This program consisted of an airborne geophysical survey, detailed 1:5,000 scale mapping and sampling, bulk-pit sampling, and a diamond drilling program consisting of 4,248 m in 18 holes. The results of the helicopter-borne time-domain electromagnetic survey are shown in Figure 9-1. Warm colors (red) represent high signal, and cold colors (blue) represent low signal. The continuous northeast-trending, high-electromagnetic anomaly is approximately 18 km in length. Interpretation of the geophysical survey results, coupled with the mapping and sampling program, led the researchers to believe that graphite mineralization was present along the 18 km corridor of metasediments on the flank of the Kigluaik Mountains.

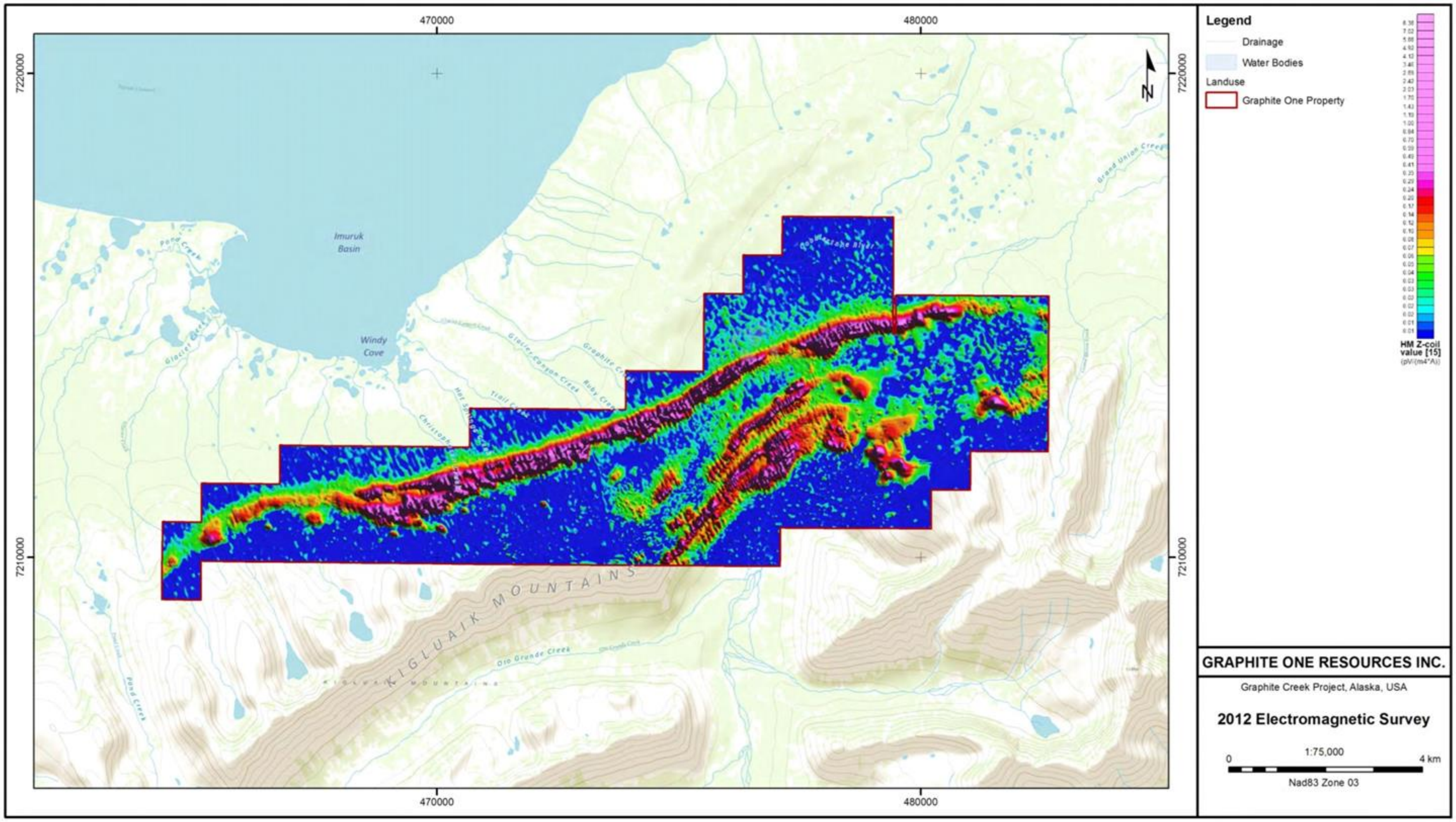
A total of 591 rock samples were collected by Graphite One's consultant, APEX, across the property. Graphite mineralization grading between 0.05% and 51% C(t) in Cg was found to occur within biotite-quartz schist and sillimanite-garnet-biotite-quartz schist units. The sillimanite-garnet-biotite-quartz schist is typically high-grade due to graphite concentrated as massive to semi-massive segregations that contain up to 80.9% Cg. Of the 591 grab samples collected in 2012, 11 samples yielded >45% Cg, 47 samples had >10% Cg, and 137 samples had >3% Cg.

Fifteen bulk samples weighing between 558 kg and 739 kg, totaling 9,916 kg, were collected from three different areas, including Graphite Creek, Christophosen Creek, and Child Drainages.

The initial drillhole spacing was approximately 200 m between holes along the strike, but later in the program, some infill drilling was carried out with hole spacings as close as 50 m. Graphite mineralization was encountered in all drillholes, including the last hole, 12GCH008, which was collared approximately 2.3 km to the west along the strike to test the lateral extent of the mineralization.

Several composite samples were selected from the drill core and submitted for laboratory analysis to characterize the graphite flake size and structure along with the nature and abundance of the various gangue minerals. The graphite was described by Hazen Research (Hazen) of Golden, Colorado, as occurring mostly as liberated flakes/crystals in the -40 mesh (<425 µm) fractions and occurring together with less common intergrowths of graphite and other gangue schist components (quartz, mica, and other siliceous materials and iron oxides). The samples supplied to Hazen were described as "…consist(ing) mainly of quartz, with minor amounts of mica, clay, magnetite, ilmenite, and titanium oxides. The graphite is present as minute scales or flakes; fine, undulated stringers along schist planes; liberated lath-shaped or tabular-foliated crystals; or as blocky and irregular deformed particles" (Hazen Research Inc., 2012b). One 5 kg composite sample was collected from a drill core and sent to ActLabs in Thunder Bay, Ontario, for x-ray diffraction analysis. Mineral 'mapping' on the mineral liberation analyzer shows that most of the graphite flakes/crystals/particles occur as free (liberated) graphite with 50% of the graphite passing through 120 µm and 80% passing through 330 µm filters.

Based on the 2012 drilling and exploration results, APEX reported an Inferred mineral resource of 107.2 Mt of graphite mineralization grading 5.78% Cg at a COG of 3.0% (Duplessis et al., 2013).



Source: Duplessis et al., (2013)

Figure 9-1 SkyTEM Helicopter-Borne Time-Domain Electromagnetic Image; High Moment Z-Coil Channel 05

9.3 2013 Exploration

The 2013 exploration program consisted of a small diamond-drilling program, a new resource estimate calculation, and a bench-scale beneficiation test. The diamond-drilling program consisted of 1,024 m of drilling in ten drillholes. Again, graphite mineralization was encountered in all of the drillholes. The holes were drilled with a collar spacing of approximately 250 m. They increased the mineral resource to a zone approximately 5 km in length and at depths from surface/near surface to depths of 147 m below surface.

Graphite One's consultants calculated a new resource estimate based on the cumulative drill data from the 2012 and 2013 drill programs. The APEX geologists calculated that the deposit contained approximately 186.9 Mt of graphite-bearing mineralization at a grade of 5.5% Cg using a COG of 3.0% Cg (Eccles & Nicholls, 2014). The model and resource estimate was based on the calculation of dividing the deposit into eight different domains or lodes based on lateral continuity and statistical grade analysis of the assayed core samples.

The bench-scale beneficiation study demonstrated that it was feasible to produce high-purity 99.2% Cg from a rough concentrate (Duplessis et al., 2013). The methods used included flotation cells and a leaching process to produce the high-purity graphite.

9.4 2014 Exploration

The 2014 program consisted of diamond drilling, metallurgical sample collection, and a new resource estimate calculation. That program is described in detail in a technical report issued by Graphite One in March 2015 (Eccles et al., 2015).

The drill program was designed to both increase the confidence level and the extent of the resource base. The program consisted of 20 holes totaling approximately 2,221 m logged and assayed and two holes totaling 91.6 m used for metallurgical testing. A total of 2,354 samples were collected in the 2014 program, of which 2,274 were submitted for assay and 80 were retained for metallurgical testwork. The 2014 drillholes were collared on sections approximately 50 m apart, and at least two holes were drilled on each section in an effort to confirm the continuity of the mineralization, both vertically and laterally. Once again, all holes encountered significant Cg mineralization.

The increased drill density in the central region of the deposit, combined with the demonstrated continuity of the mineralization, allowed the resource in this section to be classified as Indicated. The Indicated mineral resource area is spatially constrained by the boundary of the 2014 drill program. It defines an area measuring approximately 730 m along the northeast-striking trend of the graphitic schist, approximately 185 m across the strike of the schist, and to a depth of approximately 200 m below the surface. Using a preferred base cut-off of 3% Cg, the Indicated mineral resource estimation contains 17.95 Mt of mineralized graphite schist at a grade of 6.3% Cg. Based on this tonnage, grade, and 3% Cg cut-off, the in-situ graphite contained within the Indicated mineral resource area is estimated to be 1.13 Mt.

The Inferred mineral resource area is constrained by the drilled portions of the graphitic conductor that are not included within the Indicated resource area. Accordingly, the Inferred resource area is approximately 5.0 km along the northeast-striking trend of the graphitic schist (minus the 730 m portion of the Indicated resource), approximately 200 m across the strike of the graphitic schist and to a depth of approximately 320 m below surface. Using a preferred base cut-off of 3% Cg, the Inferred mineral resource estimates that 154.36 Mt of mineralized graphite schist at a graphite grade of 5.7% Cg are present at the Graphite Creek deposit. Based on this tonnage, grade, and 3% Cg cut-off, the in-situ graphite of the Inferred mineral resource is 8.76 Mt.

9.5 2018 Exploration

The 2018 drill program increased the Indicated resources to Measured and they gathered material for metallurgical testing. Drillholes were completed within the core area of the resource at 50 m spaced down-dip step-outs. A total of 800.87 m of drilling in six (6) drillholes was completed.

The drilling continued to show that the upper zone of graphite mineralization is fairly consistent. The lower zone of mineralization is more variable in grade and thickness of higher-grade graphite mineralization (King et al., 2018). Four of the drillholes drilled were collared below the break-in slope of the Kigluaik Mountain front. Each of these drillholes encountered a large fault gouge zone immediately below the abundant overburden before going into bedrock. This fault zone is interpreted to be part of the basin-bounding Kigluaik Fault system (King et al., 2018).

9.6 2019 Exploration

The 2019 program consisted of a short late-season drill program, rig-side geotechnical data collection, and metallurgical sampling of historic core. A total of two resource infill drillholes were drilled inside the proposed pit area and one geotechnical hole was drilled outside the proposed pit area. The resource holes were logged and assayed, while the geotechnical hole was drilled into overburden north of the Kigluaik Fault and did not intersect bedrock.

9.7 2021 Exploration

The 2021 exploration program improved the quality of the resource estimation through infill drilling, collected structural data from oriented core, continued geotechnical drilling in the proposed pit, and a generated geologic model. A total of eight resource holes were logged and assayed, contributing to resource estimation in the proposed pit area; one condemnation hole was drilled and sampled under the proposed PFS mill site, and seven geotechnical holes were drilled into overburden outside the resource area. Graphite was recorded in all the assayed holes and results from the resource drilling supported the geologic and ore-grade models developed from 2012 to 2019. The mountain range bounding the normal Kigluaik Fault was encountered in the eight resource holes and constrained the fault to a northwesterly dip of about 45 degrees (Gierymski et al., 2022).

9.8 2022 Exploration

The 2022 program comprised oriented core infill drilling in the proposed pit area, step-out drilling along the electromagnetic anomaly, and core and sonic geotechnical drilling under proposed mine facilities and access routes. A total of 1,940 m in 10 holes were drilled in the infill and exploration holes with the most western exploration hole intersecting multiple intervals containing graphite above cutoff grade. Graphite has been observed in resource drilling spanning 6.8 km (4.2 miles) along the geophysical anomaly.

9.9 2023 Exploration

The 2023 drill program increased the Measured and Indicated resource via infill drilling within the proposed pit area, conducted geotechnical work along the proposed access road corridor, and built drill trails to support infill drilling. A total of 52 resource holes were drilled, all of which encountered visible graphite.

9.10 2024 Exploration

The 2024 program converted a portion of Inferred resource within the proposed pit to Measured and Indicated, collected geotechnical and hydrogeologic data, updated surface geologic maps, updated the geologic model, and updated the resource estimation.

A total of 23 drillholes were logged and assayed within the proposed pit to infill the resource at 50 m spacing. Of these, nine resource holes that intersected the proposed pit wall were surveyed using down hole geophysical instruments by DGI Geoscience. The down hole instruments were selected to measure structural features and hydrologic parameters, and they comprised an optical televiewer (OTV), acoustic televiewer (ATV), fluid temperature conductivity probe, spinner flowmeter probe, and borehole magnetic resonance (BMR). Structural measurements from the OTV and ATV instruments were used to inform the geologic model and pit wall engineering, discussed further in Chapter 16. An additional seven geotechnical holes drilled in overburden in the lowlands under the proposed WMF and mill did not intersect bedrock.

A four-day bedrock mapping program was completed in August along the drill trail roadcuts in the proposed pit area and one day was spent mapping the ridges straddling Graphite Creek. Structural measurements of bedding and rock unit contacts demonstrate units dipping N to NE, resulting in an interpreted map pattern of alternating units striking NW-SE in the proposed pit area.

The mineral resource estimate was updated following the 2024 drill season and is discussed in more detail in Chapter 14.

10 Drilling

10.1 Overview

A summary and results of all known previous drill campaigns have been described in Chapter 9 of this report.

10.2 Summary of Drill Collar Locations and Down Hole Surveys

The 2012, 2013, and 2014 drillhole collars were surveyed using a Topcon static global positioning system (GPS). Drillhole collar elevations were determined using a differential GPS, then cross-checked with the recently acquired IfSAR bare-earth digital elevation model (DEM)/digital terrain model (DTM) data, which has a 5 m cell size resolution. Due to the vast topographic relief in places at Graphite Creek, disparities between the differential GPS and the DEM/DTM data are to be expected. No major concerns were identified.

The 2018 and 2019 drill collars were surveyed with Topcon and Javad high-precision GPS equipment using typical real-time kinematic (RTK) surveying methods to locate 2018 collars accurately in the same coordinate system used in previous exploration campaigns.

The 2021, 2022, 2023, and 2024 drillhole collars were surveyed by Recon surveyors, with the exception of hole 21GTW001, which provided zero samples. This hole was located only with a Garmin GPSMAP 64 handheld GPS device. Additionally, holes 24GCT019, 24GCT025, 24GCT026, 24GCT028, and 24GCT029 all had doghouses protecting down hole instrumentation at the time of surveying and thus were surveyed at the best-estimate location of the collar. Recon utilized Leica GS16 multi-frequency global navigation satellite system receivers to perform the 2021 drillhole collar survey by standard RTK GPS methods. Positions of all survey points were reported in UTM Zone 3 North meters, North American Datum of 1983 (NAD83) CORS 2011 (Epoch 2010.0000) datum. Elevations were reported on the North American Vertical Datum of 1988 (NAVD88) by applying the Geoid12B separation values to ellipsoid heights using Leica Infinity software version 3.3. Project control monuments, as described in the Recon report “Graphite One; Graphite Creek Project Access Route; Survey Report,” dated August 1-7, 2018, were used for all RTK base station setups and checks.

Of the 50 drillholes completed during 2012-2014, 42 drillholes were drilled at an azimuth of approximately 160°, with the holes being drilled from the northwest to the southeast. The drillhole inclination of these holes varied from -49° to -78° with 40 drillholes (80%) having inclinations of between -49° to -65°. The remaining eight drillholes were drilled vertically (-90°). Regular Reflex EZ-Shot surveys were routinely collected every 30 m down the drillhole while the drilling was in progress, after which a follow-up Reflex EZ-Trac multi-shot survey was completed for each hole at regular 1 to 10 m intervals. The exceptions to this were drillholes 12GC001, 12GC004, 12GCH006, 13GCH009, 13GCH010, 13GCH012, 13GCH013, 14GCH003, 14GCH010, 14GCH012, 14GCH013, and 14GCH017 to 14GCH020, where only 5 to 30 m interval easy shot surveys were completed. All spurious surveys were removed from the database.

The down hole surveys for the 2018 drillholes used the Reflex EZ-Trac multi-shot survey collecting a reading every 30 m coming out of the hole. Survey results were evaluated for validity and results that were deemed poor were not imported into the drilling database. Drillholes 18GC021 and 18GC022 did not have down hole surveys completed due to complications with tooling in the hole. The survey for 18GC025 was of poor quality due to a rock stuck in the drill bit, preventing the survey tool from surveying the open hole.

Down hole surveys for the 2019 drillholes used the Reflex EZ-Trac multi-shot tool, collecting a shot every 25 m coming out of the hole.

Down hole surveys for the 2021 and 2022 drillholes used the Reflex EZ-Trac multi-shot tool. Collar shots were collected 30 feet into the bedrock to confirm that the hole was progressing as planned. The completed drillholes were surveyed at 50-foot intervals while tripping out. All 2021 and 2022 assayed core holes were down hole surveyed. Survey results were evaluated for validity, and results that were deemed poor quality were not imported into the drilling database.

Down hole surveys for the 2023 drillholes used the Reflex SPRINT-IQ tool. The completed drillholes were surveyed continuously to the bottom as they entered and exited the drillhole. The survey results were evaluated for validity and the highest quality survey was approved and imported into the drilling database. The exceptions to this are three holes that were abandoned before reaching planned depth: 23GC115, 23GC118, and 23GC130, as well as the following shallow vertical geotechnical holes (23GCT014, 23GCT015, 23GCT016, 23GCT017, 23GCT018) which were not surveyed.

Down hole surveys for the 2024 drillholes used the Reflex OMNIx42 tool. The completed drillholes were surveyed to the bottom as they entered and exited the drillhole. The majority of holes were surveyed in continuous mode, while 24GC132, 24GCT027, and 24GCT029 were in multi-shot mode. The survey results were evaluated for validity and the highest quality survey was approved and imported into the drilling database. The exceptions to this are two holes, 24GC142 and 24GCT020, which were abandoned and not surveyed, and vertical geotechnical holes (24GCT021, 24GCT022, 24GCT024, 24GCT026, 24GCT031, 24GCT033, and 24GCT034) that did not intersect bedrock, were not analyzed for graphite content, and did not have down hole surveys.

10.3 Summary of 2012 Drilling

APEX on behalf of Graphite One, completed 18 diamond core drillholes of NQ2 and BTW size totaling 4,248 m (Table 10-1). Drilling took place between June 12 and August 22, 2012. The drill-tested graphite zone is 2.2 km long.

Table 10-1 2012 Drillhole Specifications

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
12GC001	474716.7	7213033.9	212.419	429	161	-51	Yukuskokon	Resource
12GC002	474437.5	7212913.8	215.549	380	160	-49	Yukuskokon	Resource
12GC003	474252.4	7212838.4	208.739	292	158	-51	Core One	Resource
12GC004	475749.3	7213665.1	118.914	258	164	-50	Yukuskokon	Resource
12GC005	474916.9	7213118.2	247.371	252	161	-50	Yukuskokon	Resource
12GC006	475143.6	7213189.7	283.112	274	160	-50	Yukuskokon	Resource
12GC007	475365	7213461.6	183.286	276	169	-50	Core One	Resource
12GC008	475574.3	7213571.6	146.636	233	157	-50	Yukuskokon	Resource
12GC009	475935.6	7213747.3	108.609	233	157	-52	Yukuskokon	Resource
12GC010	476103.1	7213852.4	96.818	230	159	-50	Yukuskokon	Resource
12GCH001	474416.6	7212823.1	249.698	173	161	-49	Core One	Resource
12GCH002	474379.2	7212784	259.832	167	161	-50	Yukuskokon	Resource
12GCH003	474335.1	7212764.8	258.988	170	157	-49	Yukuskokon	Resource
12GCH004	474515.3	7212859.1	249.647	161	157	-49	Yukuskokon	Resource
12GCH005	474515.1	7212859.5	249.38	179	147	-87	Yukuskokon	Resource
12GCH006	474622.3	7212920.4	235.336	177	158	-49	Yukuskokon	Resource
12GCH007	474789.6	7213006.2	246.779	177	156	-50	Yukuskokon	Resource
12GCH008	472159.9	7211831.4	248.307	188	160	-50	Yukuskokon	Resource

Note: Easting and northing are listed in NAD83 UTM Zone 3 coordinates

10.4 Summary of 2013 Drilling

APEX drilled ten diamond core drillholes of BTW size totaling 1,024 m between September 13 and October 13, 2013 (Table 10-2). The drilling program tested the graphite zone along a 5 km extent of the geophysical anomaly.

Table 10-2 2013 Drillhole Specifications

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
13GCH009	476212.3	7213903.9	92.27	116	162	-50	Yukuskokon	Resource
13GCH010	476428.2	7214009.2	87.5	114	160	-50	Yukuskokon	Resource
13GCH011	474016.1	7212735.7	201.2	96	158	-52	Yukuskokon	Resource
13GCH012	473703.5	7212604.4	188.91	102	159	-51	Yukuskokon	Resource
13GCH013	473496.4	7212494.2	187.89	93	161	-52	Yukuskokon	Resource
13GCH014A	473292.9	7212493.4	143.68	50	160	-52	Yukuskokon	Resource
13GCH014B	473300.6	7212440.9	150.04	111	161	-51	Yukuskokon	Resource
13GCH015	472919.2	7212104.9	239.63	114	158	-50	Yukuskokon	Resource
13GCH016	472582.8	7212084.5	145.86	82	159	-50	Yukuskokon	Resource
13GCH017	472323.1	7212012.7	191.03	147	160	-50	Yukuskokon	Resource

Note: Easting and northing are listed in NAD83 UTM Zone 3 coordinates

10.5 Summary of 2014 Drilling

APEX drilled 20 BTW and NQ2 size diamond-core drillholes totaling about 2,221 m for resource assessment, and two diamond-core drillholes (1 HQ, 1 BTW) totaling 91.6 m were drilled to obtain metallurgical samples (Table 10-3). Drilling took place between September 18 and November 14, 2014. The resulting data enabled part of the Inferred resource to be upgraded to Indicated.

Table 10-3 2014 Drillhole Specifications

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
14GC014	474615.6	7212937.5	226.72	137	251	-90	Yukuskokon	Resource
14GC018	474714.9	7213034.6	211.63	146	260	-89	Yukuskokon	Resource
14GCH001	474269.1	7212794.7	229.88	118	160	-50	Yukuskokon	Resource
14GCH002	474327.9	7212793.8	238.59	137	159	-79	Yukuskokon	Resource
14GCH003	474350.1	7212726.6	283.59	72	161	-50	Yukuskokon	Resource
14GCH004	474375.8	7212806.1	246.8	129	151	-65	Yukuskokon	Resource
14GCH005	474400	7212742.1	287.84	80	157	-50	Yukuskokon	Resource
14GCH006	474406.3	7212859.8	226.53	153	159	-61	Yukuskokon	Resource
14GCH007	474425	7212780.5	274.07	92	158	-50	Yukuskokon	Resource
14GCH008	474477.1	7212790.5	281	88	162	-51	Yukuskokon	Resource
14GCH009	474477	7212790.9	280.55	162	314	-90	Yukuskokon	Resource
14GCH010	474502.3	7212886.5	236.61	143	160	-89	Yukuskokon	Resource
14GCH011	474528.5	7212821.6	273.26	105	159	-49	Yukuskokon	Resource
14GCH012	474565.9	7212899.1	239.69	120	4	-90	Yukuskokon	Resource
14GCH013	474566	7212898.8	239.82	90	159	-50	Yukuskokon	Resource
14GCH015	474646	7212878.2	257.71	62	158	-50	Yukuskokon	Resource
14GCH016	474683.9	7212993.8	212.35	140	51	-89	Yukuskokon	Resource
14GCH017	474684.2	7212993.2	212.46	91	159	-50	Yukuskokon	Resource
14GCH019	474725.4	7212981.4	234.27	85	157	-50	Yukuskokon	Resource
14GCH020	474800.9	7212977.3	265.62	73	158	-50	Yukuskokon	Resource
14GCM010	474502.3	7212886.5	236.61	51	222	-89	Yukuskokon	Metallurgical
14GCM020	474800.8	7212977.5	265.68	41	157	-69	Yukuskokon	Metallurgical

Note: Easting and northing are listed in NAD83 UTM Zone 3 coordinates

10.6 Summary of 2018 Drilling

Six diamond-core drillholes of HQ, BTW, and HQ3 size totaling 800.87 m were drilled between August 2 and October 5, 2018 (Table 10-4). All the 2018 drillholes were within the Indicated resource area proposed pit. The 2018 and 2019 drill collars were surveyed using Topcon and Javad high-precision GPS equipment using typical RTK surveying methods to locate 2018 collars accurately in the same coordinate system used in previous exploration campaigns.

Table 10-4 2018 Drillhole Specifications

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
18GC021	474438.1	7212911	216.74	67	160	-49	Yukuskokon	Resource
18GC022	474351.2	7212853.7	219.14	157	160	-62	Yukuskokon	Resource
18GC023	474421.4	7212960.8	210.25	199	160	-58	Boart Longyear	Resource
18GC024	474393.8	7212900.1	211.36	145	160	-59	Boart Longyear	Resource
18GC025	474482.5	7212941.1	213.87	169	160	-66	Boart Longyear	Resource
18GC026	474522.9	7212961.3	214.21	64	160	-52	Boart Longyear	Resource

Note: Easting and northing are listed in NAD83 UTM Zone 3 coordinates

10.7 Summary of 2019 Drilling

Three HQ3-sized diamond-core holes were drilled for a total of 358 m between September 19 and mid-November of 2019 (Table 10-5). Two were geotechnical/resource holes within the planned pit, and 19GT001 was a geotechnical hole outside of the planned pit. Both 19GC027 and 19GC028 were logged and assayed. The resource holes had core orientation marked by Boart Longyear using a TruCore orientation tool to obtain oriented geotechnical data.

Table 10-5 2019 Drillhole Specifications

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
19GC027	474735.6	7212950.8	253.74	151	160	-50	Boart Longyear	Res+Geotech
19GC028	474443.3	7212744.9	300.51	136	160	-50	Boart Longyear	Res+Geotech
19GT001	473503	7212766.1	137.64	71	0	-90	Boart Longyear	Geotech

Note: Easting and northing are listed in NAD83 UTM Zone 3 coordinates

10.8 Summary of 2021 Drilling

Resource area diamond-core drilling began on July 17, 2021, with an AR65 drill rig operated by T&J Drilling and concluded on October 7 (Table 10-6). All resource area core drilled in 2021 was oriented using the Reflex ACT III oriented core system. Chris Brown of OTS trained drillers and geologists in the collection of oriented cores at the start of the first 2021 core hole. A total of 10 HQ3-sized diamond-core drillholes were drilled in the Inferred resource area in 2021, comprising 5,079 ft (1,548 m) of drilling. One of those holes was lost at 171 ft (52 m) in overburden and fault material before reaching bedrock; another is only 66 ft (20 m) deep in overburden. An additional 476 ft (145 m) of HQ3-sized diamond core was drilled by Mud Bay Drilling in geotechnical and condemnation hole 21GT006 outside the resource area. Additionally, Mud Bay Drilling completed five geotechnical holes beneath proposed mine facilities and two camp water wells using a sonic drill rig in sediment overburden.

Table 10-6 2021 Drillhole Specifications

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
21GT001	473443.7	7214172.3	111.158	72	0	-90	Mud Bay	Facility Geotech
21GT002	473622.5	7214314.2	140.273	76	0	-90	Mud Bay	Facility Geotech
21GT003	473986.1	7214592.3	189.673	84	0	-90	Mud Bay	Facility Geotech
21GT004	474706.5	7214196.1	207.477	62	0	-90	Mud Bay	Facility Geotech
21GT005	474067.2	7213772.2	130.127	68	0	-90	Mud Bay	Facility Geotech
21GTW001	473529.6	7213687.8	-	21	0	-90	Mud Bay	Geotech+WaterWell
21GTW007	473539	7213679.9	104.8	76	0	-90	Mud Bay	Geotech+WaterWell
21GC060	474673.1	7213070.2	198.707	151	127	-56	T&J	Resource
21GC061	474670.2	7213067.6	198.054	165	185	-48	T&J	Resource
21GC062	474782.5	7213055.2	227.456	141	173	-56	T&J	Resource
21GC063	474785	7213055.8	227.974	152	145	-45	T&J	Resource
21GC064	474761.3	7213108.3	211.261	168	174	-54	T&J	Resource
21GC065	474762.5	7213108.6	211.257	168	145	-49	T&J	Resource
21GC066	474638.2	7212807.4	307.592	326	158	-51	T&J	Resource+MonitorWell
21GC067	474349.7	7212935.8	206.979	52	144	-57	T&J	Resource
21GC068	474349.5	7212935.5	206.993	196	143	-59	T&J	Resource+MonitorWell
21GC069	474348.9	7212936.1	206.641	20	0	-90	T&J	Resource+MonitorWell
21GCT070	474326.5	7212798.9	237.54	10	260	-55	T&J	Geotech
21GT006	476596	7213038.6	193.125	145	0	-90	Mud Bay	Facility Geotech

Note: Easting and northing are listed in NAD83 UTM Zone 3 coordinates

In 2021, within the Indicated resource area/proposed pit, 1,548 m were drilled, and 1,391 core samples were analyzed. Not including condemnation hole 21GT006, the 2021 drill core analytical results (n=1,391 total samples, not including duplicates and blanks) include 11 samples yielding >30% Cg, 57 samples with >10% Cg, 299 samples containing >3% Cg, and 874 samples > 0.5% Cg. Every drillhole intersected graphite mineralization, and significant intersections of continuously mineralized core were observed. For example, drillhole 21GC064 contained 5.7 % Cg over 59 m (apparent thickness) between depths of 77.3 m and 131.25 m.

10.9 Summary of 2022 Drilling

Diamond core drilling began on July 4, 2022, with an AR65 drill operated by T&J Drilling and concluded on September 6 (Table 10-7). The drilling program included infill and step-out HQ3-sized core drilling. All resource and exploration core drilled in 2022 was oriented using the Reflex ACT III oriented core system. Chris Brown of OTS trained drillers and geologists in the collection of oriented cores at the start of the 2022 field season. A total of nine holes were drilled in the Inferred resource area in 2022, comprising 5,308 ft (1,618 m) of drilling. An additional 719 ft (219 m) of HQ3 core was drilled and assayed in three geotechnical foundation holes along with an exploration hole within the resource outside the proposed pit. Mud Bay drilled three geotechnical and monitoring well holes with a sonic rig (22GCT008, 22GCT009, and 22GCT013) resulting in no core samples.

Table 10-7 2022 Drillhole Specifications

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
22GC071	474589.85	7213009	202.96	192	171	-51	T&J	Resource
22GC072	474592.29	7213010.1	202.76	196	128	-47	T&J	Resource
22GC073	474206.02	7212823.1	206.81	152	159	-50	T&J	Resource
22GC074	474283.5	7212898.4	202.98	171	161	-50	Mud Bay	Resource
22GC075	474243.05	7212719.5	265.09	150	163	-50	T&J	Resource
22GC076	474487.96	7213009.6	195.83	235	136	-48	Mud Bay	Resource
22GC077	474329.82	7212920	206.49	197	158	-53	T&J	Resource
22GC078	474111.52	7212798.8	198.19	174	159	-55	T&J	Resource
22GC079	470106.89	7211497.5	166.50	219	169	-51	T&J	Exploration/Res
22GC080	473927.47	7212723.8	184.96	152	157	-50	T&J	Resource
22GCT010	474693.98	7212252	366.95	35	0	-90	Mud Bay	Res+Facility Geotech
22GCT011	473401.71	7211913.3	264.51	32	0	-90	Discovery	Res+Facility Geotech
22GCT012	472680.89	7211888	197.66	33	0	-90	Discovery	Res+Facility Geotech
22GT008	474276.04	7213026.6	180.62	83	0	-90	Mud Bay	Well
22GT009	474283.27	7212899.6	202.69	50	290	-85	Mud Bay	Well
22GT013	473328.27	7213675.1	89.21	55	0	-90	Mud Bay	Facility Geotech

Note: Easting and northing are listed in NAD83 UTM Zone 3 coordinates

10.10 Summary of 2023 Drilling

Diamond core drilling began on June 25, 2023, with an LF-90 drill operated by Major Drilling and concluded on October 6 (Table 10-8). The drilling program focused on infill drilling within the proposed pit area. A total of 55 holes were drilled in the Inferred resource area in 2023, comprising 28,491 ft (8,684 m) of drilling. Holes were drilled through the overburden using PQ3-sized rods and reduced to HQ3-sized once they were in competent bedrock. Two additional geotechnical holes comprising 171 ft (52 m) were drilled in overburden outside the resource area.

Table 10-8 2023 Drillhole Specifications

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
23GC081	473834.41	7212687.8	167.36	127	160	-51	Major	Resource
23GC082	474574.78	7213043.8	198.9	196	145	-51	Major	Resource
23GC083	473836.2	7212688.9	166.92	155	100	-50	Major	Resource
23GC084	474060.25	7212849.8	181.2	191	170	-49	Major	Resource
23GC085	474573.04	7213042.5	198.94	205	175	-50	Major	Resource
23GC086	474060.68	7212850	181.26	193	145	-48	Major	Resource
23GC087	474147.18	7212880.6	186.43	187	171	-48	Major	Resource
23GC088	474147.49	7212881	186.51	209	146	-51	Major	Resource
23GC089	474966.62	7213148.2	255.69	222	138	-49	Major	Resource
23GC090	474239.62	7212924.2	190.63	237	170	-49	Major	Resource
23GC091	474944.79	7213205.1	240.72	239	146	-49	Major	Resource
23GC092	474517.46	7212781	295.19	174	147	-51	Major	Resource
23GC093	474515.21	7212779.8	295.9	157	175	-52	Major	Resource
23GC094	474944.35	7213204.5	240.8	186	172	-49	Major	Resource
23GC095	474616.76	7212872.9	263.67	190	160	-50	Major	Resource
23GC096	474241.3	7212924.9	190.59	191	150	-49	Major	Resource
23GC097	474585.79	7212932.5	225.37	193	163	-51	Major	Resource
23GC098	474235.37	7212880	197.5	187	156	-50	Major	Resource
23GC099	475041.64	7213015.9	327.21	163	157	-51	Major	Resource
23GC100	474974.74	7213107.3	264.14	209	175	-49	Major	Resource
23GC101	474353.41	7212993.1	192.73	200	158	-49	Major	Resource
23GC102	474766.54	7212903.4	275.61	188	160	-51	Major	Resource
23GC103	474796.46	7212963.4	270.21	173	160	-48	Major	Resource
23GC104	474873.57	7213036.5	258.05	175	160	-50	Major	Resource
23GC105	474127.73	7212757.9	214.28	133	160	-49	Major	Resource
23GC106	474975.68	7213108.3	264.16	209	141	-50	Major	Resource
23GC107	474073.13	7212737.3	212.37	150	158	-49	Major	Resource

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
23GC108	474846.78	7213093.1	232.95	197	155	-51	Major	Resource
23GC109	475254.41	7213215.3	282.9	132	180	-50	Major	Resource
23GC110	473985.65	7212717.6	198.44	123	160	-50	Major	Resource
23GC111	473637.54	7212563.2	192.64	132	179	-51	Major	Resource
23GC112	473639.31	7212564.2	192.63	128	139	-50	Major	Resource
23GC113	475254.86	7213216.3	282.73	172	149	-50	Major	Resource
23GC114	473528.74	7212559.4	171.68	123	132	-49	Major	Resource
23GC115	474298.7	7212713.1	282.5	91	160	-50	Yukuskokon	Resource
23GC116	473767.27	7212627.5	189.83	124	136	-51	Major	Resource
23GC117	473524.26	7212557.2	171.68	117	181	-46	Major	Resource
23GC118	475181.11	7213202.4	286.47	30	160	-50	Major	Resource
23GC118A	475181.11	7213202.4	286.47	169	159	-49	Major	Resource
23GC119	473764.6	7212626.7	189.86	148	175	-51	Major	Resource
23GC120	473613.36	7212596.6	174.36	129	181	-60	Major	Resource
23GC121	473888.89	7212646.7	204.1	112	154	-51	Major	Resource
23GC122	473614.52	7212595.9	174.46	136	138	-50	Major	Resource
23GC123	473706.49	7212680.1	165.95	166	172	-50	Major	Resource
23GC124	475059.71	7213178.3	268.29	218	143	-52	Major	Resource
23GC125	473627.17	7212653.2	161.88	141	163	-49	Major	Resource
23GC126	473706.24	7212680	166.02	157	142	-50	Major	Resource
23GC127	473960.49	7212762.2	180.59	157	156	-49	Major	Resource
23GC128	474052.19	7212804.1	189.04	172	157	-51	Major	Resource
23GC129	474892.76	7212987.8	288.1	166	160	-50	Major	Resource
23GC130	475180.62	7213222.2	281.44	114	160	-55	Major	Resource
23GC131	474147.92	7212837.8	192.91	185	159	-51	Major	Resource
23GCT014	475093.98	7213356.3	251.1	16	0	-90	Major	Geotech
23GCT015	475093.45	7213357.3	250.86	36	0	-90	Major	Geotech
23GCT016	474515.53	7212782	294.43	41	0	-90	Major	Resource+Well
23GCT017	474944.34	7213205.5	240.69	27	0	-90	Major	Well
23GCT018	475041.65	7213015.9	327.21	41	0	-90	Major	Resource+Well

Note: Easting and northing are listed in NAD83 UTM Zone 3 coordinates

10.11 Summary of 2024 Drilling

Drilling began on June 16, 2024, with an LF-90 drill operated by Major Drilling and concluded on August 21 (Table 10-9). The drilling program had three areas of focus: 1) infill diamond-core drilling within the proposed pit area, 2) geotechnical diamond core drilling with down hole geophysics and hydrogeologic measurements for pit wall design, and 3) geotechnical core/standard penetration test (SPT) drilling in lowlands overburden for facility foundation design (primarily the WMF). Hydrogeologic installations consisting of vibrating wire piezometers (VWPs) and digital temperature cables (DTCs), in addition to monitoring wells, were opportunistically coupled to the pit geotechnical and lowlands drillholes. All drillholes intersecting bedrock were logged and sampled for contribution to the resource estimate. Holes were drilled through the overburden using PQ3-sized rods and reduced to HQ3-sized after they were into competent bedrock. A total of 31 holes (3,525 m) were drilled during the 2024 season—24 holes and 9,623 ft (2,933 m) were within the pit area, and seven were in the lowlands 1,939 ft (591 m). One hole, 24GC142, was abandoned in the overburden and was not sampled. It was re-drilled as hole 24GC142A.

Table 10-9 2024 Drillhole Specifications

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
24GCT019	473788.7	7212717.4	158.34	145.08	179	-50	Major	Resource+Geotech
24GCT020	475059	7213233.1	262.95	78.79	180	-50	Major	Resource+Geotech
24GCT020A	475061.6	7213235.4	262.78	164.59	179	-49	Major	Resource+Geotech
24GCT023	473682.7	7212510.5	220.42	120.09	161	-50	Major	Resource+Geotech
24GCT025	474571.8	7212703.5	354.45	157.89	160	-51	Major	Resource+Geotech
24GCT027	474571.8	7212703.5	354.45	39.93	154	-89	Major	Resource+Geotech
24GCT028	474229.6	7212621.1	308.63	143.87	157	-50	Major	Resource+Geotech
24GCT029	474229.5	7212621.2	308.63	39.93	326	-90	Major	Resource+Geotech
24GCT030	473909.3	7212574.9	232.5	120.4	200	-51	Major	Resource+Geotech
24GCT032	474934.2	7213020	286.06	164.9	160	-50	Major	Resource+Geotech
24GC132	473969.7	7212814.9	173.79	172.21	171	-51	Major	Resource
24GC133	473971.1	7212817	173.75	186.54	136	-50	Major	Resource
24GC134	473719	7212539.6	213.3	85.34	161	-50	Major	Resource
24GC135	474369.4	7212646.9	337.71	121.31	160	-51	Major	Resource
24GC136	474331.1	7212615.8	340.57	109.73	159	-51	Major	Resource
24GC137	474315.4	7212662.8	315.76	127.1	159	-51	Major	Resource
24GC138	474470.9	7212670.5	348.69	127.1	161	-52	Major	Resource
24GC139	474420.8	7212661	341.35	122.22	160	-50	Major	Resource
24GC140	474193	7212600.5	307.37	104.8512	175	-50	Major	Resource
24GC141	474140.3	7212581.4	305.41	132.59	178	-56	Major	Resource
24GC142	474836.8	7213196.4	224.89	45.57	140	-50	Major	Resource, Abandoned

Hole ID	Easting (m)	Northing (m)	Elevation (m)	Depth (m)	Azimuth (deg.)	Plunge (deg.)	Drill Co.	Objective
24GC142A	474834.8	7213198.9	224.87	194.77	138	-50	Major	Resource
24GC143	474180.9	7212660.4	278.43	120.4	166	-49	Major	Resource
24GC144	474113.3	7212635.4	272.16	108.2	158	-50	Major	Resource
24GCT021	473628.7	7213648.6	107.54	30.7848	0	-90	Major	Facility Geotech
24GCT022	473675.1	7213231.2	120.38	144.78	0	-90	Major	Facility Geotech
24GCT024	473152.4	7213967.3	86.64	30.48	0	-90	Major	Facility Geotech
24GCT026	472839.2	7213878.9	73.22	162.0012	0	-90	Major	Facility Geotech
24GCT031	472400.7	7213706.3	55.4	30.7848	0	-90	Major	Facility Geotech
24GCT033	473261.3	7213537.9	88.29	146.61	0	-90	Major	Facility Geotech
24GCT034	474618	7213537.6	164.12	45.72	0	-90	Major	Facility Geotech

Note: Easting and northing are listed in NAD83 UTM Zone 3 coordinates

10.12 Core Logging and Sampling

Throughout the life of the project (2012-2024), drills have been sighted in by geologists, and the core(s) have been retrieved and placed into boxes by the drill companies, then transported via helicopter and truck to logging facilities. During transport, the core has remained in the possession of the company. After reaching the logging facilities, the core was logged by geotechnicians, who converted run blocks from feet to meters, re-labeled core boxes in meters, measured and recorded recovery, rock quality designation (RQD), and sampled specific gravity (SG) values. Geologists logged lithology, structure, texture, alteration, mineralization, and selected sample intervals, as well as internal QA/QC duplicates, blanks, and standards. Core box photographs were taken before the core was cut and sampled.

Samples were selected on an approximate 1 m basis from the top of the bedrock continuously to the bottom of the hole. Where proximal, sample boundaries were matched to geological contacts to avoid crossing the contacts.

11 Sample Preparation, Analyses, and Security

The sample preparation, analysis, and security procedures and protocols followed during the various exploration phases carried out on the property are presented in the previous technical reports issued by Graphite One. For detailed descriptions and analyses of the various protocols followed, refer to Duplessis et al. (2013), Eccles & Nicholls (2014), Eccles et al. (2015), King et al. (2019), and Gierymski et al. (2022). The procedures and protocols employed are described in detail, and the results of all verification procedures and quality control protocols are discussed at length. Qualified personnel supervised all phases of the sample handling, preparation, and analysis.

11.1 Sample Preparation

Graphite One contracted ActLabs to staff and maintain the sample preparation facility in Nome, Alaska, for all the drilling campaigns from 2012 to 2024. ActLabs conducted activities such as drying, crushing, splitting, pulverizing, and packaging all drill core samples for shipping from Nome to the ActLabs facility in Ancaster, Ontario, Canada for analysis.

The samples' preparation protocol consisted of:

- Drying the samples at a nominal 60°C for 24 hours
- Splitting the core in half lengthwise. Retaining one-half the core for future reference and utilizing one-half the core for assay analysis
- Crushing one-half the core through a Rocklabs Boyd jaw crusher to 85% passing 2 mm (10 mesh). The crusher is cleaned with air between every sample, and barren rock is run through the crusher after high-grade samples, in addition to blowing out with compressed air
- Riffle splitting the crushed sample to obtain a 250 g subsample
- The crusher rejects are placed in a sealed polyurethane bag, which is then placed into a rice bag, palletized, and stored in Nome for use later if needed
- Pulverizing the 250 g sample in a ring-and-puck pulverizer to at least 95% passing 105 µm (150 mesh)
- Cleaning the ring and puck bowl with barren sand after each sample for about 20 seconds
- Placing the pulverized sample in a sample packet and boxing for shipping
- Storing the unutilized one-half core in the original box for later use, if needed

11.2 Sample Analyses

Graphitic carbon analyses were conducted at ActLabs, who is ISO 17025 and ISO 9001 certified. Pulp samples that arrived at ActLabs in Ancaster were visually inspected for sample integrity and cross-checked with the shipping manifest for accuracy. All samples were analyzed with a LECO CR-412 carbon analyzer following standard procedures. A representative 0.5 g sample was removed from each sample packet, digested with hydrochloric and perchloric acids, and treated in a multi-stage furnace to eliminate all forms of carbon other than graphite. The remaining material was combusted and quantified in a LECO analyzer to determine % Cg.

11.2.1 Summary of Field Data Verification Procedures

The sample preparation lab in Nome is owned by Graphite One but managed and operated by ActLabs. Sample handling, preparation, and analytical procedures have been defined before each drilling campaign. Throughout the years, improvements have been made to these procedures. Improvements have included:

- Increasing the pulp sample from a nominal 30 g in 2012 to 2014 to a nominal 100 g in 2021 through 2024. In 2023 and 2024, a second 100 g pulp sample was prepared from each sample and stored in an archive
- Core splitting was converted from a wheel-operated splitter in 2012 through 2014 to a core saw in 2018 and beyond
- The frequency and type of standards, blanks, and duplicates varied over the years was based on recommendations from ActLabs and Hobbie Consulting. Hobbie Consulting was tasked with ensuring QA/QC compliance met requirements prior to incorporation into the database. Details of previous years' QA/QC program results can be found in the referenced reports

11.2.2 2012 Data Verification

In 2012, Graphite One inserted field blanks and field duplicates (1/4 core) into the sample stream. Blanks were inserted at a rate of one per 10 core samples and were preferentially placed directly after highly mineralized core samples. Field duplicates were inserted at a rate of one per 20 samples. In 2012, no standards were inserted into the sample stream delivered to ActLabs; instead, the program depended on ActLabs' internal standards (Duplessis et al., 2013).

ActLabs submitted 5,462 samples for graphite analyses in 2012, including 4,106 core samples, 245 prep/crush duplicates, 488 blanks, and 623 surface soil and rock samples.

A total of 112 blank and 56 duplicate pulps were re-assayed after returning values more than two standard deviations from the expected value.

11.2.3 2013 Data Verification

The overall 2013 drill core protocol and methodology—including drill core collection, core geotechnical logging, geological logging, sampling, on-site sample preparation, quality control procedures, chain of custody, and shipping and analysis—were almost identical to those reported for the 2012 drill program. However, in 2013, field blanks were inserted independent of mineralization (Eccles & Nicholls, 2014.)

ActLabs submitted 978 samples for graphite analyses in 2013, including 834 core samples, 48 prep/crush duplicates, and 96 blanks.

Only one blank pulp had to be re-assayed after returning values more than two standard deviations from the expected value.

11.2.4 2014 Data Verification

After the first three 2014 drillholes, four certified reference materials (CRM) were added to the QA/QC protocol. These are CDN Resource Laboratories Ltd.'s CRMs—CDN-GR-1, CDN-GR-2, CDN-GR-3, and CDN-GR-4. One control sample, either a blank or standard, was inserted at a rate of one for every 10 core samples. In 2014, the only duplicate samples inserted by Graphite One were field duplicates (1/4 split-core) and were inserted at a rate of one per 20 samples. About 10% of core samples were duplicated and sent to two separate and independent laboratories to validate the data provided by ActLabs (Eccles et al., 2015)

ActLabs submitted 2,762 samples for graphite analyses in 2014, including 2,274 core samples, 133 prep/crush duplicates, 176 blanks, and 100 CRMs.

A total of 89 CRM, 146 blank, and 117 duplicate pulps were re-assayed after returning values more than two standard deviations from the expected value.

11.2.5 2018 Data Verification

In 2018, the CRMs CDN-GR-1, CDN-GR-3, and CDN-GR-4 as well as field blanks were inserted into the sample stream by Graphite One; however, no duplicates were inserted. An alternating standard or field blank was inserted every 10th sample in sequence. A field blank was also inserted after a semi-massive to massive graphite sample. Unlike in previous years, a core saw was used to split the core (King et al., 2018).

ActLabs submitted 777 samples for graphite analyses in 2018, including 685 core samples, 53 blanks, and 39 CRMs.

All the blanks' values were below the detection limit for Cg. All the standard sample assay values fell within the accepted two standard deviation limits.

11.2.6 2019 Data Verification

In 2019, the CRMs CDN-GR-1, CDN-GR-3, and CDN-GR-4 as well as BL-9 (a commercial blank SRM), were inserted into the sample stream by Graphite One. An alternating standard or field blank was inserted every 20th sample in sequence. A blank was also inserted after a semi-massive to massive graphite sample. No field blanks or duplicates were inserted by Graphite One.

ActLabs submitted 327 samples for graphite analyses in 2019, including 308 core samples, 11 blanks, and eight CRMs.

All the blank values were below the detection limit for Cg. All the standard sample assay values fell within the accepted two standard deviation limits.

11.2.7 2021 Data Verification

In 2021, Graphite One inserted CRMs, field blanks, and prep/crush duplicates (splits from the crush reject) into the sample stream.

Four graphite CRMs were used in 2021: CDN-GR1, CDN-GR2, CDN-GR3, and CDN-GR4. An alternating CRM was inserted at a rate of 5%. Duplicates and field blanks were also inserted at the same proportion, with field blanks placed preferentially after a semi-massive to massive graphite sample. Field blank material was composed of a metagranite from a quarry east of Nome. This is the same field blank material used in Graphite One's drill programs from late 2012 through 2019.

ActLabs submitted 1,826 samples for graphite analyses in 2021. These comprised 1,538 core samples, 91 prep/crush duplicates, 106 field blanks, and 91 CRMs.

The results of field blanks, CRMs, duplicate samples inserted by Graphite One, ActLabs' internal repeat assays, and lab standards were verified and plotted to confirm results were within acceptable limits.

Prep (crush) duplicate samples showed acceptable repeatability. Two field blanks and three CRMs fell outside of acceptable limits—two of CDN-GR-1 (low) and 1 of CDN-GR-3 (low). Two of the three CRMs were re-assayed and produced passing results. The third failed CRM was on the margin of failing and not re-assayed. Both failed blanks were re-assayed and re-produced failing results, likely due to contamination during the pulverizing process of these samples.

11.2.8 2022 Data Verification

In 2022, the CRM, field blanks, and prep/crush duplicates were the same composition and inserted at the same rate as in 2021.

ActLabs submitted 2,218 samples for graphite analyses in 2022, including 1,880 core samples, 111 prep/crush duplicates, 121 field blanks, and 106 CRMs.

A total of 11 CRM, one blank, and three duplicate pulps were re-assayed after returning values more than two standard deviations from the expected value.

11.2.9 2023 Data Verification

In 2023, new CRMs were purchased from OREAS, including OREAS 722 with a Cg of 2.03%, OREAS 723 with a Cg of 5.87%, OREAS 724 with a Cg of 12.06%, and OREAS 725 with a Cg of 24.52%. These replaced the CDN-GR standards used in previous years. The blank and duplicate QA/QC procedure remained the same.

ActLabs submitted 9,806 samples for graphite analyses in 2023, including 8,288 core samples, 500 prep/crush duplicates, 490 field blanks, and 528 CRMs.

A total of seven CRM, five blanks, and 18 duplicate pulps were re-assayed after returning values more than two standard deviations from the expected value.

11.2.10 2024 Data Verification

In 2024, the use of the OREAS CRMs continued along with the duplicate and blank material and insertion rate used previously.

ActLabs submitted 3,470 samples for graphite analyses in 2024, including 2,903 core samples, 173 prep/crush duplicates, 203 field blanks, and 191 CRMs.

A total of one CRM, one blank, and one duplicate pulp was re-assayed after returning values more than two standard deviations from the expected value.

11.3 Samples Security

In 2012, 2013, 2014, 2018, 2019, and 2021-2024 core and rock samples were transported from the field to camp by helicopter, where they were palletized, loaded onto a flatbed truck, and driven to Graphite One's warehouse in Nome for processing. Geotechnical logging, geological core logging, core photography, core splitting, and core sampling were conducted at the Nome facility. All measurements and core logging observations were recorded directly into a digital format that included a predetermined set of codes to describe characteristics, including rock type, lithology, mineralization, texture, and competency over the entire drill core length. Digital photographs of each core box were taken using a stationary camera and lighting.

Shipping of the pulp samples from Graphite One's sample preparation lab in Nome to the ActLabs analysis facility in Ancaster, ON was conducted by ActLabs personnel through 2021 and by Graphite One personnel 2022-2024. Samples were shipped via a commercial carrier with package tracking. To complete the chain of custody, individual samples with the same sample numbers originally recorded in the field were continued all the way to ActLabs. Similarly, metallurgical samples for flake-size testing were sent to Hazen in Golden, Colorado, and/or ActLabs in Thunder Bay, ON, and/or SGS Mineral Services, Lakefield, ON. After the samples arrived at the laboratories, they remained in the custody of the independent lab until final processing was completed. ActLabs has achieved the ultimate accreditation to international standards, which is the ISO 17025 standard. Hazen also holds several professional accreditations.

11.4 QP Opinion on QA/QC Procedures

It is the opinion of the QP, Robert M. Retherford, that the QA/QC procedures and protocols used by Graphite One's geological and geophysical consultants and contractors follow industry best practices. The sample data provided by previous exploration programs are suitable for the purpose for which they are used in this report.

12 Data Verification

Site visits were conducted by several of the QPs, as detailed in Chapter 2. The purpose of the site visits were to fulfil the requirements specified under NI 43-101 guidelines, become familiar with the property, and verify key data and information to be used as source inputs for this technical report and resulting resource estimates.

12.1 Field Verification

Alaska Earth Sciences, Inc. (AES) representative and former QP William Ellis visited the property in 2021 and 2022 and was able to locate many drill collars and sample sites. Past work was clearly carried out as described in the previous technical reports issued by Graphite One.

AES representative Robert M. Retherford, QP, Geology, visited many collar locations in 2022 and 2024 and was able to verify the coordinates to within the accuracy of his hand-held GPS. He visited and sampled several historic sample locations, and the analyses returned for his samples correlated well with historically recorded values. Retherford also inspected the core and sample storage areas, core logging facility, and the sample preparation facility. All these facilities were observed to be exactly as described in the previously issued technical reports. Random sections of drill core were examined and compared to the descriptions recorded in the drill logs. The logs were judged to be accurate and reflected the observations made by both Ellis and Retherford. Several samples were collected from stored sample rejects and from stored drill core. These samples were kept in the custody of the representatives until they were shipped to the ALS Limited (ALS) minerals sample preparation facility in Fairbanks, Alaska. The samples were analyzed for Cg, and the results were compared to the results reported by Graphite One in its previous technical reports. The results of the check assays were found to correlate very well with the previously reported values, as illustrated below in Table 12-1.

Table 12-1 Comparison of Previously Reported Assay Values to Check Assays

Type	Sample Location	Sample Description	Original Assay Cg (%)	Check Assay Cg (%)
ROCK	West side Graphite Creek, below adit	Quartz biotite schist in outcrop. Disseminated Graphite <0.5%	Low Grade	<0.02
ROCK	West wall, old Graphite Creek adit	Channel sample across 50 cm band of quartz biotite garnet + sillimanite schist	15-20% (Est.)	18.1
ROCK	West wall, old Graphite Creek adit	Grab sample from pod of high-grade graphite	>50% (Est.)	>50
PULP	Sample P661772	Grain size varies from powder to 1.5 mm. Tan, some oxidization. Qz–Bi, minor graphite	0.91	1.17
PULP	Sample P661776	Grain size as above. Med grey. Graphitic streak overall. Qz, Bi, Garnet, Sillimanite, graphite	6.17	5.34
CORE	Hole 14GCH016 63.67–64.67	Qz Bi Schist with minor garnet and minor sillimanite. 2-5% graphite. Minor Po? Brownish–red oxide, possibly iron carbonate	4.71	4.61
CORE	Hole 14GCH016 16 68.00–69.00	Nearly massive graphite schist with 5% pink garnets and minor Qz-Bi-Si	15.00	14.45

Type	Sample Location	Sample Description	Original Assay Cg (%)	Check Assay Cg (%)
CORE	Hole 14GCH016 17 71.23–72.23	Qz Bi Garnet Sillimanite schist with ~10% graphite. Intermediate between low-grade below and high-grade above. Blob of MX graphite at 72.15 m	13.50	11.25
CORE	Hole 12GCH004 33.32–34.00	Qz Bi schist with some pink garnets. 2 cm garnet at 33.58 m	4.26	5.41
CORE	Hole 12GC005 180.00–181.00	Qz Bi Garnet schist with ~3% graphite. Wavy bands of biotite and graphite. Flakes to 1 mm	7.16	6.08

12.2 Database Verification

An unlocked version of the geological database was obtained by the authors from Graphite One in Microsoft Excel format. The lithologic and structural descriptions were compared to field observations, and no discrepancies were observed. The assay results in the database were compared to original certificates of analysis, and no errors or discrepancies were noted. Collar coordinates were compared to field observations made during the site visit, maps, and original field observations. No discrepancies beyond normal GPS variations were discovered.

The data recorded in the project database were found to be correct, verifiable, suitable, and adequate for the purposes for which they were used.

12.3 Adequacy Statement

Retherford is confident that the data and results are valid based on the site visits that both he and Ellis made in 2021, 2022, 2023, and 2024, including the methods and procedures used. It is the opinion of Retherford that all work, procedures, and results have been adhered to and best practices and industry standards as required by NI 43-101.

The datasets employed for use in the mineral resource estimates are a mix of historic data and recent data. There is always a concern regarding the validity of historic data; therefore, extensive validation and verification must be performed to confirm that the data may be relied upon.

Both Retherford and Ellis reviewed extensive validation and verification studies to confirm the validity of the mineral resource estimates.

13 Mineral Processing and Metallurgical Testing

13.1 Introduction

Two metallurgical testwork campaigns were conducted on samples from the Graphite Creek deposit. Both were conducted at SGS Mineral Services in Lakefield, Ontario. The first campaign was conducted on drill samples representing the PFS pit in 2020. With additional drilling to expand the reserve for the FS in 2023, a second campaign was conducted to verify the additional ore would be amenable to the flowsheet, confirm the flowsheet was optimized, and determine expected variability when processing different ore types and grades.

13.2 PFS Metallurgical Testwork

Samples were provided to SGS in February of 2020, and testing was completed by June 2021. The testing program is summarized in SGS Canada Inc.'s Project 17658-01, 2021 draft report. Locked-cycle testing (LCT) conducted during this campaign was successful at producing 95.7% total carbon (C(t)) at 92% recovery. It was the basis for using 95% C(t) final concentrate at 92% recovery in the PFS.

Five mine plan composites were generated, which reflected the expected mill feed for the first 11 years of operations. The process development was carried out on a master composite that was generated from a weighted blend of the five mine plan composites. The primary objective was to develop a flotation concentrate grading at least 95% C(t) with minimal flake degradation and maximum graphite recovery. The robustness of the proposed flowsheet was then validated in a small variability program. Tests conducted during the PFS included:

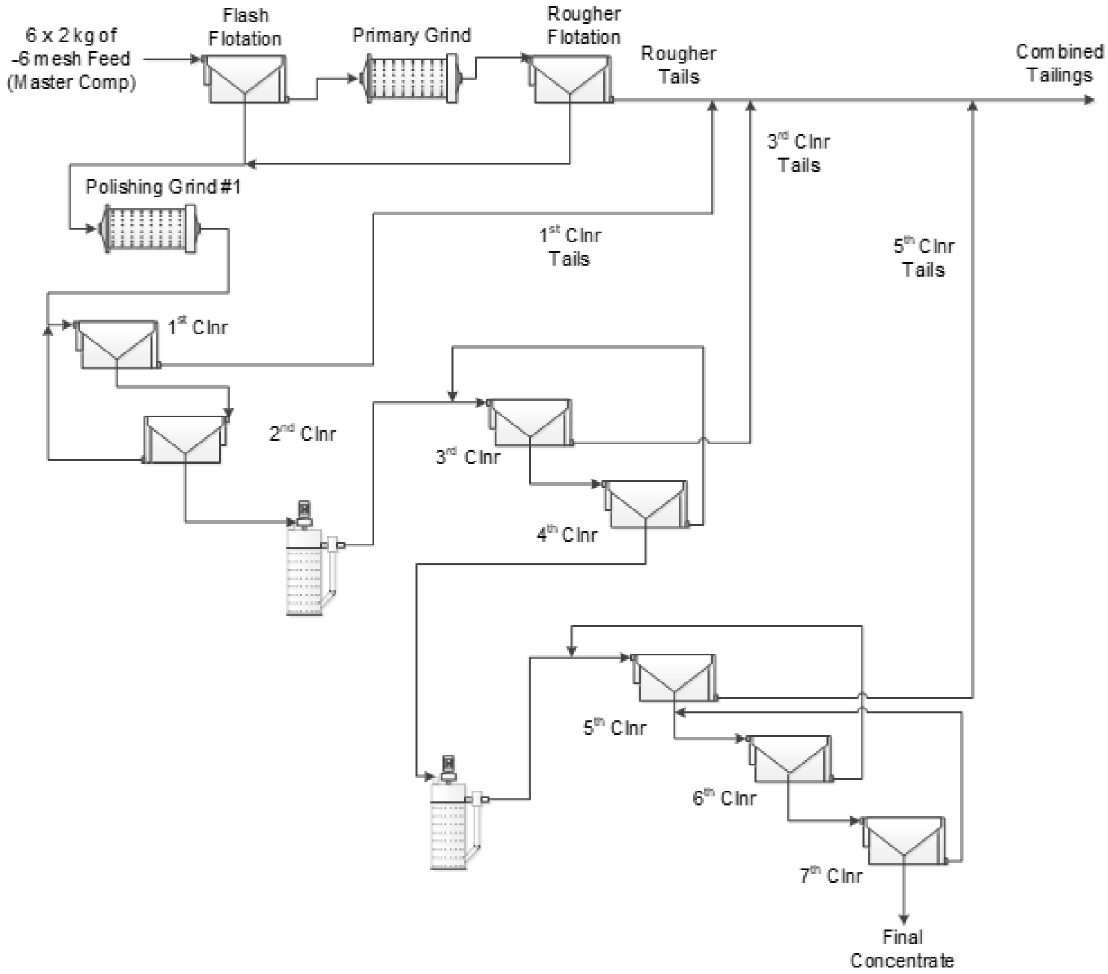
- Chemical assay and whole rock analysis
- Comminution testing (bond work index and abrasion)
- Heavy liquid separation
- Flotation parametric testing
- Solid-liquid separation

Also, during the PFS, a bulk sample of high-grade material was tested in a pilot system to demonstrate operation on a specific portion of the mineral deposit (SGS Canada Inc., 2023).

Comminution testing produced rod mill grindability work indices that ranged from 9.9 kilowatt-hour (kWh) per tonne to 10.7 kWh/t. Bond ball mill grindability tests yielded ball mill work indices (BWi) between 12.4 kWh/t and 13.7 kWh/t. The BWi values place the Graphite Creek mineralization into the soft-to-medium hardness category. The Bond abrasion index (Ai) test values of 0.258 g to 0.337 g place the Graphite Creek material into the medium-abrasivity category (SGS Canada Inc, 2021).

Heavy-liquid separation tests were conducted to assess the amenability of the Graphite Creek mineralization to preconcentration by dense-media separation. Although some upgrading of the feed grade from 3.70% C(t) to 5.64% C(t) with 55% mass rejection was achieved, the associated graphite losses of 30% rendered dense-media separation unsuitable (SGS Canada Inc, 2021).

The flowsheet development program culminated in the flowsheet depicted in Figure 13-1. The flowsheet includes a flash and rougher flotation stage to recover most of the graphite into a combined flash and rougher concentrate that is then subjected to a polishing grind. The polishing mill discharge is upgraded in two cleaning stages before stirred media milling (SMM). The SMM discharge is cleaned twice before the fourth cleaner concentrate is subjected to the final stage of SMM followed by three stages of cleaner flotation.



Source: SGS Canada Inc, 2021

Figure 13-1 Graphite Creek PFS Flowsheet

Two flotation LCTs were carried out since the first LCT produced a concentrate below the target grade of 95% C(t). The second LCT employed slightly longer grind times, which resulted in a grade improvement of the combined concentrate to 95.7% C(t). The total carbon recovery also improved to 92.0% (SGS Canada Inc, 2021).

Solid-liquid separation tests were carried out on the graphite concentrate and the rougher tailings. Magnafloc 10 was identified as a suitable flocculant for the rougher tailings and static settling tests produced underflow densities of 68 wt% solids. Vacuum-filtration tests produced filter cakes with moisture contents as low as 13.3 wt% moisture. Pressure-filtration test results on the graphite concentrate yielded high-moisture contents of approximately 22-25 wt% moisture (SGS Canada Inc, 2021).

13.3 Feasibility Metallurgical Testwork

The testwork conducted during the PFS was reviewed and used as a reference, but the FS flowsheet is based primarily on the FS testwork conducted in late 2023 and early 2024 using drill core from the 2023 drilling season. The FS testwork confirmed that the PFS flowsheet was the preferred flowsheet with some minor changes. The targets for the FS-phase laboratory test campaigns consisted of 95% graphite grade and >90% graphite recovery.

The 2023 Graphite Creek ore model was used to select cores from the 2023 drilling campaign that were representative of the new ore added to reserves. The objective was to optimize the PFS flowsheet on a representative composite sample and determine how the newly optimized flowsheet would perform on highly variable samples from the orebody. Composite samples were selected to include different ore types, grades, and spatial representation in the proposed pit. The final composite consisted of horizons from 13 different drill cores across the proposed pit area. Variability samples were chosen to examine how samples would perform independently to determine if any specific ore type, grade, or area of the pit would have throughput or recovery issues. Various horizons from 16 different drill cores were used to develop variability samples with carbon grades ranging from 3.0% to 18.8% (see Section 13.3.1.2 for details).

Testwork conducted during the FS included work by both SGS and Pocock is in Table 13-1 as follows.

Table 13-1 Testwork Conducted During FS

Category	Testing Company	
	SGS	Pocock
Types of Testing	Whole Rock	Settling – static and dynamic – tails and con
	Flotation Parametric Testing	Vacuum filtration – tails and con
	Hardness	Pressure filtration – tails and con
	Abrasion	
FS Testing Reference Reports	SGS 17658-03: Flowsheet Optimization on a Master Composite (SGS Canada Inc, 2024a)	Pocock 2446: Solid Liquid Separation Testing (Pocock Industrial, Inc., 2024a, 2024b, 2024c)
	SGS 17658-04: Variability Testing on Eighteen Composites (SGS Canada Inc, 2025a)	
	SGS 17658-05: Graphite Creek Concentrate Production Pilot Plant (SGS Canada Inc, 2024b)	
	SGS 17658-06: The Grindability and Flotation Characteristics of a Master Composite Sample (HPGR testwork) (SGS Canada Inc, 2025b)	

13.3.1 Laboratory Flotation Testing

13.3.1.1 Flowsheet Optimization – SGS Canada Inc., Project 17658-03

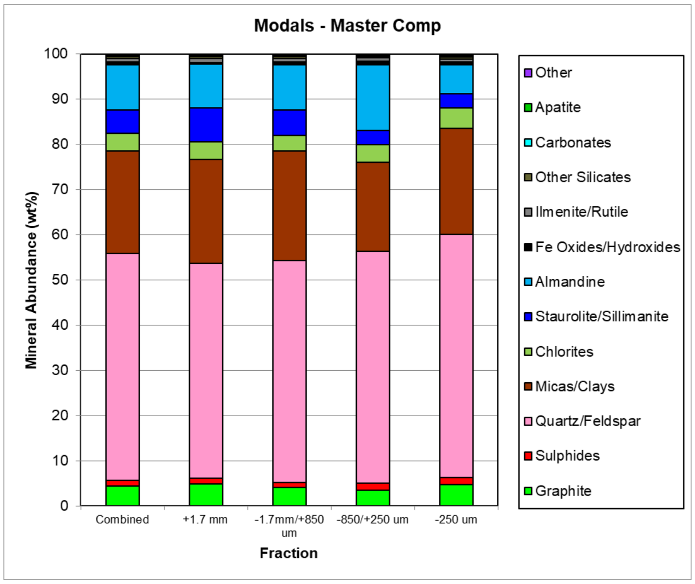
Introduction

Testwork was completed on a single composite representing the expected ore from the Graphite Creek property. The sample was supplied to SGS Canada in Lakefield in November 2023. The primary objective of the test program was to develop an optimized flowsheet to produce a graphite concentrate grading at least 95% C(t) while maintaining at least 90% carbon recovery. The study included chemical characterization, mineralogical analyses, comminution testing, and flotation testing (SGS Canada Inc., 2024a).

Sample Characterization

The composite sample, identified as GO-EDC-001, was provided to SGS by Graphite One and used to prepare the "Master Comp" which was used throughout the test program. Total and Cg head grades were 5.34% and 5.15%, respectively. Other major species were SiO_2 at 62.2%, Al_2O_3 at 15.1%, and Fe_2O_3 at 7.86%. x-ray diffraction analyses revealed that the sample matrix consists of primarily silicate minerals, including quartz, phyllosilicates, feldspars, almandine, sillimanite, and staurolite, with other minerals in trace amounts (SGS Canada Inc., 2024a).

The modal abundance of mineral groups in the Master Comp as determined by Tescan Integrated Mineral Analyzer (TIMA) is illustrated in Figure 13-2. Graphite grain size P_{80} was found to be 457 µm in a sample of Master Comp prepared to 100% passing 3,360 µm. Liberated graphite accounts for 31.3% of the total carbon in the sample, with the remainder occurring as middlings with silicates. Graphite liberation ranged from 16% in the coarse fraction (+1.7 mm) to 66% in the fine fraction (-250 µm) (SGS Canada Inc., 2024a).



Source: SGS Canada Inc., 2024a

Figure 13-2 TIMA Modal Abundance of Mineral Groups in the Master Comp

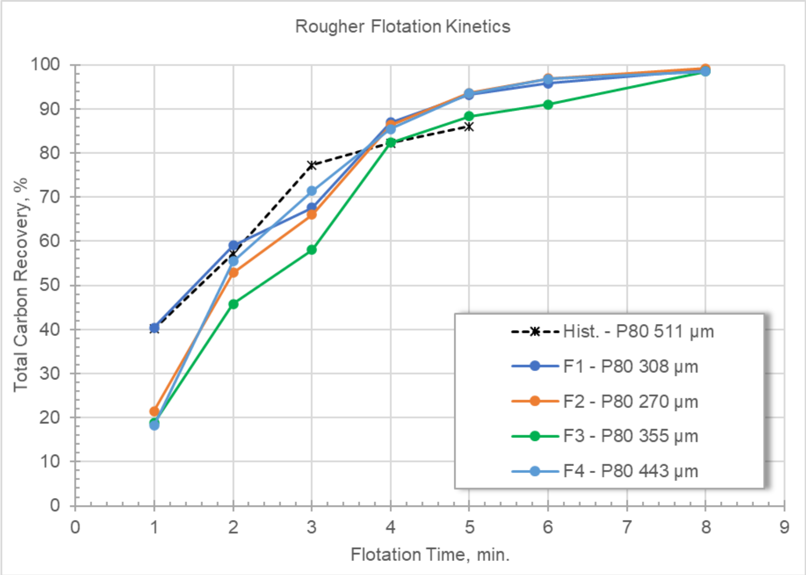
Flotation Testing

A total of 29 open-circuit flotation tests and four LCTs were conducted during this flowsheet optimization study. Ten rougher tests examined the effects of flowsheet configuration, primary grind size, pulp density, reagent dosage, and cold-weather additives. Eight primary cleaner tests were conducted to evaluate the first or second cleaner kinetics under various polishing grind durations and reagent dosages. Eleven secondary cleaner tests applied the full flowsheet to produce a final concentrate. These tests varied the applied abrasion energy (milling duration), stirred media density (ceramic vs. stainless steel), and cleaner flotation time. Finally, two full and two “mini” LCTs were conducted to evaluate the effect of recirculating loads on final concentrate grade and recovery.

Flash/Rougher

Variables examined in flash and rougher flotation tests included flowsheet configuration, primary grind, flotation time, pulp density, collector dosage, and cold-weather additive. The "mill-flot-mill-flot" (MF2) flowsheet was compared to a standard grind-flotation flowsheet. With similar total carbon recoveries of 98.5% and 97.4% (MF2 and standard, respectively), the MF2 flowsheet was selected for the remainder of the test program as it requires less power for grinding and is advantageous in graphite ores to preserve any large-flake graphite that may occur.

Rougher flotation kinetics at varying grind sizes are shown in Figure 13-3. Because of the similarity and potential for reduced grinding power, a primary grind P_{80} of approximately 400 µm was selected for the flowsheet optimization. However, during full flowsheet testing and LCT, this target was lowered to a primary grind P_{80} of approximately 350 µm to increase graphite liberation and improve the final concentrate grade (SGS Canada Inc., 2024a). Throughout all testwork, grind size was found to have the greatest influence of any variable on grade and recovery.



Source: SGS Canada Inc., 2024a

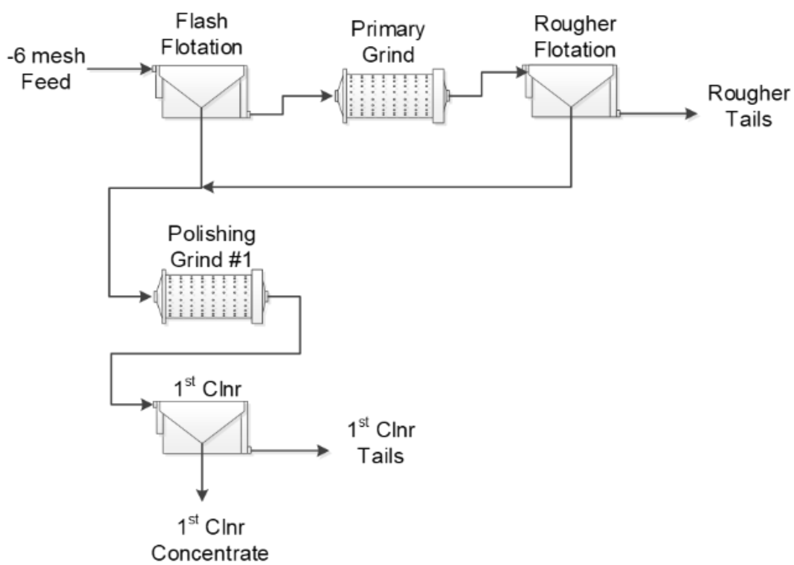
Figure 13-3 Effect of Target Grind Size on Rougher Kinetics

First Cleaner/Polishing Grind

Primary cleaner testing was conducted to optimize the first polishing grind on the combined flash/rougher concentrate. For these tests, the MF2 flowsheet (Figure 13-4) was applied, and the primary grind targeted rougher tailings P_{80} of approximately 350 µm. In all cases, total carbon recovery to the concentrates was high at greater than 90%. One test, F25, was conducted to evaluate the first cleaner performance using a coarser primary grind target for rougher tailings P_{80} of approximately 400 µm (SGS Canada Inc., 2024a).

Polishing grinds were shown to affect primary cleaner product grades but had only negligible effects on overall recoveries. The coarsest polishing grind tested in F15 with first cleaner tailings P80 of 260 µm yielded a low initial total-carbon grade of 41.2%. In comparison, high initial total-carbon grades of 61.5% and 57.6% were achieved in tests F9 and F10 at P80 of first cleaner tailings of 95 and 97 µm, respectively. Overall, first cleaner concentrate total-carbon grades followed a similar pattern with 53.8% and 50.7% C(t) in the finest tests (F9 and F10, respectively) compared to an overall first cleaner concentrate grade of 33.7% in the coarsest test (F15). However, in all primary cleaner tests, total recovery to the first cleaner concentrate was over 90% at all polishing grind targets (SGS Canada Inc., 2024a).

Primary cleaner tests were conducted using the coarser primary grind (F17 and F25) and yielded comparable results to the finer tests with overall total carbon recoveries to the first cleaner concentrate of 95.6% and 95.1%, respectively. Both tests used a lower collector dosage and coarser polishing grind to achieve overall concentrate grades of 41.4% and 39.0% in F17 and F25, respectively. The conditions of F17 (P80 of 370 and 261 µm for rougher and first cleaner tailings, respectively, with 35 grams per tonne (g/t) fuel oil in the flash/rougher circuit) were selected as the baseline for secondary cleaner tests (SGS Canada Inc., 2024a).



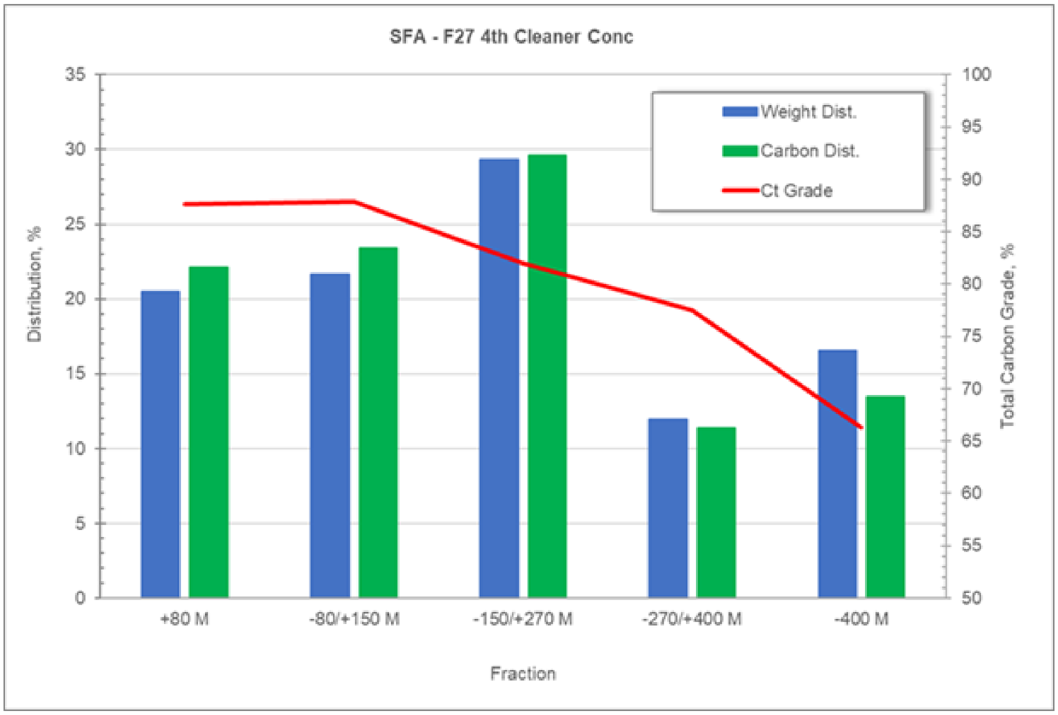
Source: SGS Canada Inc., 2024a

Figure 13-4 MF2 Flowsheet for First Cleaner Kinetics Testing

Secondary Cleaner Testing

Secondary cleaner tests were conducted using the full (open circuit) MF2 flowsheet. The full flowsheet includes one primary, one polishing, and two abrasion-stirred media-mill grinding stages as well as seven stages of cleaning. A series of tests examining the effect of abrasion time on the final concentrate grade was conducted. The longest time in this series per stage (20 minutes) yielded the highest total-carbon grades of 96.3% and 97.9% in two tests. However, these tests yielded lower total carbon recoveries at 79.7% and 71.8% (SGS Canada Inc., 2024a).

Additional adjustments to stirred media milling included the use of less dense ceramic-stirred milling media and increased abrasion times in the second stirred media milling stage. Middling cleaner products were examined by size fraction analyses. A study of the 4th cleaner concentrate revealed that the grade of fines (<38 µm) produced after both stirred media milling stages was significantly lower in total-carbon grade at 66.3% as compared to 81.3% total-carbon grade of the unsized product (SGS Canada Inc., 2024a). Size-fraction analysis of the F27 fourth cleaner concentrate clearly illustrates this effect, as shown in Figure 13-5.



Source: SGS Canada Inc., 2024a

Figure 13-5 Size Fraction Analysis of 4th Cleaner Concentrate

Locked-Cycle Testing

LCT examined the effect of middling recirculation on total carbon grade and recovery in the final concentrate. Four LCTs were performed on the Master Comp in this test program using conditions summarized in Table 13-2.

Table 13-2 Locked-Cycle Test Conditions

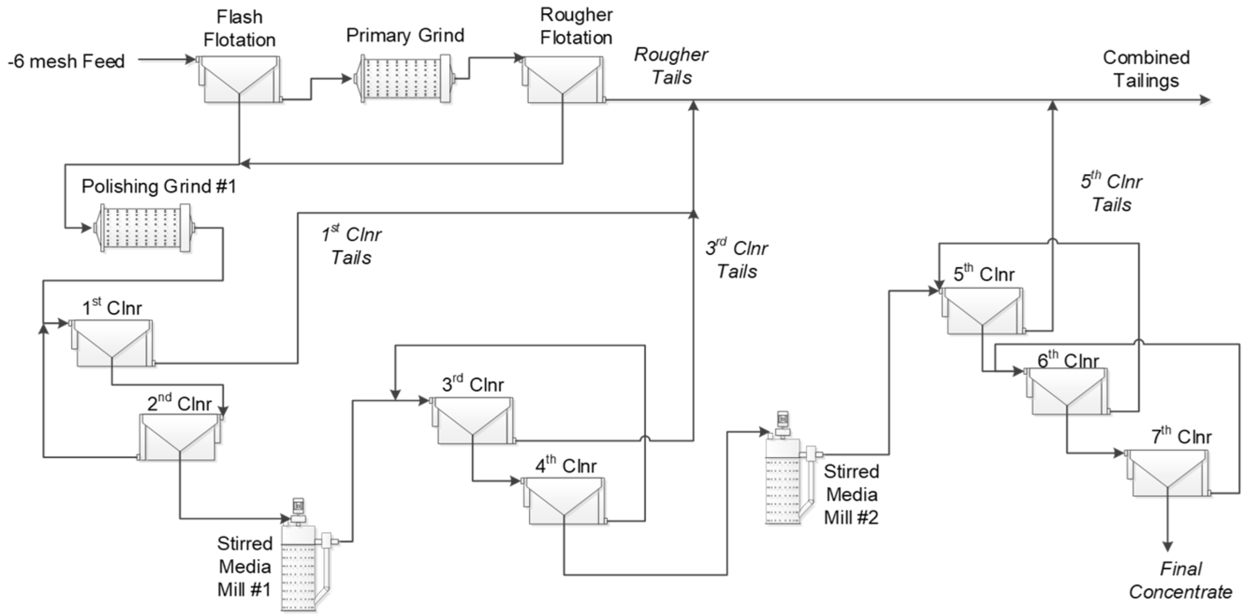
Test ID	No. Cycles	Grind Times (min)				Notes
		1°	Polish	SMM1	SMM2	
LCT1	6	4.5	5.5	20	20	Based on F29
LCT2	6	5.5	5.5	35	35	Finer 1° and SMMs
LCT3	3	5.5	9	30	30	Finer Polish
LCT4A	3	6.5	10	35	35	Target final conc P_{80} ~140 µm; measured each stage and adjusted times next stage
LCT4B		7.5	10	35	35	
LCT4C		7	15	40	40	

Source: SGS Canada Inc., 2024a

LCT revealed the deleterious effect of recirculating load on the final concentrate grade. Reconfiguration of middlings product recirculation, as well as increased grinding and abrasion times, were applied and showed improvement (SGS Canada Inc., 2024a). Two of the three LCT4 cycles achieved the target total carbon grade of 95%. However, further refinement of the recirculating load conditions is required for full optimization.

LCT1 and LCT2

The flowsheet used in tests LCT1 and LCT2 is presented in Figure 13-6. Tests LCT1 and LCT2 resulted in significantly lower projected final total carbon concentrate grades of 82.1% and 85.1%, respectively (SGS Canada Inc., 2024a). As each test progressed, the final concentrate total carbon grade decreased while the circulating load increased, as indicated by mass accounting. LCT3 and 4 confirmed that this was a result of missing the targeted grind size in the first and second regrind circuits.

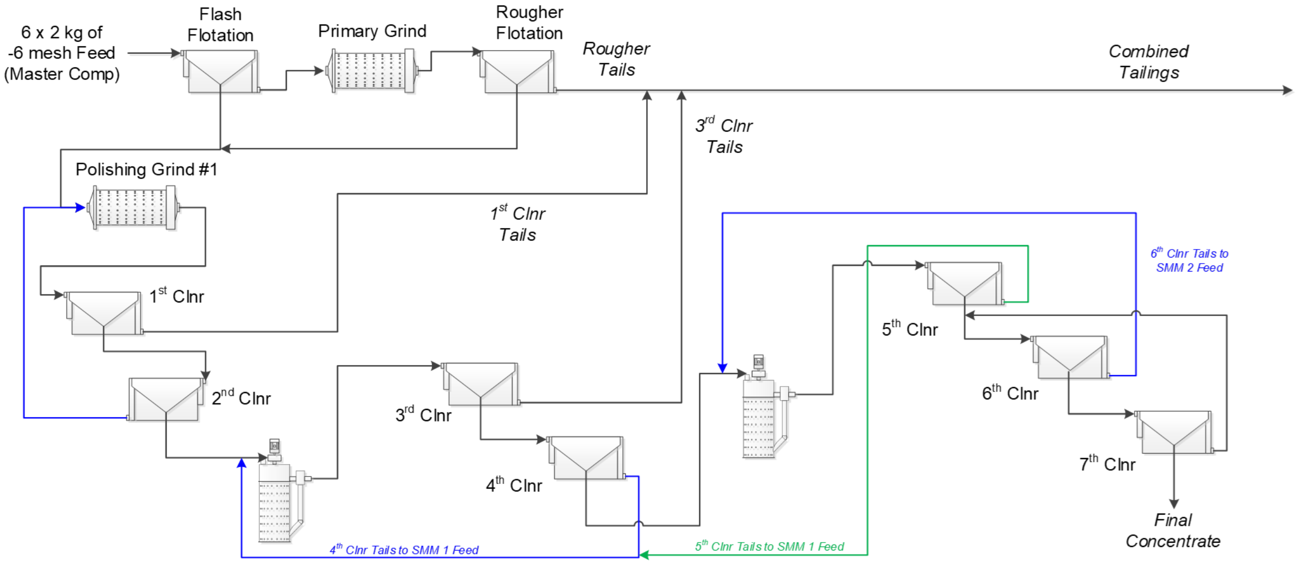


Source: SGS Canada Inc., 2024a

Figure 13-6 LCT1 and LCT2 Flowsheet

LCT3 and LCT4

Two "mini" LCTs were conducted to examine the effect of finer polishing and target a specific concentrate P_{80} of approximately 140 µm (SGS Canada Inc., 2024a). The flowsheet configuration was also adjusted to give circulating middlings products increased abrasion time. Specifically, in LCT3, second, fourth, and sixth cleaner tailings were recirculated to the previous milling stage as opposed to the previous concentrate (see Figure 13-7). LCT4 also recirculated the fifth cleaner tailings to the second stirred media-milling stage as opposed to the combined tailings stream. The total carbon grade of the projected final concentrate in LCT4 was 94.2% with a high total carbon recovery of 94.1%. Two of the three cycles in LCT4 achieved the target grade of 95.0% (cycles A and C).



Source: SGS Canada Inc., 2024a

Figure 13-7 LCT3 and LCT4 Flowsheet—LCT3 Includes Blue Paths; LCT4 Includes Blue and Green Paths

Conclusions

Throughout the test program, size fractional analyses were conducted on stage and rougher concentrates. It was observed that the fines fractions (<38 µm) reporting to the concentrate streams carried lower total-carbon grades. Entrainment of gangue particles in the smaller size fractions may account for this effect. It is recommended that a split flowsheet processing coarse and fine fractions be tested separately in a larger-scale program. Additionally, testwork that includes froth washing may further illuminate the extent of the entrainment effect and how much it can be mitigated.

LCT revealed the deleterious effect of recirculating load on the final concentrate grade. Reconfigured middlings product recirculation and increased grinding and abrasion times were applied and showed improvement. Two of the three cycles of LCT4 achieved the target total carbon grade of 95%, although conditions were adjusted to maintain the targeted concentrate P_{80} (SGS Canada Inc., 2024a). Further refinement of the recirculating load conditions is required for full optimization. However, the ability to achieve the target total-carbon grade while maintaining >90% recovery was confirmed.

Increased polishing and stirred media milling led to increased final concentrate grades in the open-circuit primary and secondary cleaner tests. Additionally, using ceramic media in place of denser stainless steel in the stirred media mills yielded improved final concentrate grade (e.g., 95.2% C(t) in F23), indicating that light abrasion is key to achieving the target total carbon grade. It is recommended in future test programs to mineralogically examine the liberation and association properties of graphite in both the stirred media mill feed and discharge to identify where and how breakage is occurring.

Lowered flash/rougher flotation density provided positive results, with a total carbon recovery of 98.3%, slightly higher than that of standard density tests. It is recommended to examine reduced flash/rougher flotation pulp density in larger scale operations if optimization is required. It should be noted that because of the quick-floating and persistent frothing nature of graphite concentrates, lower-than-average pulp densities were applied in the laboratory relative to cleaner stages in all tests (SGS Canada Inc., 2024a).

13.3.1.2 Variability Flotation Testing—SGS Canada Inc, Project 17658-04

A series of rougher and cleaner tests were carried out on 18 variability samples in this program using an open-circuit variant of the flowsheet developed for the Master Composite sample under SGS Project No. 17658-03 (SGS Canada Inc., 2024a). These samples were selected to represent the expected variability throughout the updated FS pit. The primary objectives were to quantify the variability throughout the ore body and validate the optimized flowsheet, which was developed for the Master Composite sample under SGS project number 17658-03 (SGS Canada Inc., 2024a).

This testwork showed a large degree of variability for hardness, abrasion, concentrate grade, and recovery among the samples tested. However, grind size proved to be the dominant factor controlling concentrate grade and recovery. With the variable hardness, several tests had to be repeated to meet the targeted grind size. When the targeted grind size of 350 µm was achieved, most of the samples performed well (SGS Canada Inc., 2025a).

The results of comminution tests conducted on six variability samples showed a large range of characteristics between the samples. Abrasivity varied from 0.005 g (VAR-002) to 0.324 g (VAR-006). The tested samples varied from very soft to moderately soft with regards to rod mill grindability with RWI values ranging from 7.2 kWh/t (VAR-006) to 12.5 kWh/t (VAR-011). Ball mill grindability showed much more variability with BWI values ranging from 9.2 kWh/t (VAR-006) to 20.3 kWh/t (VAR-011) (SGS Canada Inc., 2025a).

The process is initiated with flash flotation, followed by a primary grind targeting a P_{80} of 350 µm, and four stages of rougher flotation. The combined flash and rougher concentrates were then polish-ground in a polishing mill, followed by a total of seven stages of cleaners. Two SMM units were used to clean the graphite surfaces of the 2nd and 4th cleaner concentrates. For most of the variability samples, two tests were conducted, one on the coarse grind size and the other on the finer grind size. Results are shown in Table 13-3, Table 13-4, and Table 13-5.

Conclusions

The samples' performance showed a high degree of variability with respect to hardness, abrasion, concentrate grade, and recovery; however, the overall performance of the samples was satisfactory and demonstrated the durability and versatility of the flowsheet. In general, tests with finer grind size generally performed better than the coarser grind size tests.

Most of the variant samples performed well in the rougher tests with reasonable recoveries and grades. VAR-001, VAR-002, and VAR-004 were exceptions showing poor recoveries in the rougher tests. This is likely because the samples were not well-liberated, as revealed in TIMA-X mineralogical analysis performed on the rougher tails of test V36 of the VAR-002 sample. Further, the significant performance difference of VAR-004 between tests V3 and V20 with primary grinds of 579 µm and 328 µm, respectively, indicates that liberation as a function of grind size is highly important.

Under the tested conditions, the high-grade variability samples with head grade > 15% C(t), VAR-003 and VAR-004, did not produce a 95% C(t) grade; this was likely due to poor liberation or insufficient polishing or cleaning-stage dilution (SGS Canada Inc., 2025a).

Table 13-3 Summary Flotation Results of Low-Grade Variability Samples

Composite	C(t) Assay (%)	Rougher Testing							Cleaner Testing						
		Test #	P80* (µm)	C(t) Assay (%) Combined Flash & Ro	C(t) Recovery (%)			Cg Assay (%) Ro Tail	Test #	P80 (µm)		C(t) Assay (%) 7th Clnr Conc	C(t) Recovery		Cg Assay (%) Ro Tail
					Flash	Ro	Flash & Ro			7th Clnr Conc	Ro Tail		7th Clnr Conc	Flash & Ro Conc	
VAR-002	4.55	V6R	455	14.4	49.9	29.4	79.3	1.05							
		V19	288	12.9	45.5	39.8	85.3	0.84	V40	132	330	84.1	53.1	72.1	1.39
		V36	193	13.9	45.2	41.1	86.3	0.76							
VAR-005	3.55	V11	356	21.8	67.0	28.2	95.2	0.17	V35	280	559	98.0	*76.0*	*85.4*	0.51
									V41	268	440	97.6	*90.2*	*93.0*	0.25
VAR-006	4.77	V4	315	28.8	77.1	21.9	99.0	0.05	V34	294	455	94.7	89.2	93.7	0.31
									V42	281	432	95.8	93.4	95.2	0.23
VAR-007	3.49	V12	340	25.2	64.9	30.7	95.6	0.16	V33	264	484	98.1	*72.3*	*89.5*	0.38
									V43	271	411	96.4	92.1	93.9	0.22
VAR-013	5.27	V8	310	23.6	73.0	24.1	97.1	0.18	V27	209	428	83.8	*91.9*	*97.5*	0.16
									V52	227	370	81.4	92.0	98.1	0.12
VAR-014	5.14	V16	349	24.1	61.9	34.2	96.1	0.25	V26	210	360	87.8	*87.7*	*93.3*	0.43
									V53	196	378	90.2	85.4	97.0	0.20
VAR-015	4.78	V9	382	23.5	58.9	31.2	90.1	0.46	V25	187	506	86.0	*86.8*	*93.4*	0.34
									V54	198	367	87.0	79.5	96.9	0.16
VAR-017	3.23	V17	369	20.8	58.9	35.0	93.9	0.21	V23	178	529	95.3	*86.9*	*91.6*	0.29
									V56	243	398	81.8	89.1	95.7	0.16
VAR-018	3.00	V18	373	19.0	68.6	26.4	95.0	0.15	V22	217	514	93.0	*78.9*	*91.5*	0.25
									V57	206	375	89.7	84.2	95.0	0.16

*PSA on Ro Tail. Target 350 µm

Italicized recoveries based on assay estimates of low-weight cleaner tails

Source: SGS Canada Inc., 2025a)

Table 13-4 Summary Flotation Results of Medium-Grade Variability Samples

Composite	C(t) Assay (%)	Rougher Testing							Cleaner Testing						
		Test #	P_{80}* (µm)	C(t) Assay (%) Combined Flash & Ro	C(t) Recovery (%)			Cg Assay (%) Ro Tail	Test #	P_{80} (µm)		C(t) Assay (%) 7th Clnr Conc	C(t) Recovery		Cg Assay (%) Ro Tail
					Flash	Ro	Flash & Ro			7[th] Clnr Conc	Ro Tail		7[th] Clnr Conc	Flash & Ro Conc	
VAR-001	8.38	V7R	367	23.0	27.9	44.5	72.4	3.03							
		V21	197	20.6			93.3	0.93	V39	132	187	89.6	47.9	75.5	2.64
VAR-008	5.74	V13	278	27.8	69.5	28.5	98.0	0.14	V32	213	445	93.8	87.9	92.5	0.50
									V47	201	377	94.0	92.4	96.9	0.22
VAR-009	6.99	V1	250	33.3	71.0	27.2	98.2	0.17	V31	228	386	83.7	91.2	97.8	0.21
									V48	202	340	85.6	94.2	98.1	0.18
VAR-010	7.62	V14	275	25.4	65.5	33.3	98.8	0.1	V30	198	431	92.2	91.1	96.8	0.28
									V49	238	381	84.4	92.1	98.2	0.16
VAR-011	7.99	V5	310	27.6	69.1	29.5	98.6	0.15	V29	273	546	77.6	87.1	94.4	0.58
									V44	254	400	82.0	91.5	97.4	0.29
									V50	250	428	83.2	88.5	97.6	0.26
VAR-012	5.65	V15	342	18.6	55.4	42.0	97.4	0.18	V28	195	471	84.1	87.7	95.2	0.34
									V51	182	385	80.6	89.7	96.0	0.28
VAR-016	6.89	V10	331	21.0	4.1	94.2	98.3	0.15	V24	217	403	91.2	79.3	97.5	0.23
									V55	200	372	80.7	88.1	96.5	0.31

*PSA on Ro Tail. Target 350 µm

Source: (SGS Canada Inc., 2025a)

Table 13-5 Summary of Flotation Results of High-Grade Variability Samples

Composite	C(t) Assay (%)	Rougher Testing							Cleaner Testing						
		Test #	P_{80}* (µm)	C(t) Assay (%) Combined Flash & Ro	C(t) Recovery (%)			Cg Assay (%) Ro Tail	Test #	P_{80} (µm)		C(t) Assay (%) 7th Clnr Conc	C(t) Recovery		Cg Assay (%) Ro Tail
					Flash	Ro	Flash & Ro			7[th] Clnr Conc	Ro Tail		7[th] Clnr Conc	Flash & Ro Conc	
VAR-003	17.0								V38	195	574	83.9	80.7	90.2	2.53
		V2	290	44.0	66.2	33.2	99.4	0.16	V45	134	407	87.7	88.1	98.5	0.40
VAR-004	18.8	V3	579	51.4	60.8	23.0	83.8	4.48	V37R	189	499	82.4	82.6	96.8	0.98
		V20	328	40.6	60.1	39.4	99.5	0.16	V46	177	397	86.6	81.4	99.1	0.32

*PSA on Ro Tail. Target 350 µm

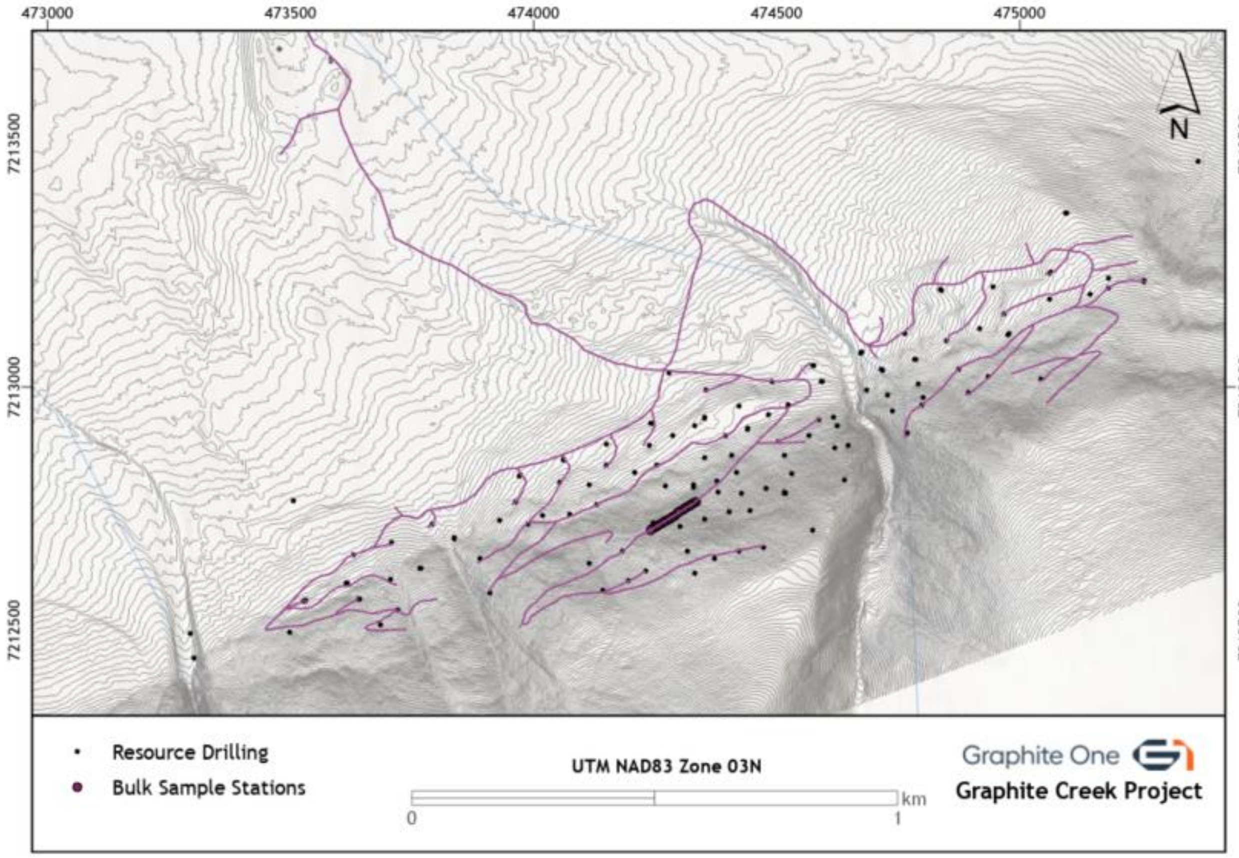
Source: (SGS Canada Inc., 2025a)

13.3.1.3 Pilot Flotation Plant – SGS Canada Inc., Project 17658-05

Introduction

As part of a parallel test program, approximately 9.2 t of Graphite Creek ore was processed through a flowsheet aimed at producing a final concentrate grading of 95.0% C(t) or greater (SGS Canada Inc., 2024b). The as-received material was stage-crushed to minus ¼-inch and composited to prepare a pilot plant composite feed with a head grade of 6.2% C(t).

The sample for this testwork was obtained from surface material at the Graphite Creek site. A bulk sample site was selected in a high-grade zone with surface exposure near the center of the Graphite Creek deposit. Sample sites were located approximately 5 m apart along a 110-m length (see Figure 13-8). Material was sampled along the roadcut of a drill trail using an excavator during the 2023 field season.



Source: Graphite One

Figure 13-8 Map of Bulk Sample Location Relative to Resource Drillholes Near the Center of the Graphite Creek Deposit

Sample Preparation and Characterization

A representative subsample from the pilot plant composite sample was subjected to head analyses, and the results are provided in Table 13-6.

Table 13-6 Head Assay of PP Comp Sample

Element		PP Comp	Element		PP Comp
SiO_2	%	56.8	Ag	g/t	< 0.8
Al_2O_3	%	16.4	As	g/t	< 30
Fe_2O_3	%	8.68	Ba	g/t	943
MgO	%	1.94	Be	g/t	0.45
CaO	%	1.08	Bi	g/t	< 10
NA_2O	%	0.79	Cd	g/t	< 0.9
K_2O	%	2.42	Co	g/t	21
TiO_2	%	1.17	Cu	g/t	29
P_2O_5	%	0.17	Li	g/t	< 40
MnO	%	0.12	Mo	g/t	< 6
Cr_2O_3	%	0.04	Ni	g/t	66
V_2O_5	%	0.03	Pb	g/t	< 20
LOI	%	9.75	Sb	g/t	< 10
Sum	%	99.5	Se	g/t	< 30
S %	%	0.03	Sn	g/t	< 20
C(t) %	**%**	**6.20**	Sr	g/t	110
Cg %	**%**	**6.09**	Tl	g/t	< 30
TOC %	%	0.09	Y	g/t	39.4
TIC %	%	0.02	Zn	g/t	91

Source: SGS Canada Inc., 2024b

The pilot plant was set up using the same flowsheet and conditions as the pilot plant campaign conducted on Graphite Creek ore at SGS Lakefield in 2022 (SGS Canada Inc., 2023), along with the benchmarking laboratory testing ahead of the main pilot plant testing.

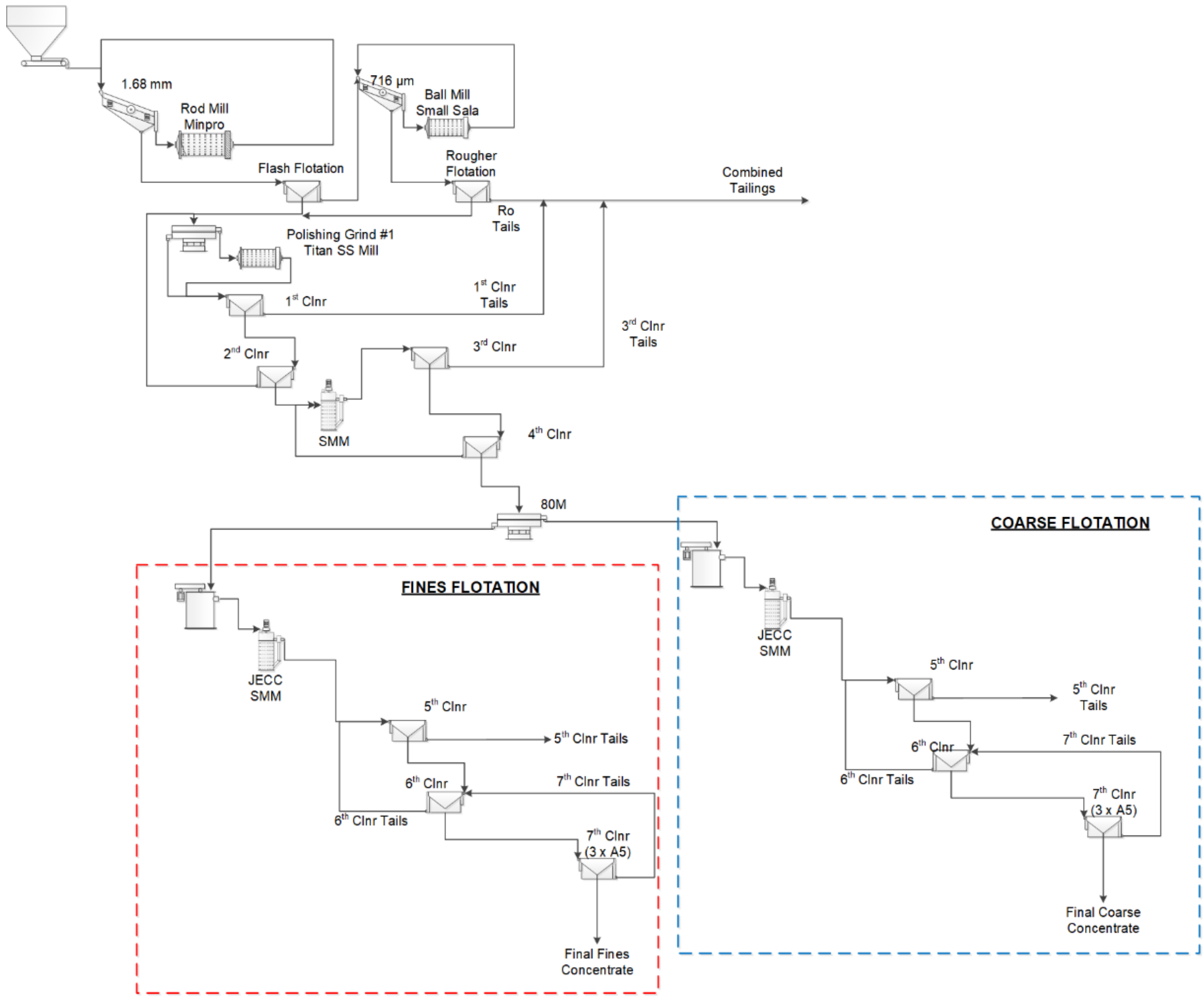
Flotation Testing

The pilot plant campaign was operated in two phases: Phase 1, which included primary and secondary grinding circuits followed by flash/rougher flotation and four cleaning stages; and Phase 2, which involved regrinding the fourth cleaner concentrate, followed by three additional cleaning stages (SGS Canada Inc., 2024b). The overall process flowsheet is shown in Figure 13-9.

Phase 2 was set up to clean and upgrade the fourth cleaner concentrate generated in Phase 1. Based on bench-scale laboratory tests, it was decided that the final concentrate would be produced in separate campaigns processing coarse and fine fractions of the fourth cleaner concentrate. The fine and coarse fractions were separated using wet screening at 80M (180 µm) (SGS Canada Inc., 2024b).

The full mass balances for Phase 1 and Phase 2, including combined tailings and concentrate, are shown in Table 13-7. Results suggested that 95.0% of the total carbon could be recovered in the combined flash and rougher concentrate at a grade of 25.6% C(t). The first four cleaners, together with regrind circuits, upgraded the concentrate to 80.3% C(t) in the fourth cleaner concentrate with a recovery of 92.3%. The further upgrading that occurred in the separate Phase 2 flotation processes achieved seventh cleaner concentrates of 95.9% C(t) at 19% recovery in the coarse fraction and 94.7% C(t) at 68.7% recovery in the fine fraction. The combined concentrate graded 94.9% C(t) at a recovery of 87.8% (SGS Canada Inc., 2024b).

The pilot plant operation produced a total of ~385 kg of graphite concentrates, grading very close to 95% C(t) on average. The P_{80} of the combined concentrate was 166 µm. Grade-by-size analysis showed that only the -400M (-38 µm) concentrate was off-spec with a grade of 92.6% C(t). The grades of coarser concentrates met or exceeded the desired 95% C(t) grade (SGS Canada Inc., 2024b).



Source: SGS Canada Inc. (2024b)

Figure 13-9 Overall Pilot Plant Flowsheet for Project 17658-05

Table 13-7 Combined Phase 1 and Phase 2 Metallurgical Balance

Stream	Wt%	Assays, % C(t)		Recovery, % C(t)
		act	adj	
Plant Feed	100.0	6.19	6.19	100.0
Flash Tails	96.6	5.05	5.02	78.3
Ro Tails	79.0	0.46	0.39	5.0
Comb Flash & Ro Conc	21.0	30.1	28.0	95.0
Phase 1 Combo Tails	92.9	0.51	0.51	7.7
4th Screen OS	1.3	89.2	88.3	19.2
4th Screen US	5.8	79.1	78.4	73.1
C-5th Clnr Tails	0.1	12.1	12.1	0.2
C-7th Clnr Conc	**1.2**	**95.4**	**95.9**	**19.0**
F-5th Clnr Tails	1.3	21.1	21.1	4.3
F-7th Clnr Conc	**4.5**	**94.2**	**94.7**	**68.7**
Combined Tailings	**94.3**	**0.80**	**0.80**	**12.2**
Combined Concentrate	**5.7**	**94.5**	**94.9**	**87.8**

Source: SGS Canada Inc., 2024b

Conclusions

The pilot test results were considered indicative of operations under locked-cycle operation but were not used directly for flowsheet development. The results also demonstrated the flowsheet's adaptability to accommodate specific ore conditions at the deposit's surface (more weathering, finer tails).

Due to the larger available sample of tailings from this test, the pilot tailings were used to provide the geotechnical testwork material. This testwork was conducted in support of the WMF described in Section 18.1.9.2. Because the pilot sample was obtained from the surface, it exhibits a significantly larger fines fraction. This is expected to provide a more conservative result when used for the geotechnical stability analysis.

13.3.2 Comminution and HPGR Testing – SGS Canada Inc., Project 17658-03

Comminution Testing

Several comminution tests, including SAG mill comminution (SMC), Bond rod grindability (RWI), Bond ball grindability (BWI), and Bond abrasion index (Ai) tests were carried out on the Master Comp sample (SGS Canada Inc., 2024a). A summary of the results is presented in Table 13-8. Grinding indices indicated that the master composite was generally softer but slightly more abrasive as compared to the SGS database.

Table 13-8 Summary of Grindability Testing of the Master Comp

Composite	SMC Test® Parameters			Bond Indices		
	A x B	t_a	SCSE (kWh/t)	RWI (kWh/t)	BWI (kWh/t)	Ai (g)
Master Composite	85.5	0.81	7.24	9.7	13.0	0.373

Source: SGS Canada Inc, 2024a

High-Pressure Grinding Roll Testing

Due to the high cost of energy at the Graphite Creek site, an investigation was conducted to evaluate the suitability of HPGR grinding on the Graphite Creek ore in hopes of reducing the energy intensity of the comminution circuit. Testing was conducted at SGS Lakefield on a single sample labeled *HPGR Comp.* The testwork included open- and closed-circuit HPGR grinding tests and flotation tests comparing material reduced via HPGR versus material processed through a standard crushing circuit (SGS Canada Inc., 2025b).

Flotation testing showed that the HPGR process demonstrated a distinct advantage over standard sample preparation in flotation kinetics and grind-size consistency, resulting in faster flotation and higher, more stable recovery rates at the optimal grind size. However, a high-level study comparing the HPGR and SAG mill circuit energy consumption, capital costs, and operational costs concluded that the HPGR circuit would not be advantageous with respect to overall costs (Erickson, M.T., 2025).

13.3.3 Solid Liquid Separation Testing

Pocock Industrial (Pocock) in Salt Lake City, Utah, conducted solid-liquid separation (SLS) tests on representative concentrate and tailings samples for Graphite One. Static thickening tests examined flocculation requirement, hydraulic loading rate, unit area requirements, feed solids concentration sensitivity, and predicted underflow solids concentration (Pocock Industrial, Inc., 2024a, 2024b). Dynamic thickening tests examined feed rate versus flocculant dosage, overflow suspended solids, and underflow density at natural pH on each sample (Pocock Industrial, Inc., 2024a, 2024b). Table 13-9 contains data used to size the concentrate and tailings thickeners.

Table 13-9 Graphite Concentrate and Tailings Thickener Data

Material Tested	Recommended High-Rate Thickener Operating Parameter Ranges							
	Tested Feed Solids(1) (%)	Flocculant			Recommended Net Feed Loading		Predicted Overflow TSS Conc. Rang (mg/l)(6)	Predicted Underflow Density(7)
		Type(2)	Dose(3) (g/Mt)	Conc.(4) (g/l)	Operational Design Basis	Net Feed Loading (m^3/m^2hr)(5)		
Combined-Graphite Concentrate	5.24	SNF923 SH	55 – 60	0.1	Conservative	1.53	150 - 250	30% - 33%
					Moderate	2.62		
					Aggressive	3.73		
New Combined Plant Tails	20%	SNF923 SH	20 – 25	0.1	Conservative	1.93	150 – 250	68%
					Moderate	2.92		
					Aggressive	3.86		

Source: Pocock Industrial, Inc., 2024a, 2024b. See referenced reports for table notes.

Graphite concentrate pressure filtration tests generated a set of filtration data used to design and size the concentrate pressure filters. Tests examined the effect of cake thickness and dry time on production rate and filter cake moisture (Pocock Industrial, Inc., 2024a). A membrane squeeze was recommended to minimize the heating load on the downstream drying unit operation. Pressure filter sizing data is shown in Table 13-10.

Table 13-10 Graphite Concentrate Pressure Filter Data

Material --- Design Condition	Feed Solids Conc.	Dry Bulk Density (MT/m^3)	Design Thickness	Sizing Basis (m^3/MT)(1)	Design Cake Moisture(2)	Total Cycle Time(3) (min)	Volumetric Production Rate(4) (MTPD/m^3)	Area Basis Production Rate(5) (MTPD/m^2)
Thickened Combined-Graphite Concentrate --- Membrane Squeeze with Air Blow	30.8	893.7	Chamber: 50 mm --- Cake: 42.3 mm	1.399	23.5%	12.5	68.64	1.389

Source: Pocock Industrial, Inc., 2024a. See referenced reports for table notes.

Tailings vacuum filtration tests generated data used to design and size vacuum belt filters for the tailings material. The tests examined the effect of cake thickness and dry time on the production rate and filter cake moisture (Pocock Industrial, Inc., 2024a). Vacuum belt filter sizing data is shown in Table 13-11.

Table 13-11 Tailings Vacuum Filter Data

Material	Test Conditions/ Filtration Aid(1)	Feed Solids(2)	Filter Cloth (cfm/ft^2)	Bulk Cake Density (dry kg/m^3)	Cake Thick. (mm)	Filter Cake Moisture (%)	Production Rate (dry kg/m^2 hr)(3)(4)	Design Condition Notes/ Comments
Thickened New-Combined Plant Tails as Received	No Filter Aid	62.6	60 CFM PP Mono/Multi	1,713.5	10	14.8	578.34	14.8% is the upper moisture limit for design
					15	14.8	523.05	
					20	14.8	483.01	
					25	14.8	451.90	

Source: Pocock Industrial, Inc., 2024a. See referenced reports for table notes.
cfm = cubic feet per minute

14 Mineral Resource Estimates

14.1 Introduction

Modeling, resource estimation, and statistics were performed by Christopher Valorose under the supervision of Robert Retherford. The Measured, Indicated, and Inferred Graphite Creek Resource Estimate is reported in accordance with the Canadian Securities Administrators National Instrument 43-101 and has been estimated using the CIM "Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines" dated November 23, 2003, and CIM "Definition Standards for Mineral Resources and Mineral Reserves" dated November 27, 2010. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability. There is no guarantee that all or any part of the Mineral Resource will be converted into a Mineral Reserve.

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

> *An 'Indicated Mineral Resource' is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics can be estimated with a level of confidence sufficient to allow the appropriate application of technical and economic parameters, to support mine planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings, and drillholes that are spaced closely enough for geological and grade continuity to be reasonably assumed.*

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

The project area is based in the UTM coordinate system, North American Datum (NAD) 1983, and UTM Zone 3. Multiple drill programs have been completed in 2012-2014, 2018-2019, and 2021-2024. A total of 94 holes drilled in 2022, 2023, and 2024 were added to the drillhole database since writing the 2022 PFS. The drill data within the resource area was provided in a series of .csv files exported from an acQuire database. A total of 157 drillholes have assay data available. All collar coordinates, down hole surveys, assays, and geologic data were compared to original logs and assay certificates, and no significant discrepancies were found.

Results from previous resource estimations and geologic modeling were provided and used as a basis for future modeling. Lithologic units, overburden, and faults were provided as updated wireframes or were updated using the new data. Mineral resource modeling, estimation, and statistics were carried out using the commercial mine planning software Vulcan (version 2024.3).

14.2 History

A series of resource estimations have been made as exploration progressed from 2013 to 2024. Parameters for previous estimates are as follows:

- A maiden Inferred Resource estimate was calculated in 2013 using 17 diamond drillholes arrayed over a 2.2 km (1.3 miles) strike length (Duplessis et al., 2013). Seven of those holes were in the southwestern 900 m of the 2012 drill pattern, which is within the current proposed pit footprint. 2013 Inferred Resource: 6.2 Mt of in situ Cg at 5.78% using 3% cut off, in 107.2 Mt.
- After the 2013 drilling campaign (which extended the resource along the strike about 400 m northeast and about 2.3 km southwest), a new Inferred Resource using 28 holes was calculated for the expanded 4.7 km strike length (Eccles & Nicolls, 2014). 2014 Inferred Resource: 10.35 Mt of in situ Cg at 5.54% using 3% cut-off, in 186.9 Mt.
- After the 2014 drilling program, an Indicated resource estimate was prepared for a 730 m strike length segment of the drill-tested trend and an Inferred Resource for the 4000 m of strike outside of the Indicated Resource area. 2015 Inferred Resource: 8.76 Mt of in situ Cg at ~6% using 3% cut-off, in 154.36 Mt. Indicated Resource: 1.13 Mt of in situ Cg at ~6.3% using 3% cut-off, in 17.93 Mt. (Eccles et al., 2015).
- A revised restatement of resources was done in a PEA in 2016. 2016 Inferred Resource: 8.77 Mt of contained Cg at 5.7% using 3% cut-off, in 154.44 Mt. Indicated Resource: 1.13 Mt of contained Cg at 6.3% using 3% cut-off, in 17.97 Mt.
- A statement of resources in the 2017 NI 43-101 PEA reported the same resource as the 2016 PEA.
- After the 2018 drilling, a new Inferred, Indicated, and Measured Resource was calculated (King et al., 2019). Inferred Resource: 7.34 Mt of contained Cg at 8.0% using 5% cut-off, in 91.89 Mt. Indicated Resource: 0.72 Mt of contained Cg at 7.7% using 5% cut-off, in 9.26 Mt. Measured Resource: 0.14 Mt of contained Cg at 8.0% using 5% cut-off, in 1.69 Mt Cg at 8.0% using 5% cut-off, in 1.69 Mt.
- A new resource estimate was calculated for the 2022 PFS that included drilling through most but not all of the 2022 season (Goodwin et al., 2022). Inferred Resource: 13 Mt of contained Cg at 5.11% using a 2% cut-off, in 254.67 Mt. Indicated Resource: 1.44 Mt of contained Cg at 5.15% using a 2% cut-off, in 27.87 Mt. Measured Resource: 0.27 Mt of contained Cg at 5.83% using 2% cut-off, in 4.67 Mt.
- When the entire 2022 drilling season data was available, updated resource values were shared via press release in 2023. Inferred Resource: 12.34 Mt of contained Cg at 5.07% using 2% cut-off, in 243.70 Mt. Indicated Resource: 1.61 Mt of contained Cg at 5.03% using a 2% cut-off, in 31.96 Mt. Measured Resource: 0.32 Mt of contained Cg at 5.63% using 2% cut-off, in 5.63 Mt.

14.3 Drillhole Data

14.3.1 Drillhole Database Validation

Previously, Graphite One maintained multiple databases. For the PFS of 2022, all data was consolidated and validated into a single Microsoft Access database for use going forward. Since the PFS, the database was transferred and validated into an industry-standard acQuire database. Data provided for the resource estimation was provided in multiple .csv files exported from the Graphite One acQuire database. The provided data was compared to previous estimation data, and no discrepancies were noted in assay, down hole survey, or geology data. However, due to updated surveys, minor changes to collar locations of 2018 and 2019 drillholes were noted. Previous resource estimations included a full comparison of the drillhole databases to the original logs and assay certificates. Drill data since the PFS has been compared to original logs and assay certificates.

The methods used for surveying drill collar locations and down hole surveys are described in Chapter 10, Section 10.2.

When compared to the original logs, minor differences were found in the 2012-2014 collar coordinates within the database provided. One 2012 hole (12GCH008) had a 2-m difference in the Y coordinate, and all 2014 drillholes had minor X and Y coordinate discrepancies of less than 0.72 m. Differences in elevation up to 5.4 m were also seen, primarily in the 2012 drilling, with more minor differences seen in the 2014 drilling. In all cases, the discrepancies are considered insignificant, and coordinates provided in the drillhole database were used in resource estimation as the database had been verified and used in previous estimates.

All EZ-Shot down hole surveys were compared with original logs, and one discrepancy in hole 13GCH013 was found and corrected. The remaining multi-shot surveys were reviewed visually when loaded in Vulcan, and no significant issues were seen. The 2012-2014 survey results all used a standard declination correction of 12.016777. Due to the project's location, declination can vary significantly from year-to-year, and thus, it was determined to use new correction factors for 2012, 2013, and 2014 data. Down hole surveys for 2012-2014, 2018-2019, 2021-2022 have been corrected using a declination determined by using the magnetic field calculator on the NOAA website. The down hole surveys in 2023 and 2024 had their declination determined by the online survey tool software in ImdexHub and were imported directly into the database from the cloud. The maximum difference in sample location (the bottom sample in all holes) when using the new declination correction factor was less than 1.7 m in all holes, and the average maximum distance was approximately 0.7 m (Table 14-1).

Table 14-1 Maximum Difference in Sample Location Using Updated Declination in Down Hole Surveys

HOLE ID	Max Difference (m)	HOLE ID	Max Difference (m)
12GC001	1.612	13GCH014B	0.761
12GC002	1.364	13GCH015	0.791
12GC003	0.965	13GCH016	0.572
12GC004	0.962	13GCH017	1.065
12GC005	0.895	14GC014	0.016
12GC006	1.020	14GC018	0.060
12GC007	1.002	14GCH001	0.959
12GC008	0.840	14GCH002	0.452
12GC009	0.798	14GCH003	0.755
12GC010	0.816	14GCH004	0.925
12GCH001	0.658	14GCH005	0.833
12GCH002	0.618	14GCH006	1.207
12GCH003	0.631	14GCH007	0.954
12GCH004	0.602	14GCH008	0.918
12GCH005	0.109	14GCH009	0.094
12GCH006	0.669	14GCH010	0.110
12GCH007	0.640	14GCH011	1.097
12GCH008	0.674	14GCH012	0.052
13GCH009	0.809	14GCH013	0.935
13GCH010	0.779	14GCH015	0.642
13GCH011	0.664	14GCH016	0.099
13GCH012	0.681	14GCH017	0.948
13GCH013	0.617	14GCH019	0.899
13GCH014A	0.319	14GCH020	0.769
Average	**0.722**		

Logged lithology in the drill database was compared to the original logs with no errors or omissions found.

All assay results for Cg (%) were compared to original certificates, and 100% of the assay results in the provided database were verifiable with no errors or omissions found.

Density data was also provided, but no comparisons back to original logs or certificates were undertaken. Rather, a visual and statistical validation was undertaken with no significant errors discovered.

After validating the provided data, a Vulcan database was created for further modeling, statistics, and resource estimation. No overlapping samples or geologic intervals were found. The Vulcan database used in resource modeling and estimation is considered reliable for mineral resource estimation purposes.

14.3.2 Data Summary

The drillhole database is composed of 188 drillholes—33 of which are metallurgical, geotechnical, or abandoned holes with no assay data available. Of the 155 remaining holes with assay data, three holes are outside the resource estimation boundary. All 155 holes with assay data are included in the statistical summary and resource estimation as search ellipses can potentially search beyond the block model boundary. A summary of the final assay data available is provided in Table 14-2.

Table 14-2 Summary Statistics for Unconstrained Graphite Samples

Final Assay Data - All Graphite Samples	
Count	22,805
Mean	2.90
Standard deviation	4.35
Maximum	81.90
Upper quartile	3.63
Median	1.78
Lower quartile	0.42
Minimum	0.02
Variance	18.95
Coeff. Of Variation	1.50
Percentile 10	0.02
Percentile 20	0.27
Percentile 90	6.44
Percentile 99	22.00

The Graphite Creek resource estimate has been calculated utilizing the Cg percent assay grade. Graphite is the only commodity at this stage demonstrating potential for economic concentration. Previous resource modeling interpreted nine mineralized lodes using an approximate 3% Cg cut-off. The interpretation was updated with the new 2023 and 2024 drill results. All mineralized wireframes/solids were snapped directly to drilling to provide distinct contacts between mineralized and unmineralized zones (see Section 14.4.2, Lode Models). It should be noted that the more densely drilled lodes with abundant samples have an excellent single population and log normal bell curve (lodes 01 to 03), whereas when the number of drillholes intersecting the respective lode decrease, the number of samples within that lode are less, and as such, the data populations are more erratic (albeit still exhibiting single populations). Because the Graphite Creek samples exhibit a single population, linear estimation techniques were applied. Summary statistics, histograms, and log normal curves for each lode are provided in Figure 14-1 through Figure 14-11.

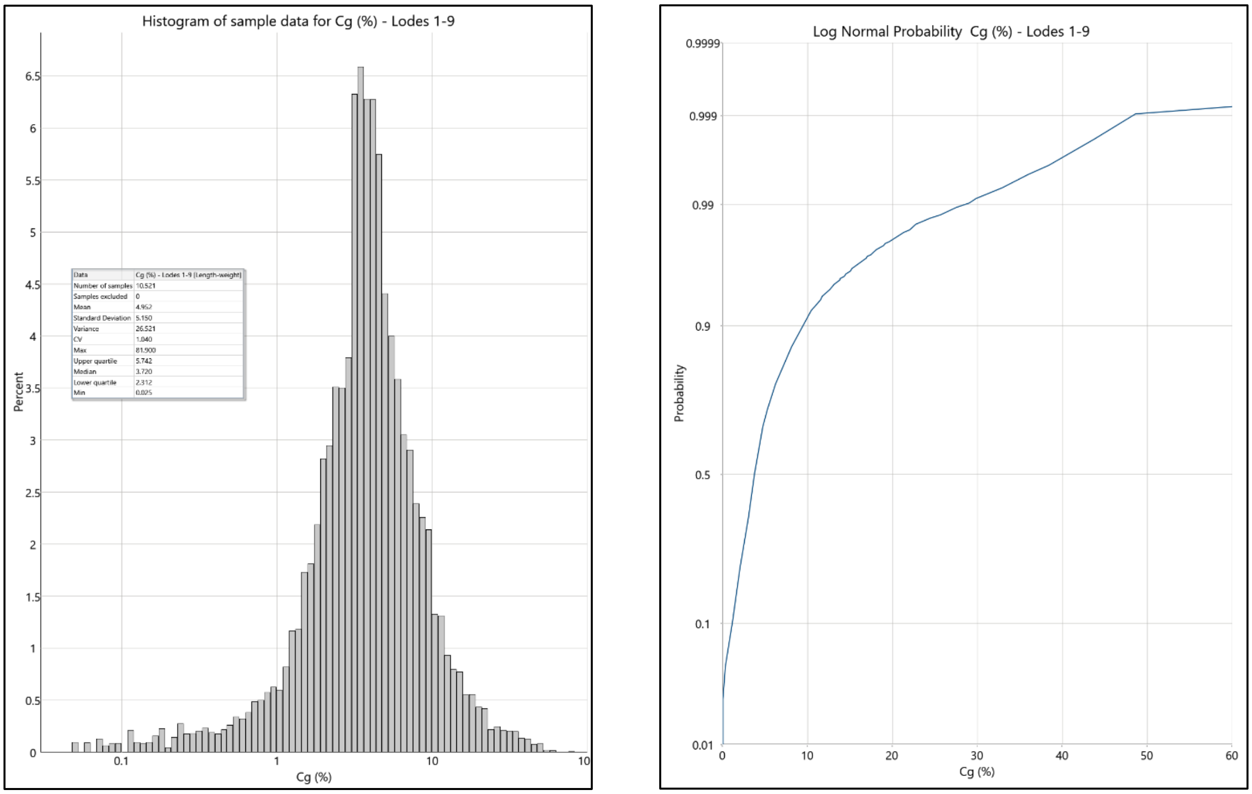


Figure 14-1 Histogram and Probability Plot of Cg (%) Sample Data in All Lodes

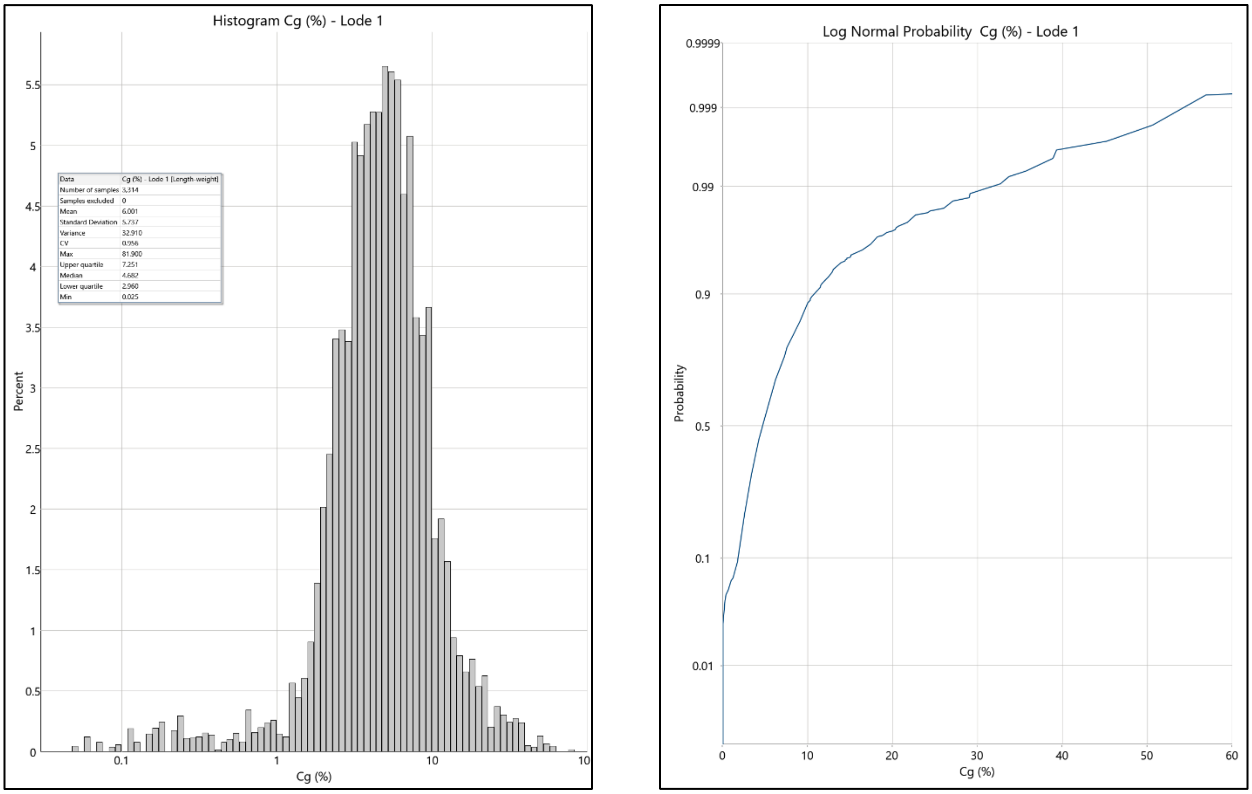


Figure 14-2 Histogram and Probability Plot of Cg (%) Sample Data in Lode 1

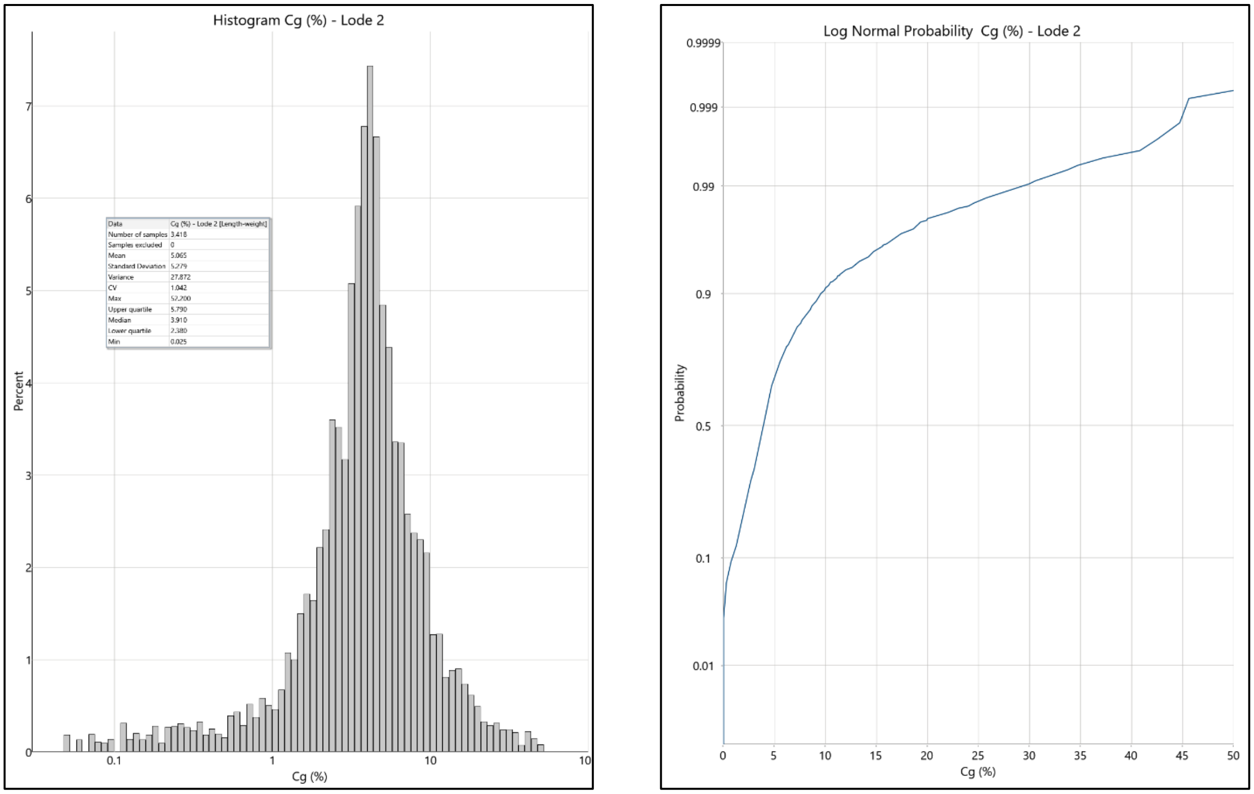


Figure 14-3 Histogram and Probability Plot of Cg (%) Sample Data in Lode 2

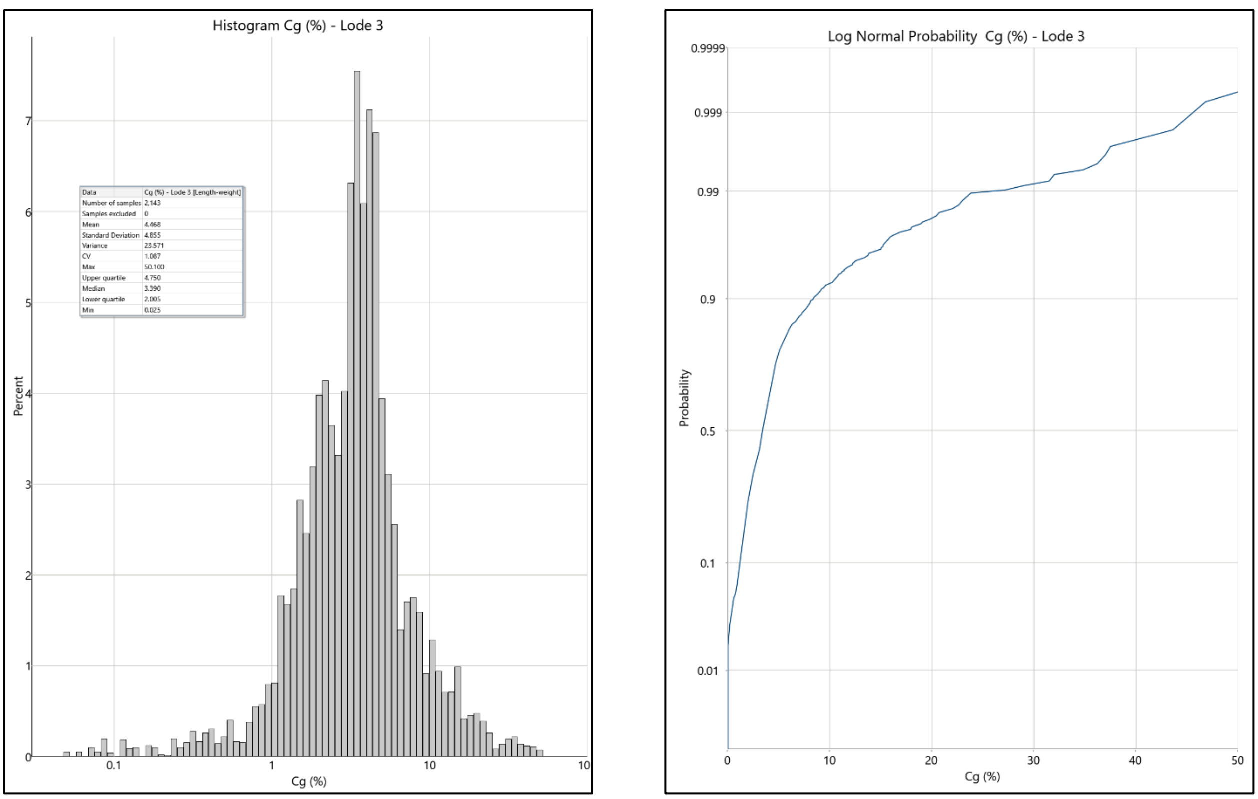


Figure 14-4 Histogram and Probability Plot of Cg (%) Sample Data in Lode 3

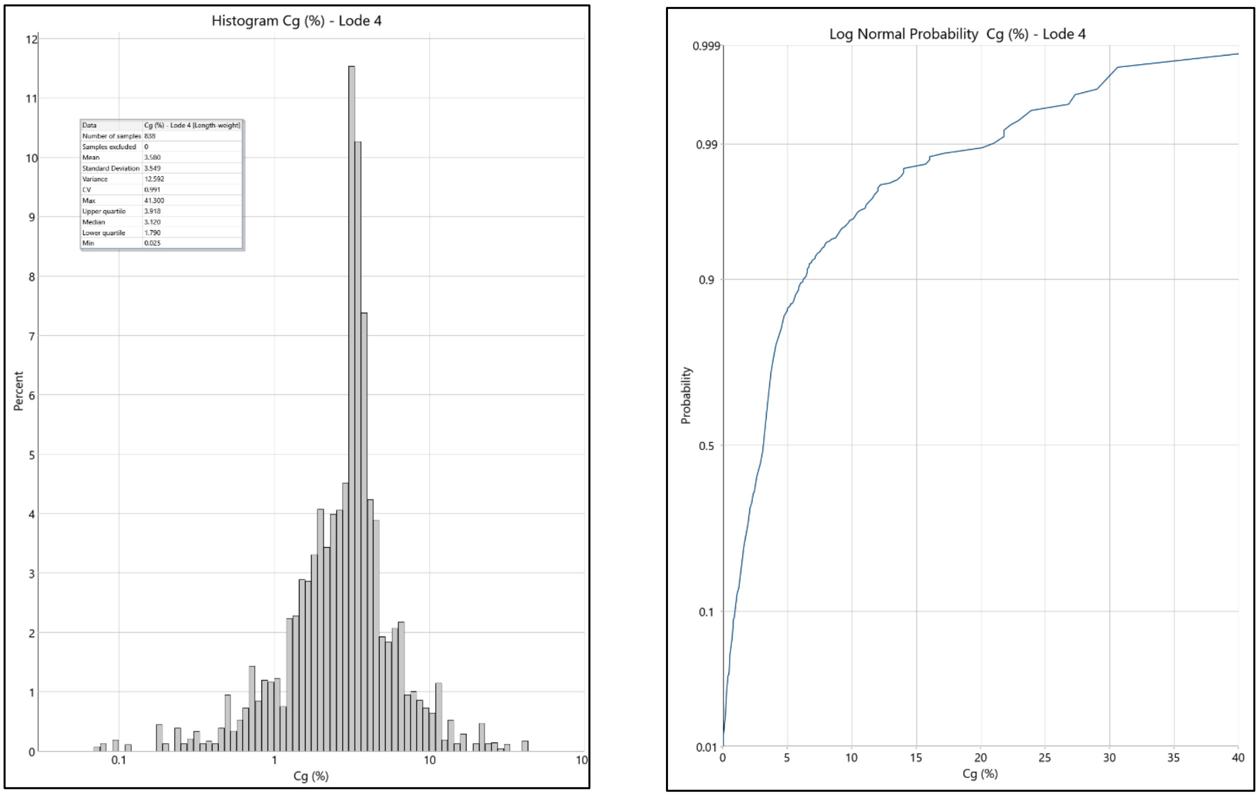


Figure 14-5 Histogram and Probability Plot of Cg (%) Sample Data in Lode 4

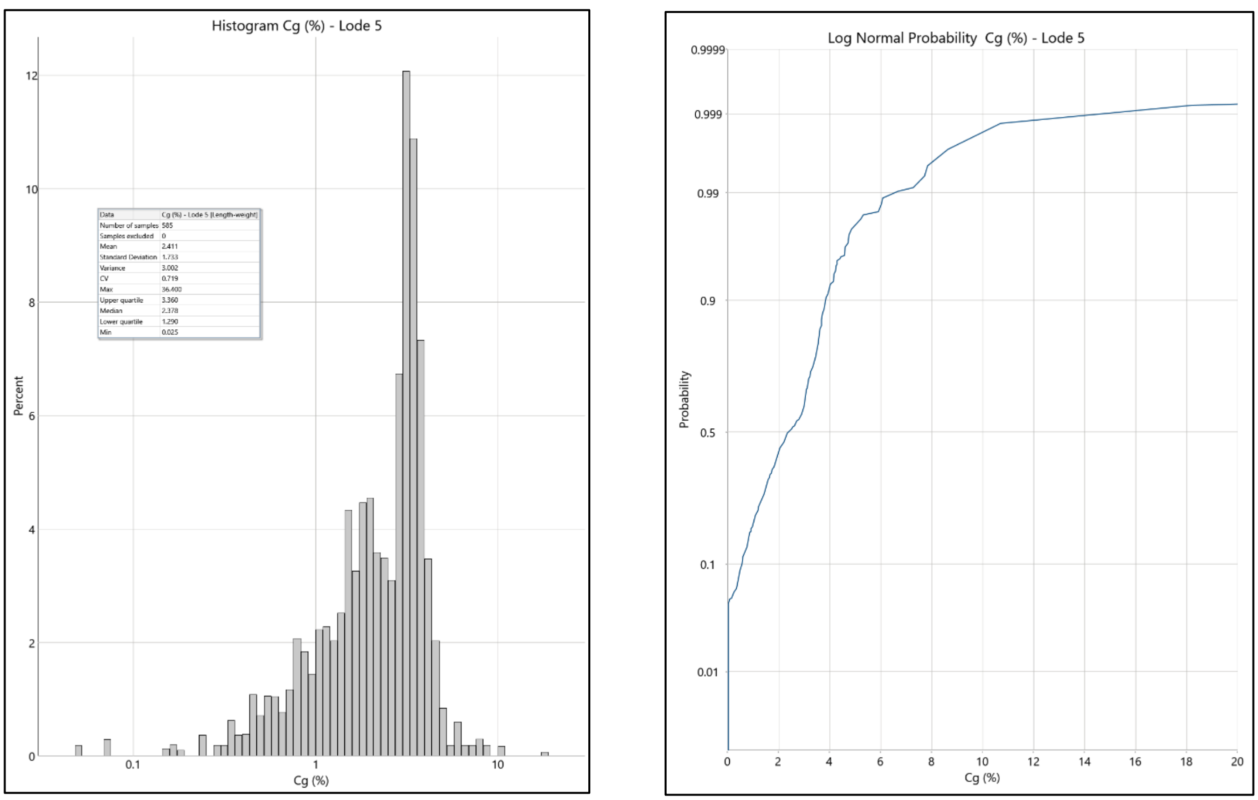


Figure 14-6 Histogram and Probability Plot of Cg (%) Sample Data in Lode 5

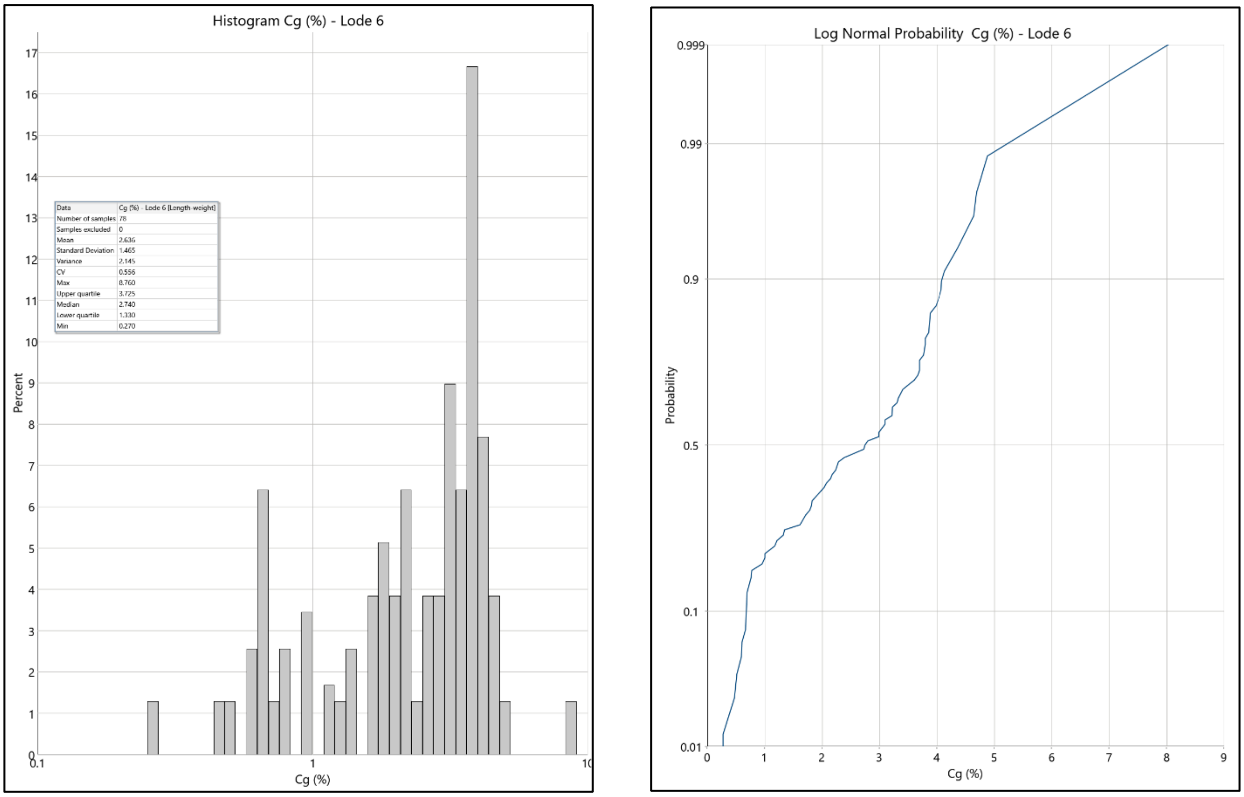


Figure 14-7 Histogram and Probability Plot of Cg (%) Sample Data in Lode 6

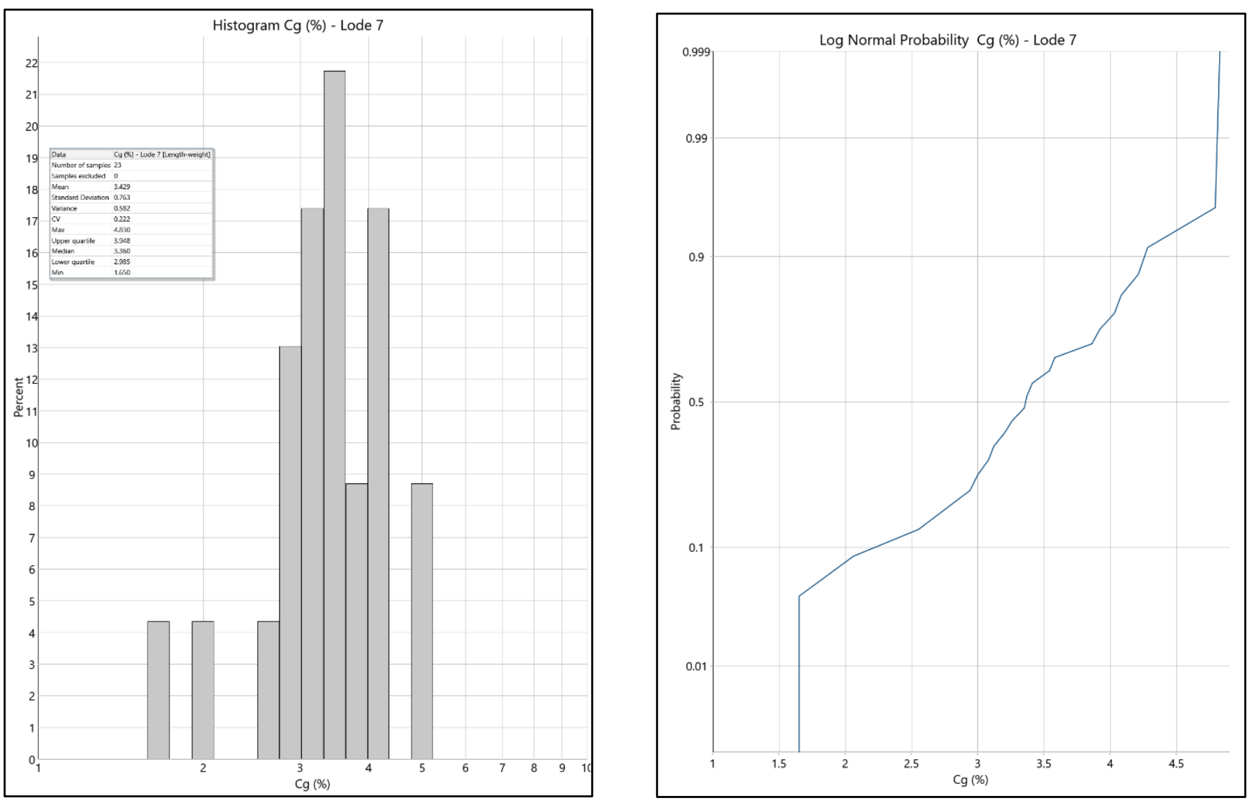


Figure 14-8 Histogram and Probability Plot of Cg (%) Sample Data in Lode 7

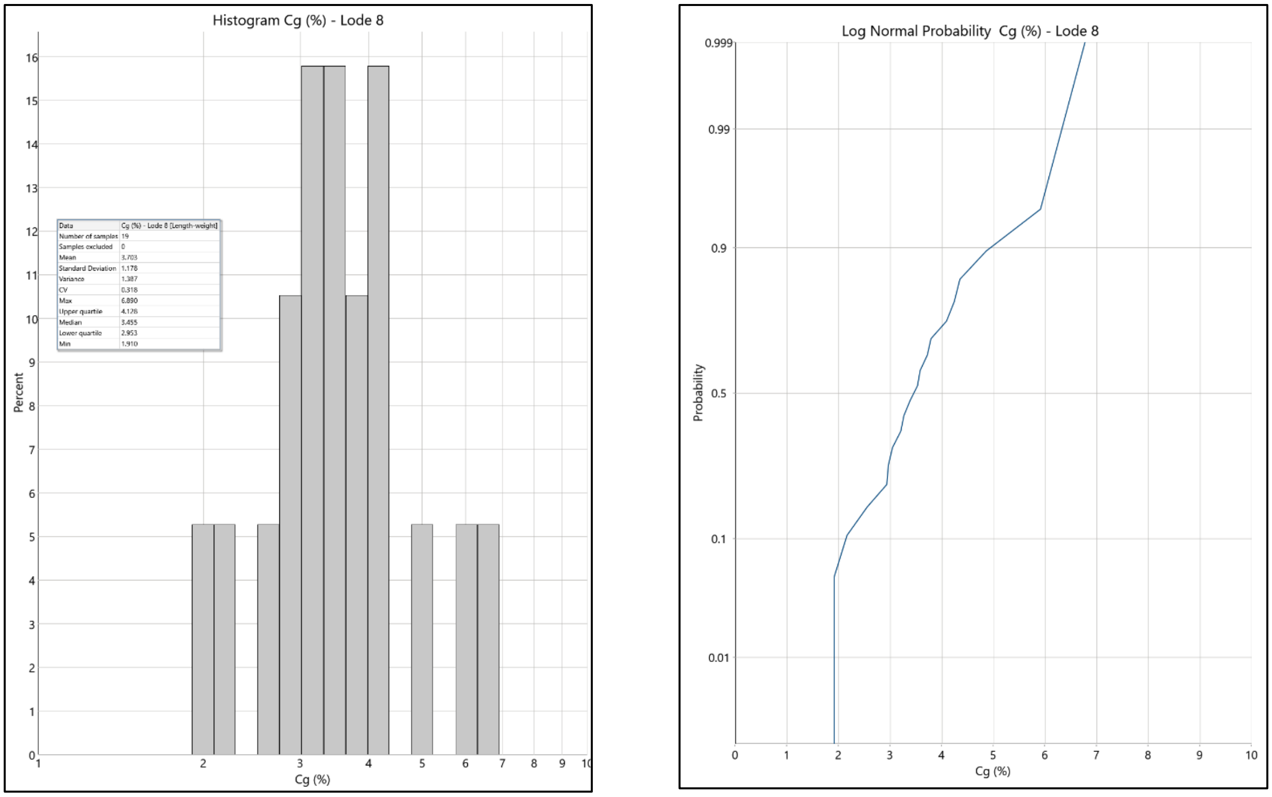


Figure 14-9 Histogram and Probability Plot of Cg (%) Sample Data in Lode 8

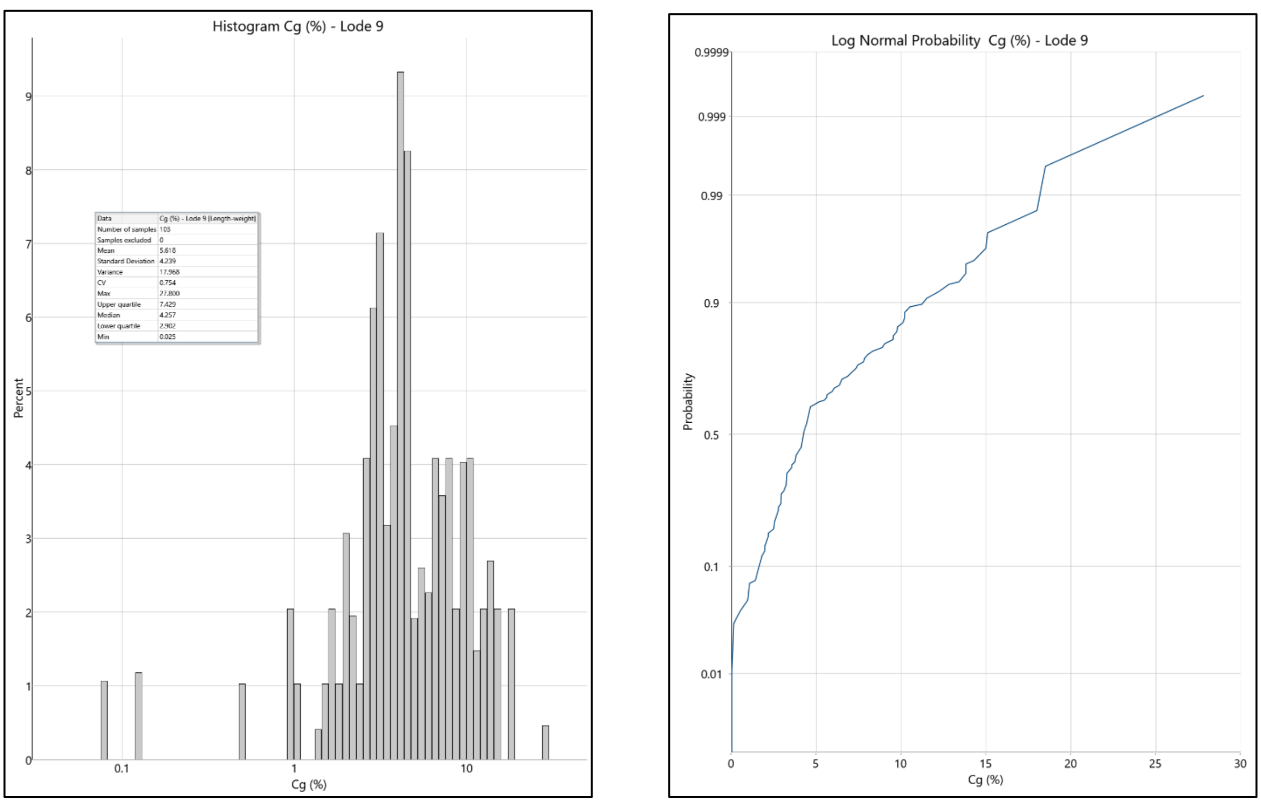
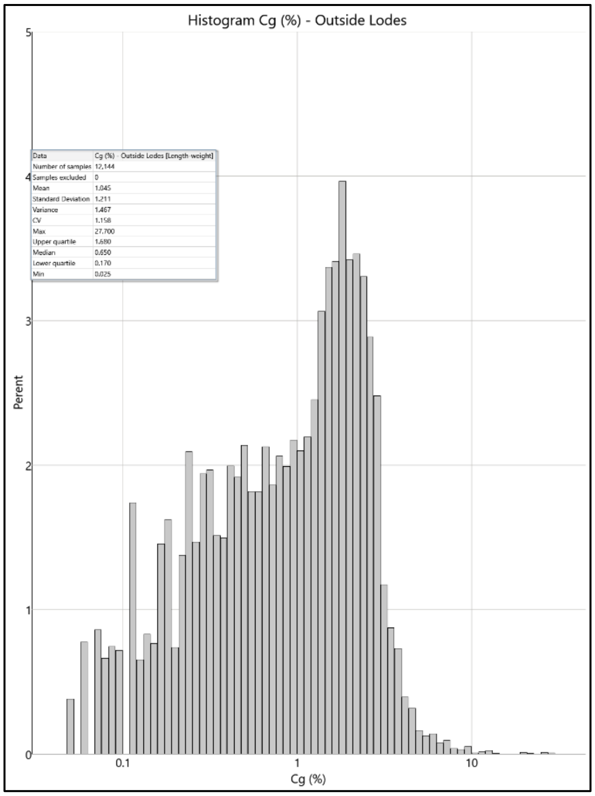


Figure 14-10 Histogram and Probability Plot of Cg (%) Sample Data in Lode 9



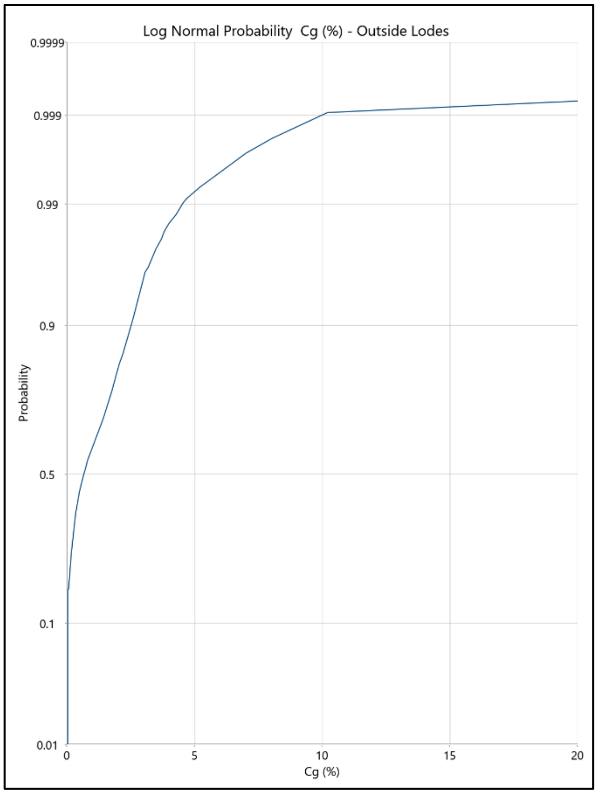


Figure 14-11 Histogram and Probability Plot of Cg (%) Sample Data Outside Lodes

14.4 Geological Models

14.4.1 Topography

During the 2018 and 2022 seasons, light detection and ranging (lidar) was flown over the project area and the two proposed access corridors. The lidar data created a topographic surface covering the entire deposit area with an approximate one-meter grid resolution. The final topographic surface was used for resource estimation purposes.

14.4.2 Lode Models

Nine different mineralized lodes have previously been recognized in the project area. Previous estimations have used a 3.0% Cg lower cutoff for lode interpretation, and this practice was continued with allowances of lower grade to allow for continuity of individual lodes. The mineralized lodes were updated using the following process:

- Wireframe solids of previous estimation lodes were provided
- The wireframe points were extracted, and relevant points were snapped to drillholes at sample locations accounting for a 3% Cg lower cutoff
- A hanging wall surface and footwall surface for each lode was created. The standard smoothing and filtering process in Vulcan was used to create a smoother, more geologically reasonable interpretation. Care was taken to honor all drillhole snapping

- The resulting hanging wall and footwall surfaces were combined into a 3-D wireframe solid
- All lodes were extended beyond overburden, topography, Graphite Creek Fault, and the Kigluaik Fault

From previous reports, the mineralization was extrapolated down dip approximately 150 m from the drillhole and extrapolated up-dip to the surface. Rock chip samples collected during the 2012 field season confirmed mineralization at the surface. The lodes were extrapolated halfway to the next drill section or 90-to-120 m along strike from the last drillhole.

The top of the lodes was either cut by one of the overburden surfaces (see Section 14.4.2) or the topographic surface described (see Section 14.4.1). The down-dip mineralization was either extended 150 m down dip from the nearest drillhole or was cut in instances where the extension of mineralization intersected the interpreted Kigluaik Fault surfaces (see Section 14.4.5). Lodes 1 through 5 intersected the Graphite Creek Fault and are cut into an East and West Lode.

14.4.3 Lithological Models

A geologic lithology model was created in Leapfrog Geo software prior to the 2024 field season and rebuilt post-season with 2024 mapping and drill results. The geologic model boundary matches the resource boundary. The implicit geologic model is based primarily on logged lithology intervals in drillholes, simplified and composited by modeler discretion using the select interval tool. The model is further constrained by the bedrock map polylines of the pit area and structural discs created from surface and drillhole structural measurements and lidar surface morphology. The following units were modeled: overburden (OB), the Kigluaik Fault (K-Fault), felsic intrusive (INF, PEG), quartz diorite (QDIO), mafic intrusive (INM), marble (MBL), quartz-biotite (± sillimanite) schist (QBS, QBSS), quartz-biotite-garnet-sillimanite schist (QBGSS), and quartz-biotite-garnet schist (QBGS). The overburden, Kigluaik Fault, and quartz diorite were used in the resource model; the remaining lithology units were not used during resource estimation.

The Kigluaik Fault is the most important structure in the resource area. It forms a hard boundary between unmineralized overburden in the hanging wall and the ore-hosting bedrock in the footwall. The Kigluaik Fault also exists as a distinct zone that carries some graphite ore with an average thickness of roughly 10 m. Due to the presence of graphite ore, the Kigluaik Fault is modeled as both a domain boundary/mesh and a tabular volume.

The upper limit of the fault is modeled as a 3D mesh surface with no volume, defining the contact between unmineralized overburden above and mineralized fault zone and bedrock below. The hanging wall surface is built using a combination of contact points (between OB/NR and FLT), structural discs interpreted from surface morphology (lidar surface points from OTS), and manual adjustments. The solid volume of the fault zone is built using contact points (between FLT and underlying bedrock) and manually placed structural discs. The base of the fault solid is equivalent to the footwall of the Kigluaik Fault. Drilling data indicates the Kigluaik Fault has been eroded away locally and replaced with overburden; the footwall block is modeled to reflect this, see Figure 14-12.

The overburden unit is modeled based on logged intervals. Where logged data was absent, it was modeled as the material between the Kigluaik Fault hanging wall and surface topography. This interpretation is supported by all available drill log data.

The quartz diorite (QDIO) is modeled based on logged intervals and mapped surface expression.

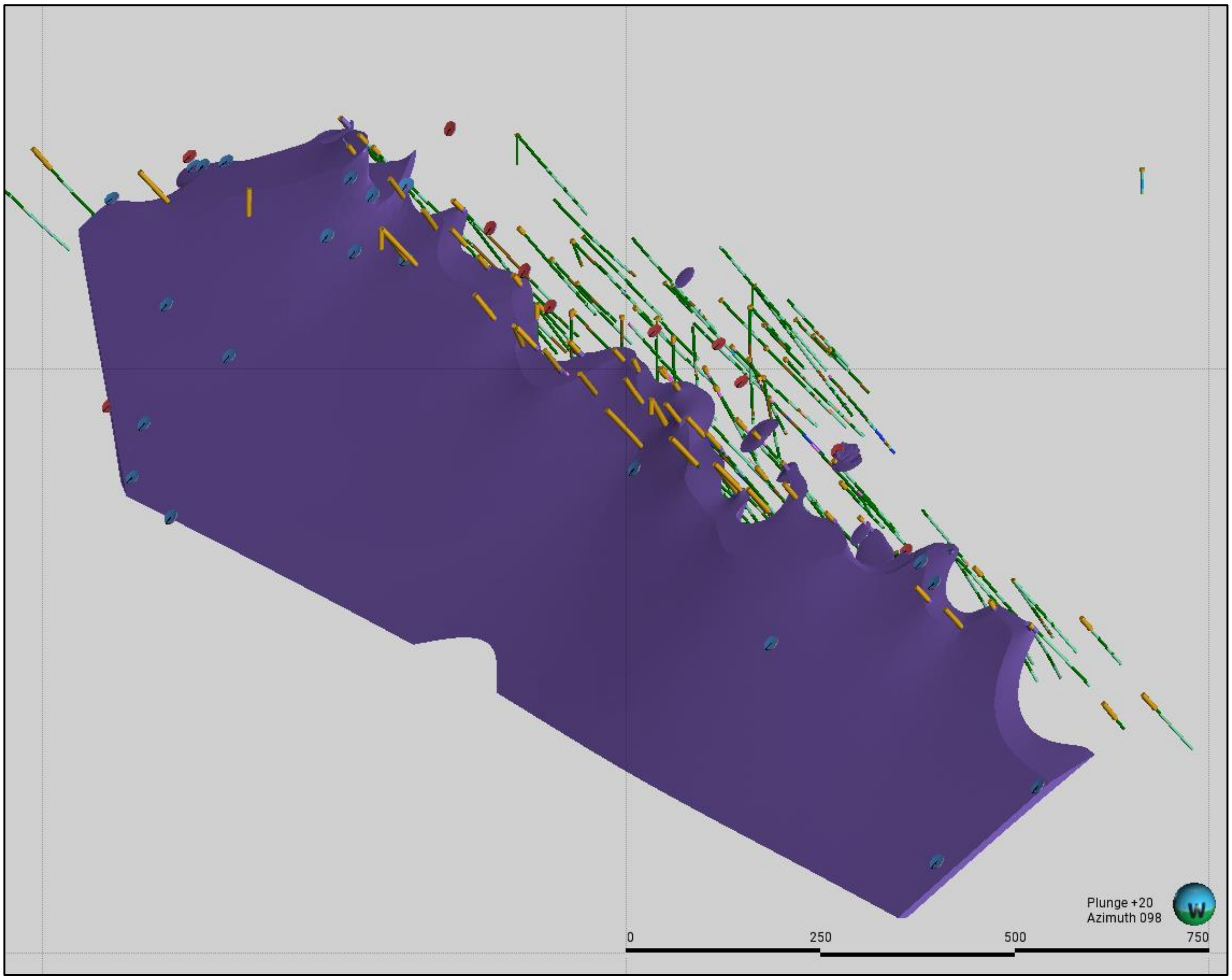


Figure 14-12 The Kigluaik Fault Surface (Purple) with Drillhole Lithology and Structural Discs as Modeled in Leapfrog Geo Software

Additional work on the deposit's lithological model is ongoing. Further incorporation of lithological controls into the estimation is warranted and can potentially affect future resource estimations. However, the current resource estimation is considered appropriate, and further incorporation of lithological controls is not expected to have a significant large-scale effect on the model.

14.4.4 Overburden Model

Two overburden models were created for use in the resource model. Both models were compared after creation and were approximately equivalent.

Using the Leapfrog Geo software, an overburden solid was created as part of the overall lithologic model described in Section 14.4.3 and was applied to flag the block model.

An additional overburden surface was created in a similar detailed manner as the lithology models described in Section 14.4.3. Additional points were added beyond the drilling area to extend the surface appropriately. Care was taken to snap the surface to drill intercepts and to correlate the surface well to previous models. This surface was used to flag all samples above it as overburden, and these samples were not included in the resource estimation.

14.4.5 Fault Models

One major fault is present in the project area:

- The Kigluaik Fault is a major range-bounding fault trending NE-SW throughout the resource area. North of the fault is deep overburden

One minor fault is presumed to be present in the project area:

- The Graphite Creek Fault is interpreted as a NW-SE trending fault and is a bounding surface for the mineralized lodes. The lodes intersecting the fault are split at the fault surface into an East and West Lode. Four drillholes have interceptions that are interpreted to be part of this fault (19GC027, 21G061, 12GC001, and 23GC102).

Previous interpretations included a West Fault, which was modeled in a N-S orientation on the western edge of the main resource area. However, the fault has not been updated and is no longer considered a main fault in the deposit.

The Kigluaik Fault has been modeled as a major range-bounding fault throughout the project’s history. Originally, the fault was modeled as a simple vertical surface, as no drilling intersected the fault. The 2021 drill results included six holes drilled down dip of the fault surface, intersecting the Kigluaik Fault at approximately 40 m in depth. These intersections, plus structural information obtained from the oriented core, indicate the fault has a dip of approximately 45° to the northwest as opposed to a more vertical dip. Subsequent drilling has included drilling north of the fault, and all intercepts indicate a similar shallow dip throughout the length of the deposit. The shallower dip allows mineralization to extend down dip without being truncated. The Kigluaik Fault was modeled as part of the deposit-wide lithology model described in Section 14.4.3. The hanging wall surface was used to flag the block model.

The majority of the Graphite Creek Fault has been interpreted from pre-2019 geologic interpretations. The Graphite Creek Fault was intersected during the 2019, 2021, and 2023 seasons. The Graphite Creek Fault was adjusted to account for the new intersection points.

It should be noted that the Kigluaik Fault continues to be a driving factor in global resources. The shallow dip continues to be encountered in drilling. However, additional clarification of the fault orientation outside of the core resource area, particularly to the northeast direction is needed. Additional drilling is needed to define the Graphite Creek Fault further and its effect on the East and West lodes.

14.5 Drillhole Flagging and Compositing

Drillhole samples situated within the mineralized lodes were selected and flagged with the wireframe name/code. The flagged samples were checked visually next to the drillhole to check that the automatic flagging process worked correctly and that wireframes were snapped to drillholes correctly. All samples were correctly flagged, and there was no need to manually flag or remove any samples.

The drillhole sample width analysis showed a variable sample length from 0.1 m to 5.13 m with a dominant sample length population at 1.0 m (Table 14-3 and Figure 14-13). The majority of the samples are nominal 1.0 m. Within the mineralized lodes, only 12 samples are above 2.0 m in length (0.35%). Previous estimations selected a composite size of 3.0 m. The current estimation selected a composite size of 2.0 m because it portrays a more realistic interval equivalent to the anticipated mining unit, provides more detail within mineralized lodes, and compares well with potential mining equipment size.

Table 14-3 General Statistics for Sample Length (m)

	ALL	Outside Lode	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9
Count	22,805	12,144	3,314	3,418	2,143	838	585	78	23	19	103
Mean	0.93	0.93	0.93	0.91	0.92	0.92	0.93	1.00	1.00	1.00	0.95
Standard Deviation	0.22	0.19	0.28	0.21	0.19	0.17	0.15	0.05	0.00	0.00	0.17
Maximum	0.05	0.04	0.08	0.05	0.03	0.03	0.02	0.00	0.00	0.00	0.03
Upper Quartile	0.23	0.21	0.30	0.23	0.20	0.18	0.16	0.05	0.00	0.00	0.18
Median	5.13	3.15	5.13	4.00	3.05	1.32	1.31	1.31	1.00	1.00	1.19
Lower Quartile	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Minimum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Coeff. of Variation	0.93	0.95	0.90	0.89	0.95	0.93	0.97	1.00	1.00	1.00	1.00
Variance	0.01	0.04	0.10	0.13	0.01	0.30	0.21	0.69	1.00	1.00	0.34
Percentile 10	0.61	0.61	0.58	0.59	0.62	0.63	0.69	1.00	1.00	1.00	0.70
Percentile 20	0.84	0.87	0.77	0.79	0.87	0.84	0.92	1.00	1.00	1.00	1.00
Percentile 90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percentile 99	1.37	1.30	1.53	1.25	1.15	1.15	1.04	1.07	1.00	1.00	1.16

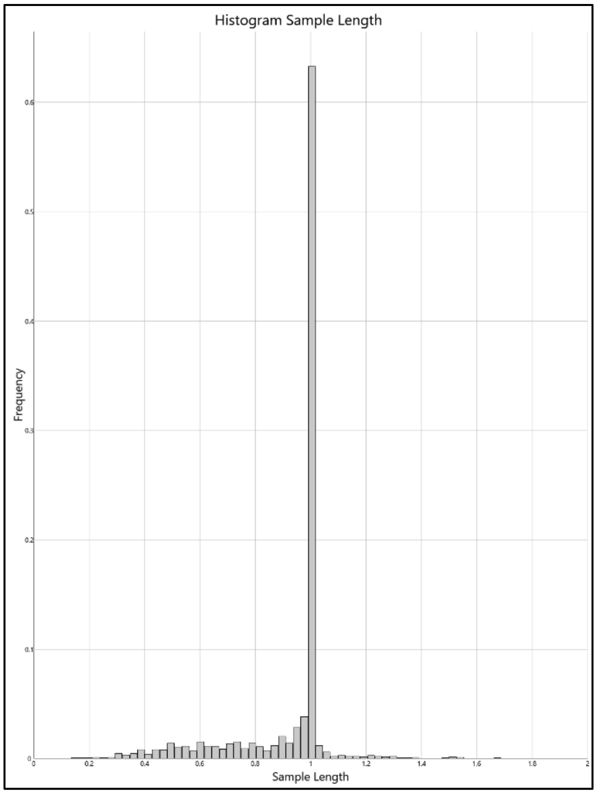


Figure 14-13 Histogram of Sample Lengths for Drill Core Assay Data

Length-weighted composites were calculated for all the graphite assay samples. The compositing process starts from the first point of intersection between the drillhole and the mineralized wireframe and is stopped at the end of the mineralized wireframe. Small (orphan) composites were distributed evenly among intervals of the same mineralized wireframe. Un-assayed intervals were ignored in the composite process.

Upon completion of the 2.0 m compositing process, the composites were examined to determine if any noticeable biases were applied to the grades during the compositing process. There was little to no change in the grade for the Graphite Creek sample file. The composited samples were used for sample statistics, capping, estimation input files, and validation comparisons.

14.6 Data Analysis/Grade Capping/Outlier Restrictions

Composites within the nine lodes were examined for capping analysis. Log probability plots and histograms of the composites for each of the nine lodes are seen in Figure 14-4 through Figure 14-25. The figures show that the graphite values (% Cg) belong to a consistent population within each lode and do not require capping of the data. There is the appearance of a higher-grade population as seen at the tailing end of the histograms above approximately 10%. However, the end of the histogram shows continuity of grade rather than anomalous grade or outlier data. Such high grade is supported by field visits and observations in the core during all drill seasons. Due to the low coefficient of variation and lack of clear high-grade outliers, it was decided not to apply capping to the estimation within lodes 1 through 9.

It was determined to use capped composites when estimating blocks outside of lodes 1 through 9. A graphite value of 25% was used to cap the raw assay data prior to compositing. Overall, the value of 25%

is the approximate 99th percentile. Capping at 25% affects approximately 193 composites and results in a loss of about 1.8% of GT.

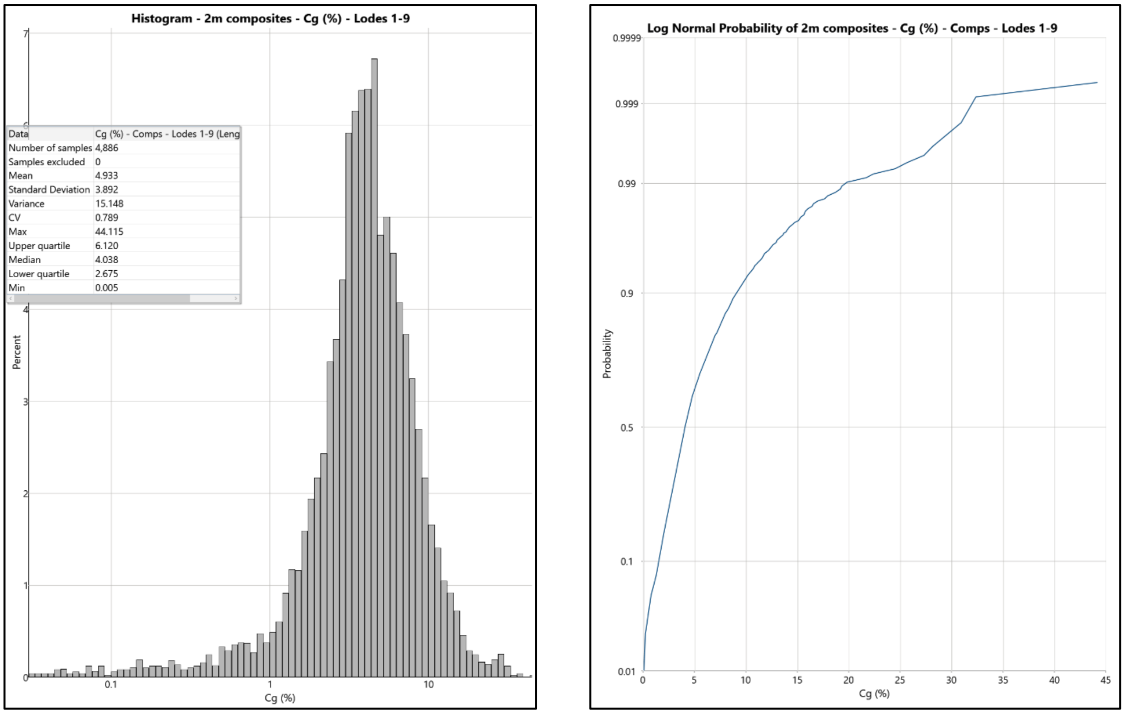


Figure 14-14 Histogram and Probability Plot of 2-Meter Composites for All Lodes

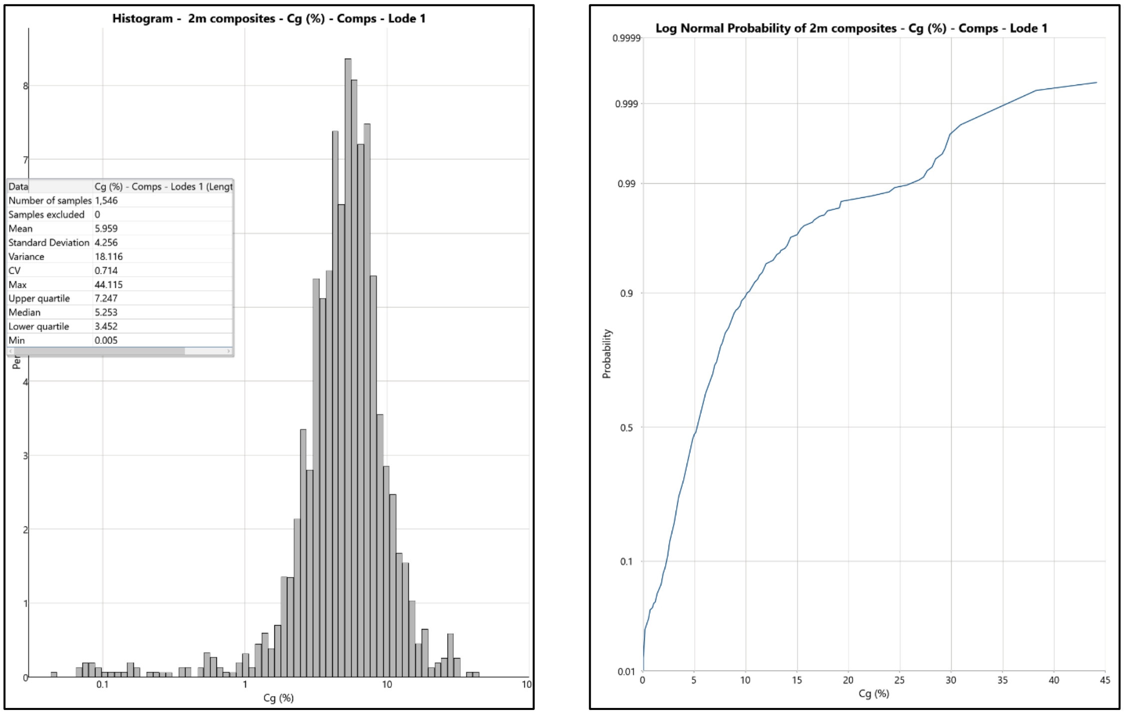


Figure 14-15 Histogram and Probability Plot of 2-Meter Composites for Lode 1

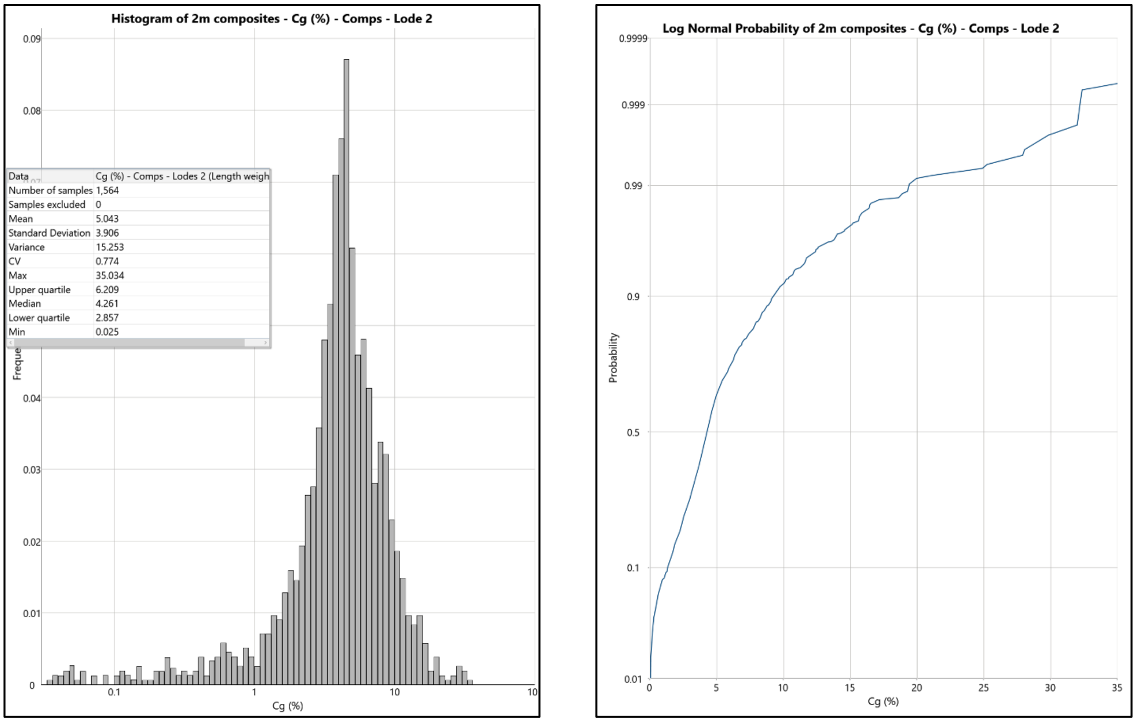


Figure 14-16 Histogram and Probability Plot of 2-Meter Composites for Lode 2

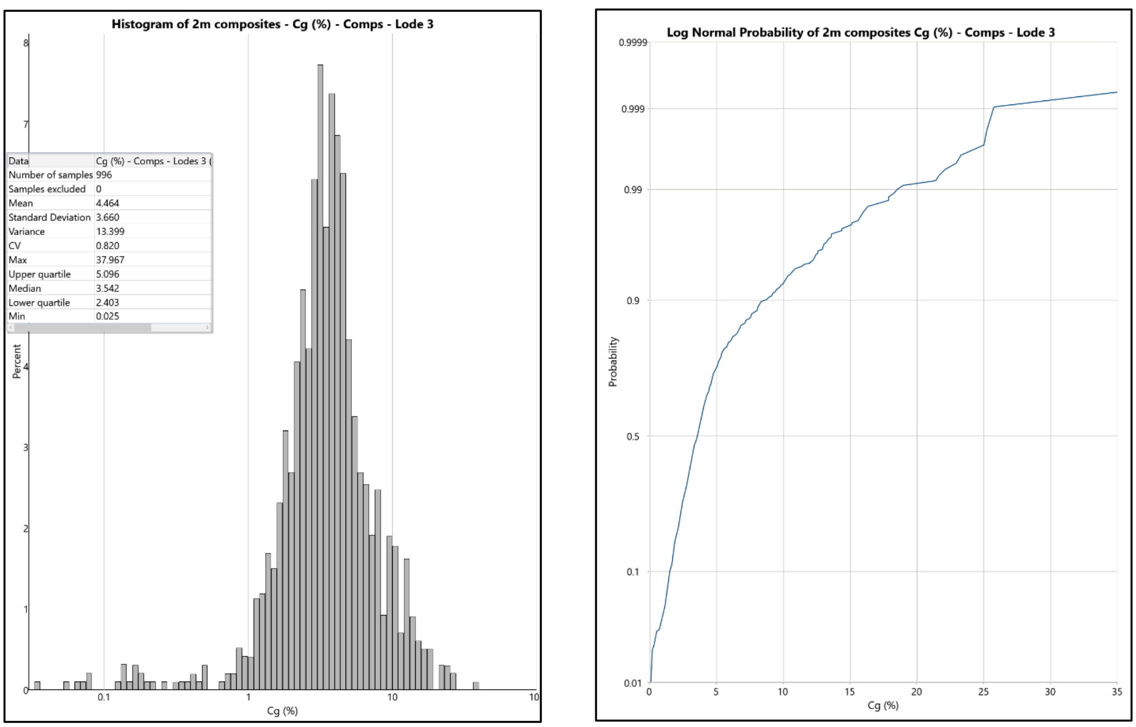


Figure 14-17 Histogram and Probability Plot of 2-Meter Composites for Lode 3

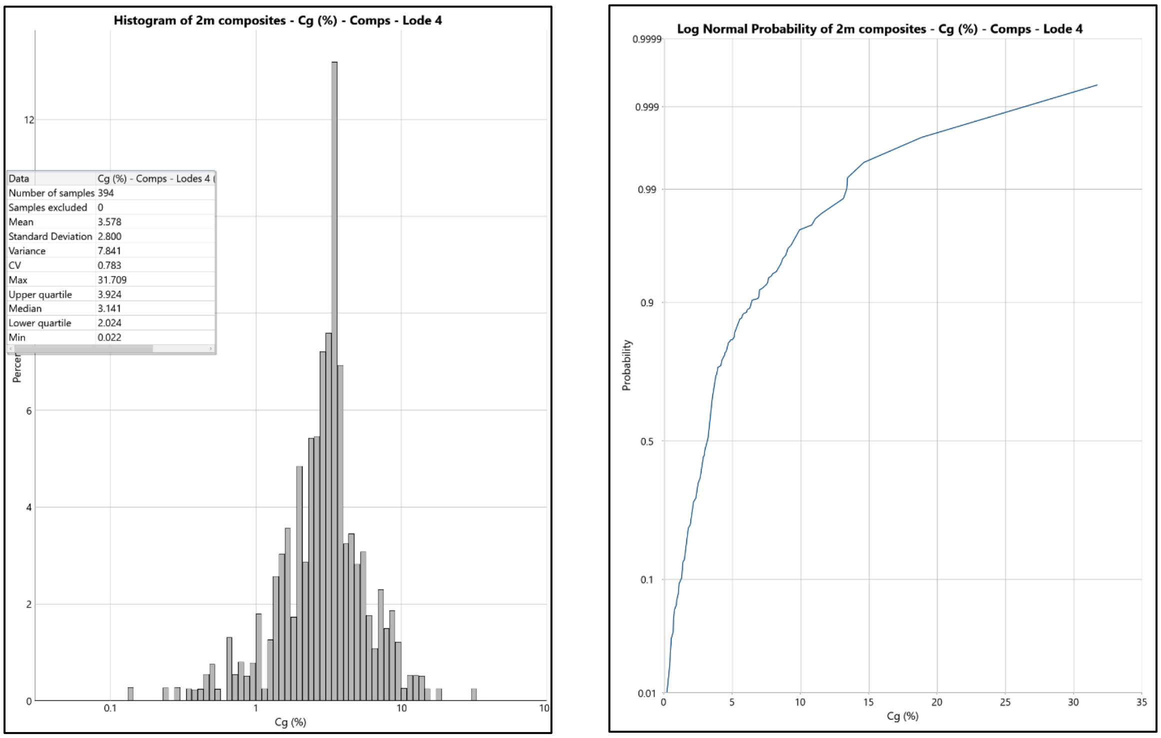


Figure 14-18 Histogram and Probability Plot of 2-Meter Composites for Lode 4

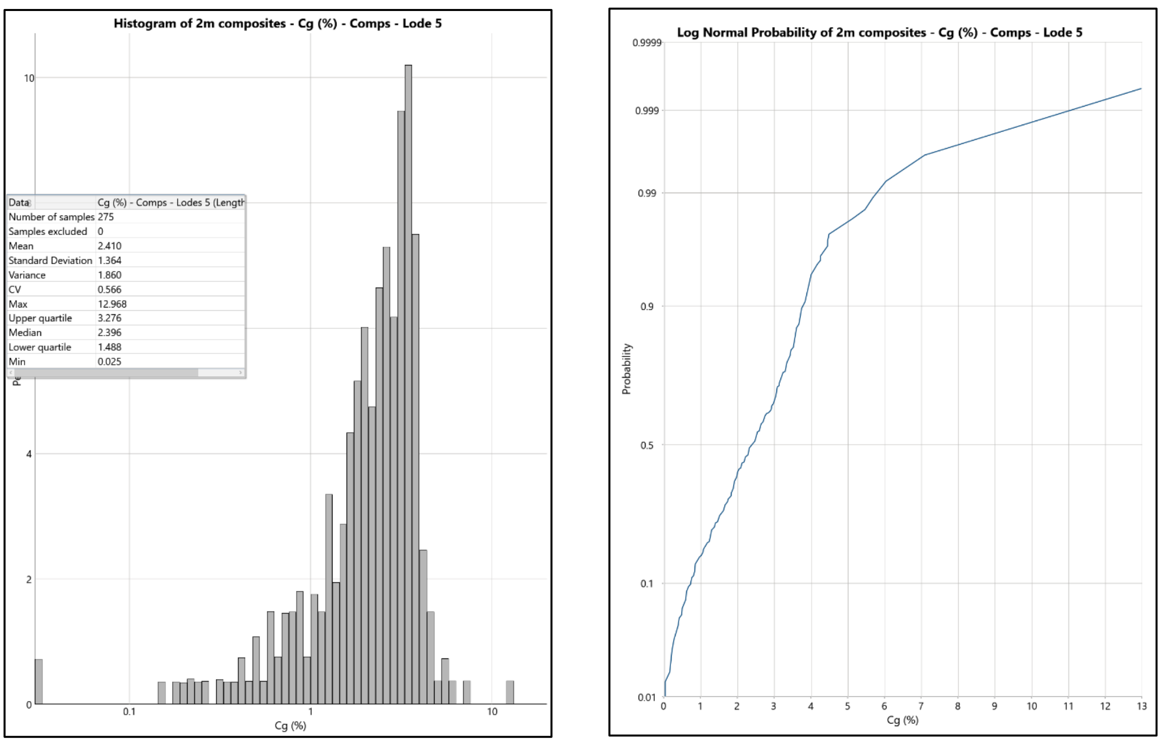


Figure 14-19 Histogram and Probability Plot of 2-Meter Composites for Lode 5

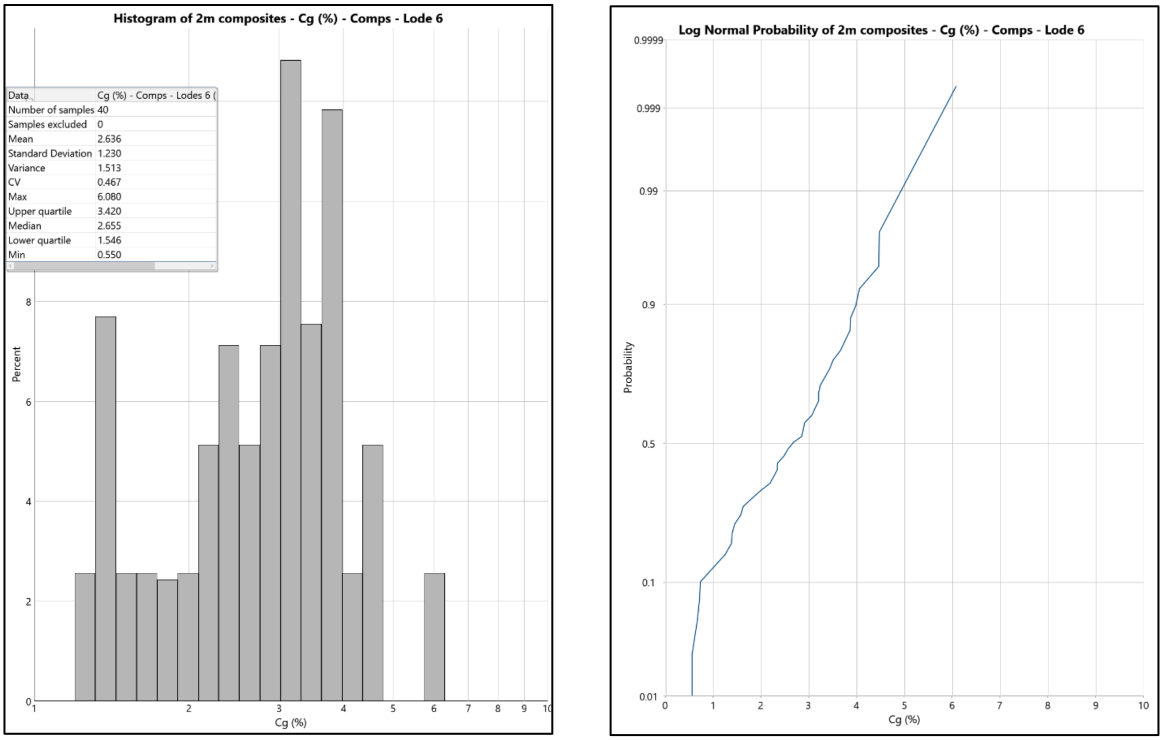


Figure 14-20 Histogram and Probability Plot of 2-Meter Composites for Lode 6

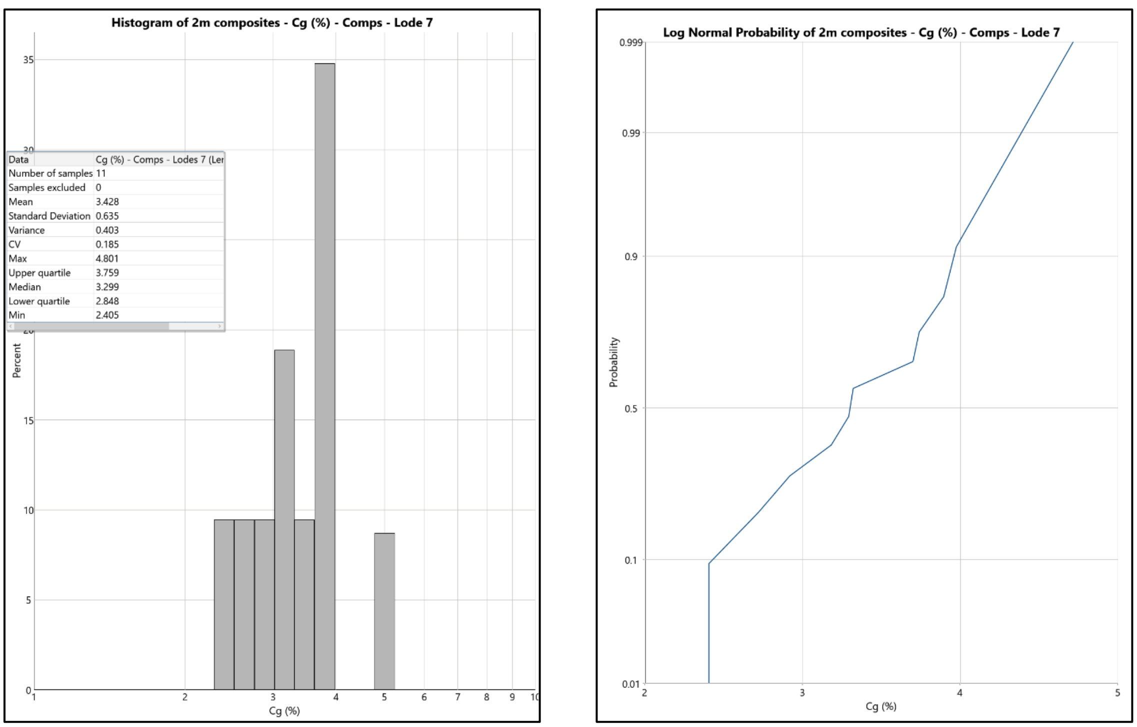


Figure 14-21 Histogram and Probability Plot of 2-Meter Composites for Lode 7

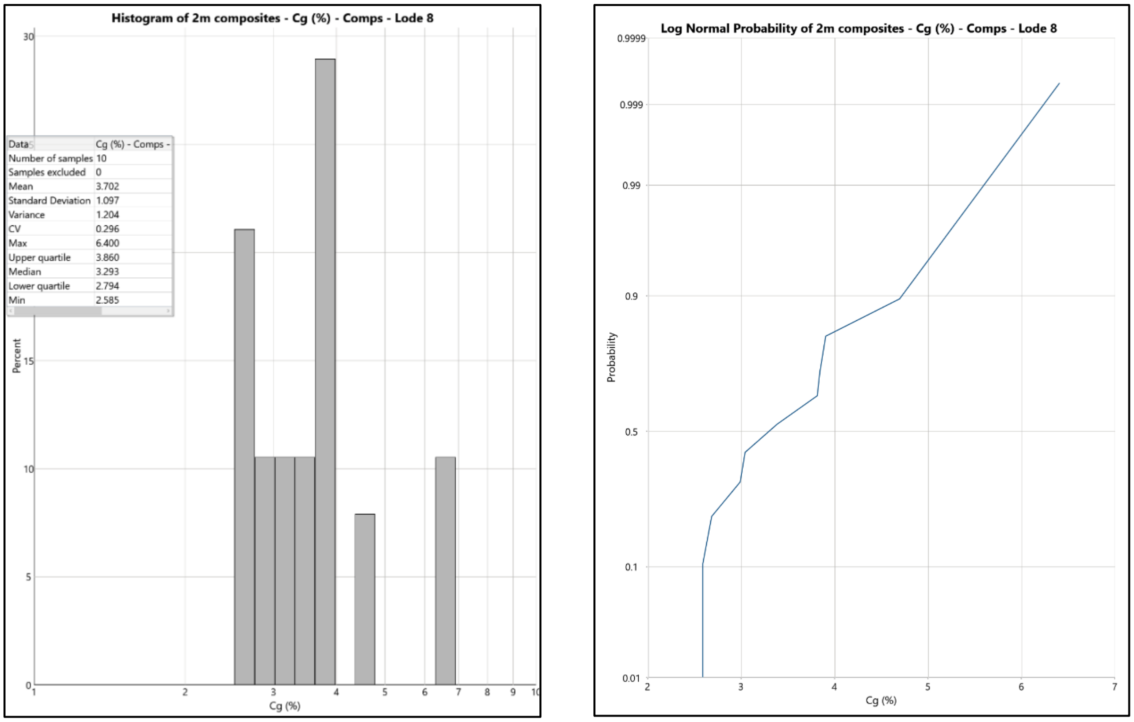


Figure 14-22 Histogram and Probability Plot of 2-Meter Composites for Lode 8

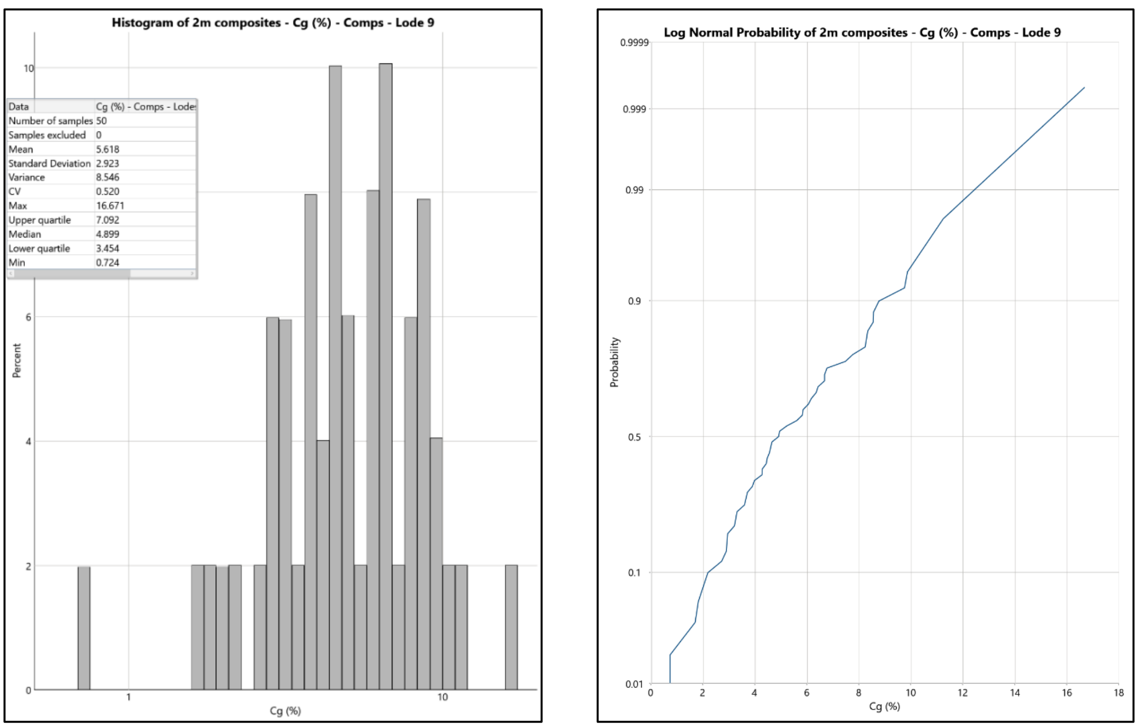


Figure 14-23 Histogram and Probability Plot of 2-Meter Composites for Lode 9

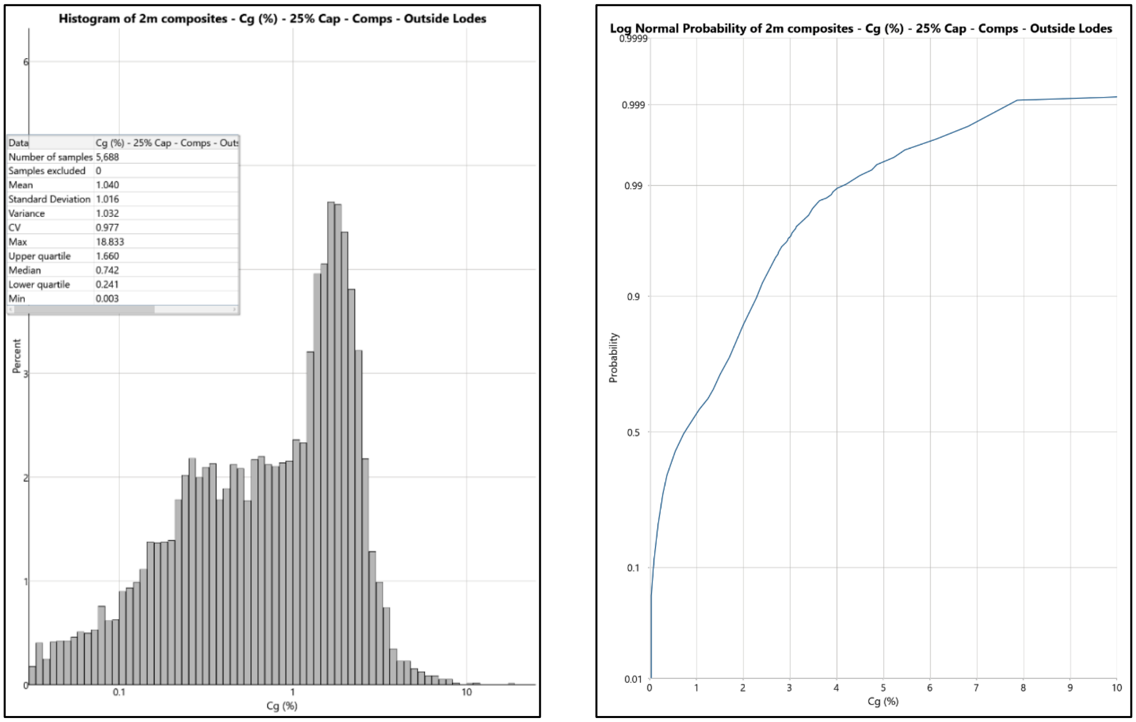


Figure 14-24 Histogram and Probability Plot of 2-Meter Composites for Outside Lodes

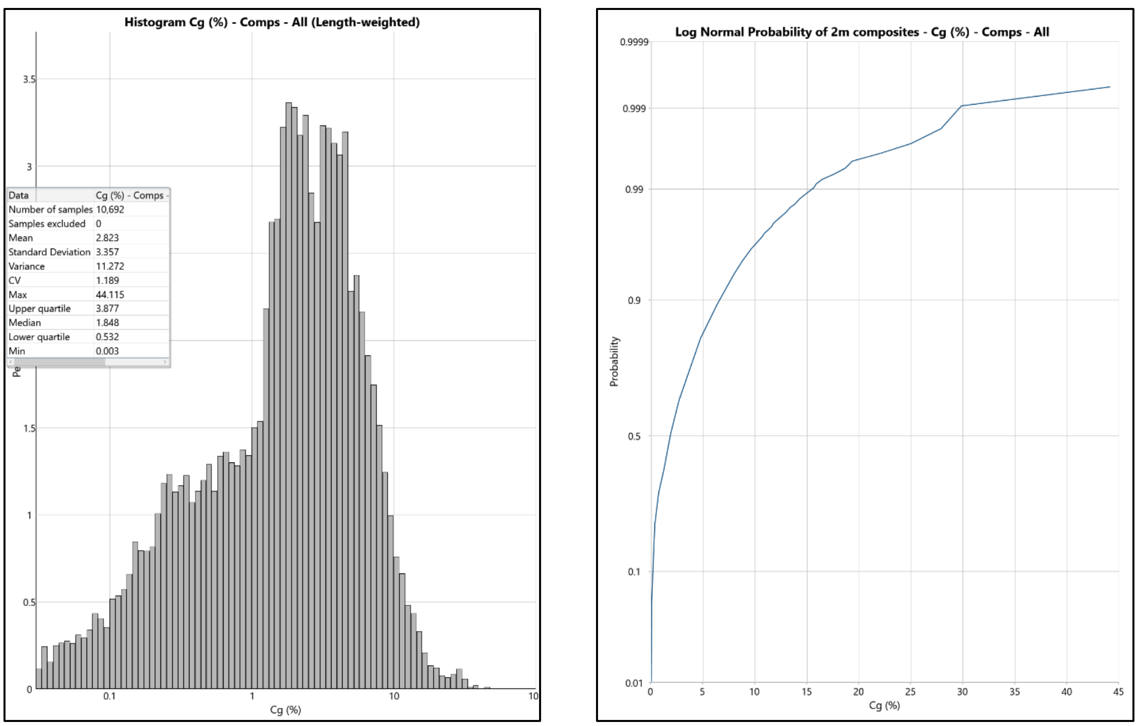


Figure 14-25 Histogram and Probability Plot of 2-Meter Composites for All Composites

14.7 Grade Continuity/Variography

Variography on the composited data was used to produce spherical correlograms. All nine lodes have similar orientations and grade characteristics, and grades encountered outside the lodes occur within similar orientations. Thus, treating all composites as one domain for variogram modeling was deemed appropriate. The variograms were created along a 067° strike orientation, slightly more east than previous variogram models of 060° but still similar. The best-fit dip along the semi-major direction is now 42° (compared to 53°) which is similar to the major structural feature of the region (Kigluaik Fault). The variogram orientation is similar to the previously described graphite mineralization. However, surface orientation measurements taken in 2024 indicated lithologic bedding orientation striking to the northwest, dipping to the north-northeast (see Chapter 7, Section 7.2). Orthogonal variograms were created to determine appropriate ranges for estimation along the major, semi-major, and minor directions.

The maximum range of the variogram in the major axis direction extends beyond 300 m, indicating extensive mineralization along the strike of the deposit. The maximum range along the semi-major direction extends up to 200 m, while the minor direction extends to 30 m. These ranges correlate to the modeled lode shapes and are supported by logged mineralization trends. The ranges have been modeled to be longer than previously estimated due to the more detailed orientation and additional drillhole data.

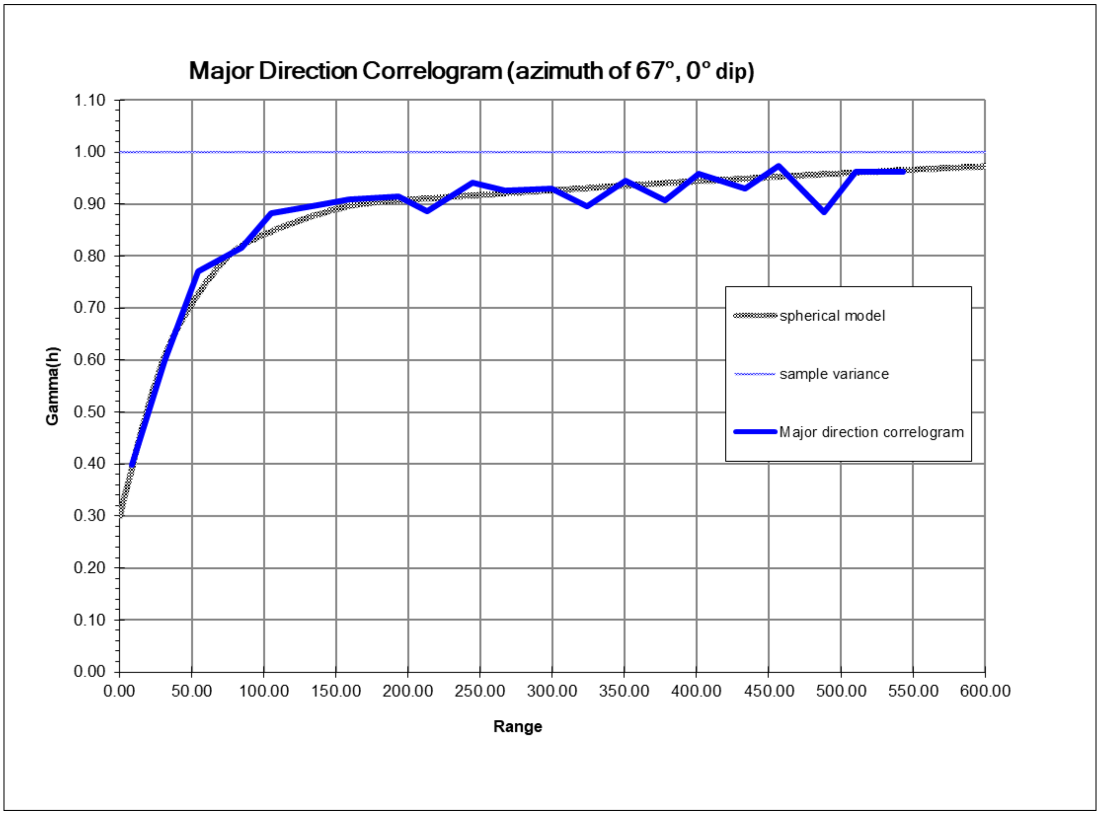


Figure 14-26 Major Direction Correlogram

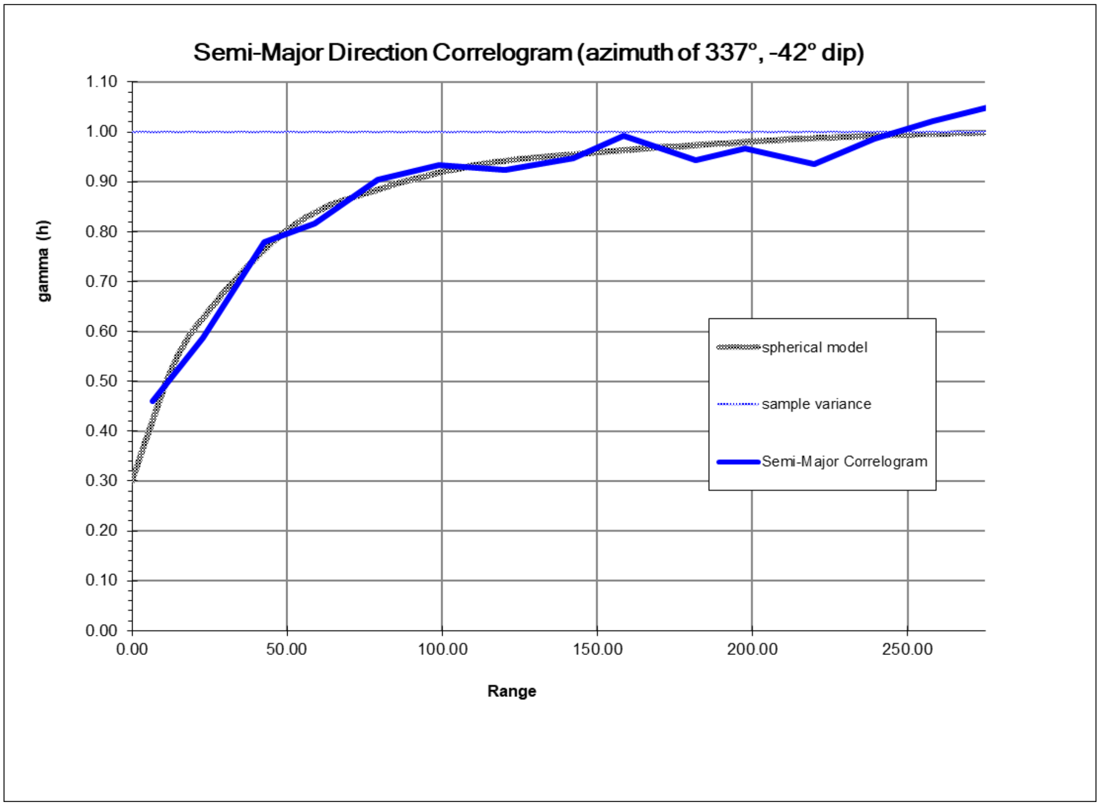


Figure 14-27 Semi-Major Direction Correlogram

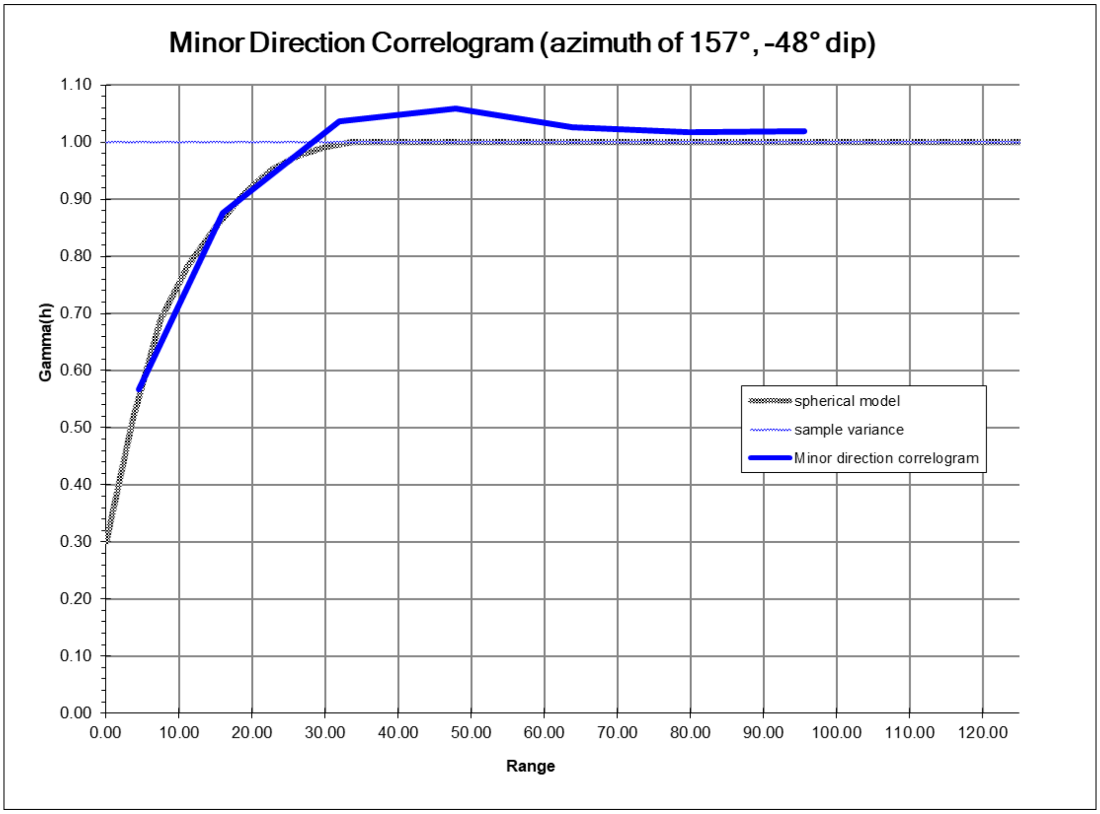


Figure 14-28 Minor Direction Correlogram

14.8 Block Model Extents and Block Size

A parent block size of 4 m (X) x 4 m (Y) x 4 m (Z) was chosen for the resource estimate. Previous estimations have used a 2-m block size; however, calculation of mining methodology and reserves has continued to use a 4 m model, so a 4 m block is used in estimation going forward. The block model was rotated to an absolute bearing of 067° to be parallel to the strike of graphite mineralization. The block model extents were extended past mineralized wireframes to encompass grade potential.

Table 14-4 presents the coordinate ranges and block size dimensions that were used to build the 3D block models from the mineralization wireframes. A comparison of wireframe volume versus block model volume was performed to verify there was no overstating of tonnages. Each block was coded with the lode number to confirm that the mineralized lodes were treated as hard boundaries.

Table 14-4 Block Model Extents and Offset. Offset are Distance from Origin.

	Easting	Northing	Elevation
Minimum	472160	7211350	-170
Offset	5100	1132	820
Cell Size	4	4	4
Rotation (Absolute Bearing)	067	067	067

14.9 Grade Estimation

14.9.1 Estimation Methods

The resource estimation of graphite (% Cg) was calculated using inverse-distance weighted squared (IDW2) for each of the nine lodes. During estimation, a block discretization of 4 x 4 x 4 was applied to all blocks. Each lode was estimated as a hard boundary, which means that only composites located within that lode were used to estimate the grade of the blocks within that lode.

Blocks not within a mineralized lode were estimated using IDW2 but with a soft boundary where samples within and outside the mineralized lodes are used for estimation. However, composites within a mineralized lode were weighted 50% less than composites outside, limiting the effect of higher-grade composites while still allowing enough composites to estimate blocks. After estimation, blocks above the topography surface, above the overburden surface, and north of the Kigluaik Fault were assigned a graphite value of zero.

14.9.2 Sample Selection

A multi-pass approach was used in grade estimation with variable sample selection criteria depending on the estimation pass (Table 14-5). Identical selection criteria were used for each mineralized lode. Prior to the estimation of each individual lode, a single block search for all blocks was completed to allow any block pierced by a drillhole to be estimated. For each of the nine mineralized lodes, a total of seven passes was completed. Passes 1, 2, 3, and 5 required at least two drillholes. Passes 4 and 6 are considered ‘donut hole’ passes and require only one drillhole at smaller distances to fill in blocks that may have been missed in previous passes. Pass 7 was a final estimation requiring only one drillhole and closely followed the previous estimations’ final pass to fill in all remaining blocks within mineralized lodes. Blocks outside of mineralized lodes were estimated using only passes 1 through 6, as pass 7 was considered too wide without a wireframe constraint.

Table 14-5 Summary Table of Estimation Criteria for Graphite Estimation

Pass	Note	Approx. Factor of Max. Sill Variance Range	Min. # Of Samples	Max. # Of Samples	Max. # Per Drillhole	Ellipse Range			Corresponding Category
						Major	Semi-Major	Minor	
BOX	Box search	N/A	1	99	2	1	1	1	Measured
1		60%	3	7	2	30	20	8	Measured
2		85%	3	7	2	92	63	8	Indicated
3		90%	3	7	2	175	125	8	Inferred
4	"donut hole"	50%	2	7	2	87	62.5	8	Inferred
5		100%	3	7	2	300	150	8	Inferred
6	"donut hole"	150%	2	7	2	150	75	8	Inferred
7	fill remaining blocks	300%	2	7	2	1500	500	8	Inferred

14.9.3 Search Ellipsoid

The directions of the search ellipse were defined in previous estimations, and the same directions were used in the current estimation (Table 14-6).

Table 14-6 Search Ellipsoid Orientation for the Graphite Estimation

Lode	Search Ellipsoid	Strike (°)	Dip (°)	Plunge (°)
Lode 01	Lode 01 E	60	53	0
	Lode 01 W	68	39	0
Lode 02	Lode 02 E	61	53	0
	Lode 02 W	70	44	0
Lode 03	Lode 03 E	61	57	0
	Lode 03 W	71	51	0
Lode 04	Lode 04 E	58	61	0
	Lode 04 W	67	55	0
Lode 05	Lode 05 E	60	62	0
	Lode 05 W	72	55	0
Lode 06	Lode 06	61	61	0
Lode 07	Lode 07	64	51	0
Lode 08	Lode 08	66	55	0
Lode 09	Lode 09	59	51	0
Outside	Outside	60	53	0

The multi-pass approach used increasing sizes of search ellipsoids based on the variogram ranges in each direction (see Section 14.6). The ranges and passes were also used in defining the classification of resources (see Section 14.11). After the initial box search, the search ellipsoid ranges were approximated to be equal to variable factors of the maximum sill variance range. Passes 1, 2, 3, 5, and 7 used approximately 60%, 85%, 90%, 100%, and 300% of the maximum sill variance range, respectively. Passes 4 and 6, with their less selective sample searches, used ranges equal to half of passes 5 and 7, respectively.

The additional drilling since the PFS and new variography created ranges differing from previous estimates. While previous estimates adjusted ranges to provide continuity with historical work, minimal adjustments were required in the current estimation. The adjustments in variography ranges used resulted in a lower final major direction range in pass 1 but longer major direction ranges in passes 2 and 3. The major direction is along the strike of the graphite mineralization, and its continuity is observed in the field, so the longer ranges in passes 5 and 7 are considered acceptable.

14.10 Bulk Density (Specific Gravity)

A total of 15,614 bulk density measurements were collected from the 2012-2014, 2018-2019, and 2021-2024 drill cores within the resource area. These were collected at regular intervals, averaging 1.0 m, down each of the 56 drillholes (excluding the three metallurgical and geotechnical drillholes). The density measurements were calculated on-site by ActLabs staff in 2012-2014 and by Graphite One staff in 2018-2019, and 2021-2024 using the weight-in-air/weight-in-water methodology. Of the 15,614 bulk density samples collected only 6,976 bulk density samples were situated within the mineralized wireframes. A histogram and summary statistics of the density samples are shown in Figure 14-29 and Table 14-7.

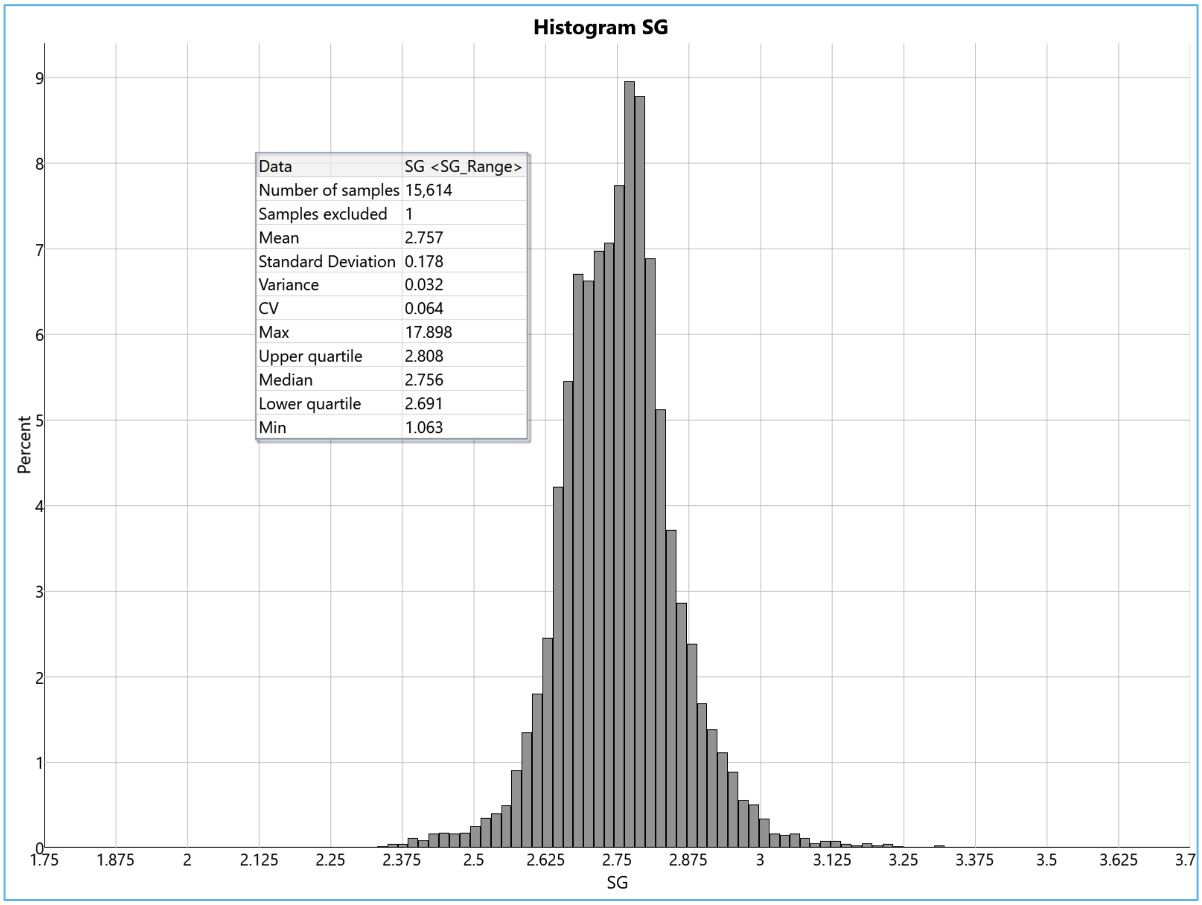


Figure 14-29 Histogram of Bulk Density (Specific Gravity) Data

Table 14-7 General Statistics of Bulk Density (Specific Gravity) Data

	Outside Lodes	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9
Count	8,592	2,351	2,158	1,185	511	398	156	25	27	165
Mean	2.77	2.74	2.75	2.74	2.74	2.73	2.70	2.65	2.83	2.70
Standard deviation	0.21	0.16	0.12	0.10	0.10	0.09	0.07	0.06	0.52	0.10
Maximum	17.90	6.58	5.31	3.93	3.19	3.11	2.93	2.80	5.44	2.91
Upper quartile	2.81	2.80	2.81	2.80	2.79	2.79	2.74	2.68	2.78	2.77
Median	2.77	2.73	2.75	2.73	2.73	2.71	2.69	2.66	2.70	2.71
Lower quartile	2.71	2.67	2.69	2.68	2.67	2.66	2.66	2.61	2.67	2.64
Minimum	1.07	1.06	2.30	2.34	2.25	2.29	2.53	2.52	2.63	2.45
Coeff. Of Variation	0.07	0.06	0.04	0.04	0.04	0.03	0.03	0.02	0.18	0.04
Variance	0.04	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.27	0.01
Percentile 10	2.66	2.60	2.64	2.65	2.64	2.64	2.63	2.55	2.66	2.54
Percentile 20	2.69	2.65	2.67	2.67	2.66	2.66	2.66	2.60	2.67	2.62
Percentile 90	2.88	2.87	2.87	2.87	2.86	2.84	2.80	2.71	2.83	2.82
Percentile 99	3.02	3.07	3.05	2.99	3.00	3.01	2.90	2.79	4.75	2.90

The 2012 Maiden Inferred Resource Estimate of the Graphite Creek property used a conservative density value of 2.7 kg/dm^3 (Duplessis et al., 2013). In 2013, the Expanded Graphite Creek Inferred Resource Estimate estimated the density value for each block using the density dataset collected (Eccles & Nicholls, 2014). The high level of detailed density collection (i.e., one density measurement per every meter and in every drillhole) has been maintained during the 2014 and 2018-2024 drill seasons. Accordingly, it was decided to estimate the value of density for each individual block within the block model (as was done for graphite assay data).

The estimation technique used to calculate the density value for each block was inverse distance squared. The density was calculated using the mineralized lodes as hard boundaries, where all blocks within the lodes were estimated as one domain, and all blocks outside the lodes were estimated as another domain. For future use in mine planning, it was thought this would provide accurate density measurement for areas outside of mineralization.

A separate set of 2-m composites was created for the bulk density measurements using an identical method as was used for the graphite composites. Only composites between 2.0 and 3.2 were selected during estimation as this was considered a valid range, effectively providing a top cut of 3.2 and removing nine composites from estimation. Search ellipsoids were oriented along the average orientation of mineralization with a bearing of 064° and dip of 54° to the NW. A multi-pass approach was used to estimate the bulk density with identical sample selection criteria and search ellipsoid ranges as the graphite estimation. Blocks above topography were assigned a density value of zero. Blocks above the overburden surface and north of the Kigluaik Fault were assigned a density value of 2.6, as were any remaining blocks without an estimation.

A comparison of the estimated density to the 2-m composite density can be seen in Table 14-8. In the primary lodes (lodes 1-3), the difference is less than 1%; the maximum difference in lodes 1-6 and lode 9 is 1.12%. Lode 8 has a 4.78 difference but consists of only 19 samples and is a more conservative lower value in the blocks compared to composites. Thus, the effect of overestimation of density in the mineralized lodes is considered minimal.

Table 14-8 Comparison of Mean Specific Gravity Values Between Raw Samples, 2-Meter Composites, and Estimated Blocks by Lode

	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9	Outside Lodes
Raw	2.736	2.752	2.744	2.738	2.729	2.704	2.654	2.826	2.695	2.771
2 m Composites	2.728	2.749	2.747	2.742	2.723	2.704	2.651	2.733	2.704	2.767
Blocks - ALL	2.738	2.746	2.749	2.738	2.713	2.710	2.699	2.711	2.702	2.754
Blocks - M+I	2.742	2.732	2.743	2.742	2.718	2.708	0.000	2.715	2.746	2.754
% Diff ALL vs 2 m	0.36%	-0.12%	0.06%	-0.16%	-0.39%	0.21%	1.80%	-0.80%	-0.06%	-0.46%
% Diff M+I vs 2 m	0.51%	-0.65%	-0.17%	-0.03%	-0.17%	0.15%	N/A	-0.68%	1.56%	-0.50%

14.11 Block Model

14.11.1 Visual Validation

The blocks were visually validated on cross sections and plan view comparing block grades versus the composite sample grades for all sections and drillholes (Figure 14-30 through Figure 14-32). The estimated graphite showed a good correlation to the composite values. Reasonable variation and orientation of the grade was also observed.

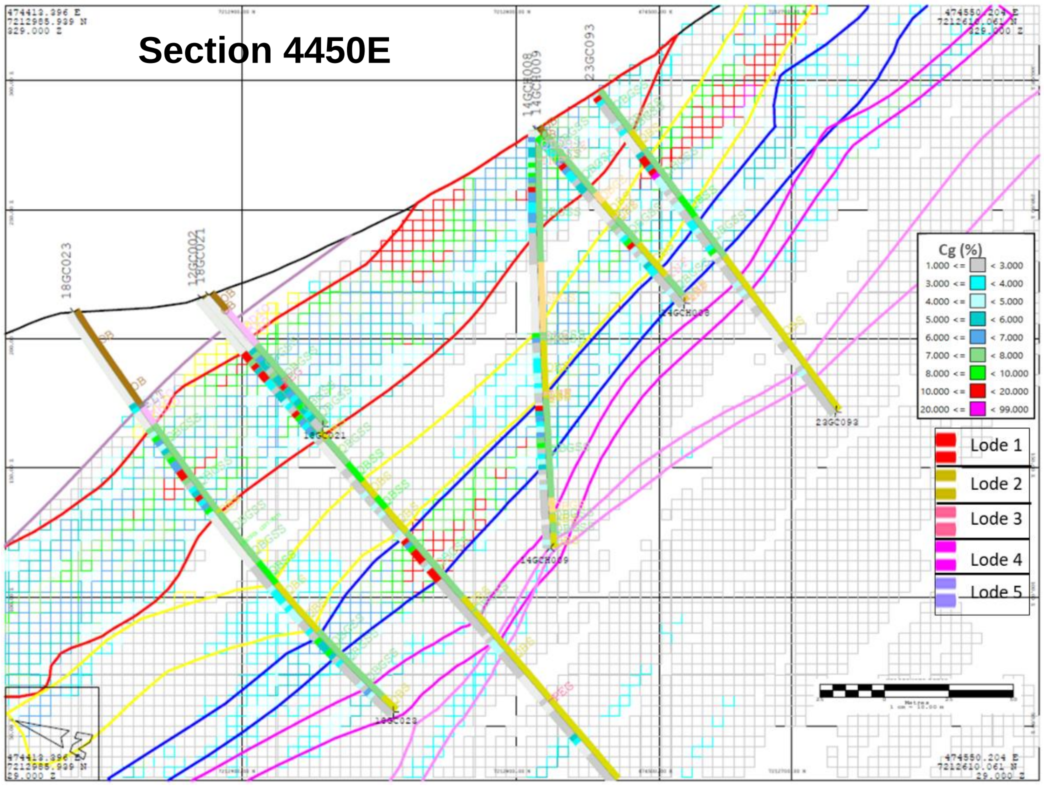


Figure 14-30 Section 4450E Showing Block Model Cg (%) Grades Within Mineralized Lodes

Figure 14-31 Section 4400E Showing Block Model Cg (%) Grades Within Mineralized Lodes

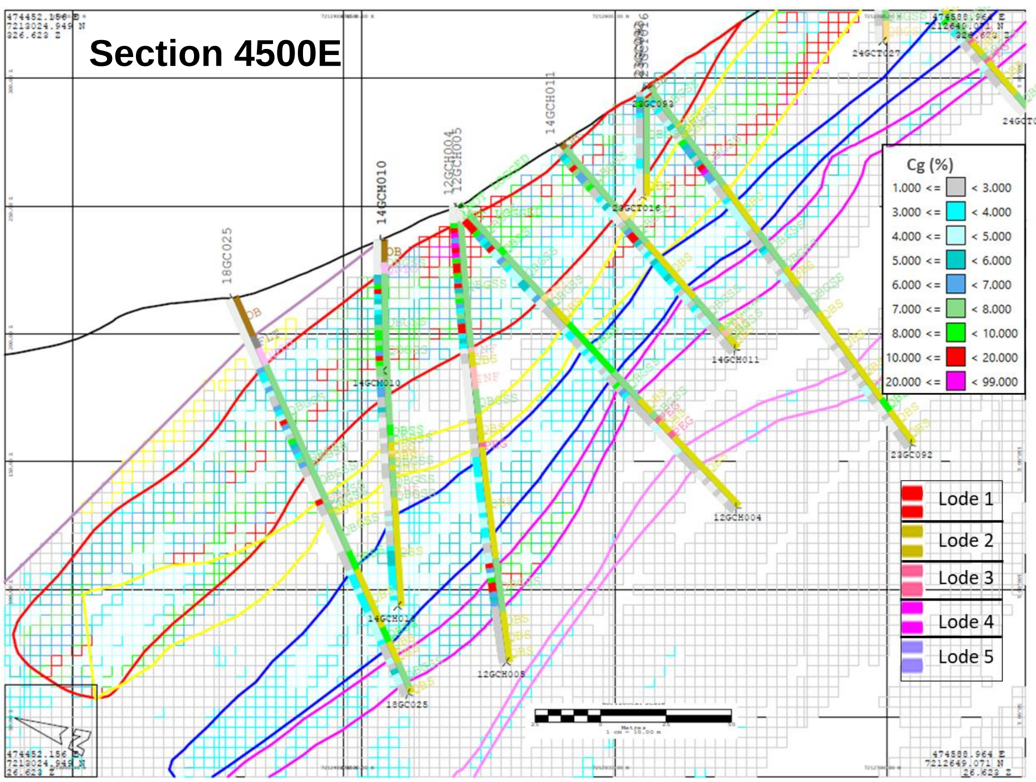


Figure 14-32 Section 4500E Showing Block Model Cg (%) Grades Within Mineralized Lodes

14.11.2 Statistical Validation

A statistical comparison of the raw data, 2-m composite data, and the resulting block data for each mineralized lode is provided in Table 14-9. The block data is also broken down into the Measured and Indicated category (see Section 14.11). The comparison shows a good statistical comparison between the estimated blocks and the 2-m composite within the closer-spaced areas of the resource (i.e., the Measured and Indicated resource). The comparison of all estimated blocks, including the wider spaced areas with less data, shows more variation in the average grade, including instances of higher average grades in specific lodes. This would be expected and can be attributed to the lack of data to define the estimation further and is not considered unreasonable. Similar statistical comparisons of the density (specific gravity) estimation are provided in Table 14-11.

Table 14-9 Representative Statistics of Sample Data, 2-Meter Composites, and Estimated Cg (%) by Lode

	2- Meter Length-Weighted Composite Statistics by Lode - Cg (%)									
	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9	Outside
Count	1,546	1,564	996	394	275	40	11	10	50	5,688
Mean	5.96	5.04	4.46	3.58	2.41	2.64	3.43	3.70	5.62	1.04
Standard Deviation	4.26	3.91	3.66	2.80	1.36	1.23	0.64	1.10	2.92	1.02
Maximum	44.12	35.03	37.97	31.71	12.97	6.08	4.80	6.40	16.67	20.35
Upper Quartile	7.25	6.21	5.10	3.92	3.28	3.42	3.76	3.86	7.09	1.66
Median	5.25	4.26	3.54	3.14	2.40	2.66	3.30	3.29	4.90	0.74
Lower Quartile	3.45	2.86	2.40	2.02	1.49	1.55	2.85	2.79	3.45	0.24
Minimum	0.01	0.03	0.03	0.02	0.03	0.55	2.40	2.59	0.72	0.00
Coeff. of Variation	0.71	0.77	0.82	0.78	0.57	0.47	0.19	0.30	0.52	0.98
Variance	18.12	15.25	13.40	7.84	1.86	1.51	0.40	1.20	8.55	1.05
Percentile 10	2.25	1.32	1.50	1.23	0.72	0.72	2.42	2.59	2.19	0.07
Percentile 20	3.13	2.46	2.15	1.73	1.26	1.39	2.74	2.67	3.20	0.18
Percentile 90	10.11	9.23	8.62	6.39	3.76	3.99	3.96	4.78	8.80	2.28
Percentile 99	25.69	19.37	18.51	13.35	5.79	5.45	4.71	6.24	13.96	4.17
	Raw (Uncomposited) Statistics by Lode - Cg (%)									
	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9	Outside
Count	3,314	3,418	2,143	838	585	78	23	19	103	12,144
Mean	6.00	5.07	4.47	3.58	2.41	2.64	3.43	3.70	5.62	1.05
Standard Deviation	5.74	5.28	4.86	3.55	1.73	1.46	0.76	1.18	4.24	1.21
Maximum	81.90	52.20	50.10	41.30	36.40	8.76	4.83	6.89	27.80	27.70
Upper Quartile	7.25	5.79	4.75	3.92	3.36	3.73	3.95	4.13	7.43	1.68
Median	4.68	3.91	3.39	3.12	2.38	2.74	3.36	3.46	4.26	0.65
Lower Quartile	2.96	2.38	2.00	1.79	1.29	1.33	2.99	2.95	2.90	0.17
Minimum	0.03	0.03	0.03	0.03	0.03	0.27	1.65	1.91	0.03	0.03
Coeff. of Variation	0.96	1.04	1.09	0.99	0.72	0.56	0.22	0.32	0.75	1.16
Variance	32.91	27.87	23.57	12.59	3.00	2.14	0.58	1.39	17.97	1.47
Percentile 10	1.80	0.87	1.18	0.89	0.55	0.67	2.21	2.14	1.62	0.03
Percentile 20	2.60	1.97	1.79	1.54	1.04	1.00	2.87	2.85	2.54	0.10
Percentile 90	10.80	9.54	8.34	6.21	3.84	4.09	4.26	4.97	11.29	2.49
Percentile 99	32.37	29.48	25.82	20.84	6.56	5.73	4.82	6.70	18.23	4.52

Table 14-10 Representative Statistics of Sample Data, 2-Meter Composites, and Estimated Cg (%) by Mineralized Lode

	Measured and Indicated Estimated Block Statistics by Lode - Cg (%)									
	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9	Outside
Count	65,209	85,350	77,933	27,184	25472	4	0	1	5	441,910
Mean	5.36	4.46	4.11	3.36	2.47	2.08	0.00	3.90	4.09	1.67
Standard Deviation	2.62	2.30	2.20	1.90	0.79	1.04	NaN	NaN	1.54	1.25
Maximum	44.12	32.33	20.84	24.65	8.99	3.87	0.00	3.90	6.67	15.17
Upper Quartile	6.44	5.66	5.05	4.09	2.95	3.31	0.00	3.90	5.56	2.12
Median	5.12	4.06	3.71	2.93	2.45	1.53	0.00	3.90	4.26	1.42
Lower Quartile	3.67	2.93	2.65	2.12	1.95	1.40	0.00	3.90	2.53	0.87
Minimum	0.02	0.00	0.01	0.22	0.03	1.39	0.00	3.90	2.18	0.00
Coeff. of Variation	0.49	0.52	0.54	0.57	0.32	0.50	NaN	NaN	0.38	0.75
Variance	6.88	5.31	4.83	3.63	0.63	1.08	NaN	NaN	2.38	1.57
Percentile 10	2.61	1.91	1.74	1.54	1.48	1.39	0.00	3.90	2.18	0.46
Percentile 20	3.33	2.63	2.39	1.96	1.81	1.39	0.00	3.90	2.18	0.74
Percentile 90	8.15	7.33	7.06	5.80	3.53	2.97	0.00	3.90	5.56	3.05
Percentile 99	14.83	11.79	11.12	9.79	4.18	3.78	0.00	3.90	6.56	6.56
	ALL Estimated Block Statistics by Lode - Cg (%)									
	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9	Outside
Count	199,842	389,413	182,196	124,568	161,044	92,299	17,380	27,191	79,108	32,164,837
Mean	5.59	5.40	4.82	3.39	2.05	2.78	1.83	1.72	4.90	0.14
Standard Deviation	2.48	2.72	3.60	1.68	1.18	0.91	1.70	2.04	2.63	0.60
Maximum	44.12	32.33	29.86	24.65	11.05	4.96	3.94	5.05	14.20	17.43
Upper Quartile	6.89	6.62	5.88	4.23	2.80	3.51	3.30	4.18	6.42	0.00
Median	5.48	5.11	3.87	3.11	2.19	3.07	3.01	0.00	5.03	0.00
Lower Quartile	4.13	3.74	2.74	2.34	1.50	2.36	0.00	0.00	3.26	0.00
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coeff. of Variation	0.44	0.50	0.75	0.50	0.57	0.33	0.93	1.18	0.54	4.22
Variance	6.15	7.42	12.95	2.83	1.39	0.82	2.90	4.15	6.92	0.36
Percentile 10	2.72	2.48	1.85	1.76	0.00	1.47	0.00	0.00	0.00	0.00
Percentile 20	3.76	3.49	2.52	2.18	1.13	2.11	0.00	0.00	2.92	0.00
Percentile 90	8.46	8.51	8.59	5.62	3.51	3.70	3.84	4.48	8.23	0.00
Percentile 99	12.96	14.65	20.53	8.25	4.14	3.88	3.93	4.54	11.72	2.88

Table 14-11 Representative Statistics of Sample Data, 2-Meter Composites, and Estimated Density (Specific Gravity) by Mineralized Lode

	2- Meter Length-Weighted Composite Statistics by Lode -Specific Gravity									
	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9	Outside
Count	1,204	1,231	748	291	213	40	11	8	50	4,541
Mean	2.73	2.75	2.75	2.74	2.72	2.70	2.65	2.73	2.70	2.77
Standard Deviation	0.10	0.09	0.09	0.09	0.09	0.05	0.05	0.04	0.07	0.08
Max	3.14	3.15	3.04	3.09	2.97	2.86	2.72	2.79	2.85	3.18
Upper Quartile	2.79	2.80	2.80	2.80	2.78	2.73	2.69	2.76	2.76	2.81
Median	2.73	2.75	2.74	2.73	2.71	2.69	2.66	2.72	2.71	2.77
Lower Quartile	2.67	2.69	2.69	2.68	2.67	2.67	2.59	2.69	2.66	2.72
Min	2.36	2.39	2.34	2.25	2.29	2.62	2.55	2.66	2.53	2.25
Coeff. of Variation	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.03
Variance	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01
Percentile 10	2.61	2.65	2.66	2.65	2.64	2.63	2.55	2.66	2.59	2.67
Percentile 20	2.65	2.68	2.68	2.67	2.66	2.67	2.57	2.67	2.63	2.70
Percentile 90	2.84	2.86	2.86	2.86	2.83	2.77	2.71	2.79	2.78	2.87
Percentile 99	2.97	2.98	2.96	2.96	2.95	2.85	2.72	2.79	2.85	2.99
	Raw (Uncomposited) Statistics by Lode – Specific Gravity									
	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9	Outside
Count	2,351	2,158	1,185	511	398	156	25	27	165	8,592
Mean	2.74	2.75	2.74	2.74	2.73	2.70	2.65	2.83	2.70	2.77
Standard Deviation	0.16	0.12	0.10	0.10	0.09	0.07	0.06	0.52	0.10	0.21
Max	6.58	5.31	3.93	3.19	3.11	2.93	2.80	5.44	2.91	17.90
Upper Quartile	2.80	2.81	2.80	2.79	2.79	2.74	2.68	2.78	2.77	2.81
Median	2.73	2.75	2.73	2.73	2.71	2.69	2.66	2.70	2.71	2.77
Lower Quartile	2.67	2.69	2.68	2.67	2.66	2.66	2.61	2.67	2.64	2.71
Min	1.06	2.30	2.34	2.25	2.29	2.53	2.52	2.63	2.45	1.07
Coeff. of Variation	0.06	0.04	0.04	0.04	0.03	0.03	0.02	0.18	0.04	0.07
Variance	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.27	0.01	0.04
Percentile 10	2.60	2.64	2.65	2.64	2.64	2.63	2.55	2.66	2.54	2.66
Percentile 20	2.65	2.67	2.67	2.66	2.66	2.66	2.60	2.67	2.62	2.69
Percentile 90	2.87	2.87	2.87	2.86	2.84	2.80	2.71	2.83	2.82	2.88
Percentile 99	3.07	3.05	2.99	3.00	3.01	2.90	2.79	4.75	2.90	3.02

Table 14-12 Representative Statistics of Sample Data, 2-Meter Composites, and Measured and Indicated Estimated Density (Specific Gravity) by Mineralized Lode

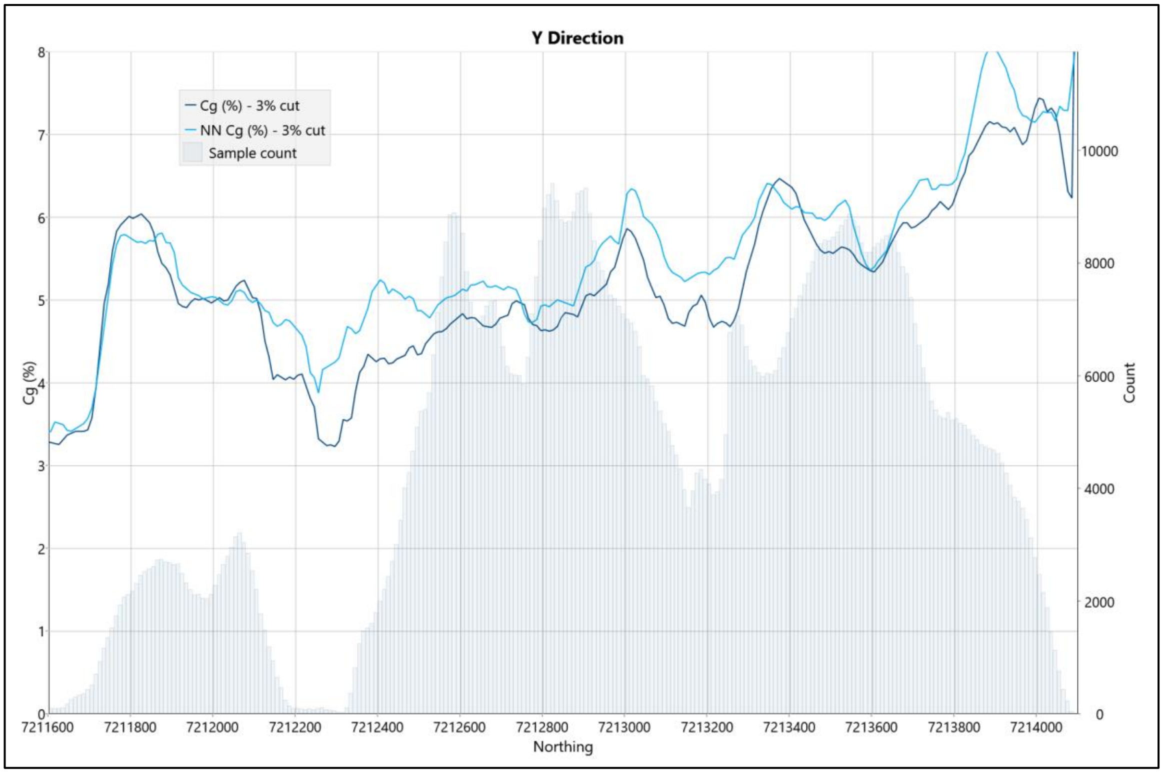
	Measured and Indicated Estimated Block Statistics by Lode – Specific Gravity									
	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9	Outside
Count	27,184	85,350	77,933	27,184	25,472	4	0	1	5	441,910
Mean	2.74	2.73	2.74	2.74	2.72	2.71	0.00	2.71	2.75	2.75
Standard deviation	0.07	0.06	0.05	0.07	0.06	0.02	NaN	NaN	0.04	0.06
Max	3.06	3.06	2.97	3.06	2.93	2.73	0.00	2.71	2.79	3.10
Upper quartile	2.78	2.77	2.78	2.78	2.75	2.73	0.00	2.71	2.78	2.79
Median	2.75	2.73	2.74	2.75	2.71	2.71	0.00	2.71	2.76	2.76
Lower quartile	2.71	2.69	2.70	2.71	2.67	2.69	0.00	2.71	2.71	2.72
Min	2.29	2.52	2.38	2.29	2.40	2.68	0.00	2.71	2.68	2.31
Coeff. Of Variation	0.02	0.02	0.02	0.02	0.02	0.01	NaN	NaN	0.01	0.02
Variance	0.00	0.00	0.00	0.00	0.00	0.00	NaN	NaN	0.00	0.00
Percentile 10	2.68	2.66	2.68	2.68	2.66	2.68	0.00	2.71	2.68	2.68
Percentile 20	2.70	2.68	2.70	2.70	2.66	2.68	0.00	2.71	2.68	2.71
Percentile 90	2.82	2.80	2.82	2.82	2.80	2.72	0.00	2.71	2.78	2.82
Percentile 99	2.87	2.86	2.87	2.87	2.89	2.73	0.00	2.71	2.79	2.90
	ALL Estimated Block Statistics by Lode – Specific Gravity									
	Lode 1	Lode 2	Lode 3	Lode 4	Lode 5	Lode 6	Lode 7	Lode 8	Lode 9	Outside
Count	199,842	389,413	182,196	124,568	161,044	92,299	17,380	27,191	79,108	32,164,837
Mean	2.74	2.75	2.75	2.74	2.71	2.71	2.70	2.71	2.70	2.75
Standard deviation	0.07	0.06	0.05	0.05	0.08	0.04	0.04	0.05	0.05	0.04
Max	3.08	3.06	3.00	3.06	2.95	2.90	2.83	2.84	2.84	3.10
Upper quartile	2.78	2.79	2.78	2.77	2.75	2.72	2.72	2.75	2.74	2.76
Median	2.73	2.75	2.74	2.73	2.71	2.70	2.70	2.72	2.71	2.75
Lower quartile	2.69	2.71	2.71	2.70	2.68	2.69	2.68	2.69	2.67	2.75
Min	2.37	2.47	2.36	2.29	2.35	2.62	2.55	2.54	2.53	2.31
Coeff. Of Variation	0.03	0.02	0.02	0.02	0.03	0.01	0.02	0.02	0.02	0.01
Variance	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Percentile 10	2.65	2.67	2.69	2.68	2.65	2.68	2.66	2.63	2.63	2.72
Percentile 20	2.68	2.70	2.70	2.70	2.67	2.68	2.67	2.68	2.66	2.75
Percentile 90	2.84	2.82	2.82	2.80	2.80	2.76	2.74	2.77	2.76	2.80
Percentile 99	2.90	2.86	2.88	2.87	2.89	2.85	2.80	2.82	2.81	2.86

14.11.3 Swath Plots

During each pass in the graphite estimation process, the nearest neighbor value was calculated into the block model. Swath plots along the Easting, Northing, and elevation were created by comparing the estimated graphite and the nearest neighbor value (Figure 14-33 through Figure 14-35). The swath plots were created in 10-meter-wide sections along each orientation and with a 3% (Cg) cutoff. The resulting swath plots showed limited over and under-estimation, especially within the Measured and Indicated blocks. When comparing all estimated blocks, the variation is larger, particularly when the number of blocks is small. This is expected with the lack of data in certain areas.

Similar swath plots were created for the density estimation with no significant issues seen.

Figure 14-33 Easting Swath Plot of Nearest Neighbor Cg (%) Vs. IDW2 Estimate Using 3% Cut-Off and 10-Meter Increments. Top Graph: All Estimated Blocks. Bottom Graph: Measured and Indicated Blocks.



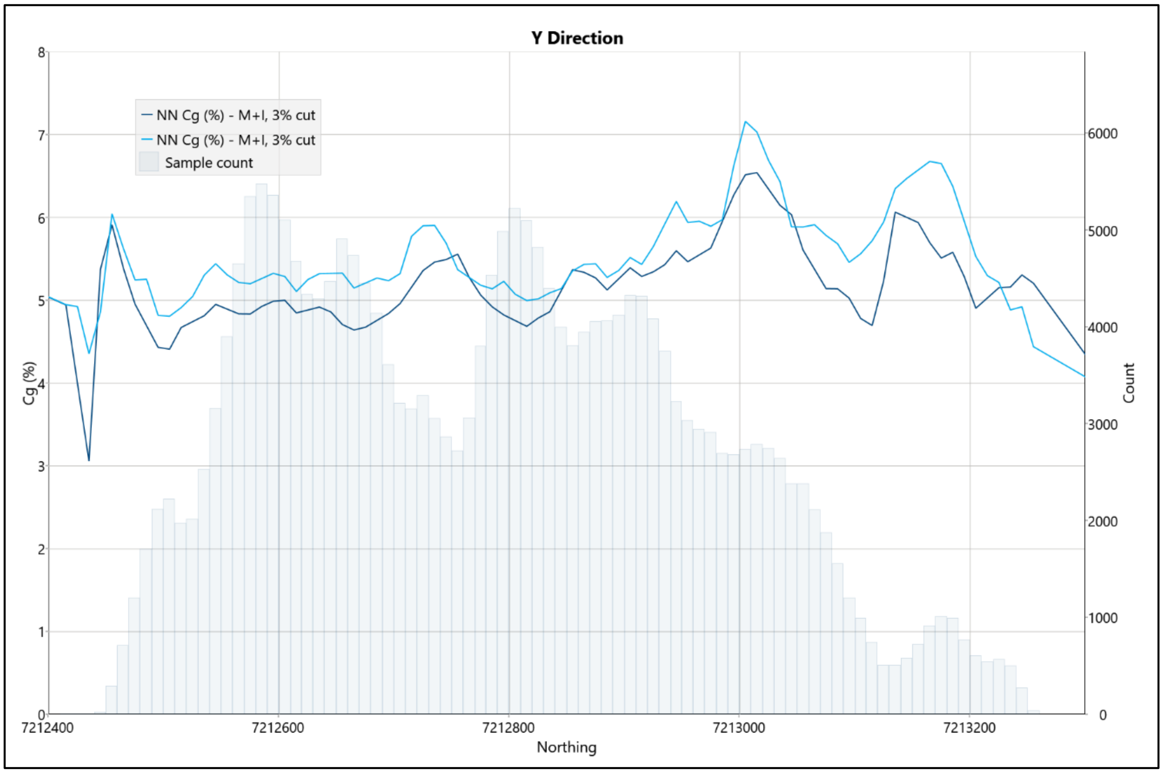
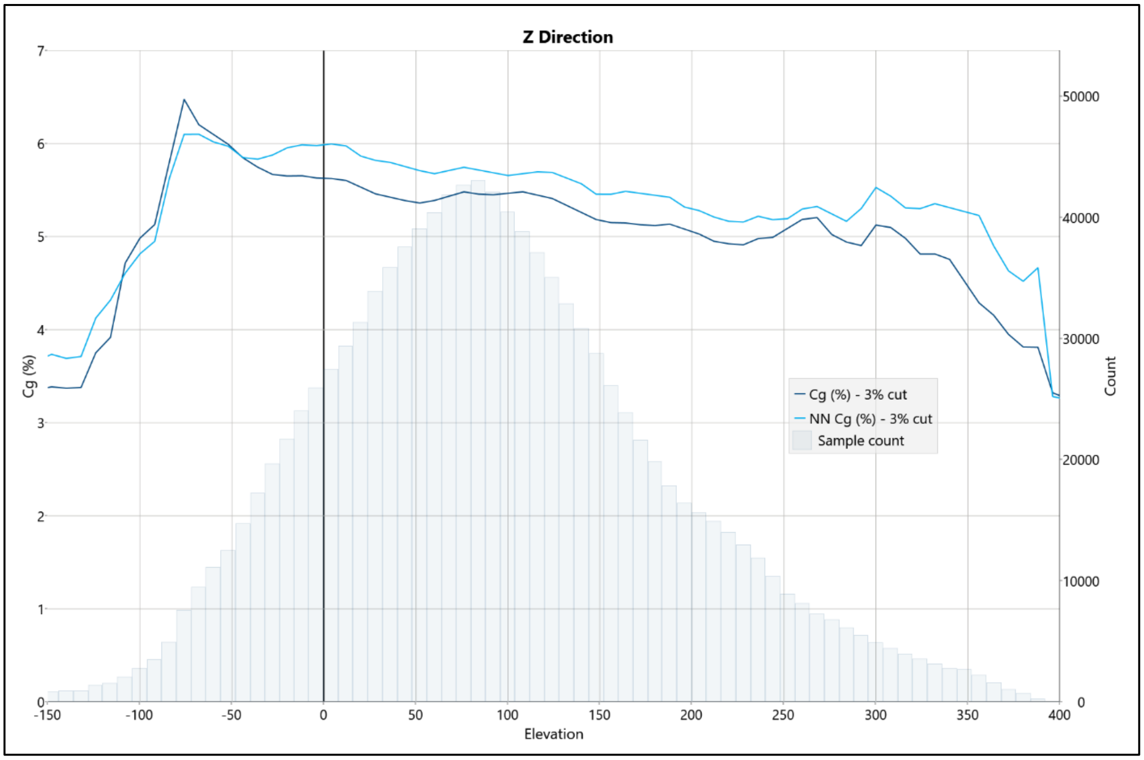


Figure 14-34 Northing Swath Plot of Nearest Neighbor Cg Vs. IDW2 Estimate Using 3% Cut-Off and 10-Meter Increments. Top Graph: All Estimated Blocks. Bottom Graph: Measured and Indicated Blocks.



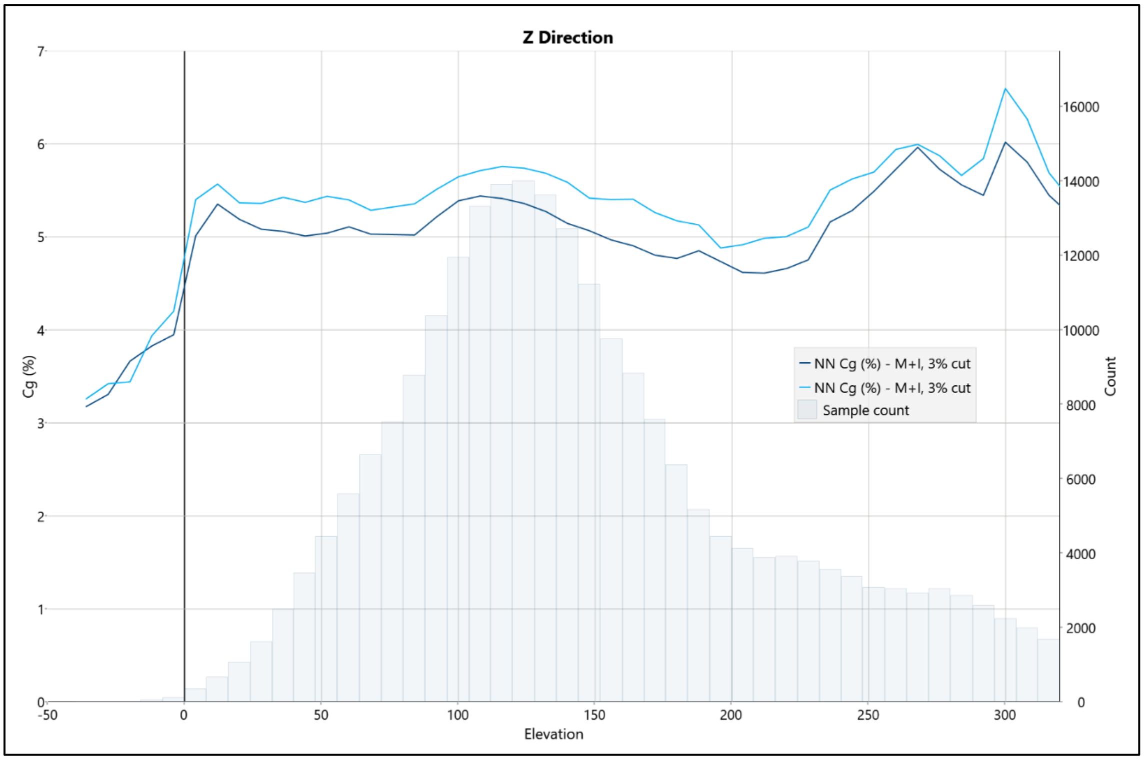


Figure 14-35 Elevation Swath Plot of Nearest Neighbor Cg Vs. IDW2 Estimate Using 3% Cut-Off and 10-Meter Increments. Top Graph: All Estimated Blocks. Bottom Graph: Measured and Indicated Blocks.

14.12 Mineral Resource Classification

The Graphite Creek Resource Estimate has been classified in accordance with guidelines established by the CIM "Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines" dated November 23, 2003, and CIM "Definition Standards for Mineral Resources and Mineral Reserves" dated November 27, 2010.

According to the CIM definition standards, the Graphite Creek Resource Estimate has been classified as 'Indicated' and 'Inferred'. The classification was based on geological confidence, data quality, and grade continuity. The most relevant factors used in the classification process were:

- Drillhole spacing; density
- Level of confidence in the geological interpretation where the observed stratigraphic horizons are easily identifiable along strike and across the deposit, which provides confidence in the geological and mineralization continuity
- Estimation parameters (i.e., continuity of mineralization)

The parameters of each estimation pass were determined by the factors listed above, so the classification of resources was guided by the estimation pass (Table 14-13). The single box search pass and pass 1 are considered to have a high level of confidence. Thus, they are unlikely to be drilled again and are placed within the 'Measured' category. Pass 2 used a range within 80% of the maximum sill variance with at least two drillholes and is considered to be the next highest level of confidence, the 'Indicated' category. All remaining blocks estimated are considered within the 'Inferred' category, which includes blocks estimated in passes 3 through 7.

Table 14-13 Classification Criteria

	Pass	Nominal Search Distance	Min. Number of Composites	Min. # Of Drillholes
Measured	BOX	1 x 1 x 1	1	1
	1	30 x 20 x 8	3	2
Indicated	2	92 x 63 x 8	3	2
Inferred	3	175 x 125 x 8	3	2
	4	87 x 62.5 x 8	2	1
	5	300 x 150 x 8	3	2
	6	150 x 75 x 8	2	1
	7	1500 x 500 x 500	2	1

The updated resource estimates for Graphite Creek, categorized as Measured, Indicated, Measured Plus Indicated, and Inferred resources, are presented in Table 14-14 and Table 14-15.

Table 14-14 Graphite Creek Updated Resource with Measured, Indicated, and Inferred Resources with Various COG

Graphite Creek Resource Estimate: March 2025				
Mineral Resource Classification	Cut-Off Grade (% Cg)	Tonnage (Mt)	Graphite Grade (% Cg)	Contained Graphite (t)
Measured	1	6.35	4.58%	290,830
	2	5.11	5.33%	272,249
	3	4.10	6.03%	246,995
	4	3.21	6.72%	215,795
	5	2.36	7.53%	177,521
Indicated	1	145.02	3.58%	5,198,904
	2	99.57	4.54%	4,523,443
	3	69.50	5.44%	3,783,614
	4	49.85	6.22%	3,099,243
	5	34.09	7.02%	2,393,982
Measured + Indicated	1	151.38	3.63%	5,489,734
	2	104.68	4.58%	4,795,692
	3	73.60	5.48%	4,030,609
	4	53.06	6.25%	3,315,038
	5	36.44	7.06%	2,571,503
Inferred	1	454.59	3.15%	14,316,710
	2	268.10	4.31%	11,567,844
	3	169.86	5.40%	9,165,919
	4	111.78	6.40%	7,154,166
	5	78.56	7.22%	5,668,987

The dip and location of the Kigluaik Fault that trends parallel and is adjacent to the deposit's mineralization is a controlling factor of the graphite resource. The fault surface was updated in 2019, 2020, 2022, and 2024. The updates in 2018 and 2019 resulted in the resource being truncated by the fault surface. New drilling in 2021 indicated a shallow dip to the fault, resulting in minimal to no truncation of the resource. Further drilling since 2021 confirms the shallow dip; however, drill intercepts outside of the main resource area are minimal. Continued drilling is required to confirm the fault interpretation to the SW and NE. Observed graphite mineralization continues to show remarkable consistency along the strike with little deviation, which provides confidence in the geological and mineralization continuity.

It should also be noted that as additional drilling occurs, the variogram ranges are updated, potentially creating variations in resource classification. The variations have minimal impact on total resources but rather the category to which they are applied. Further domain refinement based on geologic units or more dynamic grade shells can help mitigate this effect.

Table 14-15 Graphite Creek Updated Resources with Measured, Indicated, and Inferred Resources with 2% Cg COG

Graphite Creek Resource Estimate: March 2025				
Mineral Resource Classification	Cut-Off Grade (% Cg)	Tonnage (Mt)	Graphite Grade (% Cg)	Contained Graphite (t)
Measured	2	5.11	5.33%	272,249
Indicated	2	99.57	4.54%	4,523,443
Measured + Indicated	2	104.68	4.58%	4,795,692
Inferred	2	268.10	4.31%	11,567,844

Mineral resources are not mineral reserves and do not have demonstrated economic viability. The above tabulation is unconstrained by mining volumes. Values have been rounded and may not sum as a result. There is no guarantee that all or any part of the mineral resource will be converted into a mineral reserve. Based on current exploration stages, the above resource analysis indicates that the Graphite Creek property currently contains sufficient grade and tonnage to continue feasibility studies. The property includes excellent potential to increase the size of the resource.

15 Mineral Reserve Estimates

15.1 Approach

A mineral reserve is the economically mineable part of a Measured and/or Indicated mineral resource and is defined by studies at a pre-feasibility or feasibility level that include the application of modifying factors. This FS includes adequate information and considerations regarding mining, processing, metallurgical, infrastructure, economic, marketing, environmental, and other relevant factors that demonstrate at the time of reporting that economic extraction can be reasonably justified.

The QP is responsible for reviewing all mining factors and costs to verify that the mineral reserve estimates are correct. The estimation of mineral reserves is the basis of an economically viable project. Mineral reserves are inclusive of diluting material that will be mined in conjunction with the mineral reserves and delivered to the treatment plant or equivalent facility. The term “mineral reserve” need not necessarily signify that extraction facilities are in place, operative, or that all governmental approvals have been received. It does signify that there are reasonable expectations of such approvals.

Mineral reserves are subdivided in order of increasing confidence into *Probable* mineral reserves and *Proven* mineral reserves. The reserve classifications used in this report conform to the CIM’s classification of NI 43-101 resource and reserve definitions and Companion Policy 43-101CP. These classifications are listed below.

A *Probable Mineral Reserve* is the economically mineable part of an Indicated mineral resource, and in some circumstances, a Measured mineral resource. The confidence in the modifying factors applying to a *Probable* mineral reserve is lower than that applying to a *Proven* mineral reserve. The QPs may elect to convert Measured mineral resources to *Probable* mineral reserves if confidence in the modifying factors is lower than that applied to a *Proven* mineral reserve.

A *Proven Mineral Reserve* is the economically mineable part of a Measured mineral resource. Application of the Proven mineral reserve category implies that the QPs have the highest degree of confidence in the estimate and the consequent expectation in the minds of the readers of the report. The term should be restricted to that part of the deposit where production planning is taking place and for which any variation in the estimate would not significantly affect the potential economic viability of the deposit.

To convert a mineral resource into a mineral reserve, estimates of commodity prices, mining dilution, process recovery, refining/transport costs, royalties, mining costs, processing, and general and administration costs were used to estimate COGs. These input parameters, along with geotechnical slope recommendations, formed the basis for the selection of economic mining blocks.

The economic mining blocks were identified using the Lerchs-Grossmann or Pseudoflow Pit Optimization Algorithm in the Maptek Vulcan^tm^ software package, which produced a series of optimized open-pit shapes. The QP has selected one of these shapes for detailed design and quantified the mineral reserves at the determined COG within the final pit design.

15.2 Basis of Commodity Prices and Cost Assumptions

The average graphite price used in the pit optimization analyses was set at $1,200 per ton. This is based on the weighted average of 16 different final products ranging from $200 per ton to $10,250 per ton and includes an adjustment for an overall net mass increase of 44% in the STP due to the addition of other materials. Further details on commodity pricing can be found in Chapter 19.

The graphite resources are currently subject to a number of royalties ranging from 3.5% to 8.0% totaled. It has been assumed that some of the royalties will be bought out, leaving the majority of the resources with an average 5.5% royalty. Royalty payments are based on the concentrate transfer price.

A conventional truck/shovel open-pit mining method was selected for the deposit. Mining costs used in the pit optimization were based on first principles build-ups using a preliminary production schedule as guidance.

Processing and general and administrative (G&A) operating costs were developed for the treatment of mineralized material. The battery limits for determining the process operating costs commence from the crushing facilities and continue through to the placement of tailings. G&A costs cover items such as site services, transportation, and camp costs. The operating costs are based on a mill production rate of 3.6 Mtpa.

A mill recovery of 90% was utilized for the pit optimization. This information was sourced from both historical and current testwork performed by SGS at its Lakefield laboratory in 2020, 2021, 2023, and 2024.

15.3 Pit Optimization

The pit shell that defines the ultimate pit limit was derived in Vulcan using the Pseudoflow pit-optimization algorithm. The optimization procedure uses the block value and pit slopes to determine a group of blocks representing pits of valid slopes that yield the maximum profit. The block value is calculated using information stored in the geological block model, commodity prices, mining and processing costs, process recovery, and the sales pricing for the metals produced. Table 15-1 provides a summary of the primary optimization inputs.

The results of the pit optimization evaluation for varying revenue factor values are summarized in Figure 15-1. Note that the NPV in this optimization summary does not consider capital expenditures and is used only as a guide in shell selection and determination of the mining shapes. The optimization software produces both best-case and worst-case scenarios. These two scenarios provide a bracket for the range of possible outcomes to help guide the final pit selection. The best case is typically an optimistic evaluation (mine shell by shell), while the worst case is conservative (mine bench by bench from top to bottom). There is also a scenario that is a reasonably optimistic evaluation called lag, which incorporates an operational bench-sinking rate per year that can be mined, so its NPV is between the best-case and the worst-case scenarios.

The ultimate pit shell was selected based on maximizing NPV and minimizing the addition of increasingly lower grade and higher strip ratio mineralized material (i.e., higher incremental strip ratios) that generate only a minimal improvement on the overall NPV. A pit shell revenue factor of $1,200/t Cg was selected as the basis for the ultimate pit design.

Table 15-1 Open-Pit Optimization Input Parameters

Parameter	Units	Value	Reference
Net Graphite Price	$/t Cg	1,200	Owner (G1)
Operating Costs			
Mining	$/t mined	3.5	Owner (G1)
Milling	$/t processed	12.0	Owner(G1)
G&A	$/t processed	6.0	Owner (G1)
Recovery and COGs			
Process Recovery	%	90	
Mill Cut-Off Grade	% Cg	2.0	

Table 15-2 Overall Results of the Graphite Creek Open-Pit Optimization

Pit	Price	Total	Ore	Waste	SR	Cg	Cg	Rec Cg	NPV Best	NPV-Lag	NPV-Worst
	$/t	Mt	Mt	Mt	W:O	%	kt	kt	$M	$M	$M
1	760	59.0	27.8	31.3	1.13	5.67	1,416	1,346	$375	$375	$375
2	780	61.9	28.8	33.1	1.15	5.65	1,466	1,392	$382	$381	$380
3	800	72.3	32.5	39.8	1.22	5.59	1,636	1,554	$403	$401	$396
4	820	97.2	42.1	55.1	1.31	5.53	2,094	1,989	$455	$451	$437
5	840	101.9	44.0	57.9	1.32	5.47	2,164	2,056	$459	$453	$435
6	860	105.0	45.0	60.0	1.33	5.44	2,204	2,094	$461	$454	$433
7	880	115.3	48.1	67.2	1.40	5.40	2,341	2,224	$469	$462	$431
8	900	146.5	56.9	89.6	1.57	5.32	2,724	2,588	$487	$476	$417
9	920	149.1	57.7	91.4	1.58	5.30	2,754	2,616	$487	$477	$414
10	940	150.5	58.1	92.4	1.59	5.30	2,769	2,631	$488	$477	$413
11	960	154.1	59.2	95.0	1.61	5.28	2,813	2,672	$490	$478	$412
12	980	157.1	60.1	97.0	1.61	5.27	2,852	2,709	$491	$480	$410
13	1,000	160.3	60.8	99.5	1.64	5.26	2,880	2,736	$491	$480	$407
14	1,020	161.2	61.1	100.1	1.64	5.26	2,891	2,747	$492	$481	$406
15	1,040	196.8	73.5	123.3	1.68	5.08	3,359	3,191	$502	$490	$377
16	1,060	199.2	74.3	124.9	1.68	5.07	3,390	3,220	$503	$491	$375
17	1,080	201.3	74.8	126.5	1.69	5.06	3,410	3,240	$503	$491	$373
18	1,100	204.9	75.6	129.3	1.71	5.06	3,441	3,268	$503	$491	$368
19	1,120	205.1	75.6	129.4	1.71	5.06	3,442	3,270	$503	$491	$368
20	1,140	208.3	76.6	131.7	1.72	5.04	3,478	3,304	$503	$491	$366
21	1,160	209.7	76.9	132.8	1.73	5.04	3,489	3,314	$503	$491	$364
22	1,180	211.6	77.4	134.2	1.73	5.03	3,505	3,330	$503	$491	$362
23	1,200	218.8	78.8	140.0	1.78	5.01	3,552	3,374	$502	$490	$348
24	1,220	224.1	79.8	144.3	1.81	5.00	3,589	3,410	$502	$490	$338
25	1,240	225.4	80.0	145.4	1.82	4.99	3,597	3,417	$502	$490	$336
26	1,260	226.2	80.2	146.0	1.82	4.99	3,602	3,422	$502	$490	$334
27	1,280	229.7	80.9	148.7	1.84	4.98	3,629	3,447	$502	$489	$330
28	1,300	233.3	81.7	151.6	1.86	4.97	3,658	3,475	$502	$489	$326

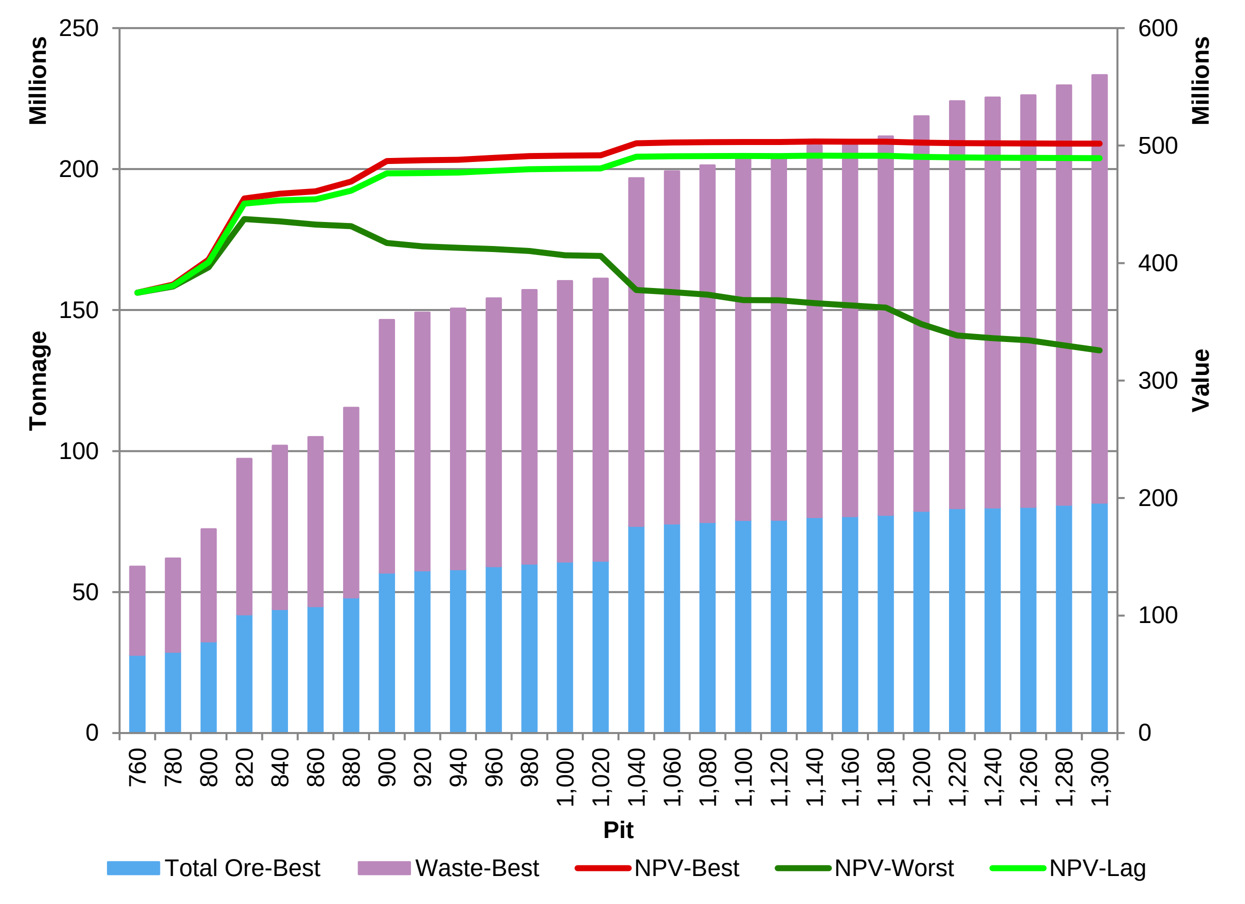


Figure 15-1 Graphite Creek Open-Pit Optimization—Overall Pit Shell Results

15.4 Open-Pit Design

The selected optimized pit shell was converted into a detailed open-pit mine design that formed the basis of the mineral reserve estimate and production schedule. The pit wall slope angles, bench heights, and access ramp parameters are discussed in further detail below. The final pit design, located along the northern flank of the Kigluaik mountain range, is approximately 1,900 m long with a maximum elevation of 440 meters above mean sea level (AMSL) and a pit bottom elevation of 30 m AMSL. The interior pit ramp is planned to exit at an elevation of 190 m AMSL. The final pit design is shown in Figure 15-2. Measured and Indicated resources above the economic COG (2.0% Cg) are shown relative to the final pit design in Figure 15-3, Figure 15-4, and Figure 15-5.

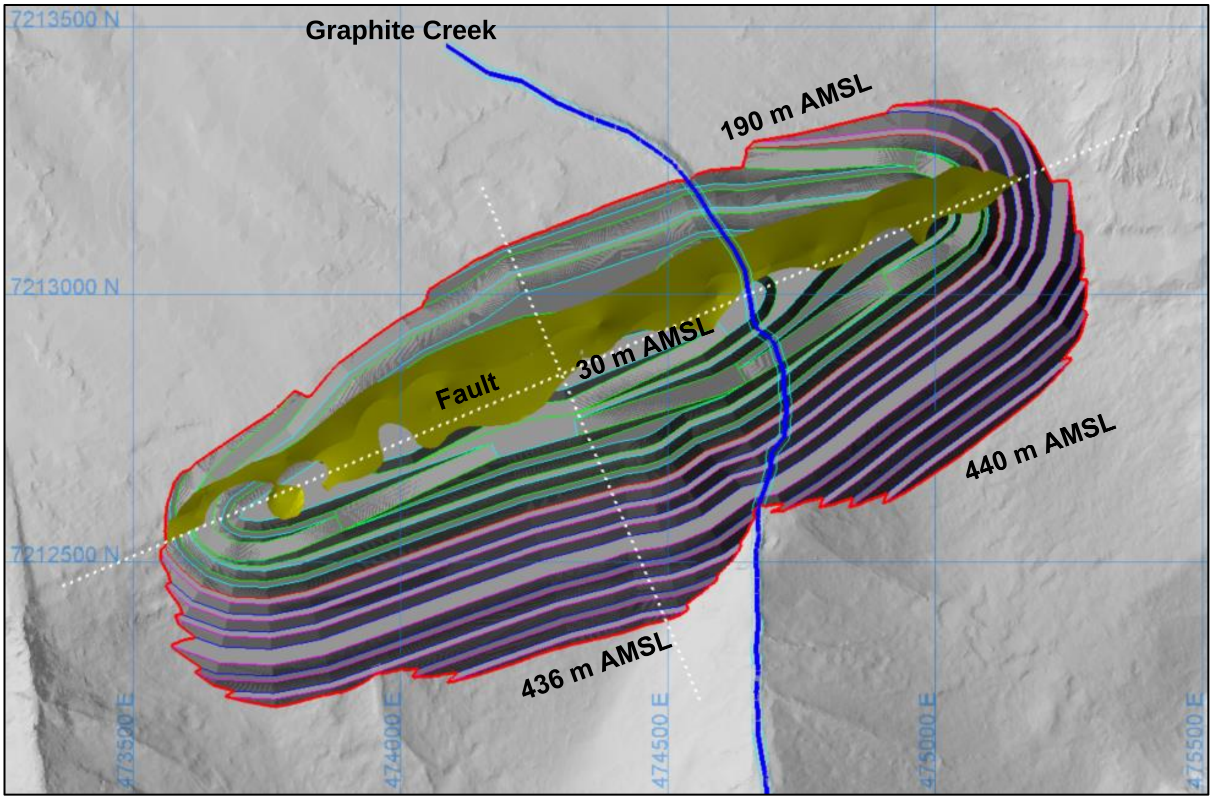


Figure 15-2 Final Open-Pit Design

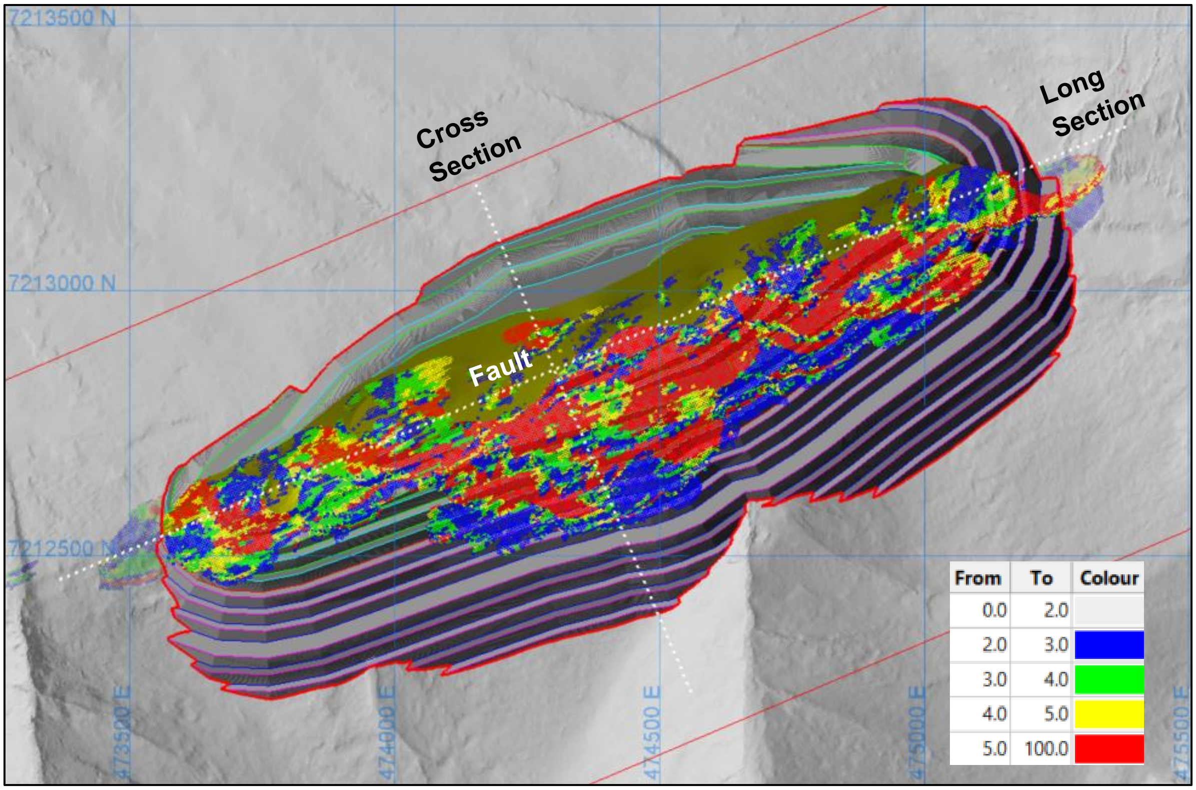


Figure 15-3 Measured and Indicated Resources Relative to the Final Pit Design

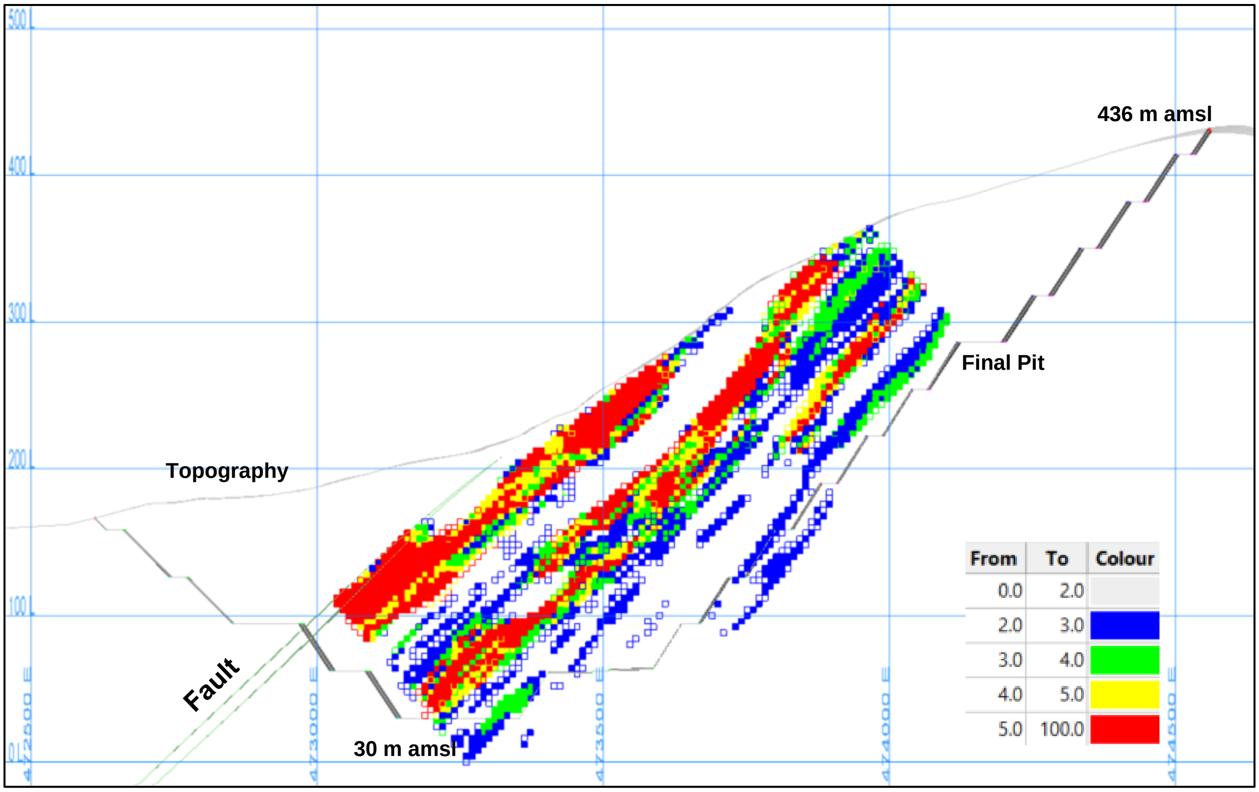


Figure 15-4 Cross Section of Final Pit Showing Measured and Indicated Resources %Cg

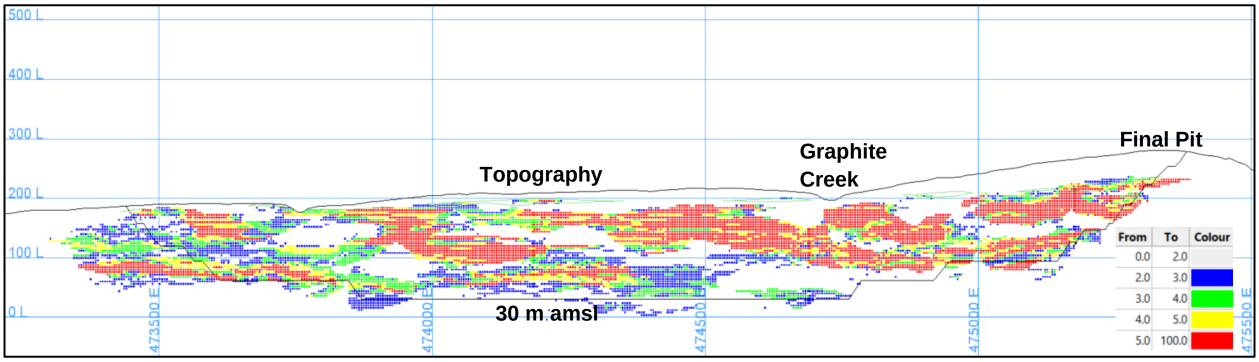


Figure 15-5 Long Section of Final Pit Showing Measured and Indicated Resources

15.5 Mining Dilution and Ore Loss

The mineral resources were reported undiluted, but the mineral reserves for the project included dilution due to the large scale of the mining equipment and the use of blasting. The dilution is also caused by a block mixing with its surroundings, which could be rocks of lower grade, during the mining process. To estimate mining dilution, the weighted average of the percentages of mineralization material and all rock types except for soil was calculated. This resulted in 2% dilution applied to the in-situ Cg grade. The blocks with diluted grades that fell below the COG were treated as waste. No additional tonnage adjustment was necessary.

15.6 Mineral Reserve Estimate

A summary of the mineral reserves for the project is shown in Table 15-3 within the designed final pit for the Graphite Creek deposit. In the detailed mine production schedule, the COG has been raised variably over the life of the project to 3.0 % Cg. Any resources below the raised COGs have been wasted. The effective date of the mineral reserve stated in this report is 25 March 2025.

The QPs have not identified any known legal, political, environmental, or other risks that would materially affect the potential development of the mineral reserves, except for the risk of not being able to secure the necessary permits from the government for the development and operation of the project; however, the QPs are not aware of any unique characteristics of the project that would prevent permitting.

Table 15-3 Proven and Probable Mineral Reserve Estimate

Class	Diluted Tonnes (kt)	Diluted Grade (% Cg)	Contained Graphite (kt)
Proven	4,099	5.80	238
Probable	67,120	5.18	3,480
Total Proven and Probable	**71,219**	**5.22**	**3,717**

Notes:
1. Mineral reserves follow CIM definitions and are effective as of 25 March 2025.
2. The mineral reserves are inclusive of mining dilution and ore loss.
3. Mineral reserves are estimated using a raised variable cut-off of 2.0% Cg – 3.0% Cg which is required to maximize secondary treatment production. The economic value is calculated based on a net average Graphite Price of $1,200/t (including transport and treatment charges), 3.5% - 8.0% royalty, and a mill recovery of 90%.
4. The final pit design contains an additional 17.4 Mt of Measured and Indicated resources between the raised COG (3.0% Cg) and the economic COG (2.0% Cg) at an average grade of 2.4% Cg. These resources have been treated as waste in the final mine production schedule.
5. The final pit design contains an additional 40.4 Mt of Inferred resources above the economic COG (2.0% Cg) at an average grade of 3.9% Cg. Inferred mineral resources are considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as mineral reserves, and there is no certainty that any part of the Inferred resources could be converted into mineral reserves.
6. Tonnages are rounded to the nearest 1,000 t, and graphite grades are rounded to two decimal places. Tonnage measurements are in metric units.
7. Totals may not add up due to rounding.

16 Mining Methods

16.1 General Mining Method

Open-pit mining has been selected as the mining method for the Graphite Creek deposit due to its relatively low cost (versus underground mining methods) and the near-surface nature of the deposit. Ore production has been restricted based on the STP target of 175,000 tpa of concentrate, which results in an on-site mill throughput of 3.6 Mtpa.

The material will be drilled and blasted on 8-m benches and excavated using a hydraulic mining shovel and a front-end loader. A fleet of 141-t trucks will haul material to the crusher or waste dump. Ore material is to be sent directly to the primary crusher or a temporary stockpile located roughly 1 km east of the pit. Waste material will be co-mingled with filtered tailings in the WMF, which is located to the north of the pit.

The mine COG is 2% Cg, which results in 88.7 Mt of ore at an average graphite grade of 4.7% Cg. To maximize the secondary treatment production, the variable COG has been optimized to be higher than 2% and up to 3%. Due to these raised COGs, 17.4 Mt of Measured and Indicated resources between the raised COG (3.0% Cg) and the economic COG (2.0% Cg) at an average grade of 2.4% Cg, are treated as waste. Over the LOM, the mine will produce 71.2 Mt of ore at an average graphite grade of 5.2% Cg, along with 229.8 Mt of waste, which includes an additional 40.4 Mt of Inferred resources above the economic COG (2.0% Cg) at an average grade of 3.9% Cg.

16.2 Mine Design

The pit design is based on the open-pit optimization-input parameters. A series of optimized shells were generated for the deposit based on varying revenue factors to produce a series of nested shells and their respective NPV results. The results were analyzed using shells chosen as the basis for ultimate limits and phase selection. The optimization software produces both best-case and worst-case scenarios, providing a bracket for the range of possible outcomes to help guide final pit selection. The best case is typically an optimistic evaluation (mine shell-by-shell), while the worst case is conservative (mine bench-by-bench from top to bottom). There is also a scenario, which is a reasonably optimistic evaluation called lag, which incorporates the operational bench-sinking rate per year that can be mined, so its NPV is between the best-case and the worst-case scenarios.

16.3 Phase Design

The ultimate pit design was split into five pushbacks to aid construction activities and help smooth production rates during operations. The approximate pushback shapes were selected from the generated pit shells as part of the pit optimization process, which provides a sequence based on overall value. The design parameters include a ramp width of 30 m, road grades of 10%, bench height of 8 m, variable slope angles by rock type, and a minimum mining width of 30 m. Final walls will be benched to a height of 32 m to satisfy the geotechnical design parameters recommended in the following sections.

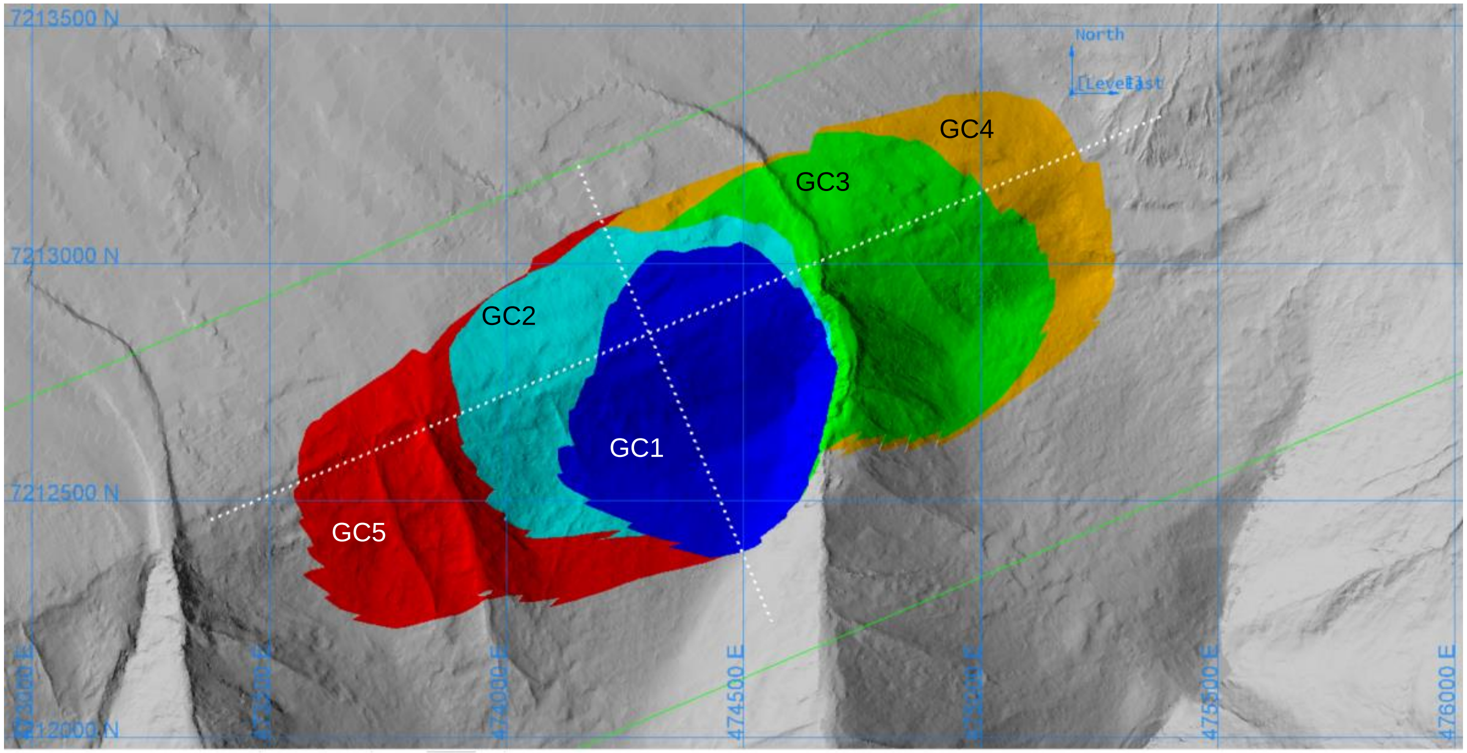


Figure 16-1 Graphite Creek Phase Design

Table 16-1 Graphite Creek Phase Design Report

Push-back	Quantity (t)	Ore (t)	Cg %	Measured (t)	Cg %	Indicated (t)	Cg %	Inferred (t)	Cg %	Cg Contained	Cg Recovered	Concentrate (t)	Waste (t)
GC1	64,336,825	20,028,307	5.55	1,344,089	6.57	18,684,218	5.48	6,033,844	3.43	1,111,998	1,000,798	1,053,472	44,308,518
GC2	45,247,652	13,610,158	5.33	783,504	5.50	12,826,654	5.32	5,386,370	4.27	725,783	653,205	687,584	31,637,494
GC3	64,404,605	14,278,320	5.45	955,987	6.01	13,322,333	5.41	8,660,841	3.86	777,920	700,128	736,977	50,126,285
GC4	57,860,495	10,973,358	4.96	461,588	5.15	10,511,770	4.95	9,301,565	4.19	544,245	489,820	515,600	46,887,137
GC5	69,133,174	12,328,719	4.52	554,105	4.58	11,774,613	4.52	10,977,511	3.64	557,541	501,787	528,197	56,804,456
Total	**300,982,751**	**71,218,862**	**5.22**	**4,099,273**	**5.80**	**67,119,588**	**5.18**	**40,360,130**	**3.87**	**3,717,488**	**3,345,739**	**3,521,830**	**229,763,889**

16.4 Open-Pit Geotechnical Considerations

Barr reviewed the previous geotechnical analysis and recommendations, in addition to the identified potential risks and opportunities highlighted in the earlier studies. From this information, the 2024 geotechnical field and laboratory testing programs were carried out to update the structural, geotechnical, and hydrogeologic models to support the FS.

Detailed engineering analyses were completed using information collected from the previous work and the 2024 work to update design recommendations for the Graphite Creek FS open pit.

16.4.1 Geotechnical Considerations

16.4.1.1 Geology and Structure

The Graphite Creek graphite-bearing schists are located in the Kigluaik Mountains 60 km north of Nome on the Seward Peninsula, Alaska. The deposit is approximately 5.0 km in length by 0.2 km in width, with a strike of approximately 70° and a dip of 35°-75° to the NW. The deposit extends along the north flank of the Kigluaik Mountains gneiss dome and immediately south of the range-bounding Kigluaik Fault based on the extent of the Inferred resource (King et al., 2019).

The deposit is on the footwall (south) side of the Kigluaik Fault. Within the proximity of preliminary pit limits, the Kigluaik Fault appears to dip to the north-northwest at about 45° in contrast to earlier models where the fault was interpreted to dip much steeper. The graphite-bearing schists strike subparallel to the mountain front and dip north between 40° and 75°. Locally, the attitude of the Kigluaik Fault and the bedding/schistosity of the metasediments is coincident or nearly so. Based on surface mapping measurements, localized folding is observed on the "<1 m scale." Oriented drilling in 2021 and 2022 encountered several intercepts of folded schist that are apparently "> 1 m scale" and not confined to a particular rock type (Gierymski et al., 2022).

The fault is a boundary between bedrock mineralization and surficial deposits (i.e., overburden) that covers the area to the north of the Kigluaik Fault on the Graphite One property. The surficial deposits include glacially deposited sand, gravel, and boulders; fluvial gravel and sand; marine and fluvial terrace deposits; and wetlands (Till et al., 2011). The pit is located coincident with the mapped fault trace. The Kigluaik Fault represents the most important source of strong ground shaking for the Graphite Creek project and may also represent a source of surface fault rupture.

Bedrock, which is either exposed or covered minimally by surficial deposits throughout most of the property area south of the Kigluaik Fault, includes the QBS, QBGS, QBGSS, QBSS, QDIO, and INF (Gierymski et al., 2022).

16.4.2 Open Pit Subsurface Investigations

The subsurface geotechnical and hydrogeologic investigations of the open pit conducted in 2019, 2022, and 2024 included 10 geotechnical holes (seven of which were drilled in 2024) (Table 16-2). Barr, Tundra, and Graphite One jointly selected the drillhole locations and investigation objectives from geotechnical, hydrogeologic, and mine planning perspectives.

Table 16-2 Drillholes for Open-Pit Subsurface Investigations

Hole ID	Northing[1] (m)	Easting[1] (m)	Ground Surface Elevation (m)	Azimuth (deg.)	Plunge (deg.)	Inclined Depth (m)
24GCT019	473789	7212717	158	178	-53	145
24GCT020A	475062	7213235	263	176	-50	165
24GCT023	473683	7212511	220	161	-51	120
24GCT025	474572	7212704	355	162	-49	158
24GCT028	474230	7212621	309	159	-51	144
24GCT030	473909	72125755	233	198	-53	120
24GCT032	474932	7213015	288	154	-51	165
22GT009	474283	7212900	203	290	-85	50
19GC027	474733	7212950	254	160	-50	151
19GC028	474442	7212746	299	160	-50	136

Notes:
Coordinates are in NAD83 UTM 3N.
Drillhole 24GCT020A was drilled to replace the originally proposed 24GCT020, which was abandoned due to drilling difficulties. However, soil samples from 24GCT020 were used for the laboratory testing.

The 2024 geotechnical drillholes are shown on Figure 16-2 below.

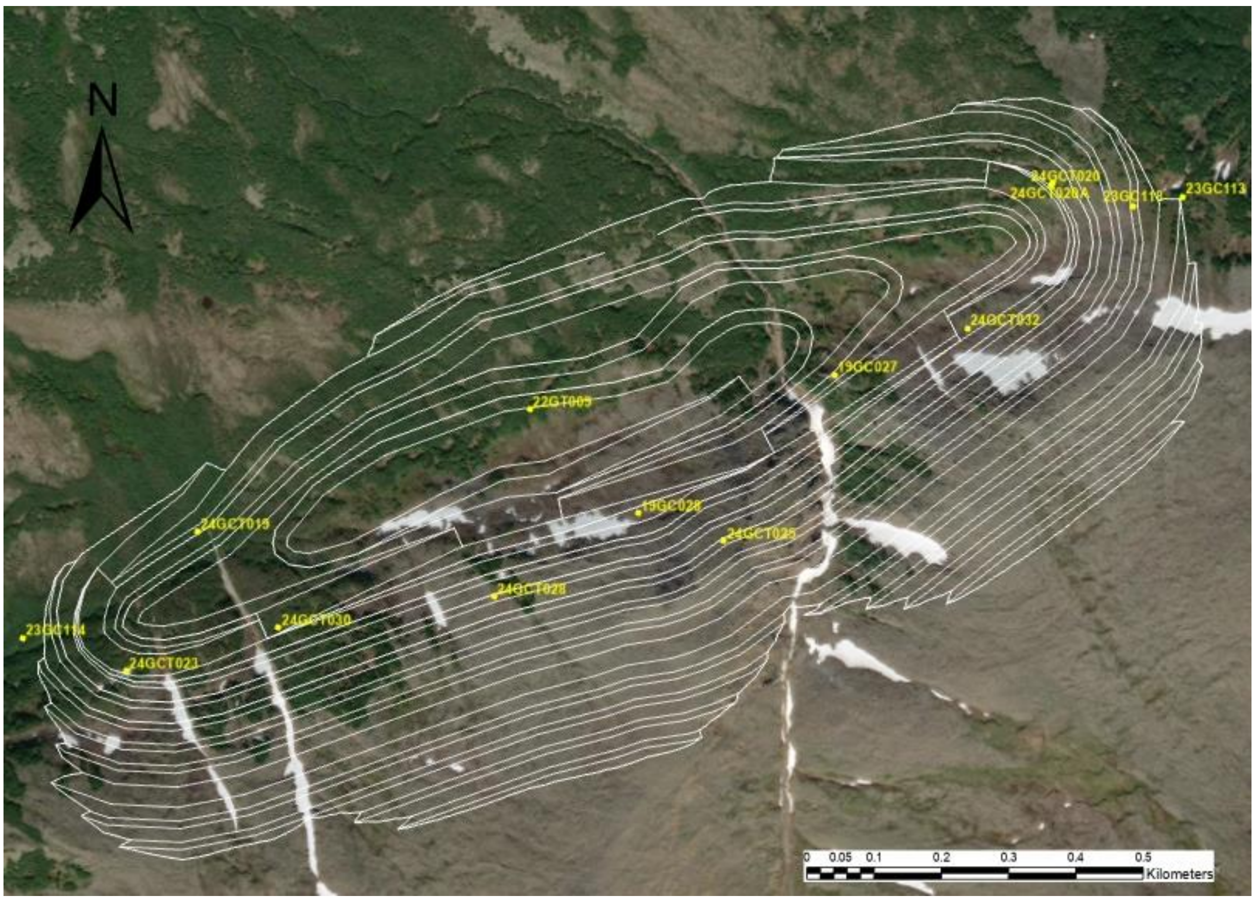


Figure 16-2 Location of 2024 Geotechnical Drillholes

In 2024, drilling was conducted by Major Drilling Group International Inc. between June 14 and August 22, 2024. Barr and Tundra staff supervised the 24-hour drilling operations, down hole geophysics, hydrogeologic testing, and borehole installations in the field with coordination support from Graphite One. It should be noted that detailed core logging was performed in the core shack in Nome and not at the rig because televiewer work was performed in the geotechnical drillholes, which provided a more reliable estimate of structural discontinuities in terms of spacing and orientation. Rock was cored using triple-tube HQ3 equipment, which resulted in a rock core diameter of 61.1 mm (2 3/8 in.). Additional testing was performed, including packer tests, borehole magnetic resonance (BMR), temperature/fluid conductivity, spinner plus heat-pulse flowmeter, ATV, and OTV. DTCs and VWPs were also installed in the drillholes. Table 16-3 presents information on packer test interval depths and the functioning VWP installation depths and elevations.

Table 16-3 Summary of the Depth Intervals of Packer Tests and VWP Installations in 2024 Drillholes

Hole ID	Packer Test Interval Inclined Depth Bgs (M)	VWP Tip Inclined Depth Bgs (M)	Approximate VWP Tip Elevation (M)
24GCT019	33.7 - 58.2	-	-
	64.4 - 81.4	-	-
	85.7 - 111.7	-	-
	119.9 - 145.1	-	-
24GCT020A	79.4 - 129.7	80.7	197.3
	146.5 - 150.3	132.5	157.6
24GCT023	39.4 - 62.5	35.9	193.5
	62.5 - 120.1	81.6	158.5
	-	99.9	144.5
	-	119.7	129.3
24GCT025	60.4 - 114.0	-	-
	114.0 - 157.9	-	-
24GCT028	23.2 - 56.8	-	-
	56.8 - 90.3	-	-
	90.3 - 117.7	-	-
	117.7 - 143.0	-	-
24GCT032	24.2 - 31.0	25	268.8
	120.0 - 164.0	70	234.4
	-	105	207.6
	-	135	184.6
	-	160	165.4

Bgs = below ground surface

Drillholes 24GCT019, 24GCT025, and 24GCT028 included open standpipe piezometers with 50.8 mm (2-in) diameter schedule 80 PVC risers. Open standpipe piezometers included airlift well development. After grouting open standpipes, VWPs, and DTCs bear cans were installed at the ground surface for protection of instrumentation.

Core was logged by Graphite One personnel at the core shack in Nome to collect geotechnical data such as lithology, total core recovery, RQD, alpha angle of discontinuities with respect to core axis, and joint roughness coefficient (JRC) of discontinuities. Rock cores were selected for laboratory testing.

The main lithology types encountered in the 2024 boreholes were QBGSS (approximately 38% of rocks encountered), QBS (approximately 32% of rocks encountered), and QBGS (approximately 11% of rocks encountered). The remaining materials encountered were overburden (surficial deposits, approximately 8%), QBSS (approximately 3%), pegmatite (approximately 2%), and fault material (approximately 2%).

16.4.3 Laboratory Testing

The open-pit geotechnical laboratory testing database, which was updated with the 2024 laboratory test results, includes rock core unconfined compressive strength (UCS) tests, triaxial compressive strength (TCS) tests, Brazilian indirect tensile strength (BTS) tests, and direct shear strength tests on natural and saw-cut joints. Barr reviewed the testing database and evaluated reliable and valid test results to estimate representative compressive and shear strength values of the intact rock and the rock masses, including discontinuities.

The mean and standard deviation values of UCS and BTS test results considered for geotechnical assessments are presented in Table 16-4. The shear strength of discontinuities and the foliation rock fabric were assessed using the direct shear strength test results presented in Figure 16-3.

Table 16-4 Summary of UCS and BTS Test Results

Lithology Code	UCS (MPa)			BTS (MPa)		
	Number of Valid Tests	Average	Std. Dev.	Number of Valid Tests	Average	Std. Dev.
QBGSS	16	64	43.5	15	8	4.1
QBS	16	77	40.5	29	7	3.4
QDIO	3	107	58.3	2	11	0.3

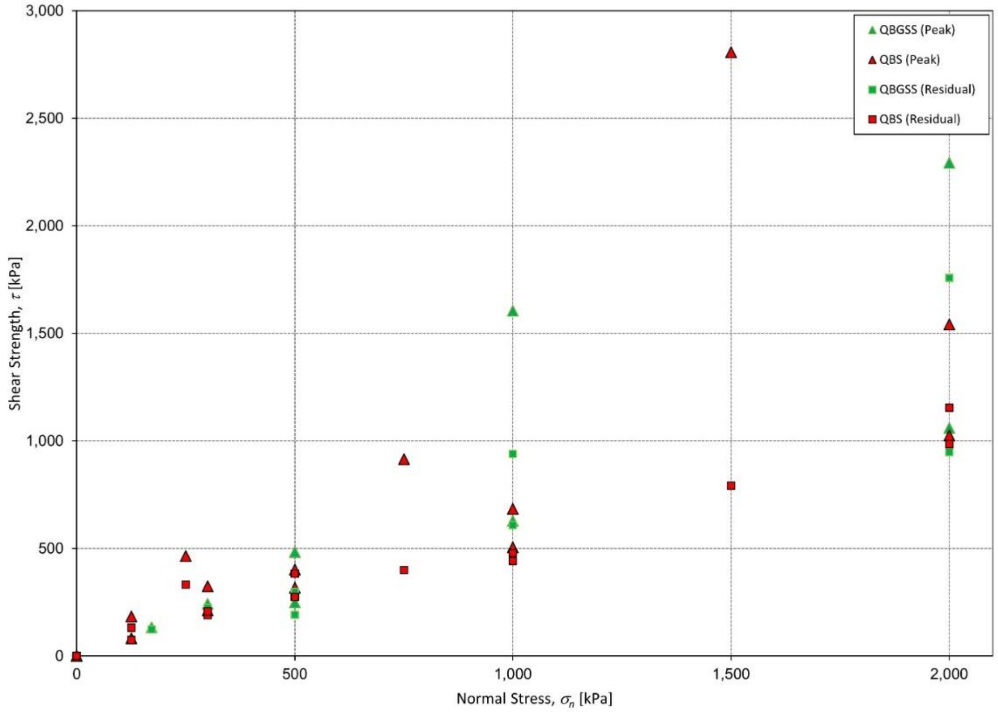


Figure 16-3 Results of Graphite Creek 2024 Direct Shear Tests on Rock Joint Surfaces

The test results suggest a variation in the friction angle between natural discontinuity (i.e., foliation) and saw-cut surfaces. After evaluating the laboratory test results, the residual and peak friction angle of natural open discontinuity (i.e., foliation) was calculated as 25.5° and 47°.

Rock mass strength anisotropy due to the widespread and consistent presence of foliation exists in schists. Barr used the UCS and TCS test results to estimate parameters for the generalized Hoek-Brown rock mass strength envelopes for schists that were combined with the shear strength of the foliation to form the generalized anisotropic strength model for engineering analysis. This approach is explained further in Section 16.4.5.

Laboratory testing of overburden soils (i.e., till matrix) and fault gouge sampled from core boxes included moisture content (ASTM D2216), Atterberg limits (ASTM D4318), sieve and hydrometer analysis (ASTM D422-16), three-point direct shear (ASTM D3080), one-point peak and residual torsional ring shear (ASTM D6467), and permeability (ASTM D5084) tests. Figure 16-4 presents the summary results of soils collected from all 2024 geotechnical boreholes for laboratory strength tests.

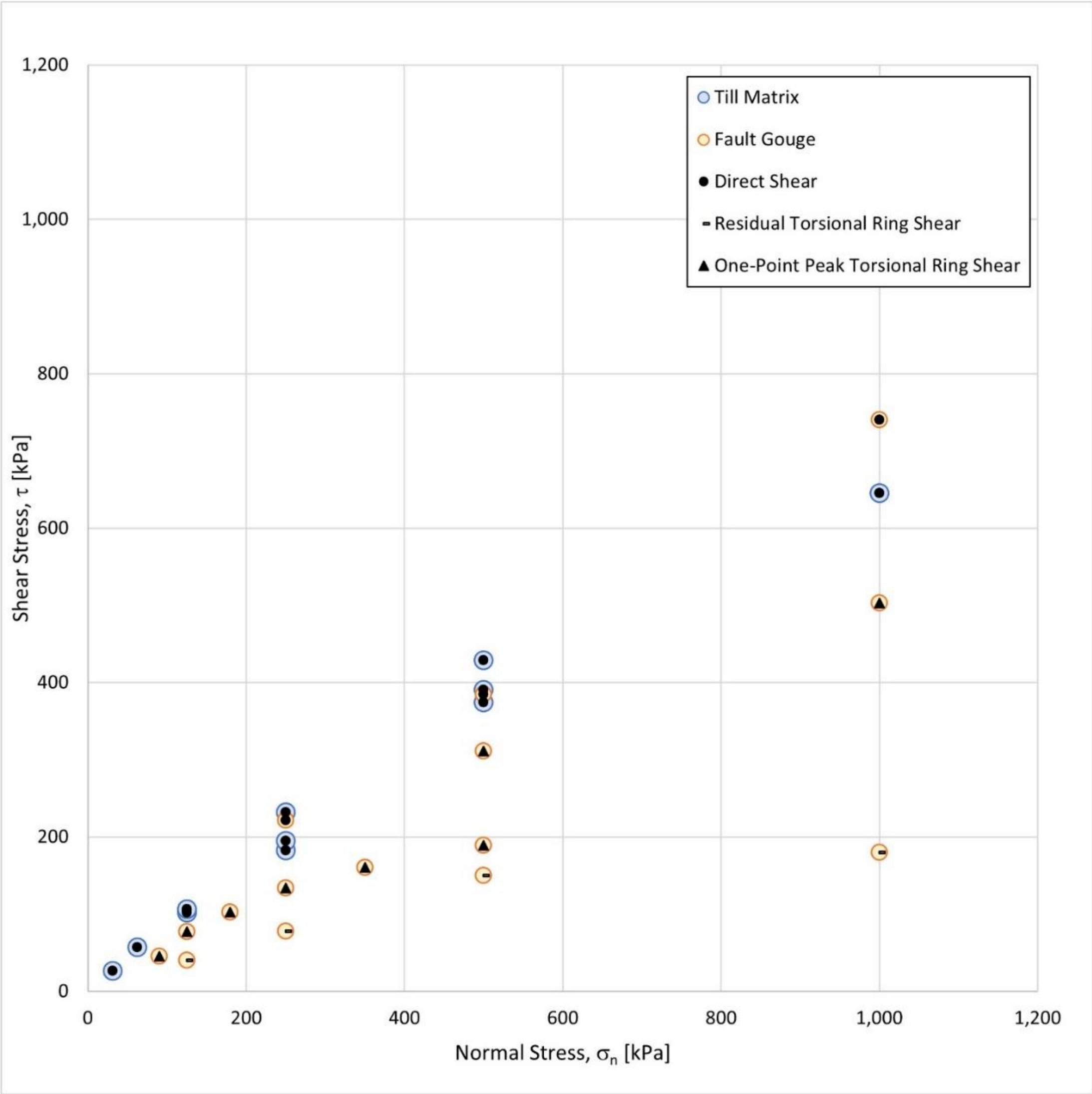


Figure 16-4 Results of Shear Strength Tests on Samples Collected from the 2023 and 2024 Drillholes in the Open-Pit Area

16.4.4 Rock Structures

Down hole imaging with optical and acoustic televiewers was performed to measure the true orientation of minor rock structures such as foliation, joints, veins, and faults identified along the 2024 drillholes listed in Table 16-2. A total of 434 structures from seven drillholes were observed on down hole images, and their distributions are presented on stereonets (Figure 16-5).

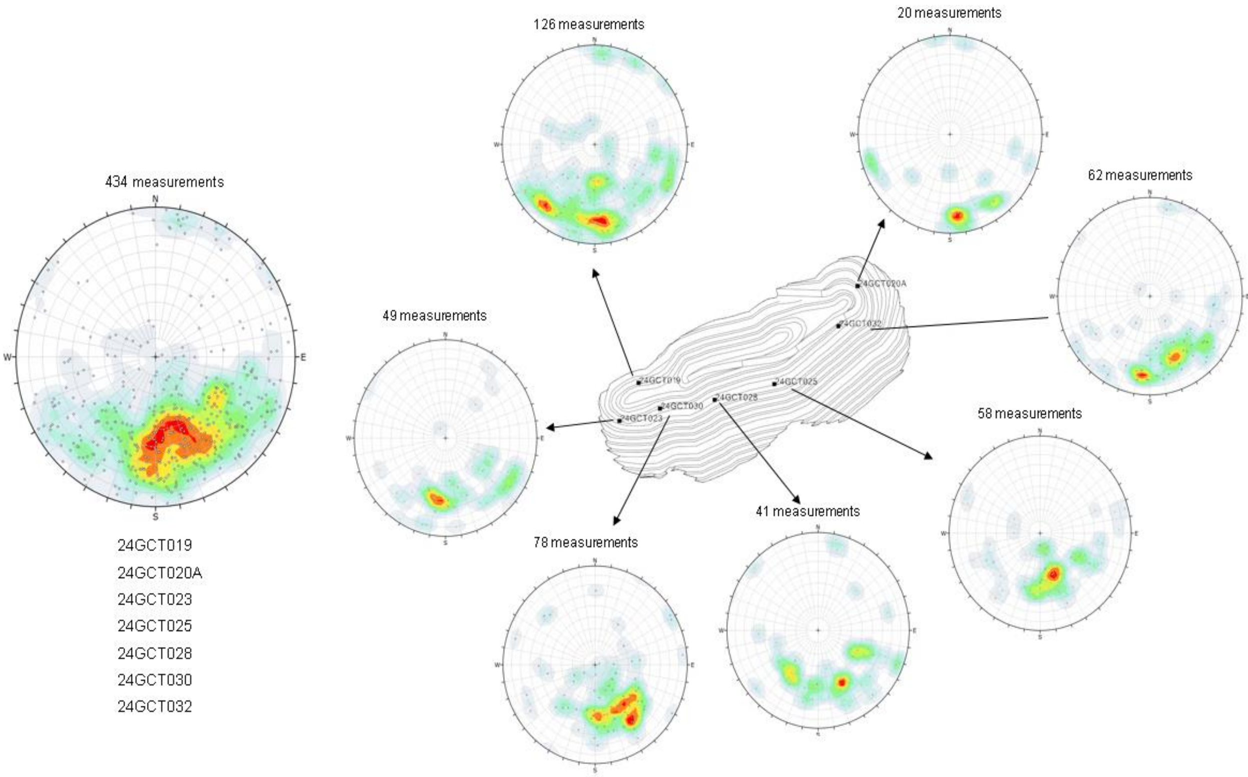


Figure 16-5 Stereonets Showing Distribution of Joints Picked from Optical and Acoustic Televiewer Images for Each Drillhole

The mean orientations of foliation/veins and joint sets were identified on stereonets using structures collected from each drillhole and the results are summarized in Table 16-5.

Table 16-5 Mean Orientations of Foliation and Joint Sets Identified on Stereonets for Each Drillhole

Drillhole	Mean Dip/Dip Direction					
	Foliation/Veins	J1	J2	J3	J4	J5
24GCT019	49/028	70/042	67/357	31/353	69/286	60/317
24GCT020A	62/351	78/068	73/344	-	71/285	-
24GCT023	42/009	-	54/006	-	62/301	67/324
24GCT025	52/357	50/062	43/352	13/346	-	48/299
24GCT028	51/013	43/038	53/007	-	55/294	58/331
24GCT030	46/339	44/038	-	44/358	-	49/320
24GCT032	54/346	-	69/008	-	65/310	54/334

As stated above, the Kigluaik Fault is the major structure that extends through the pit footprint in a generally east-west direction and dips north-northwest at about 45°.

16.4.5 Rock and Soils Strength Assessment

Based on similar geotechnical conditions, Barr categorized the main rock types within the open-pit area as follows:

- Quartz–biotite–garnet–sillimanite–schist (QBGSS) including quartz–biotite–garnet–schist (QBGS)
- Quartz–biotite–schist (QBS) including quartz–biotite–sillimanite–schist (QBSS)
- Quartz diorite (QDIO) including INF

The core logging database—including RQD, joint frequency, laboratory testing results, field observations, and estimates—was used for the rock mass strength assessment of QBGSS, QBS, and QDIO. Table 16-6 presents the mean rock mass rating (RMR) 76 based on Bieniawski's (1976) rock mass rating system.

Table 16-6 Rock Mass Rating (RMR76) of Open-Pit Rock Masses

Rock Type	RQD Range (%)	Mean UCS ± St. Dev. (MPa)	Number of Joints Per Meter	RMR (1976) Mean Joint Conditions Rating	Mean RMR76
QBGSS	75 ± 25	60 ± 39	1-20	12	63 ± 5
QBS	75 ± 25	76 ± 39	1-20	16	67 ± 5
QDIO	50 ± 50	107 ± 58	1-20	16	65 ± 5

UCS, Brazilian tensile, and triaxial compression strength testing results for the main rock types were used to calculate Hoek-Brown intact rock strength parameters and elastic constants. RSData Version 1.007 (Hoek, 2012) was used to calculate the value of the material constant m_i for each main rock type (Table 16-7).

Table 16-7 Hoek-Brown Intact Rock Strength Parameters

Rock Type	Average UCS (MPa)	Average Unit Weight (kN/m^3)	m_i	Average E_i (GPa)
QBGSS	86	28	10	20
QBS	90	28	12	20

Based on the 2024 study results, quartz diorite exists in much smaller areas and volumes compared to schists in the project area, and it was not explicitly incorporated into the pit wall stability analysis.

Rock joints and foliation shear strengths were estimated using the Barton-Bandis non-linear shear strength envelope by evaluating the results of discontinuity shear strength laboratory tests JRC values logged on cores from the 2024 drillholes and UCS (JCS) test results.

Table 16-8 Barton-Bandis Non-Linear Rock Joint Strength Parameters

Residual Friction Angle (deg.)	JRC (16th Percentile)	JCS (33rd Percentile) (MPa)
25.5	6.5	44

JRC = Joint roughness coefficient; JCS = Joint compressive strength

Overburden soils (surficial deposits) and fault gouge strengths were evaluated using the results of laboratory strength tests, including direct shear, residual torsional ring shear, and one-point peak (fully softened) torsional ring shear tests. The fully softened friction angle obtained for fault gouge material (SC-SM) was 35.8° with a cohesion of 6.2 kilopascal (kPa), and for fault gouge material (CL), the friction angle was 18.1° with a cohesion of 15.9 kPa. The peak friction angle obtained for till matrix material was 38.1° with a peak cohesion value of 31.2 kPa.

16.4.6 Stability Analysis

The acceptable factor of safety (FoS) and probability of failure (PoF) for the planned Graphite Creek open pit varies depending on the pit slope component and the likely consequences of failure. Based upon current plans, there is no major infrastructure set to be constructed proximally to any pit walls. If this were to change, it would be necessary to examine the selected acceptance criteria. Table 16-9 presents the selected acceptance criteria in bold for the Graphite Creek pit slope design.

Table 16-9 Typical FoS and PoF Acceptance Criteria Values (Read & Stacey, 2009)

Slope Scale	Consequences of Failure	FoS (Min) (Static)	FoS (Min) (Dynamic)	PoF (Max) P[FoS≤1]
Bench	**Low-High**	**1.1**	**NA**	**25-50%**
Inter-Ramp	Low	1.15-1.2	1.0	25%
	Moderate	1.2	1.0	20%
	High	**1.2-1.3**	**1.1**	**10%**
Overall	Low	1.2-1.3	1.0	15-20%
	Moderate	1.3	1.05	10%
	High	**1.3-1.5**	**1.1**	**5%**

The pit slope design recommendations presented in the next section were supported by the following slope stability analyses.

- Kinematic analysis of rock slopes to evaluate the potential for development of bench-scale and inter-ramp-scale plane and wedge failures
- Two-dimensional limit equilibrium analysis of rock slopes to evaluate the potential for the development of deep-seated pit slope instability, including groundwater pressures estimated from a finite element seepage analysis based on hydraulic conductivity data obtained from the 2024 investigation and the 2024 regional hydrogeologic model (Tundra Consulting, LLC., 2024)
- Two-dimensional limit equilibrium analysis of soil slopes to evaluate the potential for the development of pit slope instability of the north highwall due to overburden material above the Kigluaik Fault and loading from the proposed WMF

Bench-face and inter-ramp scale kinematic stability was evaluated by reviewing the stereonets, including dip and dip-direction of logged geologic structures, such as foliation and joints from the televiewer data. The most significant geologic structure controlling the pit slope angles within the larger, south-highwall region of the pit is north-dipping foliation (mean of 55°), which impacts the south-highwalls. Analysis results indicated PoF less than the design acceptance criteria for bench, inter-ramp, and overall slope scales.

The two-dimensional limit equilibrium analyses of rock slopes at inter-ramp and overall slope scales within the larger south highwall region of the pit were performed using the SLOPE/W and SEEP/W modules within the GeoStudio 2024 software. To estimate groundwater pressures and evaluate their impact on pit slope stability, finite-element seepage analyses were performed for four cross-sections using hydraulic conductivity field test results from four different 2024 drillholes. Additionally, to assess the effect of foliation on rock mass strength, an anisotropic rock mass strength model was used, which assigned different shear strengths depending on the orientation of the slip surface passing through the rock mass. Also, the rock mass shear strengths were adjusted for blast-induced damage and stress-relaxation using a Hoek-Brown disturbance factor D of 1.0 for a thickness of half the bench height behind the bench faces (Hoek, 2012), which resulted in D=1.0 thickness of 16 m assuming a 32-m overall bench height. Results of the analysis indicated FoS greater than the minimum FoS criteria (Table 16-9) for both the static (non-earthquake) and pseudo-static (dynamic or earthquake) analysis scenarios. In other words, the pit slope configuration provided in Table 16-10 below meets the minimum FoS regarding slope stability for both cases.

Results of two-dimensional limit equilibrium analyses of soil (overburden) slopes indicated FoS greater than the design criteria for both the static and pseudo-static (dynamic) analysis scenarios.

16.4.7 Open-Pit Slope Design Recommendations

Slope design recommendations were based on the findings of the kinematic evaluation with additional adjustments from the two-dimensional limit equilibrium stability analysis. Hydrogeologic conditions were considered in the stability analysis using the predictions of phreatic surfaces in the final pit configuration. The models suggested that the stability of the south highwall was primarily dependent on foliation orientation and shear strength as well as successful management of the pore-water pressures and blasting disturbance to rock slopes. Inter-ramp slope design angles were determined for the south and north highwalls for expected bedrock and overburden soils, as seen in Table 16-10.

Table 16-10 Recommended Open-Pit Slope Sectors

Pit Sector	Slope Dip Direction Range (deg.)	Rock Types
South	290 to 360	All Rock Types
West	0 to 105	All Rock Types
North	105 to 225 105 to 225	Soils (above the fault) All Rock Types
East	225 to 290	All Rock Types

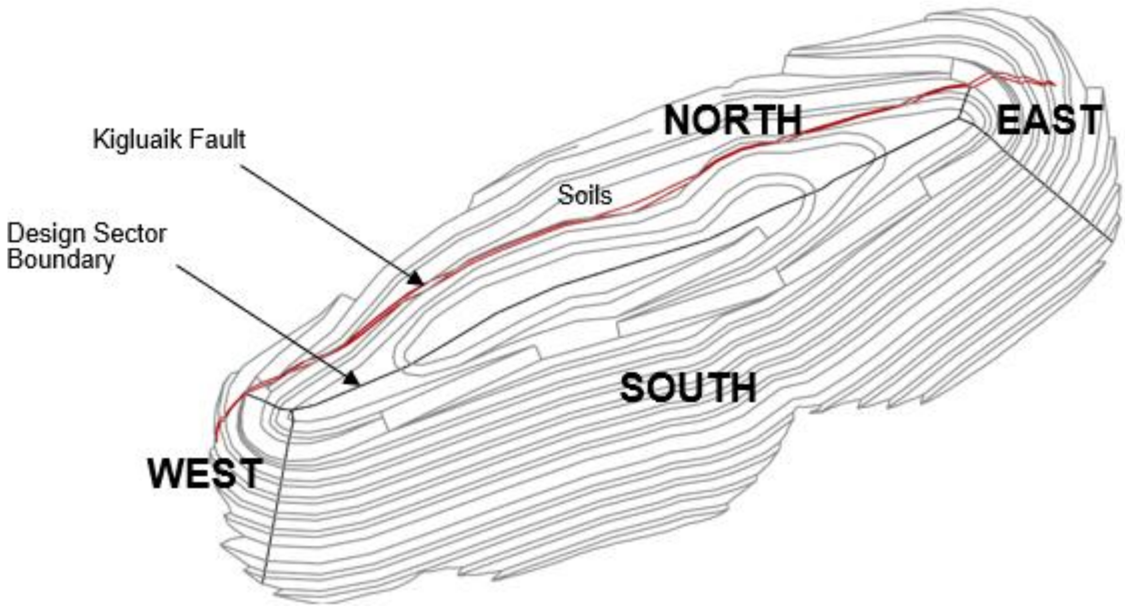


Figure 16-6 Recommended Open-Pit Slope Design Sectors

Table 16-11 Recommended Open-Pit Design Slope Configuration

Pit Sector	Bench Configuration and Height (m)	Catch Bench Width (m)	Recommended Bench Face Angle (deg)	Recommended Inter-Ramp Slope Angle (deg)	Rock Types
South	Overall Bench 32 m	10.9	57.5	47.5	All Rock Types
West[1]	Overall Bench 32 m	10.9	57.5	47.5	All Rock Types
North	Single Bench 8 m Overall Bench 32 m	6.5 10.9	45.0 57.5	28.9 47.5	Soils (above the fault) All Rock Types
East[1]	Overall Bench 32 m	10.9	57.5	47.5	All Rock Types

Notes:
[1]Recommended optional slope sectors that might be excavated using steeper slopes to improve project economics depending on the ore dimension and location. For this study, these optional slope sectors were not incorporated into the recommendations and were assumed to be consistent with the South pit sector.
[2]Maximum vertical height of inter-ramp slope is recommended to be 225 m. Overall slope angles will be reduced by incorporation of haul roads and geotechnical benches (cumulative width of 52 m) at maximum vertical heights (i.e., 225 m) in rock slopes.

Barr does not recommend slope angles steeper than those provided in Table 16-11 unless further data would support using steeper design slope angles.

Based on the pit slope recommendations summarized in Table 16-11, pit optimization was finalized using the following parameters in all slope directions (also illustrated in Figure 16-7 below):

- Bench face angle of slopes in rock = 57.5° (consistent with foliation dip on south highwall)
- Rock slope bench height = 32 m (overall bench)
- Catch bench width for slopes in rock = 11 m (minimum 10.9 m from rockfall assessment)
- Inter-ramp angle for slopes in rock = 45.6°
- Bench face angle of slopes in overburden soils above the Kigluaik Fault = 45°
- 30-m-wide geotechnical bench at 286 m AMSL on south highwall (Graphite Creek diversion)
- 30-m-wide haul road at elevations ranging from 60 m to 130 m on south highwall
- Overall slope angle = 42.4° or flatter

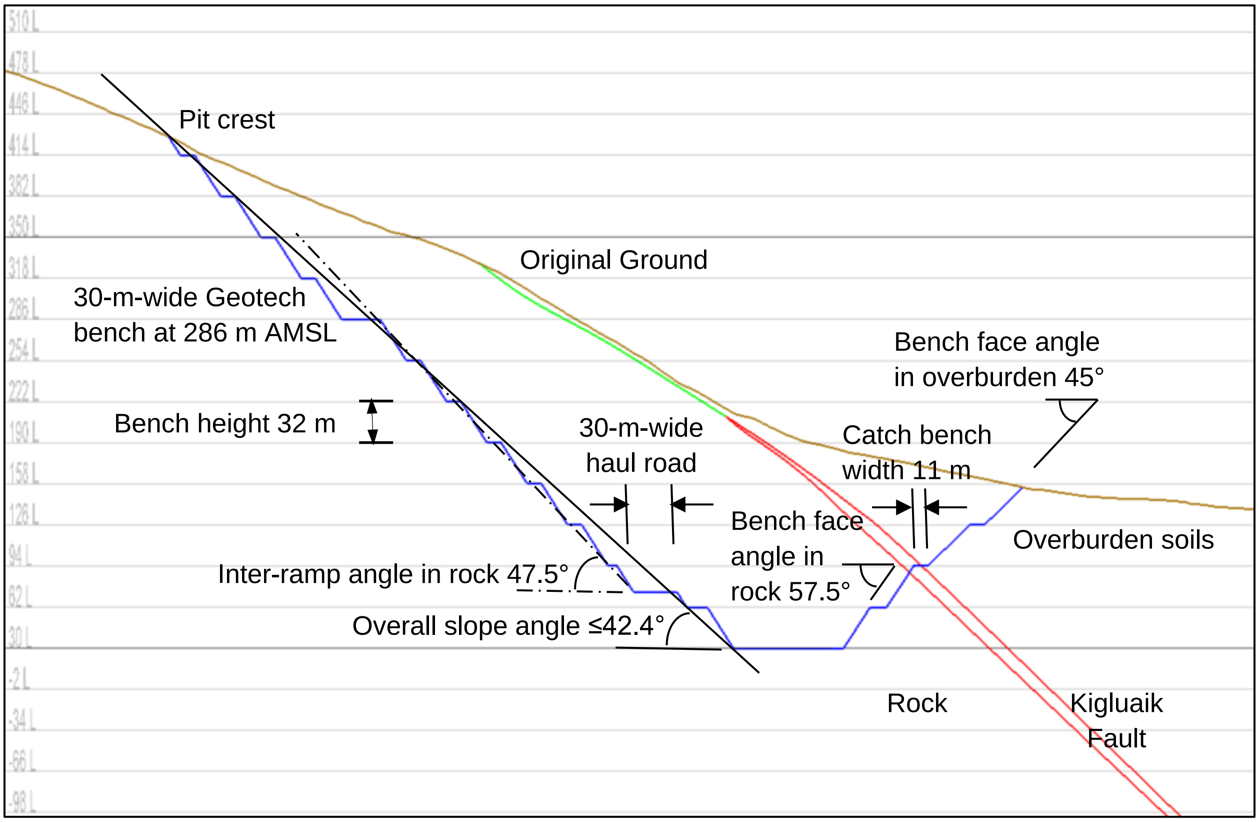


Figure 16-7 Graphite Creek Schematic Pit Wall Section

16.5 Waste Management Facility

A total of 230 Mt of waste material will be mined over the mine life. It has been assumed that all non-overburden waste materials will be PAG and will be contained in the WMF along with tailings material. The WMF is located north of the open pit, approximately 100 m away from the pit crest. The facility is designed to store approximately 307 Mt of filtered tailings and waste rock, equivalent to a storage volume of approximately 139 Mm^3. Additional details on the design of the WMF can be found in Chapter 18.

The WMF includes a HDPE basin liner and a stabilizing buttress. The buttress will be constructed with waste material from the pit. The tailings and waste rock will then be co-mingled and placed in the WMF. The objective of the co-mingling strategy is to create a blended, compacted, low-permeability material. Waste rock or processed material may also be placed in select locations in the WMF to promote internal drainage of the filtered tailings. The WMF will be constructed in three stages to accelerate contemporaneous closure activities. Stage one begins in the northeast portion of the facility. Figure 16-8 below illustrates the pit and WMF at their maximum extents.

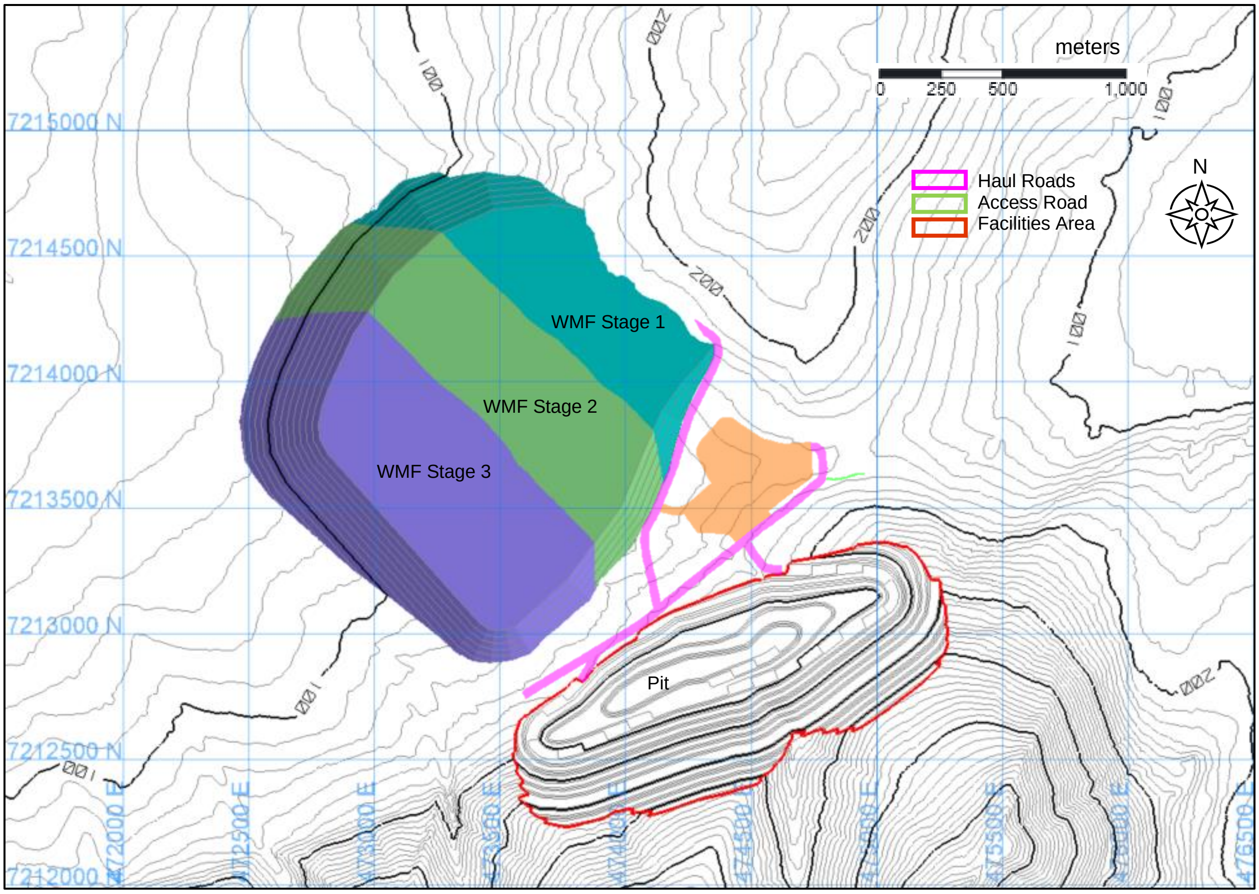


Figure 16-8 Graphite Creek Waste Management Facility

16.6 Production Schedule

The basic criteria used to develop the LOM production schedule are:

- Graphite concentrate production of approximately 175,000 tpa
- The mine operates 365 days per year, allowing for 13 non-operating days due to weather delays

The mining sequence focuses on achieving required concentrate production by mining higher-value material early in the mine life while balancing grade and strip ratio. The mine production plan has been prepared using Minemax Scheduler software from Datamine. The software creates optimal and practical LOM plans that meet project constraints such as mining rate, mill capacity, phase sequencing, maximum bench sink rates, and concentrate production requirements.

Ore production rate was determined based on STP capacity of 175,000 tpa. To achieve this, the mill production capacity was set to be at 3,600 ktpa over the LOM, and the mine COG was raised to be between 2% and 3%. Due to these raised COGs, approximately 17.4 Mt of low-grade resources with an average grade of 2.4% are considered waste. Stockpiling and reclaiming strategies are used to optimize the production schedule. After finishing the first mining phase in Year 7, stockpile inventory reaches 2.6 Mt. Stockpile reclaim begins in Year 9 and continues throughout the end-of-mine life.

The deposit is mined in five phases. The mine schedule is developed and reported monthly for the pre-production period and the first two years of production, quarterly from Year 3 to Year 5, and annually thereafter. The scheduling constraints utilize a maximum mining capacity of 17 Mt per year and the maximum number of benches mined yearly at ten in each phase.

The production schedule includes the mill ramp-up. The mill ramp-up considers the normal inefficiencies related to the start of operations. It includes the tonnage processed as well as the associated recoveries, which increases the design capacity during the second quarter of operation. The mine requires one year of pre-production before starting operations in the mill. After the pre-production period and the first year, mining is expected to be able to maintain a relatively low strip ratio that is approximately 2:1 (waste:ore) for the next five years. Stripping requirements will increase after the first phase is mined. The current expected mine life is 21 years. Table 16-12 and Table 16-13 summarize the material movement and mill schedule by year over the LOM. Figure 16-9 and Figure 16-10 show the annual tonnage mined by phase and annual LOM summary production schedule. Figure 16-11 through 16-21 present the mine development from pre-production through LOM.

Table 16-12 Annual Mine Production Schedule

Mine Production Unit	Ore (t)	Cg Grade Cg%	Contained Cg (t)	Waste (t)	Strip Ratio W:O	Total Mined (t)
-1	37,405	4.43	1,659	5,421,125	144.9	5,458,530
1	2,500,893	4.54	113,491	9,499,107	3.8	12,000,000
2	3,720,699	5.40	200,796	7,558,684	2.0	11,279,383
3	3,483,711	5.83	202,984	7,424,111	2.1	10,907,821
4	3,771,914	5.65	213,022	7,028,086	1.9	10,800,000
5	3,616,599	5.43	196,430	7,321,792	2.0	10,938,391
6	3,930,662	5.53	217,497	8,069,338	2.1	12,000,000
7	3,515,467	5.48	192,526	10,484,533	3.0	14,000,000
8	3,374,372	5.63	190,079	10,625,628	3.2	14,000,000
9	3,172,022	5.53	175,427	11,764,693	3.7	14,936,715
10	2,793,138	5.55	155,108	11,700,331	4.2	14,493,469
11	3,520,176	5.07	178,563	13,479,824	3.8	17,000,000
12	3,600,000	5.05	181,652	13,400,000	3.7	17,000,000
13	3,591,042	5.03	180,565	13,408,958	3.7	17,000,000
14	3,325,731	5.16	171,638	13,674,269	4.1	17,000,000
15	2,849,782	5.45	155,344	14,150,218	5.0	17,000,000
16	3,467,453	5.09	176,490	13,532,547	3.9	17,000,000
17	3,499,741	5.07	177,595	13,500,259	3.9	17,000,000
18	3,912,038	4.92	192,570	12,926,246	3.3	16,838,284
19	4,193,919	4.80	201,123	12,806,081	3.1	17,000,000
20	4,019,140	4.86	195,237	10,320,912	2.6	14,340,052
21	1,322,958	3.60	47,691	1,667,148	1.3	2,990,106
Totals	**71,218,862**	**5.22**	**3,717,488**	**229,763,889**	**3.2**	**300,982,751**

Table 16-13 Annual Mill and Concentrate Production

Mine & Concentrate Production	Total Feed	-Cg Grade	-Contained Cg	-Cg Recovered	Concentrate Produced
Unit	(t)	Cg%	(t)	(t)	(t)
-1	-	-	-	-	-
1	2,500,893	4.54	113,491	102,142	107,518
2	3,284,206	5.66	185,815	167,234	176,036
3	3,102,827	6.13	190,048	171,043	180,046
4	3,102,827	6.13	190,048	171,043	180,046
5	3,427,191	5.55	190,048	171,043	180,046
6	3,131,727	6.07	190,079	171,071	180,075
7	3,442,027	5.52	190,079	171,071	180,075
8	3,374,372	5.63	190,079	171,071	180,075
9	3,600,000	5.28	190,079	171,071	180,075
10	3,600,000	5.08	182,732	164,458	173,114
11	3,600,000	5.04	181,414	163,273	171,866
12	3,600,000	5.05	181,652	163,487	172,092
13	3,600,000	5.03	181,028	162,925	171,500
14	3,600,000	5.03	181,028	162,925	171,500
15	3,600,000	5.03	181,028	162,925	171,500
16	3,600,000	5.03	181,028	162,925	171,500
17	3,600,000	5.03	181,028	162,925	171,500
18	3,600,000	5.06	182,022	163,819	172,442
19	3,600,000	5.03	181,028	162,925	171,500
20	3,600,000	5.03	181,028	162,925	171,500
21	2,652,793	3.49	92,706	83,435	87,827
Total	**71,218,862**	**5.22**	**3,717,488**	**3,345,739**	**3,521,830**

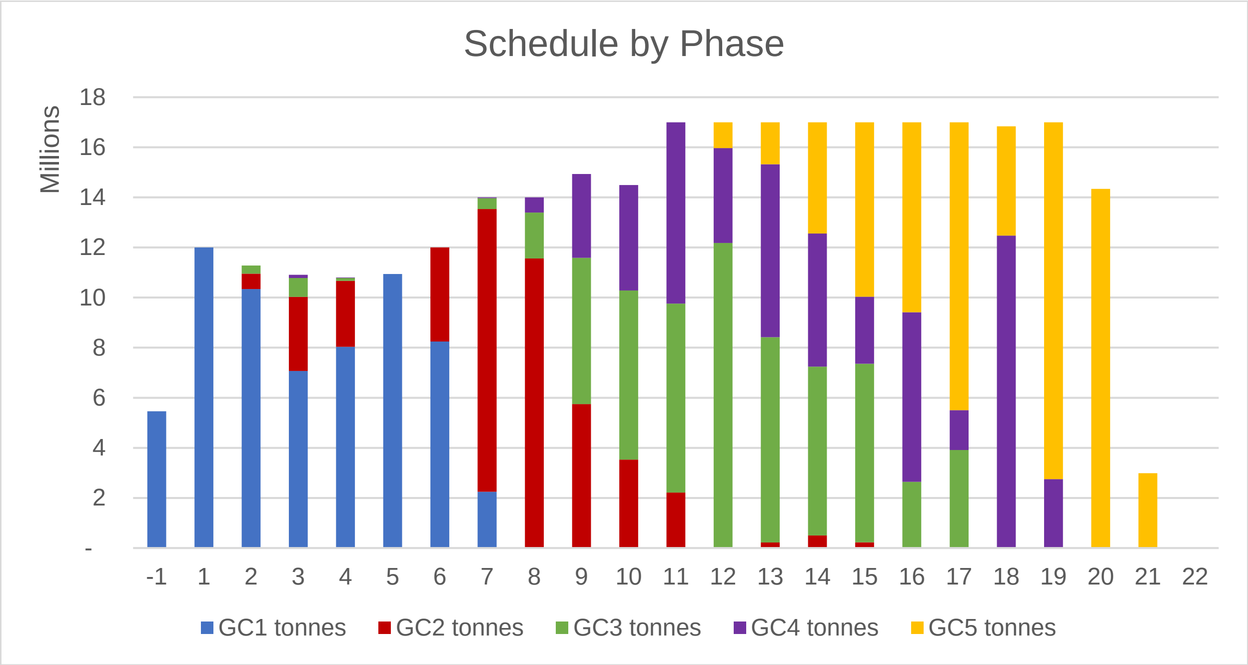


Figure 16-9 Total Tonnage Scheduled by Phase

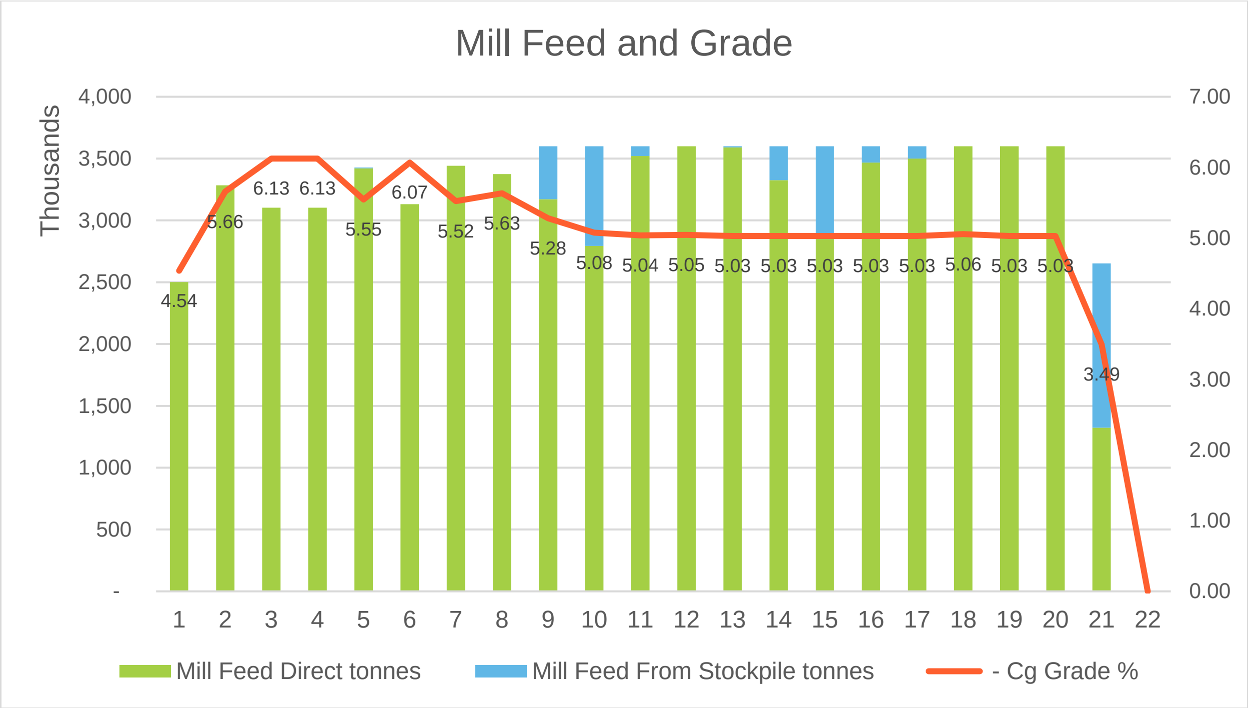


Figure 16-10 Annual LOM Production Schedule and Grade

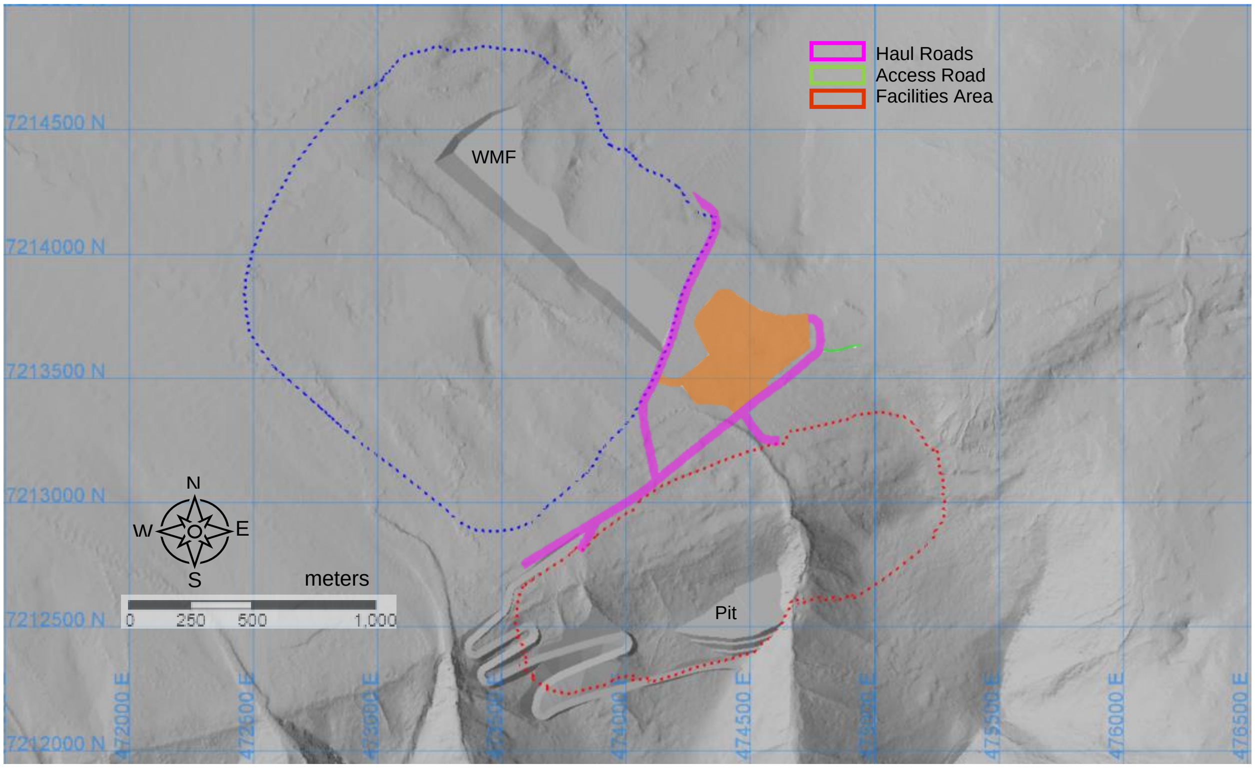


Figure 16-11 Pre-Production Map

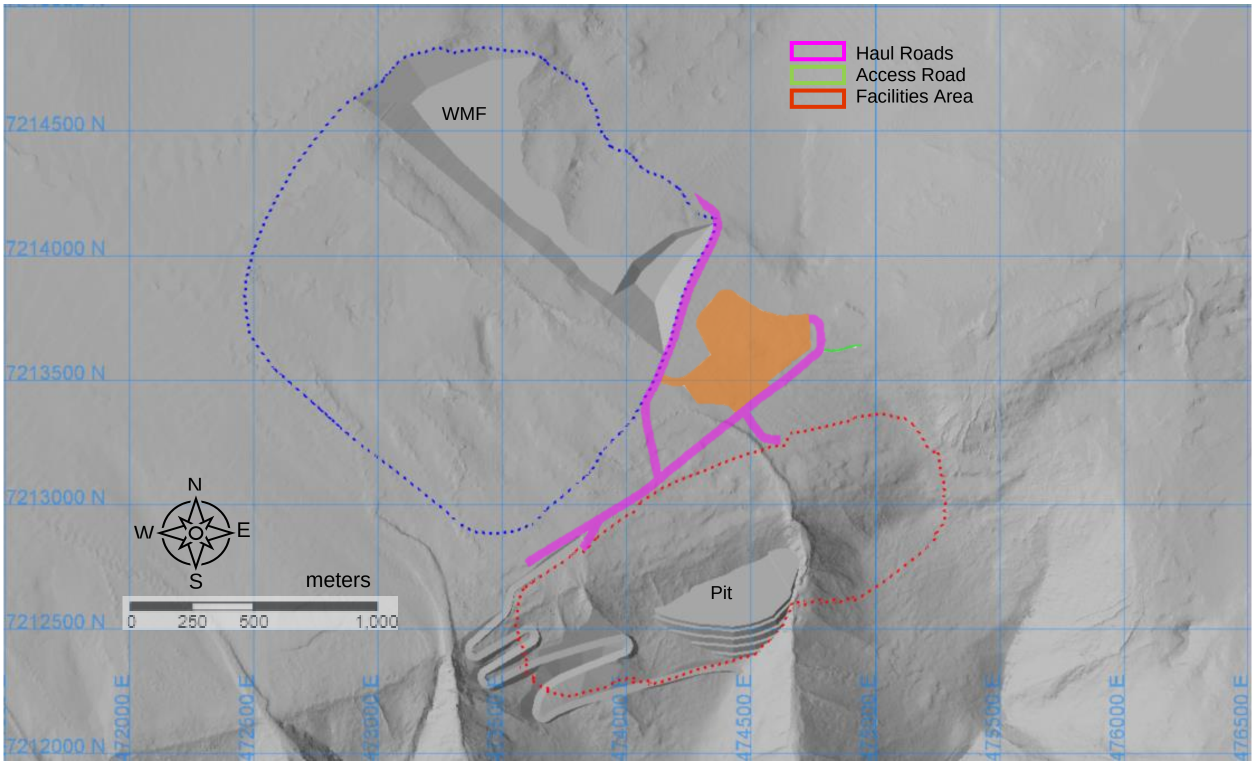


Figure 16-12 End of Year 1 Map

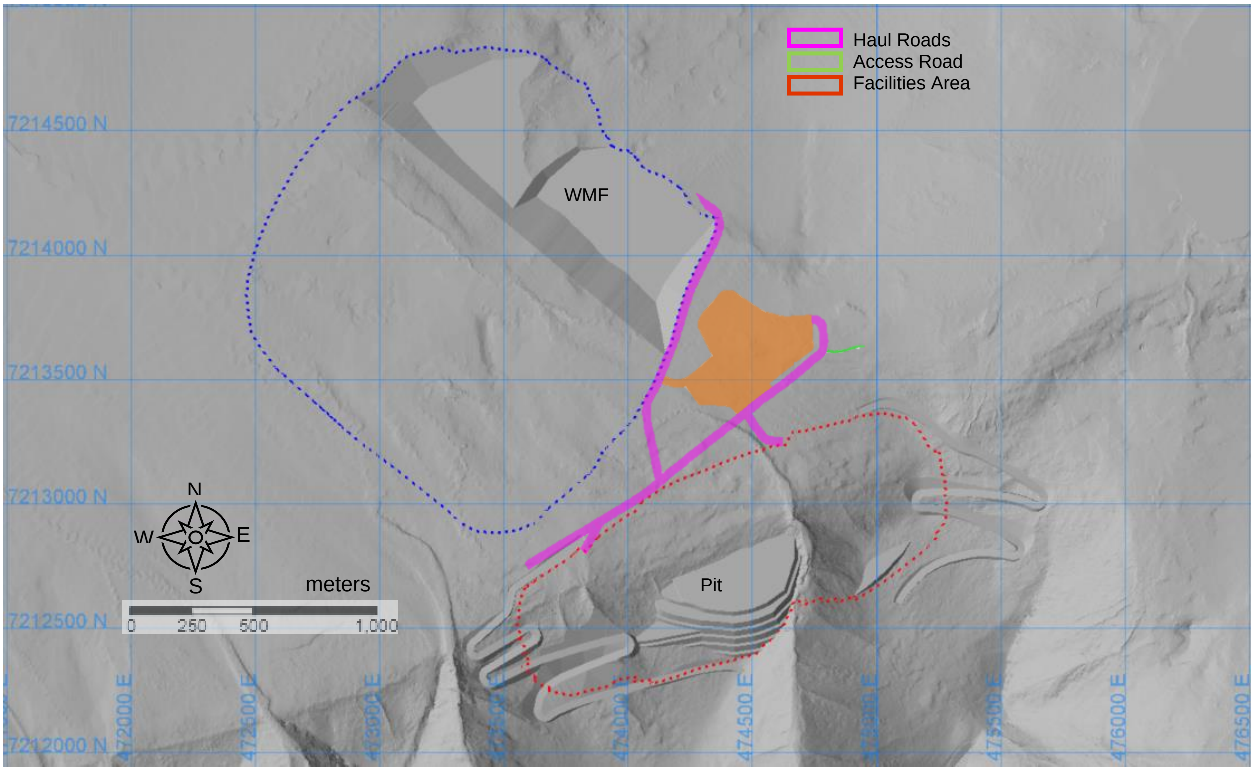


Figure 16-13 End of Year 2 Map

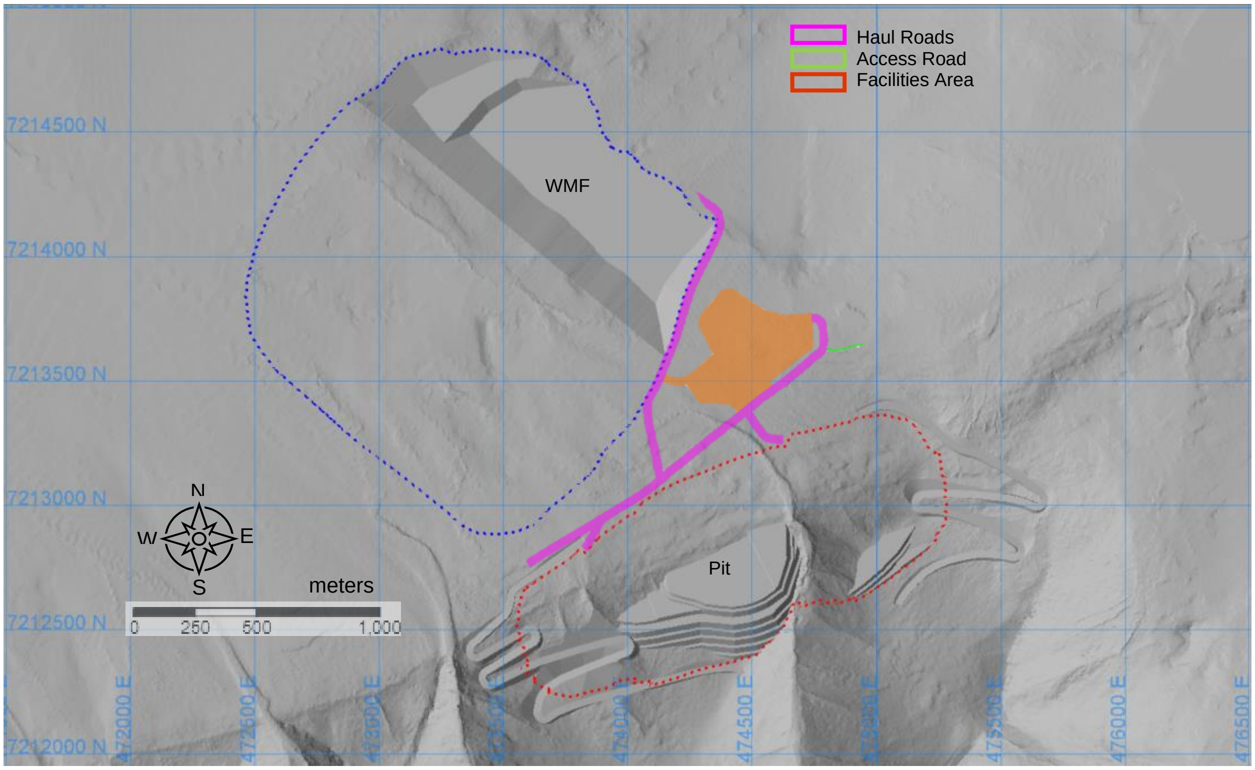


Figure 16-14 End of Year 3 Map

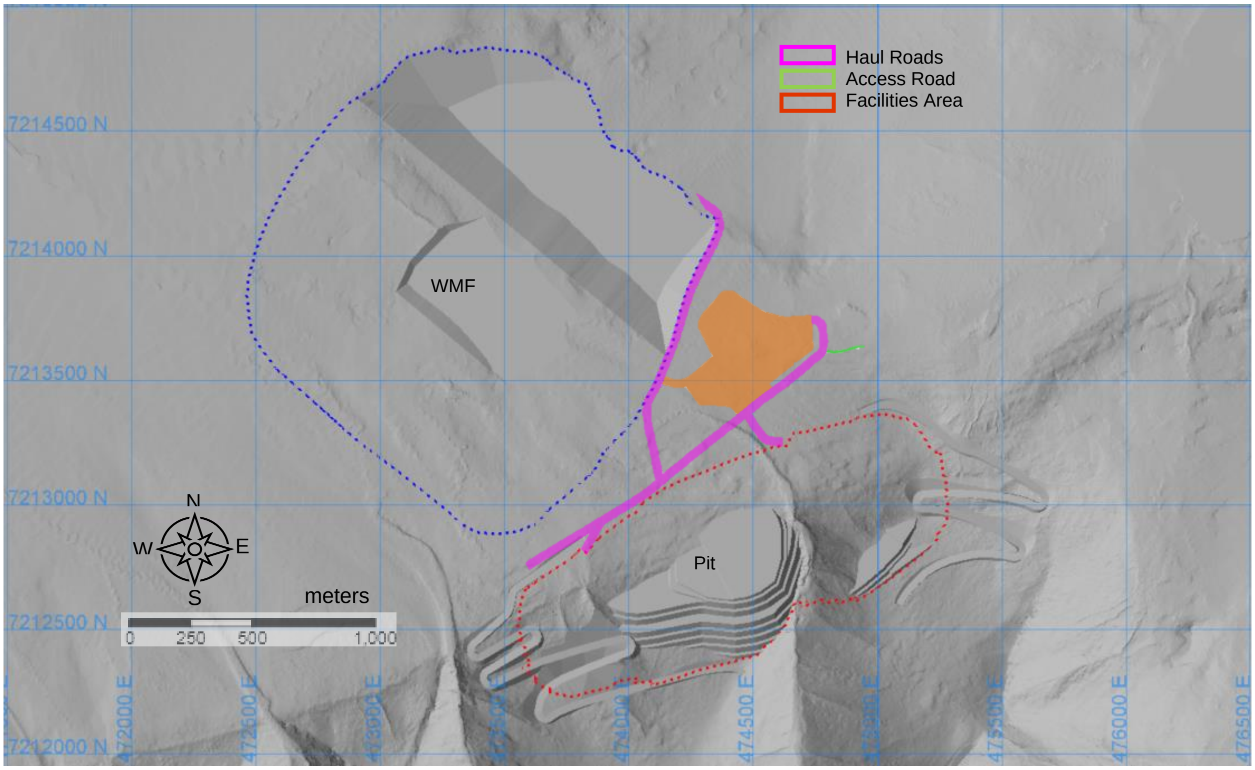


Figure 16-15 End of Year 4 Map

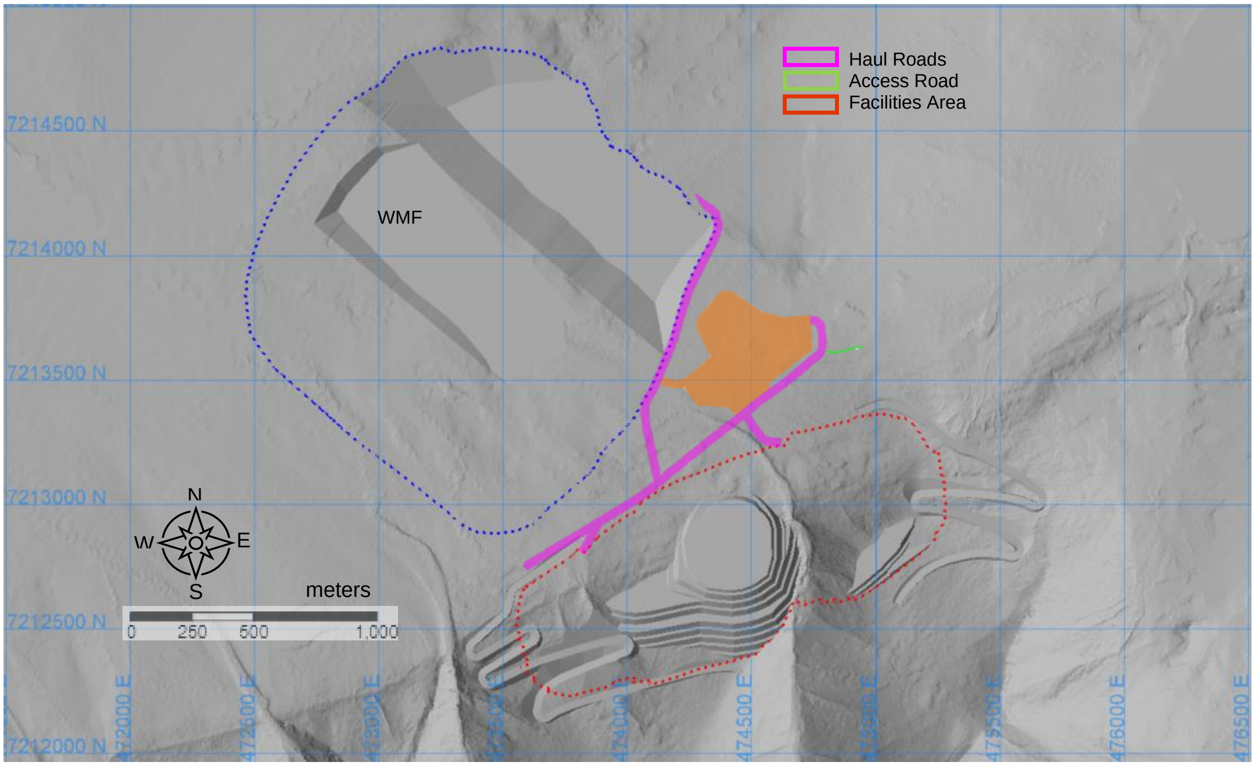


Figure 16-16 End of Year 5 Map

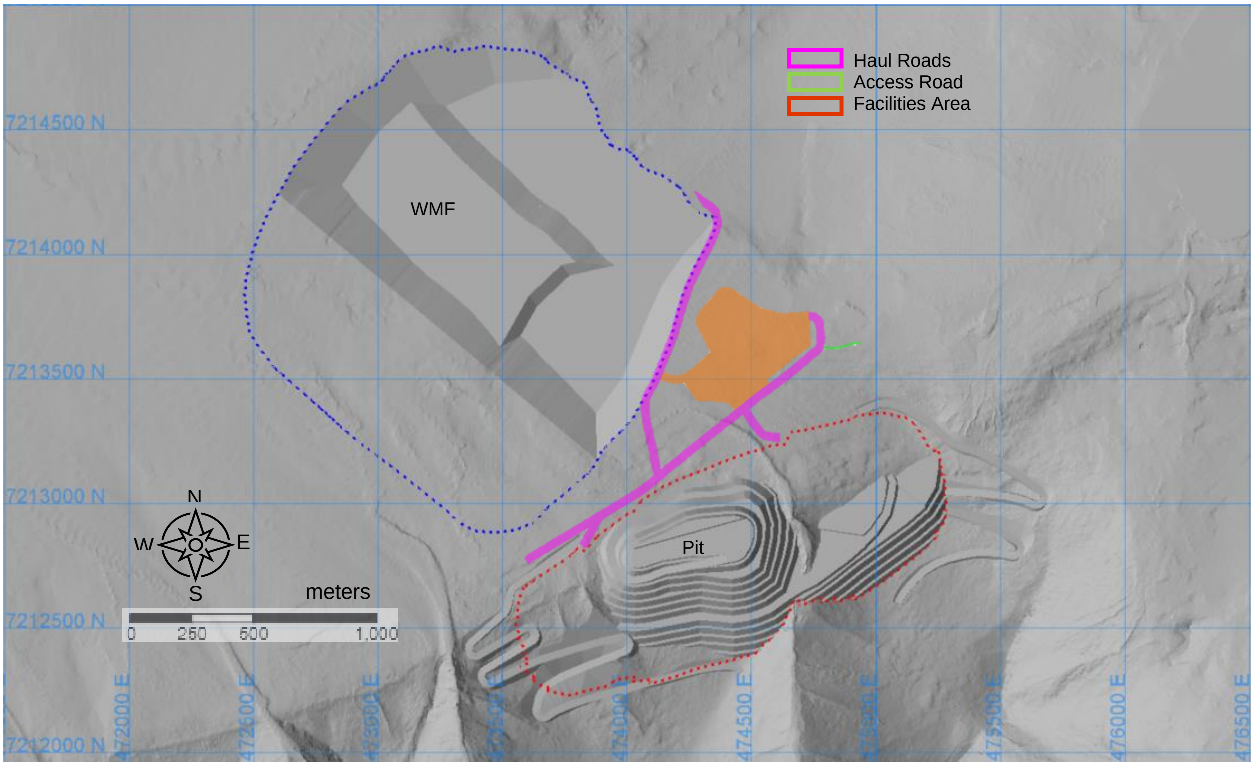


Figure 16-17 End of Year 10 Map

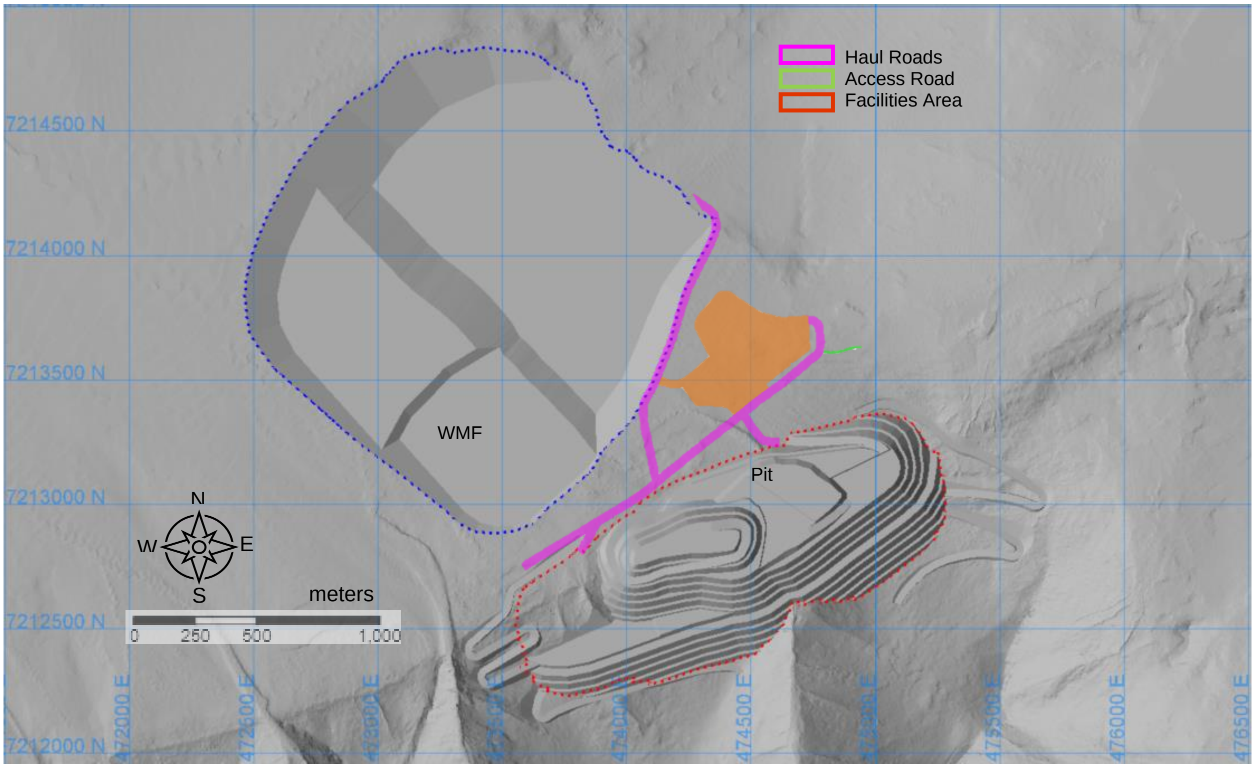


Figure 16-18 End of Year 15 Map

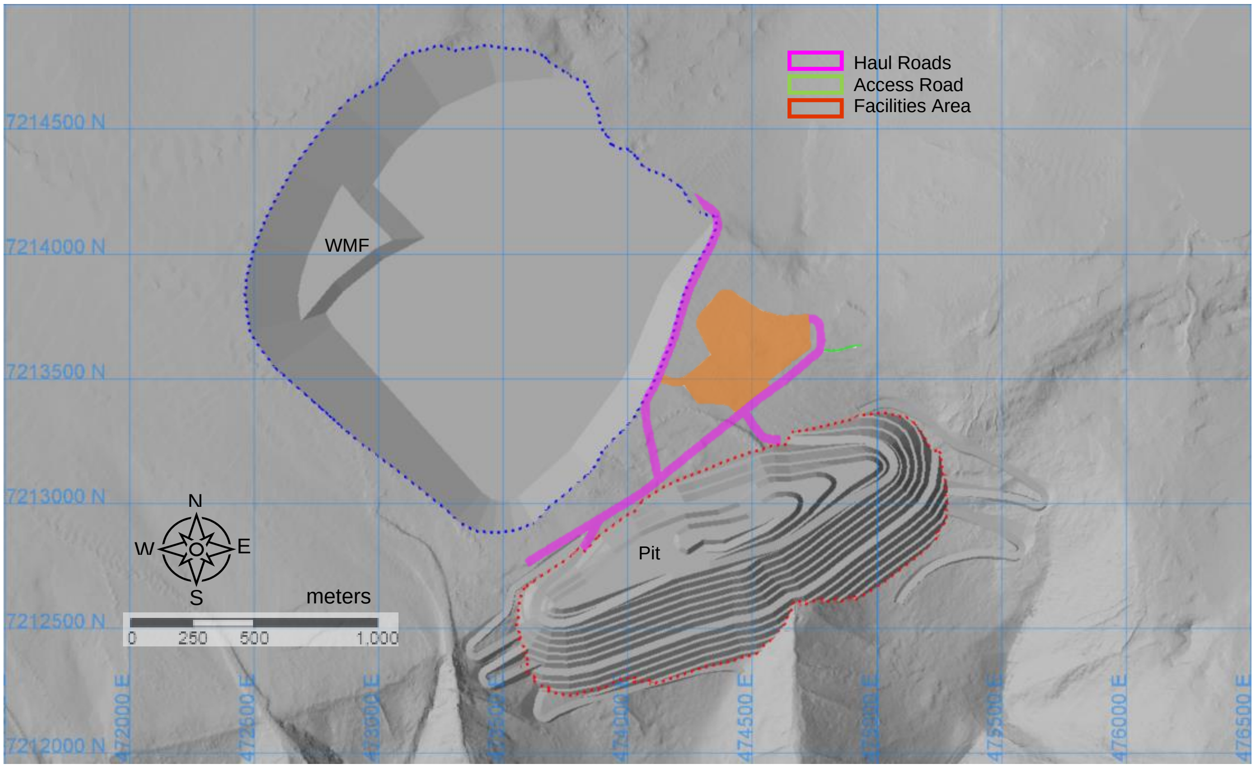


Figure 16-19 End of Year 20 Map

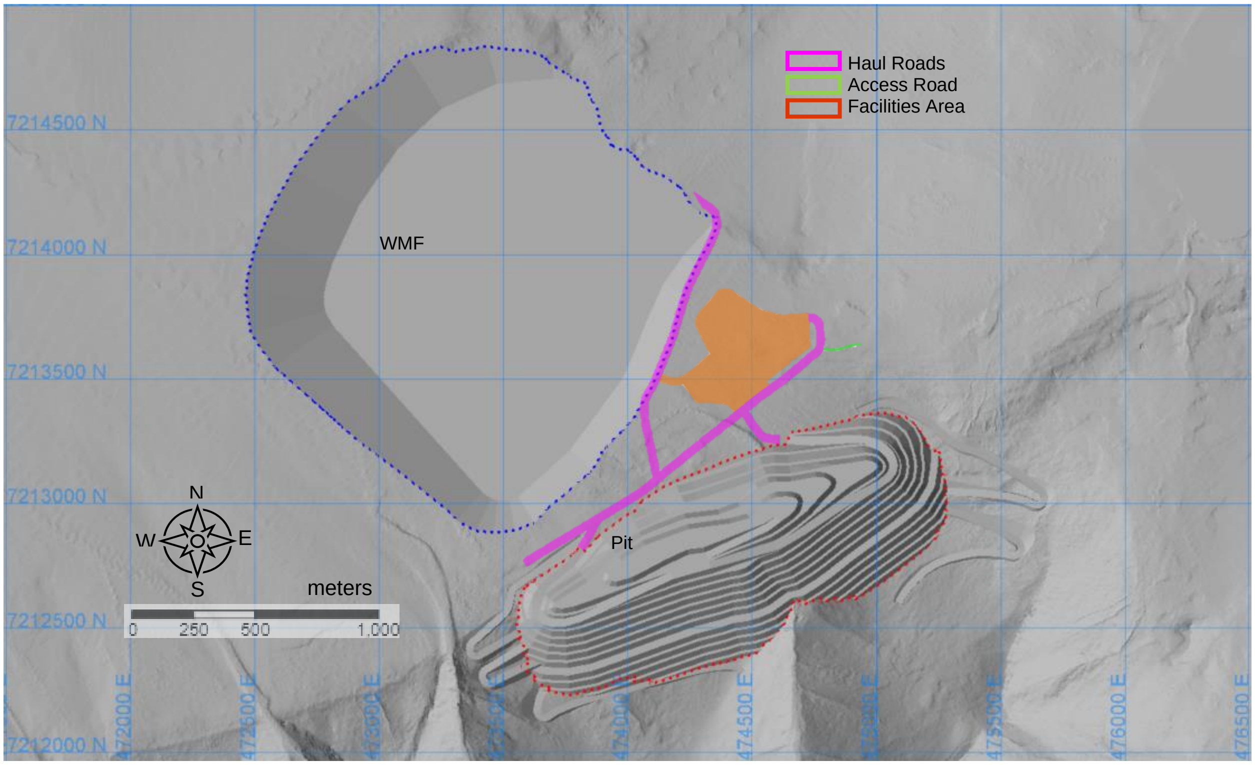


Figure 16-20 End of Year 21 Map

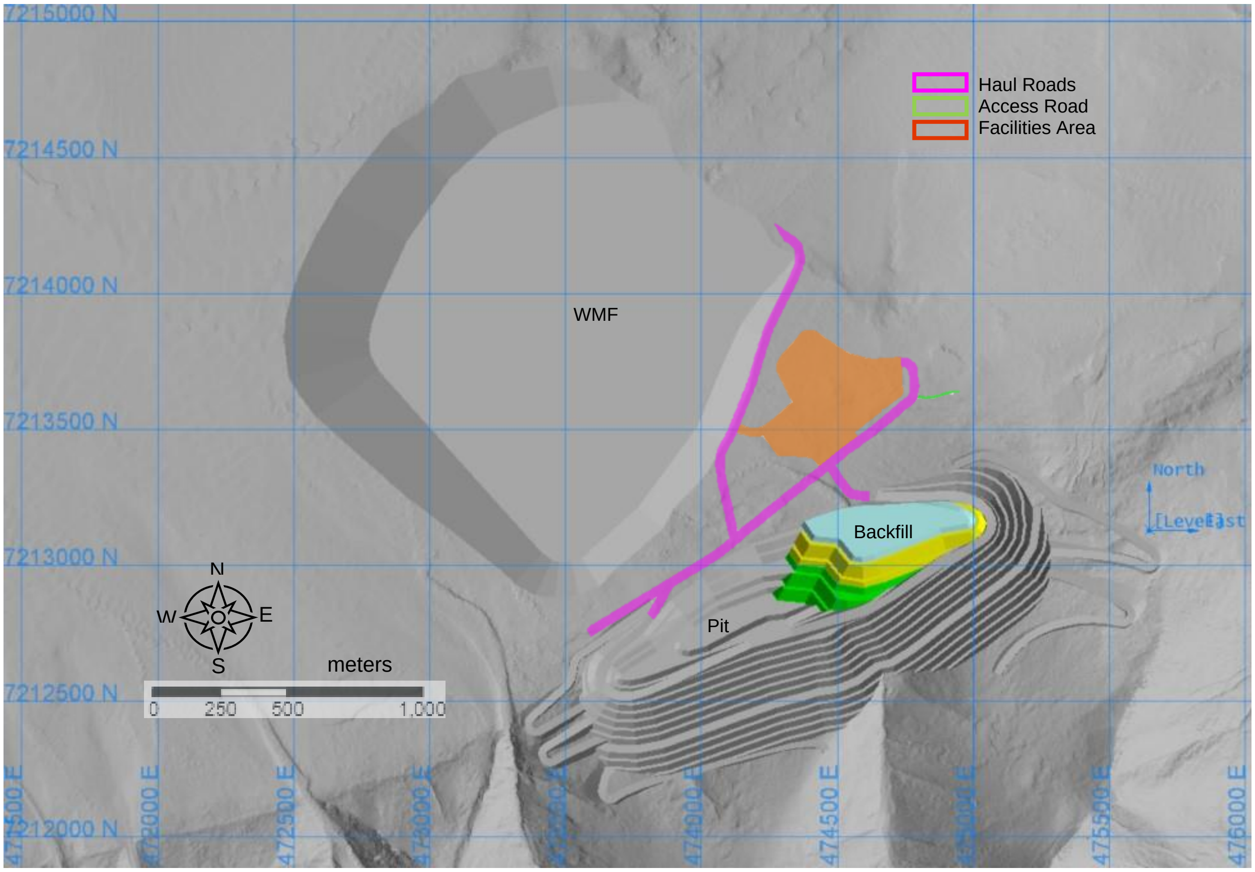


Figure 16-21 Life of Mine Map Showing Backfill

16.7 Mine Operations

Mining activities will be self-performed using conventional mining techniques (drill, blast, load, and haul). The mining fleet will consist of a hydraulic mining shovel, front-end loader, 141 t haul trucks, and 171 mm (6.75 in) diameter drills. Given the overall scale of operations and equipment requirements, the entire fleet will be diesel-powered.

The open pit is designed to utilize 8-m production bench heights in both waste and ore with adequate phase or pushback geometry to achieve a maximum production rate of 17.0 Mtpa (46.5 ktpd). Mining is scheduled to advance sequentially through the pushbacks until the entire pit is mined. Typically, two pushbacks are active at any given time providing multiple bench faces for ore and waste sourcing. Given the required production rates and the pit geometries, vertical advance rates are usually only two benches per year, except for the initial development of pushbacks one and two where the vertical advance rate reached a maximum of 10 benches per year.

16.7.1 Operating Schedule

As shown in Table 16-14, the mine is scheduled to operate 24 hours a day, seven days a week. It will utilize four rotating crews working two 12-hour shifts. Four hours per day due to unproductive time associated with breaks, lunches, shift change, fueling, meetings, blast delays, etc., has been assumed.

Approximately 13 days are estimated to be lost due to poor weather conditions predominantly in the winter season. During the weather delays, it is assumed that the equipment will be manned but nonproductive due to these weather events, thus resulting in operational standby time.

Table 16-14 Example of Gross Operating Hours and Net Operating Hours

Time Definition	Shovel	Loader	Trucks	Drills
Scheduled Days, days/yr	365	365	365	365
Shifts Per Day, no./day	2	2	2	2
Shift Length, hrs/shift	12	12	12	12
Scheduled Time, hrs/yr	**8,760**	**8,760**	**8,760**	**8,760**
Equipment Availability, %	85%	85%	85%	82%
Equipment Utilization, %	85%	85%	90%	85%
Gross Operating Hours (GOH)	**6,329**	**6329**	**6701**	**6072**
Lunch and Breaks, mins/day	120	120	120	120
Lube and Fueling, mins/day	30	30	30	30
Shift Change, mins/day	30	30	30	30
Weather Delays, days/yr	13	13	13	13
Total Fixed Delays, hrs/yr	**1407**	**1407**	**1407**	**1407**
Operating Efficiency (Meetings, Blast, etc.)	90%	90%	90%	90%
Net Operating Hours (NOH)	**4430**	**4430**	**4765**	**4199**

As with mine operations, mine maintenance is scheduled to work 24 hours a day, seven days a week to allow for continuous maintenance coverage.

Blasting will only occur during the day shift. Two blasting crews rotate on a 12-hour day shift for seven-day-per-week coverage. Additional details on blasting are provided in the blasting sub-section below.

16.7.2 Drilling

Production drilling will be performed with a 171 mm diameter drill. Drilling productivity for each material type is shown in Table 16-15 below. A pioneer drill is also included in the mining fleet as it is required for pre-production phase development.

Table 16-15 Drilling Productivity

Parameter	Unit	Ore	Waste Rock	Waste Overburden	Wall Control
Hole Diameter	mm	171	171	171	171
Material UCS	Mpa	100	120	50	120
RPM	RPM	86	81	103	81
Pen. Rate	m/hr	38	42	42	37
Hole Length	m	9.2	9.1	9.4	16.0
Drilling Time per Hole	min/hole	14.5	13.0	13.4	25.9
Non-Drilling Time per Hole	min/hole	5.8	5.8	5.8	8.0
Total Time per Hole	min/hole	20.3	18.8	19.2	33.9
Drilling Productivity	m/hr	27.2	29.0	29.3	28.3

As shown in Table 16-16, the mine requires one production drill during Year 1 to Year 10, two production drills for Years 11 to 20, then one throughout the rest of the mine life. A pioneer drill is required during the early stages of the mine and as needed throughout the LOM. The pioneer drill will assist with production as needed and serve as a backup drill for the production drills.

Table 16-16 Drilling Productivity by Period

Period	Prod Drills	Pioneer Drills	Meters Drilled	NOH*
YR -1	1	1	20,427	1,596
YR 1	1	1	47,686	3,818
YR 2	1	1	44,114	3,568
YR 3	1	1	42,820	3,460
YR 4	1	1	41,227	3,335
YR 5	1	1	44,117	3,574
YR 6	1	1	45,454	3,668
YR 7	1	1	56,018	4,504
YR 8	1	1	56,264	4,521
YR 9	1	1	61,402	4,931
YR 10	1	1	61,222	4,916
YR 11	2	1	67,664	5,418
YR 12	2	1	67,533	5,408
YR 13	2	1	67,710	5,422
YR 14	2	1	68,709	5,500
YR 15	2	1	70,413	5,634
YR 16	2	1	68,047	5,449
YR 17	2	1	72,398	5,790
YR 18	2	1	59,083	4,749
YR 19	2	1	68,713	5,502
YR 20	1	1	55,866	4,498
YR 21	1	1	18,740	1,562
LOM Max/Total	**2**	**1**	**1,205,628**	**96,822**
LOM Average	**1**	**1**	**54,801**	**4,401**

*NOH=Net Operating Hours

16.7.3 Blasting

Blasting at this mine will be primarily using gassed-emulsion explosives. The gassed emulsion will be manufactured on-site. The production and delivery of explosives and blasting accessories are assumed to be performed by a contractor. Loading of the holes and blasting will be a joint effort performed by the mine employees and the explosives contractor. The blasting patterns and powder factors for each material are shown in Table 16-17 below.

Table 16-17 Blasting Patterns and Powder Factors

Parameter	Unit	Ore	Waste Rock	Waste Overburden	Wall Control
Bench Height	m	8.0	8.0	8.0	16.0
Sub Drill	m	1.2	1.1	1.4	0.0
Hole Length	m	9.2	9.1	9.4	16.0
Hole Diameter	mm	171	171	171	171
Burden	m	4.9	5.5	5.5	4.0
Spacing	m	5.6	6.3	6.3	4.7
Powder/Hole	kg	145.7	145.7	145.7	312.2
Powder Factor	kg/m^3	0.24	0.19	0.21	0.38

Table 16-18 provides a summary of the annualized materials blasted and the quantity of explosives and explosives products consumed to blast these materials over the LOM.

Table 16-18 Blasted Materials and Explosives Quantities

Period	Ore Blasted, t	Waste Blasted, t	Emulsion, t	No. Boosters/0.45 kg	Detonators, #
YR -1	-	5,421,125	895	7,099	7,099
YR 1	2,500,893	9,499,107	2,089	16,573	16,573
YR 2	3,284,206	7,558,684	1,932	15,331	15,331
YR 3	3,102,827	7,424,111	1,875	14,882	14,882
YR 4	3,102,827	7,028,086	1,806	14,328	14,328
YR 5	3,427,191	7,321,792	1,932	15,332	15,332
YR 6	3,131,727	8,069,338	1,991	15,797	15,797
YR 7	3,442,027	10,484,533	2,453	19,468	19,468
YR 8	3,374,372	10,625,628	2,464	19,554	19,554
YR 9	3,600,000	11,764,693	2,689	21,340	21,340
YR 10	3,600,000	11,700,331	2,681	21,277	21,277
YR 11	3,600,000	13,479,824	2,964	23,516	23,516
YR 12	3,600,000	13,400,000	2,958	23,471	23,471
YR 13	3,600,000	13,408,958	2,966	23,532	23,532
YR 14	3,600,000	13,674,269	3,009	23,879	23,879
YR 15	3,600,000	14,150,218	3,084	24,471	24,471
YR 16	3,600,000	13,532,547	2,980	23,649	23,649
YR 17	3,600,000	14,540,870	3,171	25,161	25,161
YR 18	3,600,000	11,098,789	2,588	20,534	20,534
YR 19	3,600,000	13,592,927	3,009	23,880	23,880
YR 20	3,600,000	10,320,912	2,447	19,416	19,416
YR 21	2,652,793	1,667,148	821	6,513	6,513
LOM Total	**71,218,862**	**229,763,889**	**52,804**	**419,004**	**419,004**
LOM Average	**3,391,374**	**10,443,813**	**2,400**	**19,046**	**19,046**

16.7.4 Loading and Hauling

An equipment trade-off study was conducted to assist in selecting the equipment fleet. The study considered material density, tipping weight, bucket size, number of passes, shovel-truck match, loader-truck match, bench height, swell, moisture content, cycle times, production target, and so on. Based on the study, the primary equipment fleet selected for loading and hauling included a 13.2 m^3 hydraulic shovel, a 13.0 m^3 front-end loader, and a fleet of 141-t haul trucks. The two loading units can effectively load trucks with a payload of 141 t and efficiently mine the entire 8 m bench height. This fleet also affords flexibility and efficiency to the operation as it can quickly relocate to new areas if needed.

The productivity and other key parameters for the loading units and trucks are summarized in Table 16-19. In addition to loading time, the productivity of the loading units and trucks includes waiting, maneuvering, and allocating unproductive time. While the shovel has better loading time with higher productivity, the front-end loader offers more mobility and flexibility, allowing it to move easily between the active mining areas, which is essential for selective mining to maintain a consistent ore grade.

Table 16-19 Loading and Hauling Productivity

Parameters	Shovel-Truck	Loader-Truck
Material Bank Specific Gravity (sg)	2.73	2.73
Material Moisture Content (%)	3.0%	3.0%
Loose Specific Gravity - Wet (sg)	2.25	2.25
Loading Unit Calculation and Sizing		
Name of Mining Shovel-Loader	Shovel – 13.2 m^3	Loader – 13.0 m^3
Rated Bucket Size (m^3)	16.50	16.30
Tipping Weight Factor (%)	1.80	1.80
Chosen Bucket Size (m^3)	13.20	13.00
Estimated Bucket Fill Factor (%)	95%	90%
Effective Bucket Payload (mt)	28.20	26.40
Hauling Unit Calculation and Sizing		
Name of Mining Truck	Truck – 141 t	Truck – 141 t
Rated Truck Payload (mt)	142	142
Number of Passes/Truck (decimal)	5.0	5.4
Effective Passes Per Truck (#)	5	6
Effective Truck Payload - Wet (mt)	141	142
Calculated Cycle Time Information and Calculation		
Shovel-Loader Swing Time (sec)	30	40
Shovel-Loader Load Time (min)	2.5	4.0
Shovel-Loader Hang Time (sec)	7.5	7.5
Shovel-Loader Spot Time (sec)	15.0	15.0
Shovel-Loader Queue Time (sec)	7.5	7.5
Loading Cycle Time (min)	3.0	4.5
Travel Time - Loaded (mins)	5.07	5.07
Travel Time - Empty (mins)	4.6	4.6
Turn and Dump Time (mins)	1.0	1.0
Estimated Truck Delay Time (mins)	0.5	0.5
Total Cycle Time (min)	14.2	15.7
Common Production Parameters and Calculations		
Days Per Year (days/yr)	365	365
Scheduled Shifts Per Day (number/day)	2.0	2.0
Scheduled Hours Per Shift (hrs/shift)	12.0	12.0
Scheduled Hours Per Day (hrs/day)	24.0	24.0
Scheduled Hours Per Year (hrs/yr)	8,760	8,760
Lunch-Breaks (hrs/shift)	1.0	1.0
Shift-Change (hrs/shift)	0.25	0.25
Lube and Fuel (hrs/shift)	0.25	0.25
Weather, etc. (hrs/shift)	0.5	0.5
Total Fixed Delays (hrs/day)	4.0	4.0
Available Hours Per Day (hrs/day)	20.0	20.0

Parameters	Shovel-Truck	Loader-Truck
Calculated Loading Unit Production Capabilities		
Scheduled Hours Per Year (hrs/yr)	8,760	8,760
Shovel-Loader Availability (%)	85%	85%
Shovel-Loader Utilizations (%)	85%	85%
Shovel-Loader GOH Per Yr (hrs/yr)	6,329	6,329
Total Fixed Delays (hrs/yr)	1,460	1,460
Shovel-Loader NOH Per Yr (hrs/yr)	4,869	4,869
Max Prod - Shovel-Loader (mt/hr)	2,970	2,110
Shovel-Loader Oper Efficiency (%)	90%	90%
Effective Production - Shovel-Loader (mt/hr)	2,673	1,899
Effective Production - Shovel-Loader (mt/day)	35,658	25,333
Effective Production - Shovel-Loader (mt/yr)	13,015,104	9,246,711
Calculated Hauling Unit Production Capabilities		
Scheduled Hours Per Year (hrs/yr)	8,760	8,760
Truck Availability (%)	85%	85%
Truck Utilizations (%)	90%	90%
Truck GOH Per Yr (hrs/yr)	6,701	6,701
Total Fixed Delays (hrs/yr)	1,460	1,460
Truck NOH Per Yr (hrs/yr)	5,241	5,241
Maximum Production - Truck (mt/hr)	597	545.36
Truck Operating Efficiency (%)	90%	90%
Effective Production - Truck (mt/hr)	538	491
Effective Production - Truck (mt/day)	7,720	7,048
Effective Production - Truck (mt/yr)	2,817,872	2,572,598
Required Equipment and Hours to Meet Production Target		
Production Target Per Year (mt/yr)	16,000,000	16,000,000
Number of Shovel-Loaders Required (decimal)	1.2	1.7
Number of Shovel-Loaders Required (rounded)	2.0	2.0
Shovel-Loaders Required Hours (hrs/yr)	5,986	8,425
Shovel-Loaders Available Hours (hrs/yr)	9,738	9,738
Number of Haul Trucks Required (decimal)	5.7	6.2
Number of Haul Trucks Required (rounded)	6.0	7.0
Haul Trucks Required Hours (hrs/yr)	29,761	32,598
Haul Trucks Available Hours (hrs/yr)	31,448	36,690

The equipment's primary task is to load and transport ore and waste from the active mining areas to the mill, WMF, and stockpiles. As mentioned earlier, waste materials will be mixed with tailings at the WMF. A dedicated front-end loader and haul trucks will load and haul dry-stack tailings from the mill to the WMF. The same dedicated equipment fleet will move ore materials from the temporary stockpile to the mill as necessary.

Mining haulage profiles for the 141-t truck were used to estimate the travel time for hauling ore, waste, rehandling, and tailings. These profiles were developed for each mining phase's benches to every potential destination. A typical haul profile includes the distance traveled and grade-speed bin for each haul segment throughout the LOM. The grade-speed bin specifies travel speeds for various road grades with a 2% rolling resistance, which were estimated using the equipment manufacturer’s performance curves. Table 16-20 presents the grade-speed bin and the truck speed limits used to reflect actual operating conditions in the haul profiles. These haul profiles were incorporated into haulage-simulation software and a route-estimation model to calculate individual travel times for each bench in every mining pushback.

Table 16-20 Truck Speed Limits and Grade Speed Bin

Road Segment and Grade	Loaded Uphill (kph)	Empty Uphill (kph)	Loaded Downhill (kph)	Empty Downhill (kph)
Max Speed	30.0	30.0	30.0	30.0
Flat	25.0	25.0	25.0	25.0
2%	30.0	30.0	30.0	30.0
4%	22.0	30.0	30.0	30.0
6%	15.0	30.0	30.0	30.0
8%	13.5	28.0	30.0	30.0
10%	11.0	23.5	23.5	30.0

The travel and loading times from mine haulage were used to calculate the total cycle times, which were subsequently incorporated into the mine's production estimates. Table 16-21 shows the annualized productivity and the required number of loading units and trucks. At maximum production, the mine requires one hydraulic shovel, two front-end loaders, and six haul trucks.

Table 16-21 LOM Load Haul Productivity and Requirements

Period	Shovel - 13.2 m^3			Loader - 13.0 m^3			Truck – 141-t		
Years	Qty	t/NOH	NOH/Yr	Qty	t/NOH	NOH/Yr	Qty	t/NOH	NOH/Yr
YR -1	1	2,605	2,094	-	-	-	3	371	14,629
YR 1	1	2,603	4,235	1	1,842	3,463	6	481	31,459
YR 2	1	2,601	3,979	1	1,842	2,962	5	529	27,988
YR 3	1	2,596	3,866	1	1,842	4,511	6	522	28,930
YR 4	1	2,602	3,804	2	1,842	3,541	5	664	22,595
YR 5	1	2,591	3,867	2	1,842	5,101	5	860	19,491
YR 6	1	2,593	4,284	2	1,842	2,086	5	792	18,887
YR 7	1	2,596	4,278	2	1,842	3,341	6	720	23,977
YR 8	1	2,591	4,415	2	1,842	3,123	6	637	26,979
YR 9	1	2,599	4,587	2	1,842	3,725	6	583	32,236
YR 10	1	2,598	4,588	2	1,876	3,628	6	685	27,352
YR 11	1	2,612	4,624	2	1,873	4,501	6	787	26,051
YR 12	1	2,611	4,661	2	1,854	4,454	5	958	21,318
YR 13	1	2,607	4,579	2	1,854	7,453	5	970	23,922
YR 14	1	2,605	4,311	2	1,842	5,929	6	794	26,842
YR 15	1	2,602	4,702	2	1,842	4,855	6	644	32,862
YR 16	1	2,604	4,585	2	1,860	4,635	6	625	32,897
YR 17	1	2,587	4,920	2	1,847	4,785	6	781	27,628
YR 18	1	2,595	4,600	2	1,842	3,529	6	528	34,910
YR 19	1	2,591	4,854	2	1,842	4,688	4	909	23,347
YR 20	1	2,607	4,130	2	1,842	3,800	4	919	19,337
YR 21	-	-	-	1	1,842	4,616	3	666	11,198
Average	**1**	**2,600**	**4,284**	**2**	**1,847**	**4,225**	**5**	**01**	**25,220**
Maximum	**1**	**2,612**	**4,920**	**2**	**1,876**	**7,453**	**6**	**970**	**34,910**

16.7.5 Support and Service Equipment

The support and service equipment for this mine is categorized into primary support equipment (also known as “support” equipment) and ancillary equipment. While both categories are important, the support equipment plays a significantly larger role in the mine’s operations than the ancillary equipment. Support and ancillary equipment include graders, water trucks, rubber-tire dozers, track dozers, excavators, fuel/lube trucks, dewatering pumps, backhoes, pioneer drill, snow/sand truck, light plants, skid steers, and more. A detailed list of this equipment with the required quantities is provided in Table 16-22. This equipment is crucial for the successful execution of daily mining activities. Some of the tasks performed by the support equipment include:

- Haul road and access road construction and maintenance
- Bench prep and safety berm construction
- Shovel and loader support/cleanup
- WMF construction and maintenance
- Blasting support and cleanup (pad prep, berms, etc.)
- Stockpile construction and maintenance
- Field equipment support and servicing
- Pioneering and phase development
- Dust control and water for drills, etc.
- Ditch construction and maintenance

Table 16-22 Support and Service Equipment

Equipment Name	Maximum Fleet Size
Backhoe - 1.30 m^3	1
Pioneer Drill - 117-152 mm	1
Sand Truck - 35 t	1
Light Plant - 6 kW; 240 watt-led	10
Small Backhoe/Loader	1
Rock Breaker/Hammer	1
Operations Skid Steer	1
ANFO-Emulsion Truck	2
Mechanic Service Truck	2
Tire Handler Truck	1
Crane - 91 t	1
Telehandler - 11.7 t	1
Forklift - 9.1 t	1
Maintenance Fuel/Lube Truck	1
Maintenance Flatbed Trailer	1
Maintenance Skid Steer	1

16.7.6 Labor

The mine's staffing plan is designed for continuous operations—24 hours a day, 365 days a year—and includes salaried and hourly personnel. The staffing level is determined by total equipment hours, with an estimated total of 124 mine personnel in a full production year, consisting of 20 salaried employees and 104 hourly workers. The mine's functional areas are mine operations, mine maintenance, technical services, and administration.

To provide full coverage, mine and maintenance operations personnel will work a schedule of rotating shifts operating 24 hours a day, seven days a week. The technical services department will provide professional technical support to mine operations and mine management and consist of geologists, mining engineers, surveyors, and other employees. Additional details on the labor distribution and staffing requirements are presented in Table 16-23.

Table 16-23 Mining Labor Requirement

Job Title / Designation	Prod Crew A	Prod Crew B	Prod Crew C	Prod Crew D	Site Based	Total Staff
Mine Manager	1	-	-	-	1	1
Mine Shift Supervisor	1	1	1	1	4	4
Drillers	2	2	2	2	8	8
Lead Blaster	1	-	1	-	2	2
Blasting Crew Laborers	2	-	2	-	4	4
Pit Trucks Drivers	5	5	5	5	20	20
Tailings Truck Driver	1	1	1	1	4	4
Shovel	1	1	1	1	4	4
Wheel Dozer	1	1	1	1	4	4
Pit Front-End Loader	1	1	1	1	4	4
Tailings Front-End Loader	1	1	1	1	4	4
Track Dozer	2	2	2	2	8	8
Grader	1	1	1	1	4	4
Water Truck	1	1	1	1	4	4
Pumper/Utility	1	1	1	1	4	4
Subtotal - Mine Operations	**22**	**18**	**21**	**18**	**79**	**79**
Mine Maintenance General Foreman	1	-	-	-	1	1
Mine Maintenance Supervisor	1	1	1	1	4	4
Mine Maintenance Planner	1	-	1	-	2	2
Field Mechanic	1	1	1	1	4	4
Oiler/Fuel Truck	1	1	1	1	4	4
Shop Mechanics	4	4	4	4	16	16
Instrumentation/Electrical Technician	1	-	1	-	2	2
Mine Maintenance Clerk	1	-	1	-	2	2
Subtotal - Mine Maintenance	**11**	**7**	**10**	**7**	**35**	**35**
Chief Mining Engineer	1	-	-	-	1	1
Senior Mine Engineer	-	-	1	-	1	1
Planning Engineer	1	-	1	-	2	2
Ore Control Technician	1	-	1	-	2	2
Surveyors/Technicians	1	-	1	-	2	2
Chief Mine Geologist	1	-	-	-	1	1
Mine Geologist	-	-	1	-	1	1
Subtotal - Technical Services	**5**	**-**	**5**	**-**	**10**	**10**
Grand Total - LOM Mining	**38**	**25**	**36**	**25**	**124**	**124**

16.7.7 Reclamation and Closure

After mining operations conclude, the site will transition into final reclamation and closure activities. Due to the site's remote location, all reclamation activities will be self-performed utilizing the equipment fleet that supported the mining operation. Given the relatively small size of the operation and concurrent reclamation activities of the WMF throughout the LOM, it is assumed that the demolition and most reclamation activities will be completed in approximately one year.

The mill, all facilities, foundations, etc., will be demolished and removed. The debris will be disposed of in the final pit and covered in accordance with Alaska mining regulations. The haul roads, access roads, and facility pads will be dismantled and regraded to approximate original contours. Topsoil material that was salvaged during operations will be spread on the regraded areas where suitable and reseeded according to permit requirements. The last phase of the WMF will also be regraded and closed at this time. Final reclamation monitoring and maintenance are assumed to be required and have been factored into the operating cost estimate for a ten-year period following the completion of reclamation activities.

17 Recovery Methods

The project envisages a multi-location mining and processing operation consisting of producing 175,000 tpa of graphite concentrate (95 wt%) at Graphite Creek, Alaska (mill); shipping the concentrate to the STP in Niles, Ohio; and refining it into 256,510 tpa of AAM and other graphitic byproducts. The two plant locations are described separately in sections 17.1 and 17.2.

17.1 Graphite Creek Facility

The facility at Graphite Creek consists of an open-pit mine feeding 10,000 tpd of ROM ore to the mill. The mill operations consist of primary crushing, crushed ore stockpile and reclaim; SAG milling, flash and rougher flotation; and seven stages of cleaner flotation supported by three regrind stages. The tailings will be thickened, filtered, and loaded out to the WMF. The concentrate will be thickened, filtered, dried, and loaded into 20-foot containers for transport to the STP in Niles, Ohio.

17.1.1 Flowsheet Selection

The process parameters developed through the laboratory testwork were used to develop a process flowsheet and METSIM mass and energy balance model, which in turn were used to size equipment and facilities. The average LOM head grade is 5.3 wt% graphite, which was used in the model.

The process plant will consist of the following unit operations:

- Crushing
  - Primary (jaw) crushing
  - Stockpile and reclaim system
  - Associated conveying and dust collection systems
- Grinding
  - Primary grinding using a single-stage SAG mill in closed circuit
  - Flash flotation prior to cycloning
  - Cyclone separator (underflow to the SAG mill, overflow to rougher flotation)
- Graphite flotation
  - Rougher flotation using tank cells
  - Seven stages of cleaner flotation using tank cells
  - Three stages of regrind (ball mill followed by two Metso Vertimills)

- Concentrate filtration, drying, and load-out
    - Concentrate thickener (high rate)
    - Concentrate pressure filter (horizontal plat-and-frame)
    - Concentrate dryer (fluid/moving bed)
    - Concentrate storage silos and loadout
- Tailings
    - Tailings thickener
    - Tailings filters (horizontal vacuum belt)
    - Tailings loadout to WMF

A simplified process flow diagram of the mill is provided below in Figure 17-1.

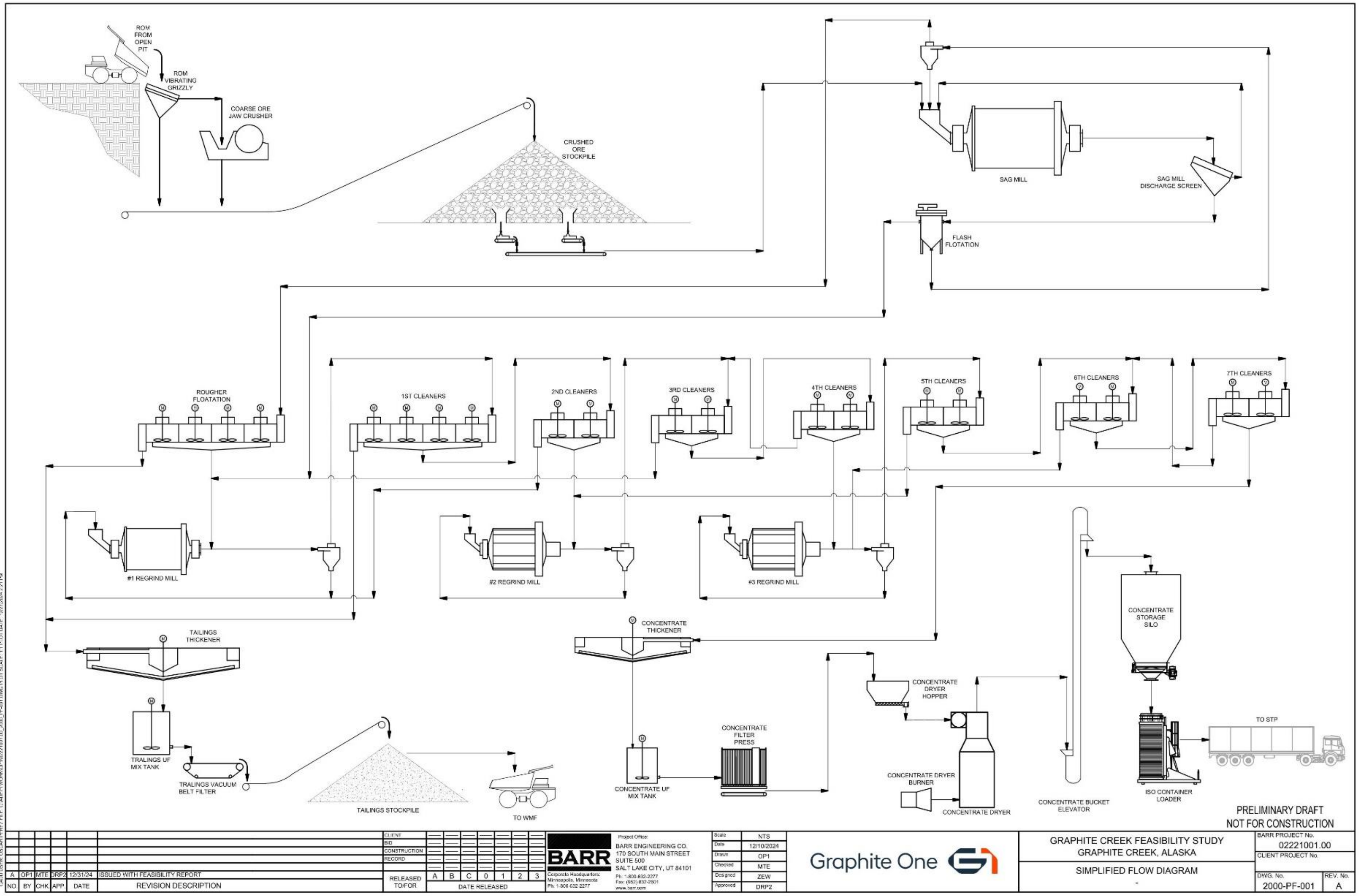


Figure 17-1 Simplified Flow Diagram for Graphite Creek Facility

17.1.2 Design Basis for the Graphite Creek Process Facility

A 10,000 tpd mill was designed to process graphitic ore mined from the Graphite Creek open-pit mine. The majority of the ore will be direct truck dumped into the crusher, but stockpiles will be used at times to control the feed grade to the mill. The mill will operate two shifts per day, 365 days a year, with an overall availability of 90%. The process plant will produce 175,000 tpa of a 95% graphitic concentrate that will be filtered, dried, and shipped to the STP. The design basis further assumes 90% graphite recovery in the mill with a final concentrate moisture content of ~1.0 wt.% or less. The design basis document provides a full description of the design basis elements.

17.1.3 Mill Process Description

17.1.3.1 Area 2100 – ROM Handling, Primary Crushing and Storage

The ROM ore will be transported to the crushing circuit by 141-t mine haul trucks. The mine haul trucks will discharge their loads into a dump hopper (2120-BN-001) equipped with a stationary grizzly (part of the dump hopper) with 609.6 mm (24 in) spacing. Oversized rocks will be reduced with mobile equipment on an as-needed basis. Ore will be reclaimed from the bin with an apron feeder (2120-AF-001) and scalped of fines with a vibrating grizzly screen. Grizzly oversize (+178 mm) will be passed through a jaw crusher (2120-CR-001, Metso C200, 400 kW (500 hp)). A hydraulic rock breaker (2120-RB-001) shall be installed adjacent to the jaw crusher to manage incoming feed material. A tramp metal magnet (2120-MC-001) will be mounted on the discharge conveyor to remove any tramp metal (e.g., shovel teeth) from the feed stream. The grizzly undersize and jaw crusher discharge will be combined and will report to the coarse ore stockpile (2130-OB-001) at a top size of 178 mm and P80 of 165 mm +/- 10%.

Primary crushing is designed to run 12 hours per day, seven days per week, while the rest of the mill will operate 24 hours per day, seven days per week.

17.1.3.2 Area 2100 – Ore Stockpile and Reclaim

The primary crushing discharge conveyor (2120-BC-001) will feed the covered coarse-ore stockpile with a 10,000-ton (24-hour) live capacity. Ore will be reclaimed from the coarse ore stockpile with two apron feeders (2130-AF-001/002) installed in a gallery under the stockpile. The apron feeders will discharge onto the SAG mill feed conveyor (2130-BC-001). Feed from the apron feeders will be controlled by variable speed drives. Appropriate operating and safety controls will be installed on the SAG mill feed conveyor for operator safety and protection.

17.1.3.3 Area 2200-Wet Grinding, Flash Flotation, and Classification

The coarse ore stockpile will feed the primary grinding SAG mill (2210-ML-001, Metso Premier™ SAG Mill, Ø8.53 m x 4.19 m, 4,200 kW (5632 hp)). Ground material will exit the SAG mill onto a wet screen (2210-SN-001, 3 m wide x 7.3 m long, 75 kW (100 hp)) where oversized material with a nominal P80 of 16,300 µm will be conveyed directly back to the SAG mill feed hopper, and screen undersized material with a nominal P80 of 1,200 µm will be sent to flash flotation (2200-FL-001, Metso SkimAir® 1200, 53 m^3 volume). Flash flotation is used to recover the recirculating load of graphite from the SAG cyclone circuit to prevent overgrinding of the graphite.

Flash flotation concentrate will combine with the rougher concentrate and feed the #1 regrind mill. Flash flotation tailings will report to a hydrocyclone classifier (2230-CY-001) from which the overflow (undersize product) will exit the grinding circuit and report to rougher flotation at a P80 of approximately 350 µm. Cyclone underflow (oversized product) will report back to the SAG mill feed hopper and SAG mill for additional regrinding (circulating load).

17.1.3.4 Area 2300 – Flotation

SAG mill cyclone overflow will report to the six rougher flotation cells (2310-FL-001, FLS NextStep™ 50 m^3 tank cells). The rougher concentrate will be joined by flash flotation concentrate in the #1 regrind mill (2320-RM-001, Metso Select™ ball mill, Ø2.70 m x 4.73 m, 450 kW (603 hp)), where further liberation of graphite flakes from gangue will take place. The #1 regrind mill will operate in a closed circuit to ensure proper particle size reduction to target a P80 of 240 µm. The second stage cleaner tailings will be sent directly to the #1 regrind mill without cycloning to prevent the build-up of fine unliberated graphite. The #1 regrind mill cyclone (2320-CY-001) overflow will feed the first stage of cleaners (2330-FL-001, 4 FLS NextStep™30 m^3 tank cells). The rougher tailings will report to the tailings thickener.

The first cleaner concentrate will feed the second stage of cleaners (2330-FL-002, 2 FLS NextStep™ 20 m^3 tank cells). The second cleaner concentrate will feed the #2 regrind mill. The second cleaner tailings will report back to #1 regrind mill, and the first cleaner tailings will be sent to the tailings thickener. Rougher and first cleaner are the only primary outlets for tailings from the system. All downstream tailings report to an upstream cleaner or to a regrind mill.

The #2 regrind mill (2330-RM-001, 1 Metso Vertimill® VTM 200 WB, 149 kW (200 hp)) also operating in closed circuit will feed the third cleaners (2340-FL-001, 2 FLS NextStep™ 20 m^3 tank cells) through the #2 regrind mill cyclone (2330-CY-001) overflow, targeting a P80 of 170 µm. The third cleaner concentrate will feed the fourth cleaners (2340-FL-002, 2 FLS NextStep™ 20 m^3 tank cells), and the fourth cleaner concentrate will report to the #3 regrind mill (2340-RM-001, 1 Metso Vertimill® VTM 125 WB, 93 kW (125 hp)) in closed-circuit operation. The third cleaner tailings will report back to #1 regrind or (optionally) to final tailings, and the fourth cleaner tailings will recycle as third cleaner feed with the potential ability to redirect and feed the #2 regrind mill (not shown on PFD).

The #3 regrind mill cyclone (2340-CY-001) overflow will target a P80 of 140 µm and feed the fifth cleaner flotation (2350-FL-001, 2 FLS NextStep™ 20 m^3 tank cells). The concentrate from the fifth cleaner flotation will feed the sixth cleaner flotation (2350-FL-002, 2 FLS NextStep™ 20 m^3 tank cells), and the concentrate from the sixth cleaner flotation will feed the seventh cleaner flotation (2350-FL-003, 2 FLS NextStep™ 20 m^3 tank cells). The seventh cleaner concentrate will be taken as final product and sent to the concentrate thickener. The seventh cleaner tailings will report to the sixth cleaner feed, the sixth cleaner tailings will report to the #3 regrind mill, and the fifth cleaner tailings will report to the #2 regrind mill.

Diesel is the only collector used in the flotation circuit. Diesel is supplied to the flotation circuit through dedicated lines and metering valves that are connected to the main diesel distribution system of the plant. The frother employed is methyl isobutyl carbinol (MIBC). MIBC is distributed using metering pumps (2620-PM-1 through 9) from MIBC storage totes.

Reference 2300-PF-001 and 2300-PF-002 for the diagrammatic representation of the flotation process flow.

17.1.3.5 Area 2400-Tailings Thickening, Filtering, Storage, and Transport

The combined tailings from the rougher and first cleaner flotation stages will report to a high-rate tailings thickener (2410-TH-001, FLS Ø36 m high-rate thickener) with an eductor-style feedwell. Flocculant will initially be mixed, stored, and pumped to the thickener at 2.0 grams per liter (g/L) concentration. Before flocculant enters the feedwell of the thickener, inline dilution with process water will reduce the concentration of the mixture to 0.2 g/L. Clear overflow of the thickener will be recycled as process water with the option to purge flow to the mill pond. Underflow of the thickener will report to a tailings underflow mix tank (2410-TK-001) at 68% solids. Tailings will be filtered in multiple vacuum-belt filters (2420-BF-001A/B/C/D/E, 5 Metso RB 4.25 x 40 m belt filters, 170 m^2 filter area each) for final tailings dewatering to 14.8% moisture or less. The filtered tailings will be conveyed by the tailings stockpile feed conveyor (2430-BC-001) to the tailings stockpile for short-term storage before being loaded by frontend loader into mine haul trucks. The tailings will be transported by haul truck to the WMF for disposal along with waste rock from the mine. Any drainage from the WMF will be captured and either recycled to the plant or treated in the wastewater treatment plant (WWTP) for discharge.

17.1.3.6 Area 2500 – Concentrate Thickening and Filtering

The graphite concentrate from the seventh cleaner will report to a high-rate concentrate thickener (2510 TH-001, FLS Ø12 m high-rate thickener). The feed density will be up to 20% solids with a feedwell dilution to a final concentration of 10% solids or less. Flocculant will initially be mixed, stored, and pumped to the thickener at 2.0 g/L concentration. Before flocculant enters the feedwell of the thickener, inline dilution with process water will reduce the concentration of the mixture to 0.2 g/L. Flocculant dosing will be in the range of ~50 g/t. The graphite concentrate thickener will achieve a target underflow density of 33% solids. The underflow will then report to a plate and frame pressure filter (2520-FP-001, Diemme GHT2500.F14 filter press with sixty-one (61) 2.5 m x 2.5 m plates). The slurry will be pumped into the filter at 552 kPa forming a 50-mm thick cake over a 3-5 cfm/ft^2 filter cloth. The filter cake will discharge at ~23.5% moisture. Total cycle time will be 15 minutes. Filtrate from the pressure filters will report to the concentrate thickener, and filter cake will report to product drying. Clear overflow of the thickener will be recycled to the process water tank (2710-TK-001).

17.1.3.7 Area 2500-Concentrate Drying, Storage, and Transport

Barr has concluded that drying the concentrates at the mine site before shipping would be more economical than drying at the STP after shipping. Therefore, a drying system using diesel as fuel (potentially augmented with waste heat from power generation) is proposed for the graphite concentrates.

The chosen dryer technology consists of a fluidized/moving bed approach fired by diesel fuel. Filter cake from the filter press will report to a surge bin from which the material will be augered to a forced-air, direct-fired dryer (2530-PL-001, Carrier 40 MMBTU/hr mechanical scatterer flash dryer). The concentrate material will be suspended in a vertical portion of the dryer, then pneumatically transported laterally to a recovery system consisting of a cyclone (2530-CY-001), a baghouse (2530-BH-001), and a day bin (product sampling location). Then the dried material will be transported to live product storage consisting of two vertical silos (2540-BN-001A/B) having a total capacity of 500 Mt. (24 hours of storage).

The vertical storage bins will be fitted with loadout equipment consisting of vibrating bin dischargers (2540-VD-001A/B), loading spout positioners (2540-PO-001A/B), ISO container loading spouts (2540 LS 001A/B), and ISO container loaders (2540-CT-001A/B) designed to load 20-foot shipping containers for transport to the STP. Shipping containers will be moved and stacked by a wheeled, telescoping stacker. Containers will be stored onsite (providing an additional nine to ten days of concentrate storage) before being transported by truck to Nome and shipped to the STP via ship and rail. Site storage and overall transport logistics of concentrate are described in Chapter 18.

17.1.3.8 Area 2600-Reagents

Provision is made for flocculant mixing, dilution, and distribution (Area 2630). Flotation agent (diesel) storage and distribution are handled by control valves from the diesel distribution lines in the mill. Frother MIBC storage and distribution are accomplished by locally placed totes of reagent and associated metering pumps, and incorporation of these into the process has been described in the preceding sections for flotation, tailings, and concentrate.

17.1.3.9 Area 2700-Plant Utilities

Process Water Storage and Distribution

The mill design will include a local, heated, process water storage tank (2710-TK-001, 945 m^3) sized to store 30 minutes of process water for the plant and fill the flotation circuit during startups. Additional process water capacity is available from the process water pond adjacent to the WWTP.

The water balance around the mill is shown in Figure 17-2 below. Approximately 20 tph of water is brought in with the ore, which has an average moisture content of 4%. Additionally, 36 tph of water is produced from the WWTP as reject brine and sludge, based on the average water treatment volume at the site. The mill requires about 31 tph (approximately 140 gallons per minute (gpm)) of freshwater feed, sourced either from wells or surface water on site.

Water leaving the mill is around 80 tph, which is directed to the tailings. This includes an estimated loss of 8 tph to the atmosphere through the product dryer and a small amount found with the dry graphite concentrate.

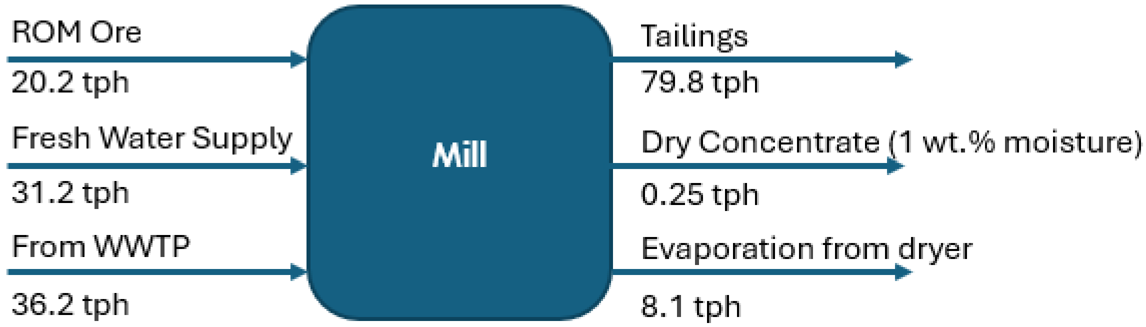


Figure 17-2 Overall Water Balance for the Mill

Fire Water

Fire water requirements were calculated based on the largest plant area demand with a service duration of 180 minutes resulting in a required volume of 818 m^3 (216,000 gallons (gal)). Fire water will be stored in a fire water system feed tank (4190-TK-001) and supplied by redundant electric pumps with diesel backup power.

Site Power

Electric power at site is supplied by diesel-fired reciprocating internal combustion engine (RICE) generators. This is further described in Chapter 18 of this report.

Heating, Ventilation, and Air Conditioning (HVAC)

Building heat will be supplied by a combination of waste heat from the generators and diesel fired unit heaters for the mill buildings. The buildings closest to the generators (tailings filtration, flotation, and concentrate drying) will be predominately heated by the generator and concentrate dryer waste heat, while the buildings farther away (truck shop, grinding, crusher) will be heated by diesel-fired unit heaters. Waste heat from the generators will be captured by a hot water/glycol loop and distributed to air exchangers. Diesel will be distributed to the unit heaters from the main diesel supply tank. Since it is separate from the mill complex, the WWTP facility will be served by diesel-fired unit heaters and a diesel tank located at the WWTP. Estimates have also been completed for air handling and heat exchangers throughout the mill and WWTP facilities.

17.1.3.10 Compressed Air Supply

Compressed air to the mill will be supplied by a dedicated air compressor (2720-CA-001A/B, one operational, one online spare, 1835 m^3/hr at 10.3 bar (1080 cfm at 150 psi), 201 kW (270 hp)) fitted with filter (2720-FT-001), dryer (2720-DR-001), and surge tank (2720 TK-001).

17.1.4 Mill Labor

The staffing plan for the mill assumes continuous operations—24 hours a day, 365 days a year—and is inclusive of salaried and hourly personnel. The staffing level was determined by mill size and complexity, operations (power plant, WTP, etc.), and expected level of maintenance required. Mill staffing was estimated at a total of 77 personnel in a full production year, consisting of 11 salaried employees and 66 hourly workers.

To provide full coverage, mill operations and maintenance personnel will work a schedule of rotating shifts operating 24 hours per day, seven days per week. Additional details on the labor distribution and staffing requirements are presented in

The mill staffing (both salaried and hourly) is exclusive of the staffing described in Chapter 16 for the mine operations. Staffing for the WTP and power plant is included with the mill. Other support staff are accounted for in the G&A estimate, as they support the overall operation.

Table 17-1 Milling Labor Requirements

Job Title / Designation	Prod Crew A	Prod Crew B	Prod Crew C	Prod Crew D	Site Based	Total Staff
Mill Manager	1				1	1
Mill Shift Supervisor	1	1	1	1	4	4
Chief Metallurgist	1				1	1
Metallurgical Engineer			1		1	1
Control Room Operator	1	1	1	1	4	4
Crusher Operator	1	1	1	1	4	4
Grinding Operator	1	1	1	1	4	4
Flotation Operator	1	1	1	1	4	4
Thickening / Filtration Operator	1	1	1	1	4	4
Concentrate Loadout Operator	2	2	2	2	8	8
Subtotal – Mill Operations	**10**	**8**	**9**	**8**	**35**	**35**
Mill Maintenance General Foreman	1				1	1
Mill Maintenance Planner	1				1	1
Instrumentation Technician	1		1		2	2
Millwright	5	1	5	1	12	12
Machinist	1		1		2	2
Oiler	1		1		2	2
Electrician	2		2		4	4
Subtotal – Mill Maintenance	**12**	**1**	**10**	**1**	**24**	**24**
Lab Supervisor	1		1		2	2
Lab Technicians	2	2	2	2	8	8
Subtotal – Assay Lab	**3**	**2**	**3**	**2**	**10**	**10**
Total Processing	**25**	**11**	**22**	**11**	**69**	**69**
Waste & Potable WTP Operator	1	1	1	1	4	4
Power Plant Operators	1	1	1	1	4	4
Total - Other Site Services	**2**	**2**	**2**	**2**	**8**	**8**
Grand Total - LOM	**27**	**13**	**24**	**13**	**77**	**77**

17.2 Secondary Treatment Plant (Ohio, USA)

17.2.1 Feedstocks and Products

Graphite One is undertaking a project to construct a greenfield STP located in Niles, Ohio. The STP aims to treat NG sourced from the Graphite Creek property in Alaska to produce anode-active materials for the lithium-ion battery market and other applications. The key products envisioned from the STP facility are:

- Secondary particle (NG) product (Anode ‘A’ – NG)
- Secondary particle (composite) product (Anode ‘A’ – composite)
- Single particle (pure) product (Anode ‘B’ - pure)
- Single particle (blended) product (Anode ‘B’ – blended)
- 99% C(t) marketable products (purified flake graphite)
- Battery conductor product

- Synthetic diamond precursor product
- 95% C(t) marketable products (unpurified flake graphite) + coke rejects
- Carbon raisers lubricants

17.2.2 Introduction and Summary

The STP aims to treat NG concentrate feed. Additionally, petroleum coke, pitch, and anode precursor material are to be processed to produce a range of unpurified, purified, and anode products. The proposed block flow diagram for the STP facility is shown in Figure 17-3.

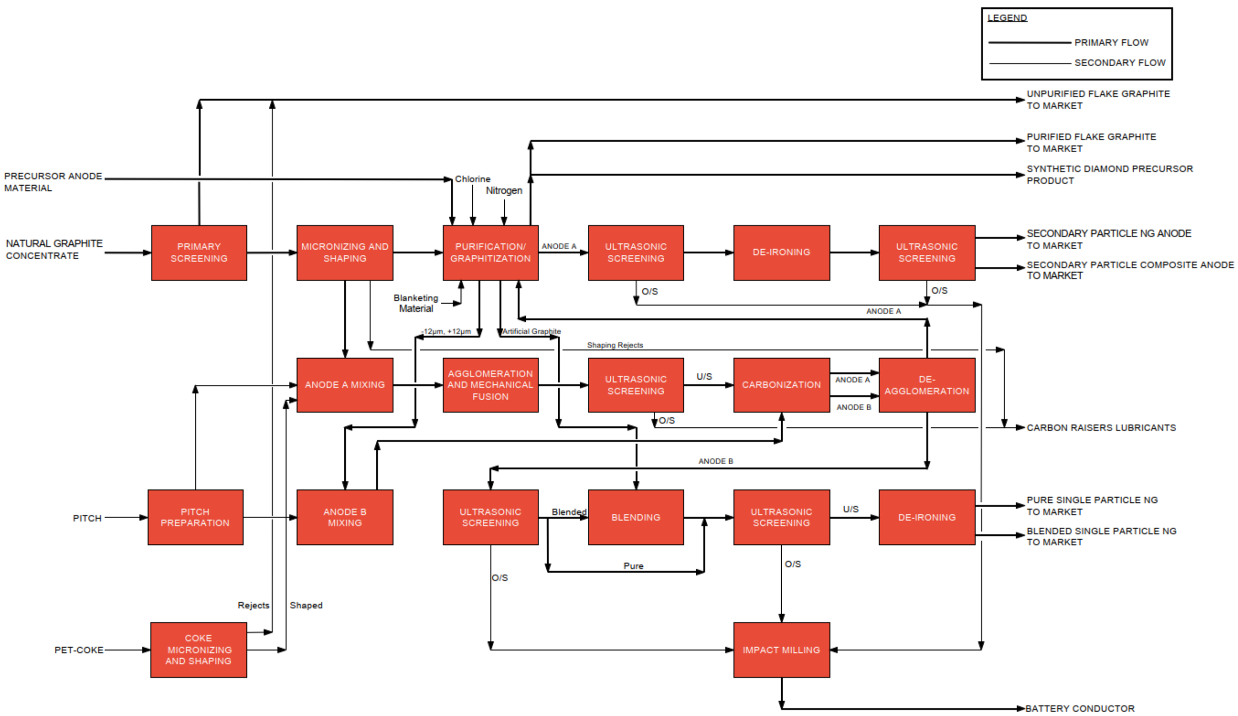


Figure 17-3 Block Flow Diagram of the STP

The process utilizes an Acheson-type high-temperature furnace for the purification and graphitization processes. Anode material production utilizes a carbonization roller hearth kiln, followed by a series of post-processing steps. Section 17.2.7 provides a description of the process.

This section outlines the process engineering completed over the study development period. These include the following:

- Developed design basis (DB) to document key project development assumptions and guide process development. The key parameters of DB are outlined in Section 17.2.4
- Prepared process design criteria (PDC) to document key assumptions for flowsheet development and mass and energy balances

- Developed mass and energy balances (M&EBs) to prepare stream tables
- Prepared process flow diagrams (PFDs)
- Estimated utility requirements, atmospheric emissions, and solids wastes and effluent production to facilitate regulatory compliance and support production and safe disposal as outlined in Section 17.2.9

17.2.3 Secondary Treatment Plant Reference Documents

The following key documents were prepared to provide a basis for the STP design.

- H373640-0000-210-226-0001 - Process Design Basis and Criteria (PDB/PDC)
- H373640-6000-210-252-0001 - Block Flow Diagram (BFD)
- H373640-6000-210-282-0001 - Concentrate Receiving and Storage PFD
- H373640-6000-210-282-0002 - Concentrate Preparation PFD
- H373640-6000-210-282-0003 - Primary Screening PFD
- H373640-6000-210-282-0004 - Unpurified Graphite Flake Collection PFD
- H373640-6000-210-282-0005 - -100 Mesh Unpurified Graphite Flake Micronizing Feed PFD
- H373640-6000-210-282-0006 - +12 Micron Graphite Flake Micronizing and Shaping PFD
- H373640-6000-210-282-0007 - -12 Micron and +320 Mesh Graphite Flake Micronizing and Shaping PFD
- H373640-6000-210-282-0008 - Micronized and Shaped Unpurified Graphite Collection PFD
- H373640-6000-210-282-0009 - Pet-Coke and Pitch and Anode Precursor Material Receiving and Storage PFD
- H373640-6000-210-282-0010 - Petroleum-Coke and Anode Precursor Material Preparation PFD
- H373640-6000-210-282-0011 - Pitch Preparation PFD
- H373640-6000-210-282-0012 - Thermal Purification PFD
- H373640-6000-210-282-0013 - Purified Graphite Flake Storage PFD
- H373640-6000-210-282-0014 - Anode B – Mixing PFD
- H373640-6000-210-282-0015 - Anode A and B Carbonization PFD
- H373640-6000-210-282-0016 - Anode A and B Deagglomeration PFD

- H373640-6000-210-282-0017 - Anode A - Dosing and Mixing PFD
- H373640-6000-210-282-0018 - Anode A - Agglomeration & Mechanical Fusing PFD
- H373640-6000-210-282-0019 - Anode A - Screening and De-Ironing PFD
- H373640-6000-210-282-0020 - Anode B - Screening and De-Ironing PFD
- H373640-6000-210-282-0021 - Anode A and B Rejects Milling PFD
- H373640-6000-210-282-0022 - Product Packaging and Bagging PFD
- H373640-6000-210-282-0023 - Thermal Purification Off-Gas Scrubbing PFD
- H373640-6000-210-282-0024 - Blanketing Material PFD
- H373640-6000-210-282-0025 - Sodium Hydroxide and Chlorine PFD
- H373640-6000-210-282-0026 - Nitrogen and Compressed Air PFD
- H373640-6000-210-282-0027 - Cooling Water PFD
- H373640-6000-210-282-0028 - Water Services PFD
- H373640-6000-210-282-0030 - Process Stream Tables

17.2.4 Design Basis

17.2.4.1 Feed Characteristics

Table 17-2 tabulates different estimated feed compositions for the STP. The NG concentrate is assumed to be dried at the Graphite Creek property in Alaska up to a residual moisture content of 1 wt.%. The volatile matter in the feed materials is assumed to be a polycyclic aromatic hydrocarbon represented at $C_{24}H_{12}$.

Table 17-2 Estimated Feedstocks Characteristics

Component	Approximate Mass Fraction (wt.%)
Natural Graphite Concentrate	
C_{fixed} (simulated as graphitic carbon)	94.10
Moisture	1.0
Volatile Matter (simulated as $C_{24}H_{12}$)	1.08
S	0.01
Ash	3.81
SiO_2	1.694
Al_2O_3	1.022
Fe_2O_3	0.864
TiO_2	0.035
K_2O	0.065
Na_2O	0.010
CaO	0.028
MgO	0.049
P_2O_5	0.016
BaO	0.011
PbO	0.001
ZrO_2	0.006
MnO_2	0.010
NiO	0.001
Petroleum Coke	
C_{fixed} (simulated as amorphous carbon)	98.4
Volatile Matter (simulated as $C_{24}H_{12}$)	0.5
Moisture	0.50
Ash	0.100
SiO_2	0.061
Al_2O_3	0.026
Fe_2O_3	0.006
MgO	0.004
CaO	0.004
S	0.50
Pitch	
$C_{18}H_{12}$	99.27
S	0.59
Ash (simulated as Al_2O_3)	0.14
Anode Precursor Material	
C_{fixed} (simulated as amorphous carbon)	99.0
Moisture	0.40
Ash	0.500
SiO_2	0.167
Al_2O_3	0.167
Fe_2O_3	0.167
S	0.10

17.2.4.2 Operating Basis

The facility throughput is based on a fixed feed rate of NG concentrate. The assumed yield for each process step estimates the production basis of unpurified, purified, and anode products. Table 17-3 tabulates key target plant operational parameters.

The STP was initially developed for a 25 ktpa module. It was then scaled/factored to a throughput of 175 ktpa. The details of this expansion have been tabulated alongside the 25 ktpa module details below.

Table 17-3 Major Operational Parameters

Description	Value
Operating days per year	300
Concentrate feed rate	25,000 tpa (27,558 short tpa) 175,000 tpa (192,903 short tpa)
Operating schedule for high-temperature processes[1]	7 days x 24 hours
Operating schedule for room-temperature processes[2]	5 days x 16 hours

[1] Refers to purification/graphitization, carbonization, and agglomeration.
[2] Refers to milling, shaping, sieving, blending, and packaging.

17.2.5 Mass and Energy Balances (M&EBs)

17.2.5.1 Methodology

A mass and energy balances model has been developed using the SysCAD™ flowsheet modeling software package (Version 9.3, Build 139). The model is based on assumptions and specifications documented in PDB and PDC. The process modeling results have been presented in the stream tables. The model outputs shown in the stream tables represent a solution with a relative mass and heat tolerance to a normalized relative error of 0.001%.

Chemical species properties have been sourced from the SysCAD™ integral database, the HSC software database (Version 6), and information available in the public domain. Some assumptions needed to be made to address gaps in thermodynamic data with certain components by drawing analogies with similar components.

It is important to note the quality of the mass and energy balance is highly dependent on the accuracy of the inputs made to the mass and energy balance simulation. The output of the mass and energy balance (summarized as the stream tables) is essentially the basis of the sizing of every component within the STP. Therefore, it is critical to identify where assumptions are made and note the implicit risk any assumption carries with respect to the accuracy of the design and, ultimately, the accuracy of the STPs capital and operating cost estimates.

17.2.6 Key Inputs

The following key inputs were assumed in the development of the M&EBs.

The M&EBs were set up to process approximately 25,000 tpa (27,558 short tpa) of NG concentrate.

The STP was initially developed for a 25 ktpa module with the concept of scaling up production in 25 ktpa modules to match the mine production of 175 ktpa. Then the 25 ktpa module was scaled/factored to a throughput of 175 ktpa. The details of this expansion have been tabulated alongside the 25 ktpa module details below.

Key process and equipment design and operating conditions were provided by Graphite One, Inc.

17.2.6.1 Elemental Balance

Table 17-4 shows the estimated elemental balance for the STP facility.

Table 17-4 Estimated Elemental Balance – 25 ktpa

Description	Estimated Carbon Elemental Nominal Mass Flow (lb/hr)	Estimated Carbon Elemental Nominal Mass Flow (kg/hr)	Estimated Carbon Elemental Nominal Mass Flow (short ton/yr)	Estimated Carbon Elemental Nominal Mass Flow (tpa)
Inputs	9,443.76	4,283.61	41,363.65	37,524.47
Natural Graphite Concentrate Feed	5,986.05	2,715.22	26,218.88	23,785.37
Pet Coke Feed	1,431.15	649.16	6,268.45	5,686.64
Anode Precursor Material Feed	1,848.04	838.26	8,094.41	7,343.13
Pitch Feed	178.52	80.98	781.91	709.34
Outputs – Products	9,126.96	4,139.92	39,976.08	36,265.69
Secondary Particle Product	164.62	74.67	721.03	654.11
Single Particle Product	225.70	102.38	988.55	896.80
99% Ct Marketable Products	1,950.27	884.63	8,542.16	7,749.32
Battery Conductor Product	4,139.12	1,877.47	18,129.33	16,446.65
Synthetic Diamond Precursor Product	1,076.06	488.09	4,713.14	4,275.69
95% Ct Marketable Products	509.74	231.21	2,232.65	2,025.43
Carbon Raisers Lubricant	1,061.46	481.47	4,649.21	4,217.69
Outputs – Losses	316.80	143.70	1,387.58	1,258.79
-100 Mesh Micronizing Losses	4.67	2.12	20.45	18.55
Pet-Coke Micronizing Losses	1.43	0.65	6.27	5.69
Pitch Jet Milling Losses	0.89	0.40	3.91	3.55
Losses to Purification Off-Gas	247.88	112.44	1,085.70	984.93
Carbonization Mass Loss	45.94	20.84	201.20	182.53
Losses to Agglomeration Off-Gas	15.83	7.18	69.32	62.89
Impact Milling Mass Loss	0.16	0.07	0.72	0.65
Total Outputs	9,443.76	4,283.61	41,363.65	37,524.47
Overall Recovery (%)	**96.65%**			

Table 17-5 Estimated Elemental Balance – 175 ktpa

Description	Estimated Carbon Elemental Nominal Mass Flow (lb/hr)	Estimated Carbon Elemental Nominal Mass Flow (kg/hr)	Estimated Carbon Elemental Nominal Mass Flow (short ton/yr)	Estimated Carbon Elemental Nominal Mass Flow (tpa)
Inputs	66,106	29,985.15	289,543	262,669
Natural Graphite Concentrate Feed	41,902	19,006.41	183,531	166,497
Pet Coke Feed	10,018	4,544.08	43,879	39,806
Anode Precursor Material Feed	12,936	5,867.67	56,660	51,401
Pitch Feed	1,250	566.99	5,473	4,965
Outputs – Products	63,888	28,979.09	279,830	253,858
Secondary Particle Product	1,152	522.54	5,047	4,579
Single Particle Product	1,580	716.68	6,920	6,278
99% Ct Marketable Products	13,652	6,192.44	59,795	54,245
Battery Conductor Product	28,974	13,142.37	126,904	115,125
Synthetic Diamond Precursor Product	7,532	3,416.45	32,992	29,930
95% Ct Marketable Products	3,568	1,618.42	15,628	14,177
Carbon Raisers Lubricant	7,430	3,370.19	32,544	29,523
Outputs – Losses	2,218	1,006.07	9,713	8,811
-100 Mesh Micronizing Losses	33	14.97	143	130
Pet-Coke Micronizing Losses	10	4.54	44	40
Pitch Jet Milling Losses	6	2.72	27	24
Losses to Purification Off-Gas	1,735	786.98	7,600	6,895
Carbonization Mass Loss	322	146.06	1,408	1,277
Losses to Agglomeration Off-Gas	111	50.35	485	440
Impact Milling Mass Loss	1	0.45	5	5
Total Outputs	66,106	29,985.15	289,543	262,669
Overall Recovery (%)	**96.65%**			

17.2.6.2 Water Balance

Table 17-6 shows the estimated water balance for the STP facility. The water balance only considers water used in the process and excludes rainwater, fire water, potable water, gland water, stormwater run-off and seepage. The “Generation/Consumption” section accounts for the water generated or consumed during reactions.

Table 17-6 Estimated Water Balance – 25 ktpa

Description	Estimated H2O Nominal Mass Flow (lb/hr)	Estimated H2O Nominal Mass Flow (kg/hr)	Estimated H2O Nominal Mass Flow (short ton/yr)	Estimated H2O Nominal Mass Flow (tpa)
Input	86,207	39,102.81	377,587	342,541
Natural Graphite Concentrate Feed (Moisture Content)	63	28.58	276	250
Petroleum Coke Feed (Moisture Content)	7	3.18	32	29
Anode Precursor Material (Moisture Content)	7	3.18	33	30
Sodium Hydroxide Solution	298.84	135.55	1,309	1,188
Process Water to Purification Off-Gas Treatment	3,082.67	1,398.27	13,502	12,249
Process Water to Carbonization Off-Gas Treatment*	18,660.20	8,464.12	81,732	74,146
Process Water to Agglomeration Off-Gas Treatment*	45,005.57	20,414.17	197,124	178,828
Cooling Tower Make-up	19,082.09	8,655.48	83,580	75,823
Output	86,797	39,370.42	380,172	344,886
Products (Moisture)	20	9.07	87	79
Off-Gas Treatment Stack	13	5.90	59	54
Bleed from purification Off-Gas Treatment	3,433.92	1,557.60	15,041	13,645
Bleed from Carbonization Off-Gas Treatment*	18,781.60	8,519.18	82,263	74,628
Bleed from Agglomeration Off-Gas Treatment*	45,466.50	20,623.24	199,143	180,659
Cooling Tower Evaporation Losses	13,558.93	6,150.22	59,388	53,876
Cooling Tower Drift Losses	2,133.37	967.68	9,344	8,477
Cooling Tower Blowdown	3,389.73	1,537.55	14,847	13,469
Generation/Consumption	591	268.07	2,588	2,348
Process Chemical Reactions	591	268.07	2,588	2,348
Difference	0		-	

* The estimated values presented are based on the issued version of the PFDs. As mentioned in the off-gas treatment process description sections for the carbonization and agglomeration areas, the process details for the same were only confirmed after the issuance of the PFDs. Therefore, these values may require re-evaluation and update in the next study phase.

Table 17-7 Estimated Water Balance - 175 ktpa

Description	Estimated H_2O Nominal Mass Flow (lb/hr)	Estimated H_2O Nominal Mass Flow (kg/hr)	Estimated H_2O Nominal Mass Flow (short ton/yr)	Estimated H_2O Nominal Mass Flow (tpa)
Input	600,226	272,258	2,628,989	2,384,979
Natural Graphite Concentrate Feed (Moisture Content)	440	200	1,929	1,750
Petroleum Coke Feed (Moisture Content)	51	23	221	200
Anode Precursor Material (Moisture Content)	52	24	229	208
Sodium Hydroxide Solution	2,092	949	9,162	8,312
Process Water to Purification Off-Gas Treatment	21,579	9,788	94,514	85,742
Process Water to Carbonization Off-Gas Treatment*	130,620	59,249	572,117	519,016
Process Water to Agglomeration Off-Gas Treatment*	315,036	142,898	1,379,860	1,251,788
Cooling Tower Make-up	130,355	59,128	570,957	517,963
Output	604,359	274,132	2,647,091	2,401,401
Products (Moisture)	139	63	608	552
Off-Gas Treatment Stack	94	43	413	375
Bleed from purification Off-Gas Treatment	24,037	10,903	105,283	95,511
Bleed from Carbonization Off-Gas Treatment*	131,470	59,634	575,839	522,392
Bleed from Agglomeration Off-Gas Treatment*	318,263	144,362	1,393,992	1,264,608
Cooling Tower Evaporation Losses	92,787	42,087	406,408	368,687
Cooling Tower Drift Losses	14,372	6,519	62,947	57,105
Cooling Tower Blowdown	23,197	10,522	101,602	92,172
Generation/Consumption	4,133	1,875	18,102	16,422
Process Chemical Reactions	4,133	1,875	18,102	16,422
Difference	-		-	

Since graphite purification and anode material production is an all-dry process, the process water demand mainly comprises the water required in the purification, carbonization, and agglomeration off-gas treatment areas. The cooling tower make-up water also contributes to the process water demand.

Table 17-8 presents a breakdown of the estimated cooling water usage. Cooling water for the furnace rectifiers, as well as screw cooler for cooling of the blanketing material, accounts for the majority of the cooling water usage. Other high-temperature processes (e.g., carbonization and agglomeration) and de-ironing also contribute to the overall cooling water demand.

Table 17-8 Breakdown of Estimated Cooling Water Usage – for 25 ktpa and 175 ktpa

Cooling Water Usage	Estimated Percentage of Total Cooling Water Usage
Cooling Water to Thermal Purification Rectifiers	26.4%
Cooling Water to Blanketing Material Cooling	29.4%
Cooling Water to Carbonization	16.7%
Cooling Water to Agglomerators	2.9%
Cooling Water to Nitrogen Package	4.4%
Cooling Water to De-Ironing	20.2%

17.2.7 Process Description

The following sections provide a brief description of the process.

17.2.7.1 Concentrate Preparation and Screening

The dried NG concentrate will be delivered from the Alaska mine to the STP in the epoxy-coated freight containers. A reach stacker is selected to transport the containers to the concentrate preparation area for de-lumping of the natural graphite flake concentrate.

The concentrate will then be transferred to the primary screening area for the size classification.

The objective of the primary screening area is to sort the natural flake graphite concentrate into five size fractions, such that each fraction may be processed based on the respective product(s).

The Stage 1 primary sorting screen aims to separate the incoming feed into the following three factions:

- +32 mesh (approximately 0.6 wt.% of incoming feed)
- +50 mesh (approximately 5.4 wt.% of incoming feed)
- Undersize (approximately 94 wt. % of incoming feed)

The undersized material from the Stage 1 primary sorting screen proceeds to the Stage 2 primary sorting screen, where the aim is to separate it further into the following three fractions:

- +80 mesh (approximately 6 wt.% of incoming feed to Stage 1)
- +100 mesh (approximately 10 wt.% of incoming feed to Stage 1)
- -100 mesh (approximately 78 wt.% of incoming feed to Stage 1)

Table 17-9 shows the particle size in µm corresponding to the U.S. standard mesh sizes.

The screens are connected to a local hygiene bag filter to address workplace hygiene issues.

Table 17-9 Corresponding Particle Sizes for Mesh Sizes

US Standard Mesh Size	Particle Size (µm)
32 Mesh	590
50 Mesh	297
80 Mesh	177
100 Mesh	149

Approximately 40 wt.% of each of the unpurified fractions (+32 mesh, +50 mesh, +80 mesh, and +100 mesh) is to be diverted to the purification area. The remaining estimated 60 wt.% is sent to the product packaging and bagging area.

The -100-mesh fraction is to be fed into the micronizing and shaping area.

17.2.7.2 -100 Mesh Unpurified Graphite Flake Micronizing and Shaping

The -100-mesh feed is to be further split into three streams discharging into their respective micronizing feed silos:

- "+12 µm" (approximately 85 wt.% of incoming feed)
- "-12 µm" (approximately 10 wt.% of incoming feed)
- "+320 mesh" (approximately 5 wt.% of incoming feed)

Note that the fraction sizes do not refer to the actual size of the particles stored in the micronizing feed silos but to the target particle size post-micronizing and shaping.

Ultimately, the "+12 µm", "-12 µm" and "+320 mesh" feeds are to be used for producing anode products. Micronizing is predicted to enhance the tap density and specific surface area of materials and in combination with shaping/spheroidizing may notably improve the performance of anode materials.

The "+12 µm" feed is to be fed to a series of mills (i.e., coarse, fine, and shaping mills).

For the "+12 µm" feed, ~58 wt.% of the incoming feed is expected to be accepted as the shaped product and the rest as rejects. The shaped product is to be sent to the purification area. Approximately 90% of the rejects are to report to "-12 µm" shaping while the remaining rejects are sent to the product packaging and bagging area for use as the carbon raisers lubricants product line.

Similar to the "+12 µm" feed, the "-12 µm" feed is to undergo micronizing and shaping to be processed to the anode material, ultimately. For the "-12 µm" feed, about 60 wt.% of the incoming feed is expected to be accepted as the shaped product and the rest as rejects. The shaped product is to be sent to the purification area (approximately 20%) and Anode 'A' preparation area (approximately 80%). The rejects are sent to the product packaging and bagging area for use as the carbon raisers lubricants product line.

The "+320 mesh" split is to only go through a micronizer. All the micronized product is to report to the purification area. Figure 17-4 shows the material flow for the -100-mesh unpurified graphite fraction.

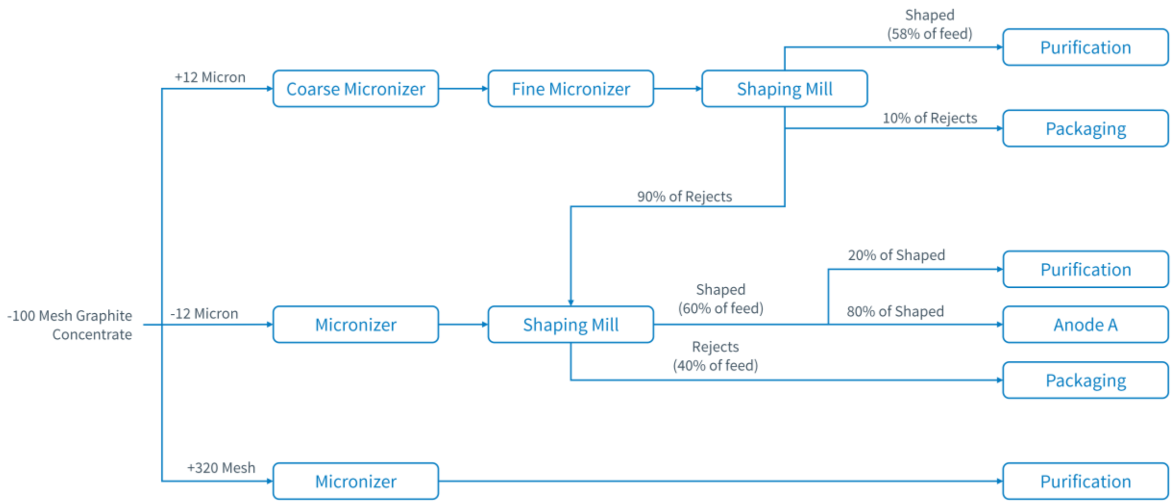


Figure 17-4 Material Flow Diagram for the -100 Mesh Unpurified Graphite Fraction

17.2.7.3 Petroleum Coke, Pitch, and Anode Precursor Material Preparation

Petroleum coke (pet-coke), pitch, and anode precursor material are assumed to be received in the 1-t (1.1 short ton) bulk bags and transferred to their respective preparation areas.

Pet-coke is to be processed through a crushing and a micronizing stage to obtain the required particle size, followed by a shaping stage to enhance the spherical morphology of the particles. The shaped coke material (approximately 80 wt.%) is to be conveyed to the Anode ‘A’ dosing and mixing area. The reject material (approximately 20 wt.%) is to be sent to the product packaging and bagging area for the 95% C(t) products line.

Anode precursor material is to be sent to the purification area without any processing.

Pitch is envisioned to be used as the agglomerating and coating agent. Pitch is to be processed through a series of milling stages to obtain a fine particle size. The milled pitch is utilized in the Anode ‘A’ and Anode ‘B’ preparation areas.

17.2.7.4 Thermal Purification and Off-Gas Treatment

The intended objective of the thermal purification area is to volatilize impurities in chloride form from the feed materials and graphitize the carbon such that products obtained are of ≥99% C(t) purity.

Acheson-type electrical furnaces are envisioned to be used for the purification and graphitization of unpurified +32/+50/+80/+100 mesh graphite flakes, +320 mesh micronized, +12 & -12 µm shaped material, and Anode ‘A’ composite and NG materials, as well as the graphitization of the pet-coke.

Due to the furnace's high operating temperature, all water and volatile matter are expected to be removed. It is also assumed that sulfur is lost to the gas phase.

Chlorine gas is to be added to the purification furnace to react with the impurities in the presence of carbon to form metal chlorides and carbon monoxide. These metal chlorides have lower boiling points compared to their corresponding oxides and thus could be removed at a lower temperature.

Graphitization is conducted at highly elevated temperatures of approximately 3,000°C to 3,200°C (5,423°F to 5,792°F) in the furnaces, where the carbon atoms and crystalline domains have enough mobility for the reconstructive transformation and development of the orderly packed graphene layers that form a crystalline graphite. The graphitization reaction can be represented as below:

$$C_{(amorphous)} \rightarrow C_{(\mathrm{graphitic})}$$

Due to the elevated temperatures, some carbon may also be lost to the gas phase.

In the graphitization furnaces, cylindrical graphite crucibles (featuring graphite lids) filled with the feed materials will be placed orderly inside the Acheson-type furnaces. Using a multi-functional crane, blanketing materials can be then added in between the crucibles. The electricity will flow through the blanketing materials causing the crucibles to heat up due to their intrinsic electrical resistance. At the end of each batch, the blanketing materials will be vacuumed off of the furnaces by the multi-function cranes and sent to the blanketing material recycling area. The operation is intended to be in batch mode with an overall cycle time of approximately 21 to 28 days including the cooling duration. After completion of the graphitization process, the material is allowed to cool naturally.

Nitrogen will be supplied to provide an inert atmosphere for the furnaces, minimizing oxidation during the purification or graphitization process.

Process cooling water is to be made available for this area to provide cooling to the furnace rectifiers.

Purified graphite flakes (+32/+50/+80/+100/+320 mesh) are to be extracted from the purification/graphitization furnaces and conveyed to the product packaging and bagging area.

The +12 µm & -12 µm purified graphite is intended to be sent to the Anode ‘B’ mixing area. The purified Anode ‘A’ products (NG and composite) are intended to be sent to the Anode ‘A’ screening and de-ironing area. Lastly, the synthetic graphite is to be sent to the Anode ‘B’ screening and de-ironing area.

Off-gas from the thermal purification furnaces would go through a hot gas cyclone, where the majority of the solids in the off-gas (e.g., metal chlorides) are assumed to be removed via the hot gas cyclone underflow. The solids are to be stored in a solid waste disposal bin, prior to shipping for safe disposal. The overflow of the cyclone is to be sent to the downstream venturi scrubber.

Some soluble chlorides (such as NaCl and KCl), and $SiCl_4$ (due to its low boiling point) are assumed to report to the venturi scrubber instead of exiting through the hot gas cyclone solids underflow. The venturi scrubber is to use process water as the scrubbing solution. The water is to be recycled within the scrubber with a wastewater bleed to prevent the buildup of contaminants. Wastewater bleed from the scrubber will be sent to the WWTP, and the losses are to be made up by the fresh process make-up water. The venturi scrubber is envisioned to cool down the gas stream.

Following venturi scrubbing, the gas stream is to be sent to a caustic scrubber to scrub the chlorine gas.

A ~50 wt.% of sodium hydroxide solution (diluted to ~20% in the scrubber by process water) is to be used to neutralize the chlorine gas.

Post caustic scrubbing, the cleaned gas is to report to a mist eliminator to remove any water droplets from the gas stream. The droplets are to be recirculated back to the scrubber, while the gas-containing carbon monoxide and hydrogen are to be flared, and the treated gas would leave the process via stack.

17.2.7.5 Anode B – Mixing

The objective of the Anode ‘B’ mixing area is to blend the components of Anode ‘B’ (pitch, +12 µm & -12 µm purified graphite) in the targeted proportions by weight and to produce a homogenous mixture before carbonization. This would ensure that uniformly coated single particles are formed.

+12 µm purified graphite, -12 µm purified graphite, and pitch are to be combined in the Anode ‘B’ dosing hoppers according to the recipe (about 97 wt.% of +12 µm & -12 µm and about 3 wt.% Pitch) dispensed into the vertical cone mixers before being sent to the carbonization area.

17.2.7.6 Anode A and B Carbonization and Off-Gas Treatment

The intended purpose of carbonization is to promote maturing of pitch (coating a thin layer of amorphous carbon over graphite particles) and release any residual volatile matter entrained within the particles.

Both Anode ‘A’ NG/composite from the agglomeration and mechanical fusing area and Anode ‘B’ from the mixing area are to be sent to the carbonization furnaces.

The materials would be filled into the saggars (made of graphite), and the filled saggars would be subsequently placed into the sealed carbonization furnace. It should be possible to reuse saggars for multiple cycles. After a certain number of cycles, the end-of-life graphite saggars are to be replaced by new ones. The saggar service life will be optimized based on the operation conditions and saggar quality.

The carbonization furnaces are assumed to operate continuously under nitrogen environment at the temperature of approximately 1,250°C (2,282°F) with the overall cycle time of approximately five hours for pre-heating, carbonization, and cooling. In the cooling zone, the carbonized material is to be cooled down by exchanging heat with the cooling water passing through the integral indirect cooling section of the furnace.

Inside of the carbonization furnace, pitch would be converted to a thin layer of amorphous carbon around the graphite particle, and any remaining volatiles and moisture are also assumed to evaporate due to the high temperature.

Some sulfur is also assumed to volatilize to the gas phase.

After the carbonization process is complete, the resulting carbonized products are to be sent to the de-agglomeration area.

The carbonization off-gas is to report to the afterburner to oxidize flue gases and annihilate volatiles. Minimal dust losses are expected in the off gas as saggars are assumed to be closed with a lid.

Off-gas process details were only confirmed after the issuance of the PFDs. For the carbonization off-gas treatment, the PFDs show a venturi scrubber and packed-bed scrubber for particulate and acid gas removal. These units are deemed no longer necessary based on the off-gas constituents. The afterburner output stream is to report directly to the stack. Additionally, they were not included in the capital costs estimate.

17.2.7.7 Anode A and B De-Agglomeration

The intended objective of the de-agglomeration area is to break apart any agglomerates formed during carbonization.

There are two types of Anode 'A' products envisioned for the process, namely Anode 'A' natural graphite (NG) and Anode 'A' composite. Anode 'A' NG, Anode 'A' composite, and Anode 'B' materials are to be processed by the cage mills operating continuously for the de-agglomeration.

Downstream from the cage mills, a pair of cyclones and baghouse are to be used for separating out the fines. De-agglomerated Anode 'A' materials (NG and composite) would be sent to the thermal purification area, while Anode 'B' would be sent to the Anode 'B' screening and de-ironing area.

17.2.7.8 Anode A – Dosing and Mixing

The intended objective of the Anode 'A' dosing and mixing area is to blend the respective components of Anode 'A' – NG and composite materials in a vertical cone mixer in the desired proportions by weight such that a homogenous mixture can be obtained prior to agglomeration.

Anode 'A' composite is intended to consist of -12 µm unpurified shaped material (~28.5 wt.%), pitch (~5 wt.%), and pet-coke (~66.5 wt.%), while Anode 'A' NG is intended to consist of only -12 µm unpurified shaped material (~95 wt.%) and pitch (~5 wt.%).

After dosing, the vertical cone mixers will blend the material together in a batch operation until the materials are thoroughly mixed. From the vertical cone mixers, Anode 'A' composite and Anode 'A' NG are to be pneumatically conveyed to the agglomeration and mechanical fusing area.

17.2.7.9 Anode A – Agglomeration, Mechanical Fusing and Off-Gas Treatment

The intended objective of the Anode 'A' agglomeration and mechanical fusing area is to produce secondary particles for the Anode 'A' product.

Anode 'A' NG and Anode 'A' composite materials are to be dosed respectively into the vertical agglomerators operating at approximately 700°C (1,292°F). The agglomerator is assumed to operate in batch mode under an inert nitrogen environment. It is expected that during the agglomeration process, the primary particles collide together to form larger secondary particles. Post agglomeration, the secondary particles are to be directed to a cooling blender to cool down the particles.

The agglomeration temperature of approximately 700°C (1,292°F) is assumed to be high enough to cause water and volatiles to evaporate and leave as off-gas. Some sulfur may volatilize to the gas phase, thereby creating a need for an off-gas treatment system.

Like the carbonization off-gas treatment, the off-gas is to report to the afterburner with the purpose of oxidizing flue gases from the agglomeration process.

The exhaust gas from the afterburner is to be sent to a venturi scrubber where process water would be used as the scrubbing solution. The water is to be recycled within the unit with a wastewater bleed to prevent the buildup of contaminants. Wastewater bleed from the scrubber is to be sent to the WWTP, and the losses would be made up by the fresh process water. The venturi scrubber is envisioned to cool down and remove particulates from the gas stream. After scrubbing, the treated gas leaves the process via stack.

Off-gas process details were only confirmed after the issuance of the PFDs. For the agglomeration off-gas treatment, the PFDs show a packed-bed scrubber for acid gas removal. Based on the off-gas calculations, this unit is no longer deemed necessary. The treated off-gas from the venturi scrubber is to report directly to the stack. Additionally, it was not included in the capital cost estimate.

Post-cooling agglomerated material will report to mechanical fusion. The intended objective of mechanical fusion is to promote even coating of pitch on the secondary particles as well as a spherical morphology. In the mechanical fusing machines, the feed material is to be charged into a rotating rotor, and compression and shear forces are applied to the materials.

Post-mechanical fusing, ultrasonic screens are to be used to separate the oversized particles (~5 wt.%) from the undersized particles (~95 wt.%). The oversized particles will be conveyed to the product packaging and bagging area as carbon raiser lubricants, while the undersized particles will be sent to the carbonization area, as explained above.

17.2.7.10 Anode A – Screen and De-Ironing

The intended objective of Anode ‘A’ screening is to separate the undersized and oversized fractions of the purified Anode ‘A’ products (NG and composite) depending on the product portfolio to which the fraction reports.

Anode ‘A’ materials (NG and composite) are to be conveyed to the ultrasonic screens to remove oversized particles (~2 wt.%). The undersized particles (~98 wt.%) from the ultrasonic screening are to be conveyed to two stages of Anode ‘A’ de-ironing to remove magnetic impurities, followed by a second stage of screening to remove larger chunks of particles. The oversized rejects will be transferred to the rejects milling area, and the undersized products will be transferred to the product packaging and bagging area. Figure 17-5 shows the material flow diagram for Anode ‘A’ NG and composite product lines.

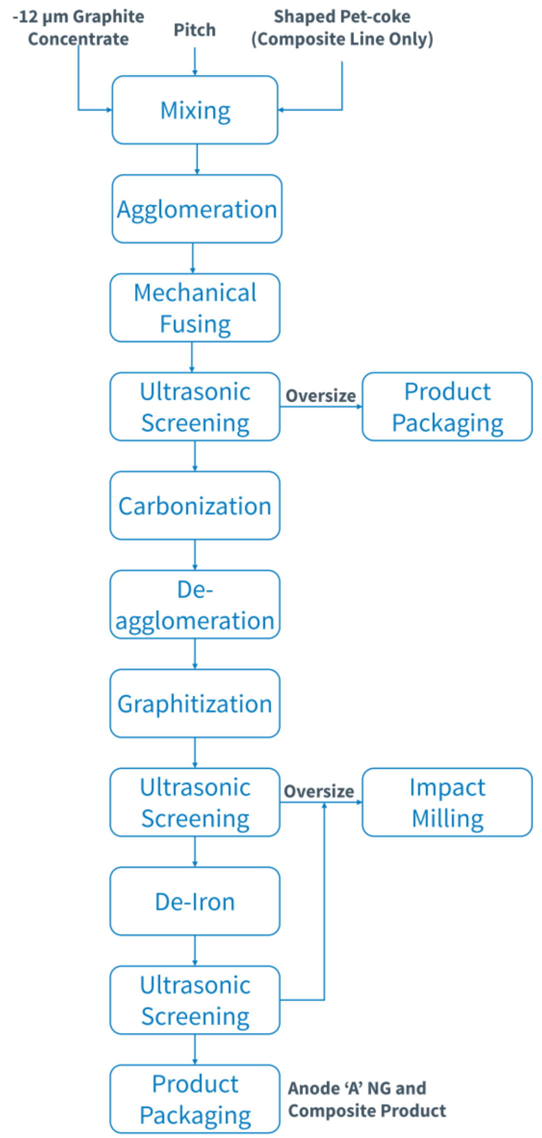


Figure 17-5 Material Flow Diagram for Anode 'A' NG and Composite Product

17.2.7.11 Anode B – Screening and De-Ironing

The intended objective of Anode 'B' screening is to separate the undersized and oversized fractions of the de-agglomerated Anode 'B' depending on the product to which the fraction reports.

Anode 'B' de-agglomerated graphite from the Anode 'A' and 'B' de-agglomeration area is to be fed to the ultrasonic screens to separate the oversized rejects (~5 wt.%) from the undersized particles (~95 wt.%). Similar to Anode 'A', the oversized rejects are to be conveyed to the rejects milling area. The undersized particles are intended to be split into two fractions—one fraction (~40 wt.%) is for making blended Anode 'B' and the other (~60 wt.%) for the pure Anode 'B'. The blended Anode 'B' fraction is to be conveyed to the horizontal ribbon blenders (assumed to be operating in batch mode) to be combined with artificial graphite (~65 wt.% of the total mixture). Following blending, the Anode 'B' blended stream is to be sent to another stage of ultrasonic screening to remove any larger chunks that may have formed during the blending process. The oversized particles from the second stage of ultrasonic screening would also report to the rejects milling area. Both pure Anode ‘B’ and blended Anode ‘B’ undersized material are to be conveyed to two stages of de-ironing to remove magnetic impurities prior to being transferred to the product packaging and bagging area. Figure 17-6 shows the material flow diagram for Anode ‘B’ pure and blended product lines.

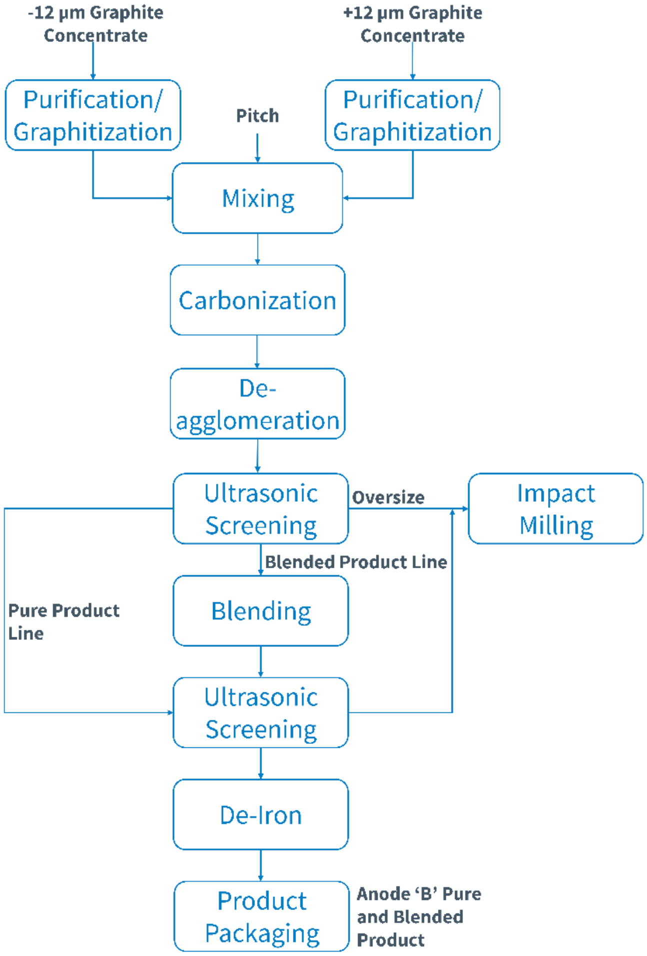


Figure 17-6 Material Flow Diagram for Anode 'B' Pure and Blended Products

17.2.7.12 Anode A and B Rejects Milling

The intended purpose of the Anode ‘A’ and ‘B’ rejects milling areas is to use the oversized rejects from Anode ‘A’ and ‘B’ sieving to produce the battery conductor products post particle size reduction via a milling stage. The mill will be equipped with a baghouse to catch fines and transfer them back into the process.

17.2.7.13 Product Packaging and Bagging

Various graphite products are envisioned to be produced in the process including unpurified, purified, and anode products, which will be packaged into bags. It is anticipated that most products will be packaged in

~600 kg (1,300 lb.) bags (~90%) and the remaining in ~22 kg (50 lb.) (~10%). The process is designed to make some minor accommodations pertaining to bag size based on the requirements of the end consumer. The bags would be transferred to a storage area via forklift.

Table 17-10 lists target products and their proposed corresponding source materials.

Table 17-10 Target Products and Corresponding Proposed Source Materials

Proposed Source Materials	Target Products
Anode ‘A’ Natural Graphite	Secondary Particle (NG) Product
Anode ‘A’ Composite	Secondary Particle (Composite) Product
Anode ‘B’ Pure	Single Particle (Pure) Product
Anode ‘B’ Blended	Single Particle (Blended) Product
+32/+50/+80/+100 Mesh Purified Graphite	99% C(t) Marketable Products
O/S Anode ‘A’ & ‘B’ Impact Milling	Battery Conductor Product
Purified +320 Mesh Flake Graphite	Synthetic Diamond Precursor Product
+32/+50/+80/+100 Mesh Unpurified Flake Graphite	95% C(t) Marketable Products
Coke Rejects	95% C(t) Marketable Products
+12/-12 µm Rejects & Anode ‘A’ Mechanically Fused O/S	Carbon Raisers Lubricant

17.2.7.14 Blanketing Material

The blanketing material is intended to be added to the graphitization/purification furnaces in between the crucibles for blanketing and conducting purposes then extracted from the furnace at the end of each cycle. At the end of each cycle, the blanketing material will be cooled before being crushed and recycled.

Fresh blanketing material will also be added to make up for any blanketing material losses during the purification/graphitization process.

Before being recycled back into the process, the blanket material is to go through a series of sorting screens (No. 1 to No. 3) as explained below:

1. Oversized material for Screen No. 1 is to be sorted to the ~10-22 mm blanket material bin, and the undersized material is to be sent to Screen No. 2
2. The oversized material for Screen No .2 is to be sorted to the ~5-10 mm blanket material bin, and the undersized material is to be directed to Screen No .3
3. The oversized material for Screen No. 3 would go to ~0.5-5 mm blanket material bin, while the undersized material is to be sent to ~0-0.5 mm blanket material bin

17.2.7.15 Reagents

Sodium Hydroxide

Sodium hydroxide is intended to be received on site in the form of a solution. Sodium hydroxide would be distributed to various areas across the plant via distribution pumps.

Chlorine

Chlorine is intended to be received on site in compressed gas cylinders and stored in the ambient indoor atmosphere.

Nitrogen

Nitrogen is envisioned to be produced onsite. A typical nitrogen supply system would consist of air purification system, air compressor, air pre-cooler, absorption systems, nitrogen receiver, and heat exchanger.

17.2.7.16 Utilities

Cooling Water

A single process-cooling tower circuit is currently designed to be used for the entire plant. Cooling water is to be processed in a closed-loop cooling tower circuit. Returning cooling water at approximately 35°C (95°F) is cooled to approximately 25°C (77°F) in the cooling tower. To prevent the accumulation of bacteria, scaling, and corrosion within the tower, cooling tower reagents (such as biocide, anti-scale, and corrosion inhibitor) are to be dosed to the tower basins. Process water is to be added as make-up to account for the losses due to evaporation, drift, and cooling tower blowdown. The cooling tower blowdown is to be sent to effluent treatment before being discharged to sewer.

Water Services

The water services are envisioned to consist of three main systems, namely the de-mineralized water system, fire water skid, and WWTP.

The de-mineralized water system is anticipated to use an ion exchange process to remove conductive ions from the raw water.

The fire water skid would distribute raw/fire water through the firewater system, providing proper coverage and adequate supply for the fire protection system.

The WWTP would treat wastewater from multiple effluent streams, such as scrubbing solutions from scrubbers, brine waste from the de-mineralized water system, and cooling tower blowdown. Treated wastewater from the WWTP is to be discharged to the city sewer.

Compressed Air and Natural Gas

A train of equipment comprising an air intake filter, air compressors, plant air receivers, compressed air dryers, and compressed dry air receivers is envisioned to provide instrument-quality air to the plant. Compressed dry air is intended to be utilized for site instrumentation, line purging, and fluidizing aid. The plant air receiver will store and distribute the compressed air supplied from the air compressor. Compressed air dryers will remove water inherent in the compressed air, while compressed dry air receivers store and distribute instrument-quality air to the plant.

A connection point for natural gas is to be made available, as required by afterburners for carbonization and agglomeration off-gas treatment.

17.2.8 Process Waste, Effluent, and Emissions

Note, it is difficult to estimate the quantities and composition of solid wastes accurately due to lack of sufficient modeling details and testwork as well as several assumptions that needed to be made. Therefore, caution must be applied when relying on the information below.

The STP was initially developed for a 25 ktpa module with the concept of scaling up production in 25 ktpa modules to match the mine production of 175 ktpa. The 25 ktpa module was then scaled/factored to a throughput of 175 ktpa. The details of this expansion have been tabulated alongside the 25 ktpa module details below.

Solid material is expected to be lost in the process as dust or due to vaporization in high-temperature processes like purification/graphitization, carbonization, and agglomeration. Table 17-11 and Table 17-12 summarize estimated process wastes.

Table 17-11 Estimated Solids Losses – 25 ktpa

Description	Estimated Nominal Mass Flow (lb/hr)	Estimated Nominal Mass Flow (kg/hr)	Estimated Nominal Mass Flow (short ton/yr)	Estimated Nominal Mass Flow (tpa)
Dust losses from -100 Mesh Micronizing	4.9	2.2	21	19
Dust Losses from Petroleum Coke Preparation	1.4	0.6	6	5
Dust Losses from Pitch Preparation	0.9	0.4	4	3
Dust Losses and Mass Loss due to Vaporization in Purification/ Graphitization	477.5	216.5	2,092	2,046
Dust Losses and Mass Loss due to Vaporization in Carbonization	56.2	25.5	246	223
Mass Loss due to Vaporization in Agglomeration	32.2	14.6	141	128
Dust Losses from Oversize Rejects Impact Milling	Negligible	Negligible	Negligible	Negligible
Total Estimated Losses	573	260	2,511	2,456

Table 17-12 Estimated Solid Losses - 175 ktpa

Description	Estimated Nominal Mass Flow (lb/hr)	Estimated Nominal Mass Flow (kg/hr)	Estimated Nominal Mass Flow (short ton/yr)	Estimated Nominal Mass Flow (tpa)
Dust losses from -100 Mesh Micronizing	34.4	15.6	150	136
Dust Losses from Petroleum Coke Preparation	10.1	4.58	44	40
Dust Losses from Pitch Preparation	6.6	2.99	29	26
Dust Losses and Mass Loss due to Vaporization in Purification/ Graphitization	3,342.8	1,516.2	14,642	13,283
Dust Losses and Mass Loss due to Vaporization in Carbonization	393.1	178.3	1,722	1,562
Mass Loss due to Vaporization in Agglomeration	225.2	102.14	987	895
Dust Losses from Oversize Rejects Impact Milling	1.2	0.54	5	4
Total Estimated Losses	4,013	1,820.2	17,579	15,947

Dust losses would be captured via local hygiene filters and baghouses.

The material vaporized to the gas phase during the purification/graphitization process is envisioned to be condensed in the hot gas cyclone and disposed of as solid waste.

The material vaporized to the gas phase during the carbonization and agglomeration processes would not report to the solids waste but would be treated via venturi scrubber and/or SO_2 scrubber as previously described in earlier sections.

Another source of solid waste would be entrained metal objects by electromagnetic separators.
Table 17-13 and Table 17-14 show estimated amounts of solids to disposal from the STP.

Table 17-13 Estimated Solids to Disposal- 25 ktpa

Description	Estimated Nominal Mass Flow (lb/hr)	Estimated Nominal Mass Flow (kg/hr)	Estimated Nominal Mass Flow (short ton/yr)	Estimated Nominal Mass Flow (tpa)
Solids to Disposal from Purification/ Graphitization Off-Gas Treatment	417	189	1,826	1,656
Entrained Metal Objects	Not estimated in this phase			

* The estimated values presented are based on the issued version of the PFDs.

Table 17-14 Estimated Solids to Disposal - 175 ktpa

Description	Estimated Nominal Mass Flow (lb/hr)	Estimated Nominal Mass Flow (kg/hr)	Estimated Nominal Mass Flow (short ton/yr)	Estimated Nominal Mass Flow (tpa)
Solids to Disposal from Purification/ Graphitization Off-Gas Treatment	2,919	1,324	12,785	11,598
Entrained Metal Objects	Not estimated in this phase			

As mentioned in the off-gas treatment process description sections for the carbonization and agglomeration areas, the process details for the same were only confirmed after the issuance of the PFDs. Therefore, these values may require re-evaluation and update in the next phase of the study.

17.2.8.1 Liquid Effluent

Note, it is difficult to estimate the quantities and composition of liquid wastes accurately due to lack of sufficient modeling details and testwork as well as several undetermined assumptions. Therefore, caution must be applied when relying on the information below.

The primary liquid effluent is expected to be the bleed streams from the three off-gas treatment areas and the cooling tower blowdown. These streams would report to the water treatment plant (WTP), and the treated water is to be discharged to the sewer. Table 17-15 summarizes the estimated liquid effluent flow rates to the WTP.

Table 17-15 Estimated Liquid Effluent to Water Treatment Plant – 25 ktpa

Description	Estimated Nominal Mass Flow (lb/hr)	Estimated Nominal Mass Flow (kg/hr)	Estimated Nominal Mass Flow (short ton/yr)	Estimated Nominal Mass Flow (tpa)
Bleed from Purification/ Graphitization Off-Gas Treatment	3,433.92	1,558	15,041	13,645
Bleed from Carbonization Off-Gas Treatment*	18,781.60	8,519	82,263	74,628
Bleed from Agglomeration Off-Gas Treatment*	45,466.50	20,623	199,143	180,659
Cooling Tower Blowdown	3,389.73	1,537	14,847	13,469
Total Estimated Liquid Effluent to Water Treatment Plant	71,072	32,238	311,294	282,401

*The estimated values presented are based on the issued version of the PFDs.

Table 17-16 Estimated Liquid Effluent to Water Treatment Plant - 175 ktpa

Description	Estimated Nominal Mass Flow (lb/hr)	Estimated Nominal Mass Flow (kg/hr)	Estimated Nominal Mass Flow (short ton/yr)	Estimated Nominal Mass Flow (tpa)
Bleed from Purification/ Graphitization Off-Gas Treatment	24,037	10,902	105,283	95,511
Bleed from Carbonization Off-Gas Treatment*	131,470	59,663	575,839	522,392
Bleed from Agglomeration Off-Gas Treatment*	318,263	144,361	1,393,992	1,264,608
Cooling Tower Blowdown	23,197	10,522	101,602	92,172
Total Estimated Liquid Effluent to Water Treatment Plant	496,967	225,420	2,176,716	1,974,684

*The estimated values presented are based on the issued version of the PFDs.

As mentioned in the off-gas treatment process description sections for the carbonization and agglomeration areas, the process details for the same were only confirmed after the issuance of the PFDs. Therefore, these values may require re-evaluation and update in the next phase of the study.

17.2.8.2 Airborne Emissions

Note, it is difficult to estimate the quantities and composition of airborne emissions accurately due to lack of sufficient modeling details and testwork as well as several assumptions that needed to be made. Therefore, caution must be applied when relying on the information below.

There are three main anticipated sources of airborne emissions as listed in Table 17-17 and Table 17-18 below.

Table 17-17 Estimated Sources of Airborne Emissions – 25 ktpa

Description	Estimated Nominal Mass Flow (lb/hr)	Estimated Nominal Mass Flow (kg/hr)	Estimated Nominal Mass Flow (short ton/yr)	Estimated Nominal Mass Flow (tpa)
Treated Gas from Purification/ Graphitization Exhaust Stack	648	294	2,838	2,575
Treated Gas from Carbonization Exhaust Stack*	3,643	1,652	15,956	14,475
Treated Gas from Agglomeration Exhaust Stack*	8,313	3,771	36,411	33,032
Total Estimated Airborne Emissions	12,604	5,717	55,206	50,082

*The estimated values presented are based on the issued version of the PFDs.

Table 17-18 Estimated Sources of Airborne Emissions – 175 ktpa

Description	Estimated Nominal Mass Flow (lb/hr)	Estimated Nominal Mass Flow (kg/hr)	Estimated Nominal Mass Flow (short ton/yr)	Estimated Nominal Mass Flow (tpa)
Treated Gas from Purification/ Graphitization Exhaust Stack	4,534	2,057	19,858	18,015
Treated Gas from Carbonization Exhaust Stack*	25,501	11,567	111,694	101,327
Treated Gas from Agglomeration Exhaust Stack*	58,189	26,394	254,869	231,213
Total Estimated Airborne Emissions	88,224	40,018	386,421	350,555

*The estimated values presented are based on the issued version of the PFDs.

As mentioned in the off-gas treatment process description sections for the carbonization and agglomeration areas, the process details for the same were only confirmed after the issuance of the PFDs. Therefore, these values may require re-evaluation and update in the next phase of the study.

In addition to the above, other minor sources of airborne emissions may include:

- Various bin vents – flow rate was not estimated in this phase
- Cooling tower estimated evaporation losses (estimated nominal flow of 6,150 kg/hr (13,559 lb./hr) for 25 ktpa and 42,087 kg/hr (92,787 lb./hr) for 175 ktpa) and drift losses (estimated nominal flow of 967 kg/hr (2,133 lb./hr) for 25 ktpa and 6,519 kg/hr (14,372 lb./hr) for 175 ktpa)

The estimated composition of the treated gas from three stacks is as follows.

Table 17-19 Estimated Composition of Treated Off-Gas – 25 ktpa and 175 ktpa*

Composition (vol.%)	Estimated Treated Gas from Purification/Graphitization Exhaust Stack	Estimated Treated Gas from Carbonization Exhaust Stack	Estimated Treated Gas from Agglomeration Exhaust Stack
H_2O (g)	3.63		
Ar (g)	0.00	0.00	0.00
CO_2 (g)	22.96	0.76	4.73
N_2 (g)	70.33	94.66	90.49
O_2 (g)	3.07	4.57	4.78
P_2O_5		0.00	

*The estimated values presented are based on the issued version of the PFDs.

As mentioned in the off-gas treatment process description sections for the carbonization and agglomeration areas, the process details for the same were only confirmed after the issuance of the PFDs. Therefore, these values may require re-evaluation and update in the next phase of the study.

The purification/graphitization process is expected to generate approximately 94.3 kg/hr (208 lb./hr) for 25 ktpa and 661 kg/hr (1,457 lb./hr) for 175 ktpa (nominal) of carbon dioxide; the carbonization process is expected to generate approximately 19.5 kg/hr (43 lb./hr) for 25 ktpa and 137 kg/hr (303 lb./hr) for 175 ktpa (nominal) of carbon dioxide; and the agglomeration process is expected to generate approximately 271 kg/hr (597 lb./hr) for 25 ktpa and 1,897 kg/hr (4,182 lb./hr) for 175 ktpa (nominal) of carbon dioxide. A total of approximately 385 kg/hr (848 lb./hr) for 25 ktpa and 2,695 kg/hr (5,942 lb./hr) for 175 ktpa (nominal) of carbon dioxide is expected to be generated from the secondary treatment plant.

18 Project Infrastructure

18.1 Alaska Site Infrastructure

The project site is located approximately 60 km north of Nome, Alaska, near the Imuruk Basin on the Seward Peninsula. No road access currently exists to the site with the Kougarok Road as the closest seasonal road to the southeast. Planned infrastructure located near or at the Alaska project site includes:

- Site access road
- Primary crusher and covered crushed ore stockpile
- Mill and support buildings
- Concentrate thickening, filtration, and drying
- Tailings thickening, filtration, and loading stockpile
- Mine WMF for dry stack tailings and mine waste rock storage
- Concentrate loading facility and shipping containers storage area
- Water management facilities, including diversion ditches, seepage collection pond, WMP, overland piping, and pumping
- Mine (WTP)
- Onsite haul and access roads and various laydown areas
- Explosives emulsion mixing facility and explosive magazines
- Metallurgical lab/assay lab
- Truck shop
- Enclosed warehousing with both cold and heated storage
- Bulk fuel storage and distribution
- Site electric power generation facilities
- Nome-based camp facilities for both construction workers and permanent operations workforce

The site layout has been designed to minimize environmental impacts, provide security-controlled site access, minimize construction costs, and optimize operational efficiency. Primary buildings have been located to allow easy access for construction and to utilize existing topography to minimize bulk earthwork volumes. The Graphite Creek site layout can be found in Figure 18-1. The Graphite Creek plant site and main infrastructure facilities can be found in Figure 18-2.

Figure 18-1 Graphite Creek Site Layout

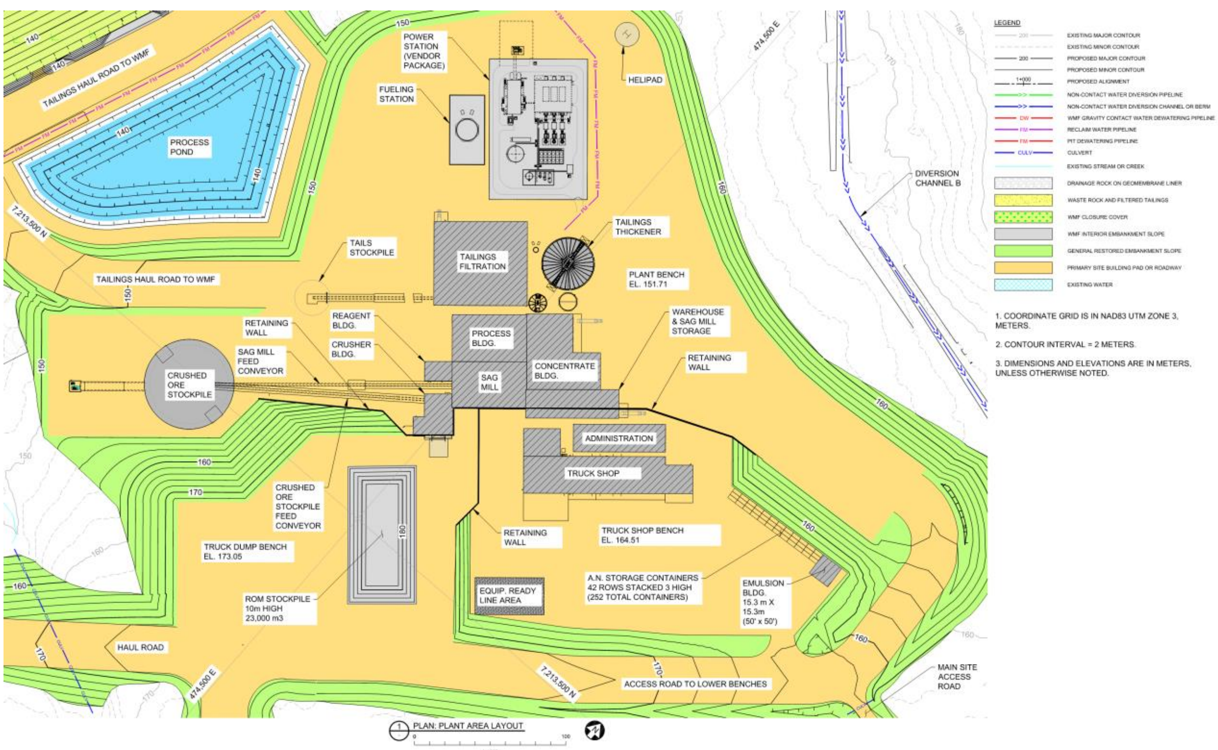


Figure 18-2 Graphite Creek Plant and Other Buildings Layout

18.1.1 Project Roads

18.1.1.1 Existing Public Roads

The Nome-Taylor Highway (Kougarok Road) is a state of Alaska-owned and operated gravel road that is only maintained year-round between Nome and approximately kilometer post (KP) 21 at the Nome River Bridge. After snowfall makes the road impassable, it is not reponed until the following spring, usually in late May. In order to support the mining operations, the Kougarok Road will need improvements such as recapping and widening in some areas as well as year-round grading and snow clearing to the junction with the proposed Graphite Creek site access road at approximately km 48. The Alaska Department of Transportation (ADOT) has provided guidance on the scope of work and costs for these improvements and additional maintenance.

Additionally, ADOT must reclassify Kougarok Road to allow the use of double trailers for hauling concentrate.

18.1.2 Site Access Road

A 27.8 km-long, two-lane, gravel, site-access road will connect the project site to the Kougarok Road, providing year-round road access to the city of Nome. The new access road includes an 8.5 m driving width and six bridge crossings designed with an 80-ton capacity. The road will begin at milepost 29.6 of the Kougarok Road. The road will immediately cross the headwaters of Nome River before trending west along the north side of Buffalo Creek. Near KP 1.5, the route will cross Buffalo Creek before cresting a low pass and descending to the Sinuk River crossing at KP 7. Around KP 9, the route will turn north along the east flank of Windy Creek valley before climbing up to Mosquito Pass (elevation 350 m). After cresting the pass at KP 15, the route will descend along the east flank of the Cobblestone River valley north to a crossing of the Cobblestone River just below its confluence with the Oro Grande Creek at KP 25. The access road terminus is located on a low ridge immediately west of Cobblestone River at the north flank of the Kigluaik Mountains. Figure 18-3 below illustrates the proposed access road.

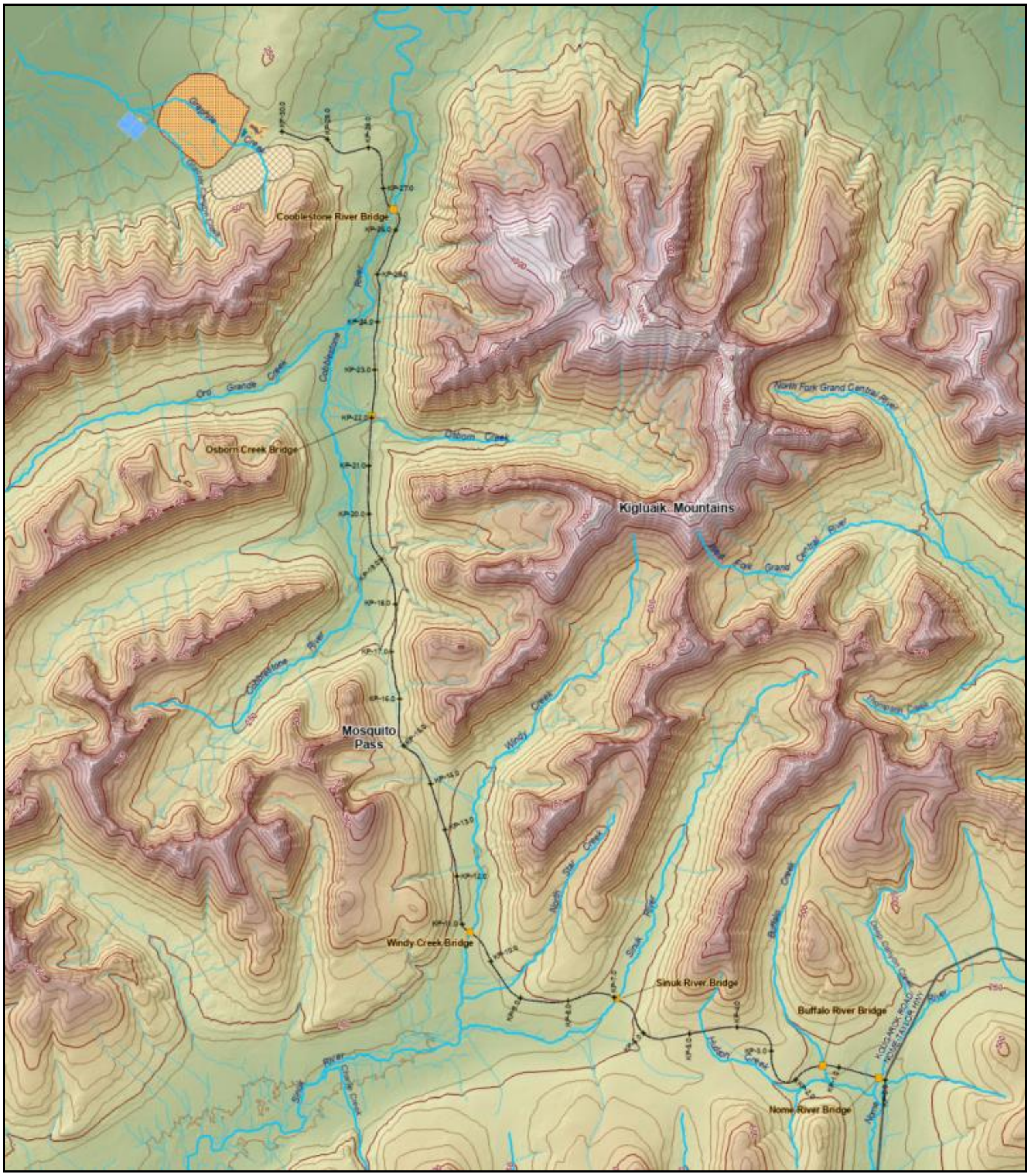


Figure 18-3 Site Access Road

The road will be constructed entirely of locally sourced material extracted from several proposed gravel borrows and rock quarry sites along the route. The road will typically utilize fill construction over native soils with side cut-to-fill construction limited to a few on-side slope sections where subgrade conditions allow.

The following design criteria were used for design of the access road:

- Design life of 50 years
- Typical transport design vehicle: WB-62, typical tractor-trailer used on resource roads
- Construction phase vehicle: 40 t articulating truck
- Design speed of 60 kph (45 mph)
- Clearing width: Extend 1.5 m beyond the cut/fill toe
- The driving surface of the two-lane road is 8.5 m (28 ft) in width
- The embankment fill is a minimum of 1 to 1.8 m, depending on the quality of the subgrade
- The surface course is 0.2 m in depth and grading B; to consist of 75-mm minus, well-graded, durable, granular material with 6% to 10% passing the 200 sieve
- Road grades: 7% preferred, 8% maximum
- Cut slope: 0.25H:1V to 4H:1V depending on rock or soil type
- Fill slope: 2H:1V to 3H:1V depending on rock or soil type
- Horizontal curve: 130 m minimum with 244 m preferred
- Vertical curve: American Association of State of Highway Traffic Officials (AASHTO) standard for design speed or specialized carrier requirements for oversized loads, K=20 typical and K=15 minimum
- Minor culverts: corrugated metal pipe with a minimum diameter of 0.6 m (24 in)
- It has been assumed that OSHA, rather than MSHA, will have jurisdiction over the road, so guardrails and berms have not been included to meet MSHA requirements

18.1.2.1 Site Roads

The main site roads will be developed after the completion of the access road. The site roads will serve the mill, truck shop, and the remainder of the support buildings in these areas. The site road will continue west beyond the mill toward the open pit, WMP, WTP, and the WMF. The site will also have designated haul roads to facilitate material movement (ore and waste) from the open pit to the primary crusher at the mill and the WMF. Where required, various temporary construction roads will be made or modified from existing roads for temporary construction laydown facilities, staged WMF construction, and general construction access.

18.1.3 Power Supply

The electrical power supply will be generated on site with no utility interconnection. The total connected load for the mill and all supporting facilities is 15.6 MW, and the nominal operating load (80% utilization factor) is expected to be 12.5 MW. A total of three diesel generator sets will be installed to operate in parallel with two operating and one on standby (N+1 arrangement). Each generator will be rated for approximately 7.5 MW output with a total operating power output of 15 MW, excluding the redundant unit. The generation system will provide 4160-volt alternating current (VAC) primary electrical supply for the site facilities. The nominal load suggests that the generation system will operate at approximately 83% of rated capacity.

All three generators will be housed within individual enclosures in a fenced yard area. This yard will also contain enclosed electrical equipment buildings, emissions control equipment, and heat recovery equipment. The heat from the diesel generators will be recovered using a glycol system, and this excess heat will be employed for area heat in the mill buildings close to the power generation area. Localized diesel-fired heaters will supply heat to the buildings further from the power generation area.

18.1.3.1 Power Distribution

A 4160 VAC electrical distribution system will be utilized with localized transformers at each area of the plant to provide the appropriate operating voltage for equipment and facilities. Main electrical distribution cables will be routed underground from the site power station. The selected distribution will be 4160 VAC for large drives and 480 VAC for smaller drives. The distribution system will employ area substations and motor control centers to distribute power for each individual use.

18.1.3.2 Construction Power

Power for construction activities will consist of leased U.S. EPA Tier 4 diesel generator sets of varying capacities depending on the application. Mine site construction will employ numerous, smaller-capacity, power-generation units for localized construction activities until the mine site power plant and electrical distribution are commissioned.

18.1.4 Fuel Storage and Distribution

18.1.4.1 Nome Fuel Storage Facility

Long-term bulk diesel and unleaded gasoline will be stored in a fuel farm adjacent to the Nome port facility. Sufficient storage will be established to sustain operations through the port closure season. The anticipated port closure period is from October 1 through May 30 (241 days), requiring no less than 30,280 kiloliters (kL) (8,000,000 gal) of diesel and 136.26 kL (36,000 gal) of unleaded gasoline storage. This study assumes the project will use an ultra-low sulfur diesel #1 blend to accommodate seasonal availability from suppliers. Nome currently has a total storage capacity of about 45,420 kL (12,000,000 gal) of ultra-low sulfur diesel #1. The local supplier will need to construct the additional required diesel capacity of 15,140 kL (4,000,000 gal) to meet project needs. This is equivalent to five additional 16-m-high by 16-m-diameter cylindrical steel tanks. Based on early discussions with fuel vendors, the capital costs of this additional construction were incorporated into the long-term fuel storage and delivery fee offered by the provider.

18.1.4.2 Bulk Fuel Storage and Distribution

Bulk fuel will be delivered via a contracted supplier to the site from Nome and will be stored on site to fuel the power plant, building heaters, concentrate dryer, and various mobile equipment. Diesel will be stored in a double-walled steel tank, 16 m in height and 16 m in diameter, with approximately 3,217.25 kL (850,000 gal) of live capacity and an ullage of 10%. This tank will reside within a concrete containment structure adjacent to the site's power generation facility. A second, double-walled, steel, unleaded gasoline tank with a capacity of 15.14 kL (4,000 gal) will also be located within the concrete containment for fueling light vehicles. The volumes stored on the mine site represent 14 days of diesel fuel storage and 30 days of unleaded gasoline storage for operational needs. The containment housing these tanks will have capacity to retain 110% of the volume of the diesel storage tank.

The fuel storage area will house diesel fast-fueling facilities for the lube trucks and large mobile equipment along with separate, low-volume, unleaded-dispensing facilities for light vehicles. Diesel fuel will be distributed from the main storage tank to the site's electrical power generation facility, concentrate dryer, and local heaters via pumps and piping. Diesel fuel day tanks for other uses on site will be refueled by mobile lube/fueling equipment and fuel transports coming to the site delivering fuel from Nome.

18.1.5 Explosives Storage

18.1.5.1 Emulsion Facility

Bulk emulsion to support blasting operations will be mixed on-site via a blasting contractor's purpose-built mobile equipment (emulsion truck). A fully enclosed and heated facility will be constructed near the mobile equipment maintenance facility to support this operation. This facility includes bays for two bulk trucks along with three storage silos for ammonium nitrate. Bulk ammonium nitrate will be delivered to the site in 20-foot shipping containers and stored near the emulsion facility.

18.1.5.2 Explosives Magazines

Two separate explosive magazines—one for high explosives and one for low explosives—will be located along the main haul road connecting the pit with the WMF on pads built specifically for this purpose. The magazines will be situated a sufficient distance from occupied facilities to meet regulatory safety requirements. The two magazines will be adequately barricaded by berms, isolated from mine traffic, and properly located away from the other to provide the required physical separation distance.

18.1.6 Fire Protection

Fire protection within the mill buildings will include a dedicated fire water system storage tank and distribution network with standpipe systems, hose stations, and portable fire extinguishers. The fire water feed system will be supplied by redundant electric pumps with diesel backup power. Electrical facilities will be fitted with separate dry-type, inert-gas, fire protection systems and hand-held fire extinguishers. The truck shop, warehouse, emergency response, emulsion, and office buildings will have their own localized fire protection systems consisting of portable fire extinguishers and other local suppression systems where appropriate.

18.1.7 Buildings

Site buildings are described below. For the location of these buildings, reference Figure 18-1.

18.1.7.1 Facilities Subsurface Investigation

The subsurface geotechnical and hydrogeological investigations of the proposed mill area conducted in 2024 included one geotechnical drillhole (Table 18-1).

Table 18-1 Drillhole Drilled for Mill Subsurface Investigations in 2024

Hole ID	Northing (m)	Easting (m)	Elevation (amsl)	Azimuth (deg.)	Plunge (deg.)	Depth (m)
24GCT034	474618.0	7213537.6	164.1	000	-90	45.72

Soils were cored using tricone and triple tube HQ3 (core diameter 61 mm or 2 3/8 in.) equipment capable of performing the SPT using standard split-spoon in addition to modified California (MC) sampling. Drilling was conducted 24 hours per day between June 16 and August 18, 2024. Soils were visually logged using ASTM D 4082, and when frozen soils were encountered, they were logged using ASTM D4083. Soils were sampled using the SPT split-spoon or MC samplers at 5-foot intervals by Barr personnel at the rig, and the blow counts were recorded. After drilling was completed, instrumentation was installed within the drillholes consisting of 25.4- or 50.8- mm (1- or 2-in) Schedule 80 PVC risers the entire depth of the drillhole.

The majority of soils (approximately 70%) were typically classified as sands in the field, while the rest (approximately 25%) were mostly classified as gravels. Clays and silts were encountered in less than 3% of soils logged. Layers of frozen soils were encountered in drillholes 24GCT024 (approximately 17% of frozen soils logged) and 24GCT026 (approximately 83% of frozen soils logged). The total length of frozen soils logged was approximately 100 m, and the depth range in the drillholes ranged from 11 to 127 m below the ground surface.

18.1.7.2 Office Building

The enclosed and heated office building will house administration offices, changing rooms, conference rooms, and break rooms. It will have two separate levels of 1,100 m^2 each and be located adjacent to the truck shop on the truck shop level.

Potable water will be supplied from a separate potable water treatment and storage system. Sewerage from the facilities will be pumped to separate wastewater treatment (septic) facilities. Solid wastes will be handled using waste bins for removal from the site and incineration, when possible.

18.1.7.3 Warehouse and SAG Mill Storage Building

The warehouse and SAG mill storage will house general warehousing, labs, and SAG mill components. This building will have two separate enclosed and heated levels of 1,100 m^2 each adjacent to the mill and SAG Mill buildings on the mill level.

18.1.7.4 Emergency Response Building

The emergency response building will be located on the mill level. The 500 m^2 enclosed and heated building will house first aid and training facilities as well as parking spaces for an ambulance and fire truck.

18.1.7.5 Helipad

The helipad will be located on the mill level, consisting of a 130 m^2 clear pad area with electrical service for lighting and ancillary equipment.

18.1.7.6 Truck Shop

Mobile equipment maintenance facilities will be housed within a single 2,800 m^2 heated enclosure. This building will house truck and mobile equipment maintenance bays, light vehicle service bays, tire handling equipment, and enclosed mobile equipment washing facilities.

A separate 450 m^2 heated enclosure immediately adjacent to the truck shop will house mobile equipment parts and components.

18.1.7.7 Mill

The mill consists of several buildings serving various purposes, many of which have common walls and process interconnects. These are described below.

Primary Crushing

The primary jaw crusher and associated equipment, including a rock breaker, will be housed within a 540 m^2 enclosed building immediately adjacent to the SAG mill building. A belt conveyor will transfer the crushed ore from the primary crusher to the crushed ore stockpile.

Crushed Ore Stockpile

The crushed ore stockpile will be housed within an enclosed 2,000 m^2 fabric-dome facility. The conical pile will be fed from a cantilevered section of the crushed ore stockpile belt conveyor. An underground reclaim tunnel will house two apron feeders, which will be fed from individual draw points under the live pile area. The apron feeders will feed a reclaim belt conveyor to transfer crushed ore to the SAG mill. The crushed ore storage capacity of 24,000 Mt provides approximately 48 hours of mill feed. The dome structure will include two equipment access doors for mobile equipment access to facilitate ore stacking and reclaim.

SAG Mill Building

The SAG mill and associated screening equipment will be housed within a 1,000 m^2 enclosed and heated building immediately adjacent to both the crusher and mill buildings.

Graphite Flotation

The flotation process equipment—including rougher, seven stages of cleaner flotation cells, three stages of regrind milling, and associated equipment—will be housed within a 1,500 m^2 enclosed and heated process building.

Concentrate Thickening and Drying

The 12-m-diameter high-rate concentrate thickener will be located outside the process building and housed within a fabric dome structure. The concentrate drying and dried concentrate storage facilities will be housed within a 1,700 m^2 enclosed and heated building immediately adjacent to the process building.

Tailings Thickening and Filtration

Tailings filtration facilities will be housed within a 3,300 m^2 enclosed and heated building immediately adjacent to the process building. Filtered tailings will be conveyed to a small, uncovered surge stockpile via a belt conveyor. Tailings will be loaded by a wheeled loader into trucks for haulage to the WMF. The 36-m-diameter high-rate tailings thickener will be placed on grade adjacent to the tailings filtration building and housed within a fabric dome structure.

Concentrate Loading, Storage, and Shipping

Dried concentrate will be conveyed into two 368-Mt silos within the 1,700 m^2 enclosed and heated concentrate drying building. Concentrate will be loaded into 20-foot shipping containers and staged at the site on the mill bench near the loading facility until the containers are trucked to the storage area in Nome.

Reagent Storage and Handling

A 225 m^2 building adjacent to the process building will house reagent mixing, storage, and distribution equipment. Flocculant will arrive as dry powder in super sacks, batch mixed and transferred to a day tank for use in the process.

18.1.8 Nome Construction Camp Facilities

The construction camp in Nome is planned to house up to 400 workers during the construction of the access road and project site facilities. The camp will be connected to Nome municipal electric grid and utilities.

18.1.9 Waste Management Facility

The primary objective of the mine WMF is to provide safe and secure storage of filtered tailings and waste rock produced as part of mining operations. The filtered tailings and waste rock will be co-disposed in a single facility. The WMF is not intended to provide storage of water or serve as a reclaim source for return water back to the mill. The primary water storage facility to manage the process and meteoric contact water is the WMP. The geotechnical characterization and analysis of the WMF are presented in further detail below.

18.1.9.1 Geology and Structure

In the close vicinity of the proposed WMF, WMP, and mill facility footprints, different soil deposits such as glacial (till), colluvial (landslide, solifluction debris), alluvial (alluvium and old alluvial fan), and lacustrine (glaciofluvial) deposits were originally mapped at the ground surface by Kaufman & Hopkins (1989). Additional details about each deposit follow.

- Till deposits are described as poorly sorted, non-stratified, debris-forming end moraines that display broader crests, less microrelief, and more reworking by solifluction.
- Solifluction debris deposits are described as thin deposits of weakly stratified, poorly sorted, pebbly silt with platy rock clasts that form well-developed lobes and smooth, sweeping terraces. Landslide deposits are found in glaciated mountain valleys as bouldery, non-stratified, blocky debris.
- Alluvium is described as stratified deposits of moderately to well-sorted gravel and sand being restricted to flood plains and active rivers. Old alluvial fan deposits are stratified gravels that include some cobbles and boulders that form inactive fans along the northern flank of the Kigluaik Mountains.
- Lacustrine deposits are found in three categories as lake terrace deposits (well-sorted and stratified sand, silt, and minor fine gravel), stratified silt and peat (weakly stratified, well-sorted lacustrine and eolian silt with lenses rich in organic material and detrital peat) and silty cover deposits (weakly stratified mantles consisting predominantly of loess and secondary periglacially fractured materials).

The proposed facilities are located north of the Kigluaik Mountains, which are a rugged, ice-sculpted massif forming an east-west trending belt about 20 km wide and 75 km long. The principal ice-sculpted peaks of the mountains lie along the axis of an asymmetrically folded antiform composed of Precambrian and early Paleozoic metamorphic rock (Till et al., 1986). The Kigluaik Fault is an east-west-trending, south-side-up, steeply dipping normal fault that separates high-grade metamorphic rocks in the Kigluaik Mountains from the Imuruk Basin to the north. Evidence for recent activity is based on prominent north-facing scarps in Quaternary deposits and range-front slope breaks. Due to a lack of age control on displaced deposits and a lack of paleoseismic studies, slip rates are not well-constrained (Koehler, Carver, & Alaska Seismic Hazards Safety Commission, 2018).

18.1.9.2 WMF Subsurface Investigations

Barr reviewed the previous work and recommendations by others; identified potential risks and opportunities highlighted in the previous studies; and designed the 2024 field program and laboratory testing to update the structural, geotechnical, and hydrogeological models to support the feasibility study.

The subsurface geotechnical and hydrogeologic investigations of the WMF conducted in 2024 included six drillholes as shown in Table 18-2.

Table 18-2 Drillholes for WMF Subsurface Investigations in 2024

Hole ID	Northing (m)	Easting (m)	Elevation (amsl)	Azimuth (deg.)	Plunge (deg.)	Depth (m)
24GCT021	473628.7	7213648.6	107.5	000	-90	30.8
24GCT022*	473675.1	7213231.2	120.4	000	-90	144.8
24GCT024	473152.4	7213967.3	86.6	000	-90	30.4
24GCT026*	472839.2	7213878.9	73.2	000	-90	162.0
24GCT031*	472400.7	7213706.3	55.4	000	-90	30.8
24GCT033*	473261.3	7213537.9	88.3	000	-90	146.6

NAD83 UTM 3N* Vibrating wire piezometer (VWP) and digital temperature cable (DTC) installed in the drillhole.

The 2024 geotechnical drillholes at the WMF are shown on Figure 18-4.

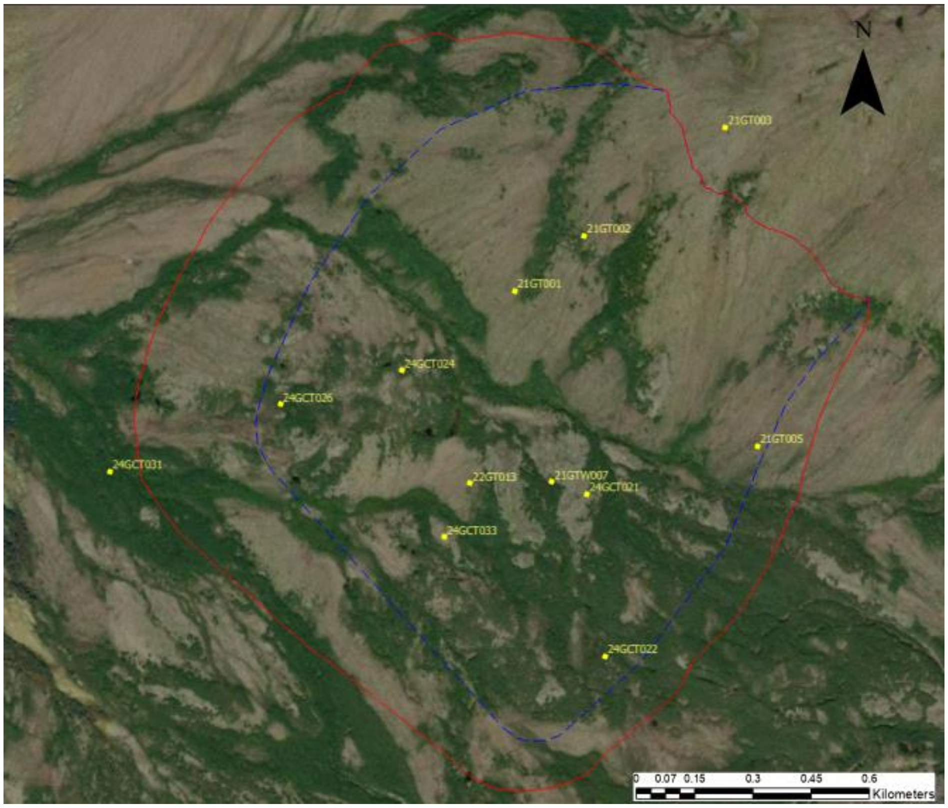


Figure 18-4 Location of 2024 Drillholes and Previous Drillholes

In the 2024 geotechnical investigation, soils were cored using tricone and triple tube HQ3 (core diameter 61 mm or 2 3/8 in.) equipment capable of performing the SPT using standard split-spoons in addition to MC sampling. Drilling was conducted 24 hours per day between June 16 and August 18, 2024. Soils were visually logged using ASTM D 4082, and when frozen soils were encountered, they were logged using ASTM D4083. Soils were sampled using the SPT split-spoon or MC samplers at 5-foot intervals by Barr personnel at the rig, and the blow counts were recorded. The constant, headwater injection tests were performed by Tundra during the drilling. After drilling was completed, instrumentation was installed within the drillholes consisting of 25.4- to 20.8 mm (1- or 2-in) Schedule 80 PVC riser the entire depth of drillhole with VWPs and DTCs installed as indicated in Table 18-2.

18.1.9.3 Seismic Hazard Assessment

Lettis Consultants International, Inc. (Lettis) performed a site-specific, probabilistic seismic hazard analysis (PSHA) and deterministic seismic hazard analysis (DSHA) for the site located on the Seward Peninsula approximately 60 km north of Nome, Alaska. Geologic and seismologic data were used to evaluate and characterize potential seismic sources, the likelihood of earthquakes of various magnitudes originating from those sources, and the likelihood of the earthquakes producing ground motions over a specified level. The seismic hazard analysis report presents details of the seismic source characterization, ground motion models (GMMs) used in the PSHA and DSHA, probabilistic and deterministic ground motion hazard results, calculation of uniform hazard spectra (UHS), and development of the safety evaluation earthquake spectrum and time histories.

The 5%-damped mean UHS for V_{s30} of 760 m/s for firm rock and 1,200 m/s for hard rock for return periods of 2,475, 3,000, 5,000, 8,000, and 10,000 years are presented in Lettis (2024). The UHS reflects the geometric mean of expected horizontal ground motions, as predicted by the GMMs. The range of uncertainty reflected in the hazard curves for the firm rock return periods is presented in Table 18-3.

Table 18-3 Probabilistic Ground Motions at Selected Return Periods (Vs 760 m/s Firm Rock)

Return Period (years)	PGA (g) Mean
[5th, 95th Percentiles]	1.0 Sec SA (g) Mean [5th, 95th Percentiles]
2,475 0.392 [0.218, 0.571]	0.240 [0.134, 0.368]
3,000 0.427 [0.239, 0.618]	0.268 [0.148, 0.407]
5,000 0.536 [0.303, 0.760]	0.351 [0.192, 0.520]
8,000 0.641 [0.368, 0.898]	0.440 [0.239, 0.636]
10,000 0.698 [0.402, 0.971]	0.487 [0.264, 0.699]

The 2,475-year return period was selected as the design earthquake for the purposes of developing spectrally matched seismic ground motions based on the Canadian Dam Association (CDA, 2013) guidance and discussion with Graphite One. Five single-component, horizontal-time histories were spectrally matched to the UHS for V_{s30} of 1,200 m/s for the hard rock 2,475-year return period. To verify that the matched time histories had similar energy release time and damage potential as the seed time histories, the duration and Arias intensity of the ground motions before and after matching were calculated and compared.

Deterministic ground motions (V_{s30} of 760 m/s) were computed for the closest and most significant deterministic seismic source to the site, the West Kigluaik Fault. For the West Kigluaik Fault, the maximum event modeled was a M 7.2 earthquake at a rupture distance of 2.23 km. The 5%-damped, 84th-percentile, horizontal acceleration response spectra were calculated using the same GMMs that were utilized for the PSHA.

The recommendation from Lettis (2024) was as follows:

> *The project site straddles the latest-Quaternary to Holocene-active Kigluaik Fault. The fault provides not only the largest contribution to strong ground shaking at the site at the return periods of engineering relevance (Global Industry Standard on Tailings Management [2020]) but also represents a potential surface fault rupture hazard to both the pit (primary displacement) and*

proposed WMF in the hanging wall north of the site (secondary displacement). Because the fault has not been studied using contemporary (standard-of-practice) tools and datasets that include high-resolution topography and aerial imagery along with 3D visualization and data manipulation tools, we [Lettis] encourage further evaluation of the fault to refine key source parameters necessary to characterize the fault and reduce uncertainty.

18.1.9.4 Material Characterization

The material characterization presented in this section is based on laboratory testing on filtered tailings samples that were received from the Graphite One pilot processing plant. The location of the bulk ore sample extraction for the pilot plant and the method of producing the resulting tailings are described in Section 13.3.1.3. In summary, the pilot plant sample consisted of 9.2 tons of Graphite Creek ore obtained from surface excavation of high-grade ore located in the center of the deposit and proximate to several exploration drillholes.

Developed and operated by SGS Lakefield, the pilot plant was focused on producing a graphite concentrate for end-user testing. The resulting tailings from the grinding and flotation operations were captured and saved. A composite sample of representative total tailings was assembled and split to provide test samples to the geotechnical laboratories.

The pilot plant filtered tailings material characterization includes evaluation of the following geotechnical properties:

- Index properties
- Hydraulic conductivity
- Unsaturated soil mechanics
- Critical state soil mechanics
- Drained shear strength
- Yield undrained shear strength
- Liquefied (i.e., residual) undrained shear strength
- Cyclic (i.e., seismic) stress-strain response
- Shear modulus characterization

Bulk samples of pilot plant filtered tailings were sent to two separate geotechnical laboratories (TerraSense and Soil Engineering Testing) for specialized testing to develop a geotechnical material characterization that would support the feasibility study analysis and modeling efforts. A summary of the geotechnical material characterization developed for the pilot plant filtered tailings with respect to index properties and static shear strength parameters is presented in Table 18-4.

Table 18-4 Material Characterization Summary

Sample ID	Specific Gravity	Fines Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	USCS Soil Type	Optimum Moisture Content (%)[1][2]	Maximum Dry Density (pcf)[2]	ϕ'_{cs} (deg)	$USSR_{peak}$	$USSR_{liq}$
TerraSense-1	2.855	46.8	23	21	2	SM	15.2	116.0	31	0.22	0.07
SET-1	2.850	46.2	21	NA[3]	NP[4]	SM	17.1	111.3			

[1] Geotechnical moisture content: $w = mass_{water}/mass_{solids}$
[2] From Standard Proctor compaction testing (ASTM D698)
[3] NA = not applicable
[4] NP = non-plastic

In addition to the summary presented in Table 18-4, the material characterization has included an assessment of consolidation, hydraulic conductivity, and unsaturated properties of the filtered tailings to inform performance during construction. The cyclic shear stress-strain response was also evaluated for potential seismic loading conditions as part of the material characterization. Further, the characterization has included an assessment of the material-specific critical-state locus and unsaturated-saturated shear modulus profiles to support both static and seismic deformation modeling.

This material characterization was intended to support a performance-based estimation with respect to various loading conditions of the WMF. Geotechnical parameters were developed to support the analysis of WMF stability using limit equilibrium methods in addition to finite difference, deformation-based numerical analysis. This material characterization also includes baseline information and parameters that provide an initial basis for potential future advanced assessments (e.g., liquefaction susceptibility and associated brittleness) that are recommended to be performed during WMF construction.

18.1.9.5 2D Slope Stability Analysis

A 2D slope stability analysis was performed using both the GeoStudio and FLAC software programs to evaluate the long-term stability conditions under the ultimate WMF geometry for the feasibility study. Two study cross-sections—selected at the maximum WMF height and along the primary topographic grades—were evaluated with respect to drained, yield undrained, and post-liquefaction undrained shear-strength conditions.

WMF cross-sections were modeled with a compacted waste rock perimeter embankment surrounding compacted filtered tailings. The waste rock and filtered tailings zones were modeled overlying a low-density polyethylene (LLDPE) T liner that would be placed on the native foundation material. The LLDPE-T liner was incorporated into the stability analysis based on the understanding that it was the leading option at the time of the feasibility study. Peak drained shear strength ($\phi' = 15^o, c' = 3.6kPa$) and residual shear strength ($\phi = 11^o, c = 0kPa$) envelopes for the LLDPE-T liner interface were incorporated into the stability analysis based on the manufacturer's specifications (Geosynthetic Research Institute, 2005). The waste-liner interface is a controlling feature in the global stability assessment.

The slope stability analysis presented herein was not performed for short-term (i.e., end-of-construction) conditions, which is meant for the detailed design analysis. For the feasibility analysis in this report, only the following conditions were analyzed with the primary intent to determine the WMF stability conditions under long-term (i.e., end-of-primary consolidation) conditions.

- Long-term conditions utilizing drained shear strengths per effective stress stability analysis (ESSA), where pore-water pressures are based on an assumed hydrostatic phreatic surface
- End-of-primary consolidation conditions, where the filtered tailings have realized the shear strength increase due to loading (i.e., following excess pore-water pressure dissipation and consolidation due to WMF construction):
    - Yield undrained strength stability analysis (USSA)
    - Liquefied undrained strength stability analysis (LIQ)

The required minimum slope stability FoS for the aforementioned analysis conditions are as follows. These recommended minimum values are consistent with the standard of practice in conformance with the International Commission on Large Dams (ICOLD) Bulletin 194 (ICOLD, 2022):

- Long-term conditions (ESSA) equal to or greater than 1.5
- End-of-primary consolidation conditions (USSA) equal to or greater than 1.5
- End-of-primary consolidation conditions (LIQ) equal to or greater than 1.1

The GeoStudio stability analysis was performed for the ESSA, USSA, and LIQ conditions, while the FLAC stability analysis was performed only for the LIQ conditions. For the LIQ analysis in both GeoStudio and FLAC, sensitivity scenarios were included to evaluate the effect of tailings post-liquefaction strength and phreatic surface location on stability under post-liquefaction conditions.

Overall, the stability analysis demonstrated the ultimate WMF preliminary design geometry had acceptable stability under long-term conditions. The computed ESSA and USSA FoS are approximately at the recommended minimum values, which is considered acceptable given the uncertainty in material parameters and phreatic conditions associated with the feasibility study. For example, Figure 18-5 and Figure 18-6 present the results for the ESSA and USSA stability analyses, respectively, for Section 1.

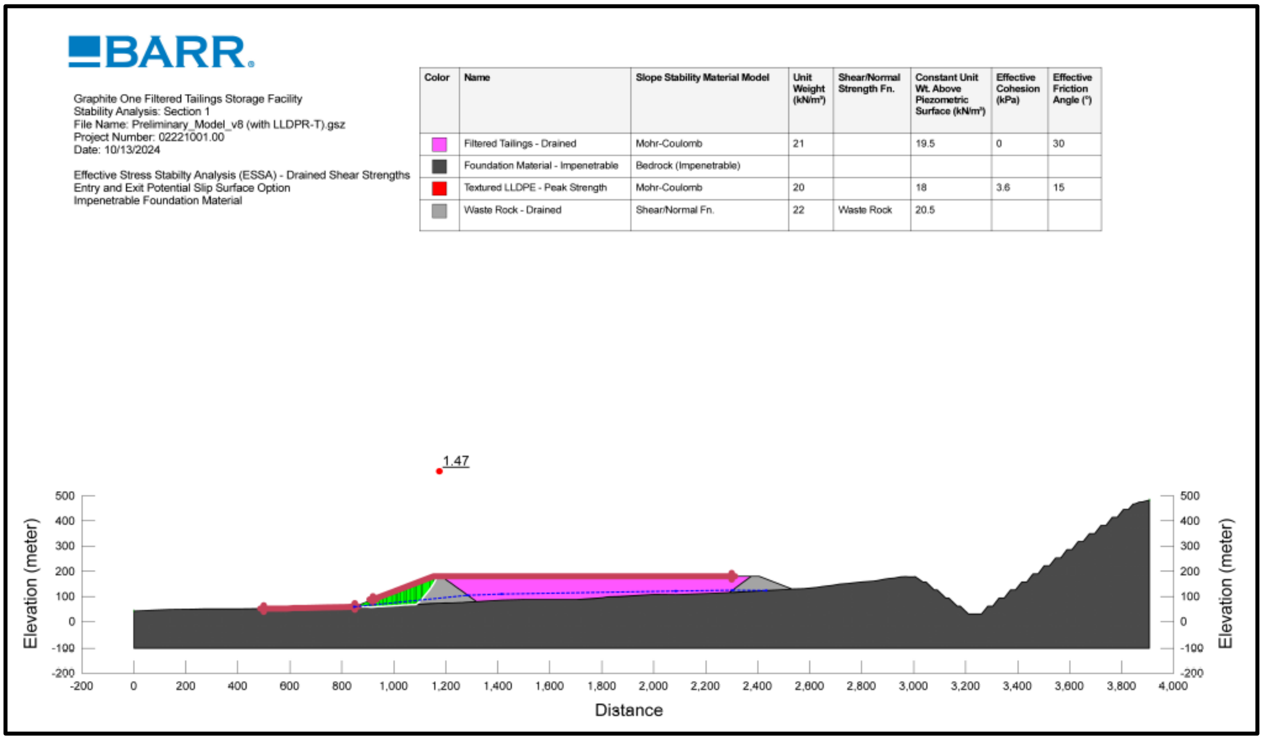


Figure 18-5 Effective Stress Stability Analysis (ESSA)

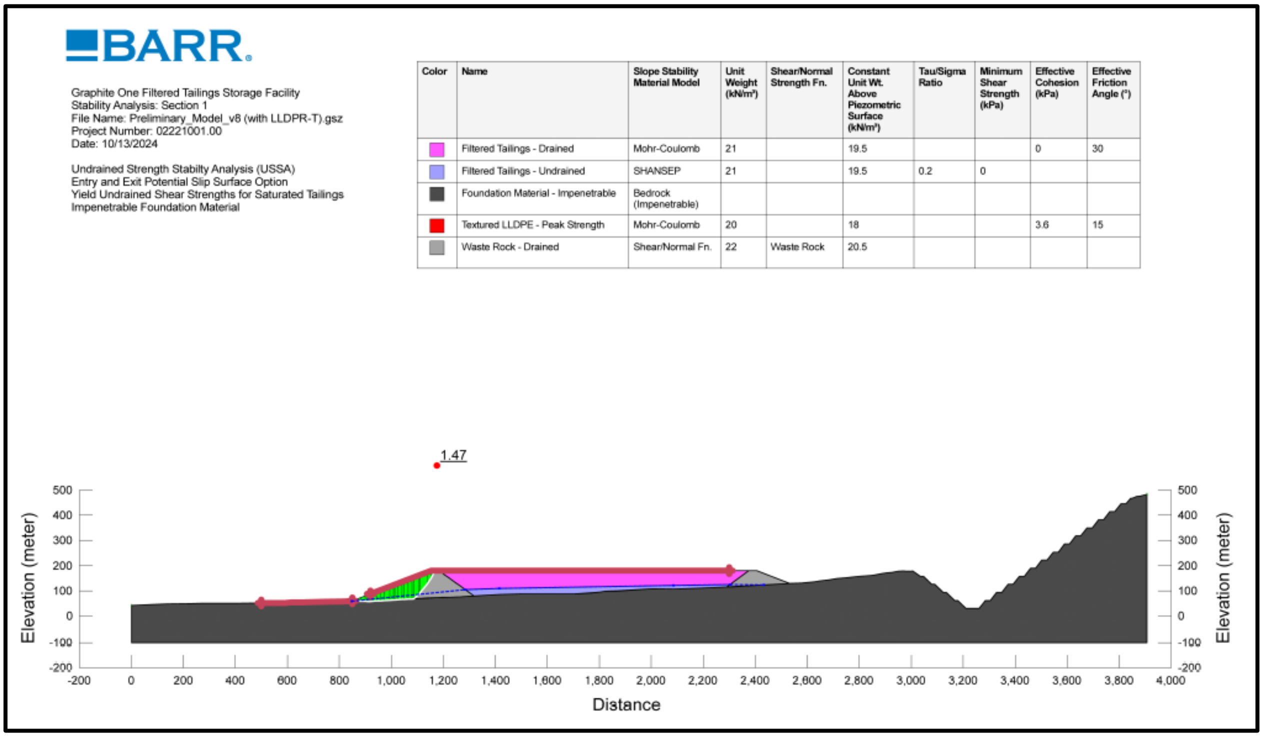


Figure 18-6 Undrained Strength Stability Analysis (USSA)

The FoS of the LIQ analysis with base-case scenario assumptions is above the recommended minimum value of 1.1. For example, Figure 18-7 presents the results for the base case liquefied undrained strength stability analysis (LIQ) for Section 1, which conservatively included the residual shear strength for the liner interface.

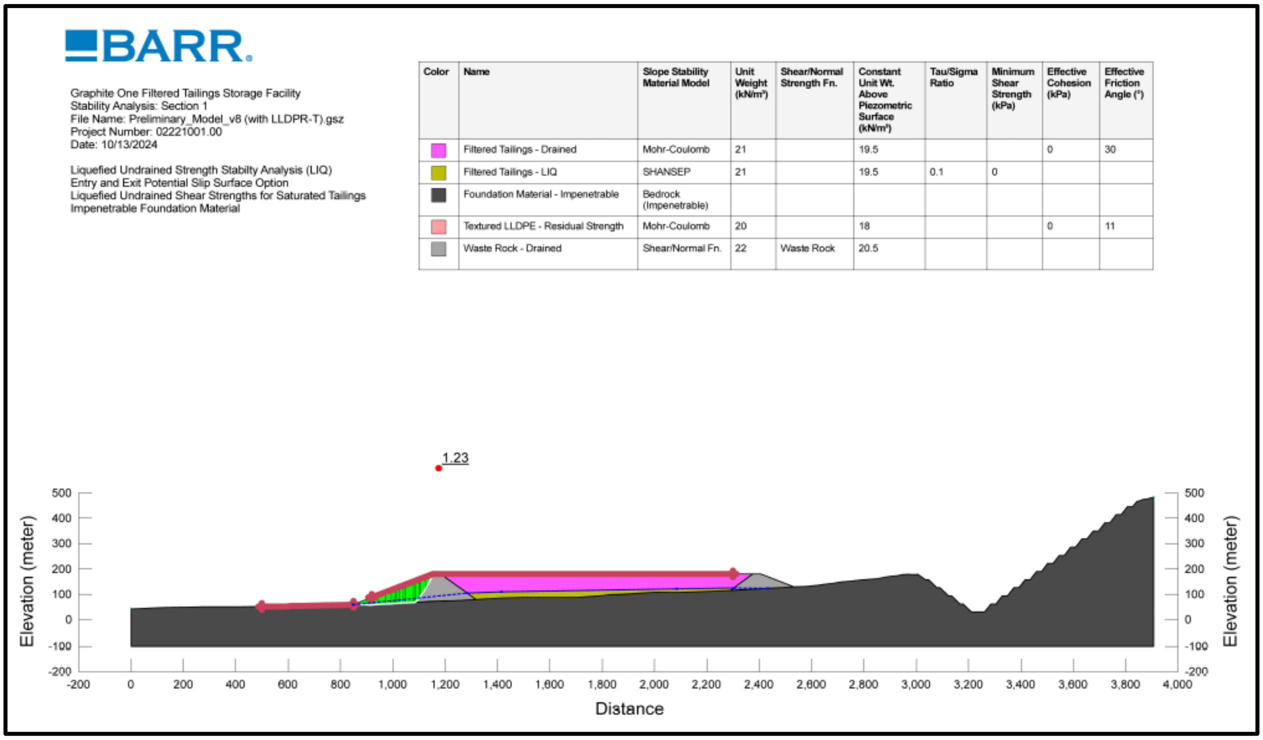


Figure 18-7 Liquefied Undrained Strength Stability Analysis (LIQ)

The sensitivity scenarios of the LIQ analysis demonstrate the significant effect of an elevated phreatic surface on the stability conditions. Meanwhile, the sensitivity analysis results also show that an elevated phreatic surface is not the exclusive factor leading to instability. The post-liquefaction shear strength and the extent of liquefaction also played a significant role. A combination of adverse factors (i.e., elevated phreatic surface, conservatively low post-liquefaction shear strength, and extent of liquefaction triggering) was required to bring the WMF to instability.

18.1.9.6 2D Static Deformation Modeling

Filtered tailings are intended to be placed at approximately the optimum moisture content (OMC) (i.e., geotechnical water content) per 90% standard Proctor compaction effort. Therefore, tailings placement at OMC will be unsaturated, exhibiting a degree of saturation on the order of 65%. As construction proceeds, the effective stresses at the base of the WMF will increase with fill height leading to consolidation (i.e., reduction in void ratio) and thus an increasing degree of saturation. Depending on the moisture content variability observed during placement and increasing degree of saturation, the filtered tailings may become nearly or fully saturated and potentially liquefiable, especially at or near the bottom of the tailings.

To evaluate the probable variability in moisture content of filtered tailings placed at the WMF, a sensitivity assessment was performed to model the potential transition of filtered tailings from unsaturated to saturated conditions using a simplified one-dimensional (1D) column model. The 1D column model was constructed in 1-m-thick lifts being placed sequentially until the design height of the WMF was reached. The filtered tailings column model was assigned the NorSand constitutive model (Jefferies, 1993; Jefferies & Been, 2016) to simulate the consolidation process. The initial moisture content of the filtered tailings is one of the controllable conditions that will impact the development of zones or layers of filtered tailings that are nearly or fully saturated during the construction sequence of the WMF.

The 1D column model estimates that if the minimum initial moisture content (i.e., geotechnical water content) of the filtered tailings during placement is below 23%, the material likely remains in an unsaturated condition throughout the construction life of the WMF. Degree of saturation results with an initial moisture content of 23% for the ultimate height of the 1D column model following staged construction are presented in Figure 18-8.

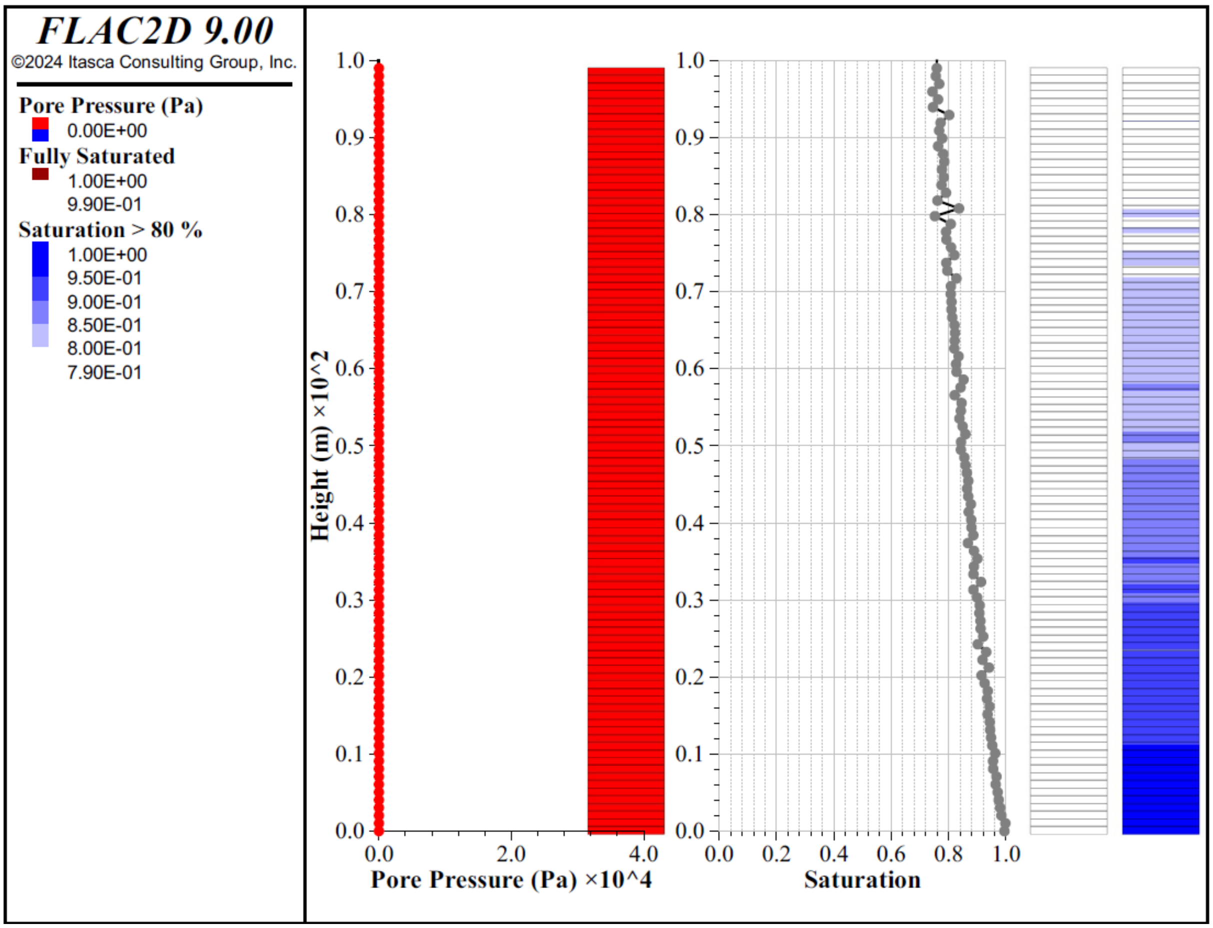


Figure 18-8 1D Staged Construction Model: Initial Moisture Content 23%

The 1D model indicates that if a minimum initial moisture content of filtered tailings is observed at 24% during construction for a 100-m stack, the bottom 7 m of the filtered tailings will transition from unsaturated to fully saturated despite a fully operational drainage element at the base of the model.

Saturation results for the initial moisture content at 24% presented in Figure 18-9 also indicate the initiation of a zone of positive excess pore pressure being generated at the base of the 1D model. Increasing the initial moisture content by one additional percent to 25% at the placement of each lift increases the column of fully saturated tailings to 20 m. The layer of full saturation and corresponding zone of positive excess pore pressure that develops at the base of the 1D model for an initial moisture content of 25% are presented in Figure 18-10.

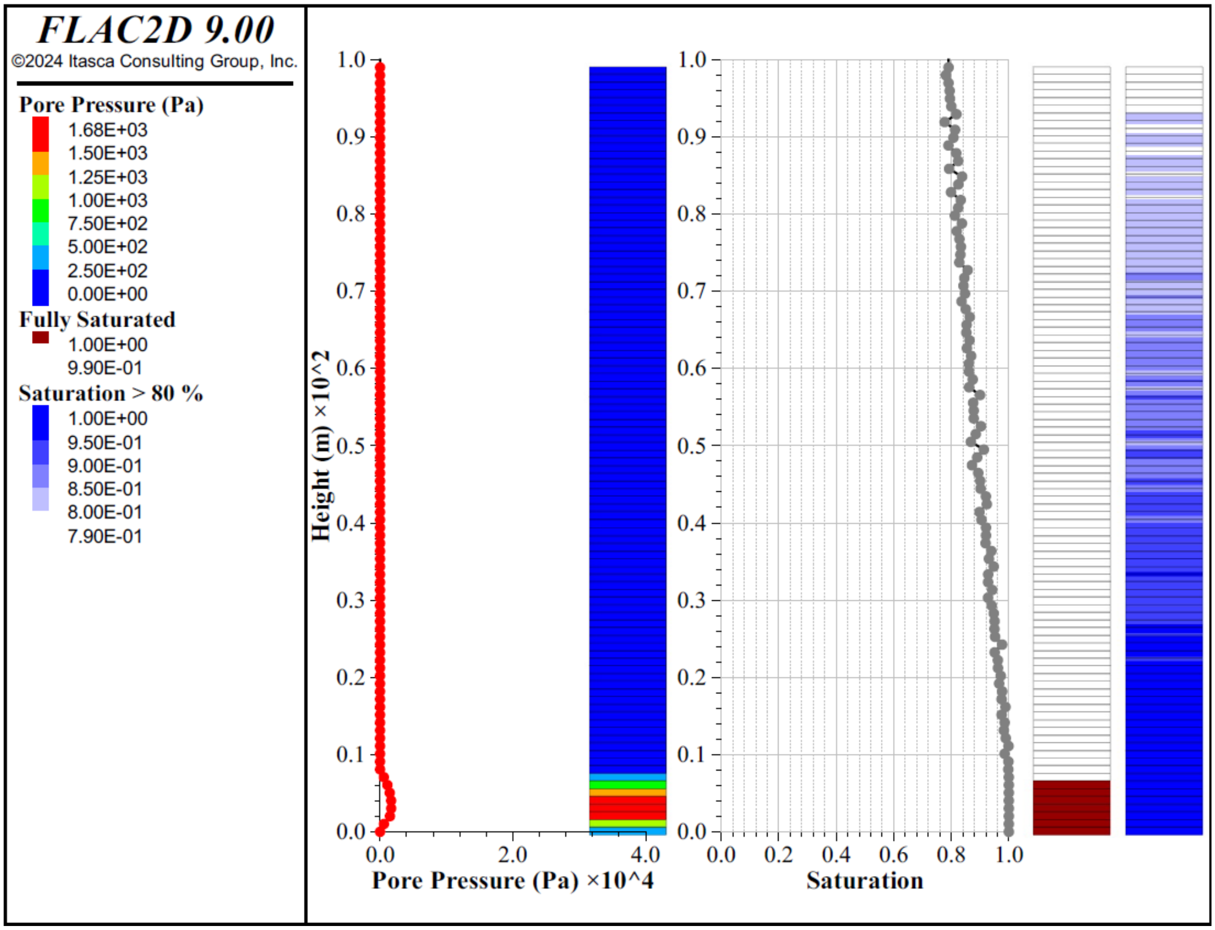


Figure 18-9 1D Staged Construction Model: Initial Moisture Content 24%

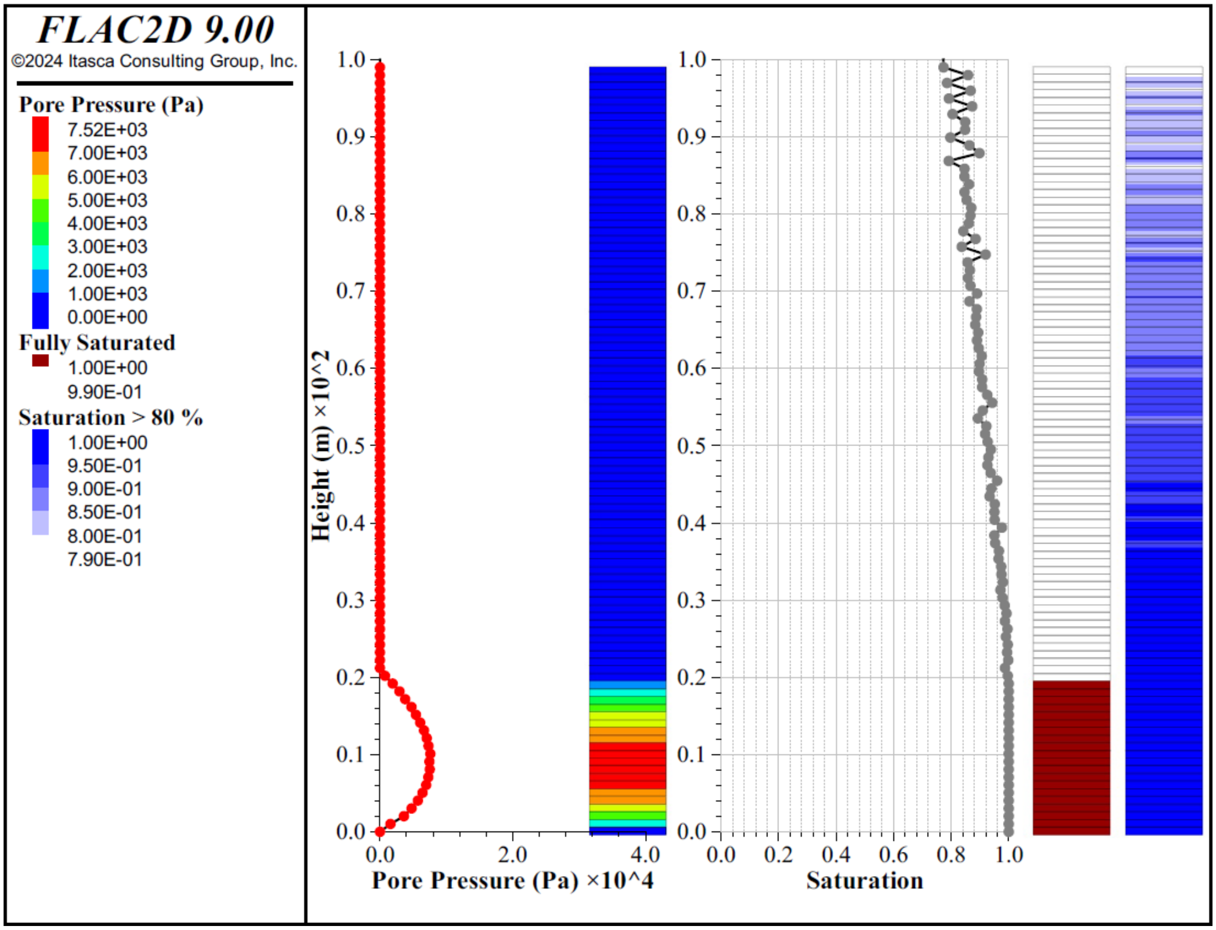


Figure 18-10 1D Staged Construction Model: Initial Moisture Content 25%

Further, the 1D model indicates that a significant layer of filtered tailings, up to approximately 40 m, achieves 80% saturation at an initial placement moisture content of 21%. Figure 18-8 through Figure 18-10 indicates a significant portion of the filtered tailings will consolidate to achieve degrees of saturation of 80% or greater. Industry practitioners (e.g., ICOLD, 2022) have acknowledged that material having a saturation as low as 85% should be considered saturated and may be susceptible to liquefaction. ICOLD (2022) further states that material having a degree of saturation between 70% and 85% should be evaluated with care.

Monitoring the initial moisture content of filtered tailings placed during construction can provide an important performance-based criterion for maintaining unsaturated conditions. The potential for liquefaction triggering in compacted filtered tailings with saturation greater than 80% is recommended for further assessment as part of the detailed design.

Static liquefaction might occur due to increasing the effective stress as part of the construction above the saturated filtered tailings at the base of the WMF. Static liquefaction may also occur due to increases in the phreatic surface elevation, which is associated with increasing consolidation due to ongoing tailings deposition during operation. An additional 2D deformation model was developed to model the post-liquefaction of the WMF for the case of complete liquefaction of the filtered tailings, regardless of the risk of triggering liquefaction by static or seismic sources. This modeling scenario represents a similar loading condition to the post-liquefaction stability analysis. All materials were assigned the Mohr-Coulomb constitutive model. The post-liquefaction model showed that even if liquefaction of the filtered tailings were to occur, the WMF perimeter structure and tailings would be limited to approximately 0.2 m of downstream deformation. The model was run using a small-strain deformation mode within the numerical modeling platform. In general, post-liquefaction deformations indicated by modeling are considered tolerable with respect to global WMF stability.

18.1.9.7 2D Seismic Deformation Modeling

The objective of the seismic deformation modeling was to evaluate whether a tolerable deformation response was predicted under the design earthquake loading. Tolerable deformations have been defined as follows:

- Structural integrity of the slope and structure is maintained with no release of tailings and/or process water outside of the WMF
- The slope does not experience excessive differential movement or strain levels above those suggesting progressive failure or secondary potential failure modes
- The defensive design features of the perimeter structure maintain integrity and functionality
- Embankment movement stabilizes after shaking

Two-dimensional dynamic deformation modeling was performed on the maximum study cross-section at the WMF to evaluate seismic loading conditions. Dynamic deformation modeling was performed by evaluating the design earthquake ground motions as provided by the PSHA results (Lettis, 2024). The 2,475-year-return period was selected as the design earthquake for the purposes of developing spectrally matched seismic ground motions based on CDA 2013 guidance and discussions with Graphite One. Five spectrally matched ground motion time histories were evaluated concerning site response using a simplified 1D column model. A single-time history was evaluated as part of the 2D numerical modeling performed in FLAC.

The WMF-filtered tailings were first modeled in FLAC to design ground motion using the elastic-perfectly plastic Mohr-Coulomb model. Seismic deformation modeling using the Mohr-Coulomb model is widely known to poorly represent accumulated excess pore pressure and displacements associated with the seismic ground motion. The results from a seismic deformation model using Mohr-Coulomb are considered to represent a worst-case scenario, at best. However, a Mohr-Coulomb model is developed first with a more specific, primary objective of ensuring the numerical and geometric components of the model are properly capturing and transmitting the seismic energy from the input ground motion. The Mohr-Coulomb model does, in fact, represent a critical step in the numerical model development before proceeding to more advanced analysis using more representative constitutive models.

Overall, the seismic deformation analysis using the Mohr-Coulomb constitutive model indicates that the WMF structure remains stable with no evidence of conditions leading to an uncontrolled release of impounded tailings or progressive failure modes.

Seismic deformation of filtered tailings was then modeled in FLAC with the PM4Sand constitutive model (Boulanger & Ziotopoulou, 2023). The PM4Sand model is considered more representative of the dynamic drained and undrained stress-strain response of sand-like materials in geotechnical earthquake engineering applications. PM4Sand was developed to help obtain reasonable approximations of undrained monotonic shear strengths, undrained cyclic shear strengths, shear modulus reduction, and hysteretic damping responses. The advanced constitutive model PM4Sand is implemented via the dynamic module of the FLAC software under an undrained scheme to best represent excess pore pressure generated during earthquake motions, nonlinearity in soil behavior, hysteretic displacements, and the sub-yield accumulation of inelastic strain.

The Mohr-Coulomb and PM4Sand constitutive models demonstrate that the WMF is resilient to seismic loading with no evidence of structural failure or conditions leading to uncontrolled tailings release. Figure 18-11 presents total displacement contours generated after the WMF has stabilized following seismic loading in the PM4Sand model. Maximum displacement magnitudes on the order of 0.4 m suggest slumping as the dominant failure mechanism at the downstream toe of the waste rock perimeter embankment with no triggering of flow liquefaction. The seismic deformation analysis supports the structural integrity of the WMF under the applied design earthquake scenario.

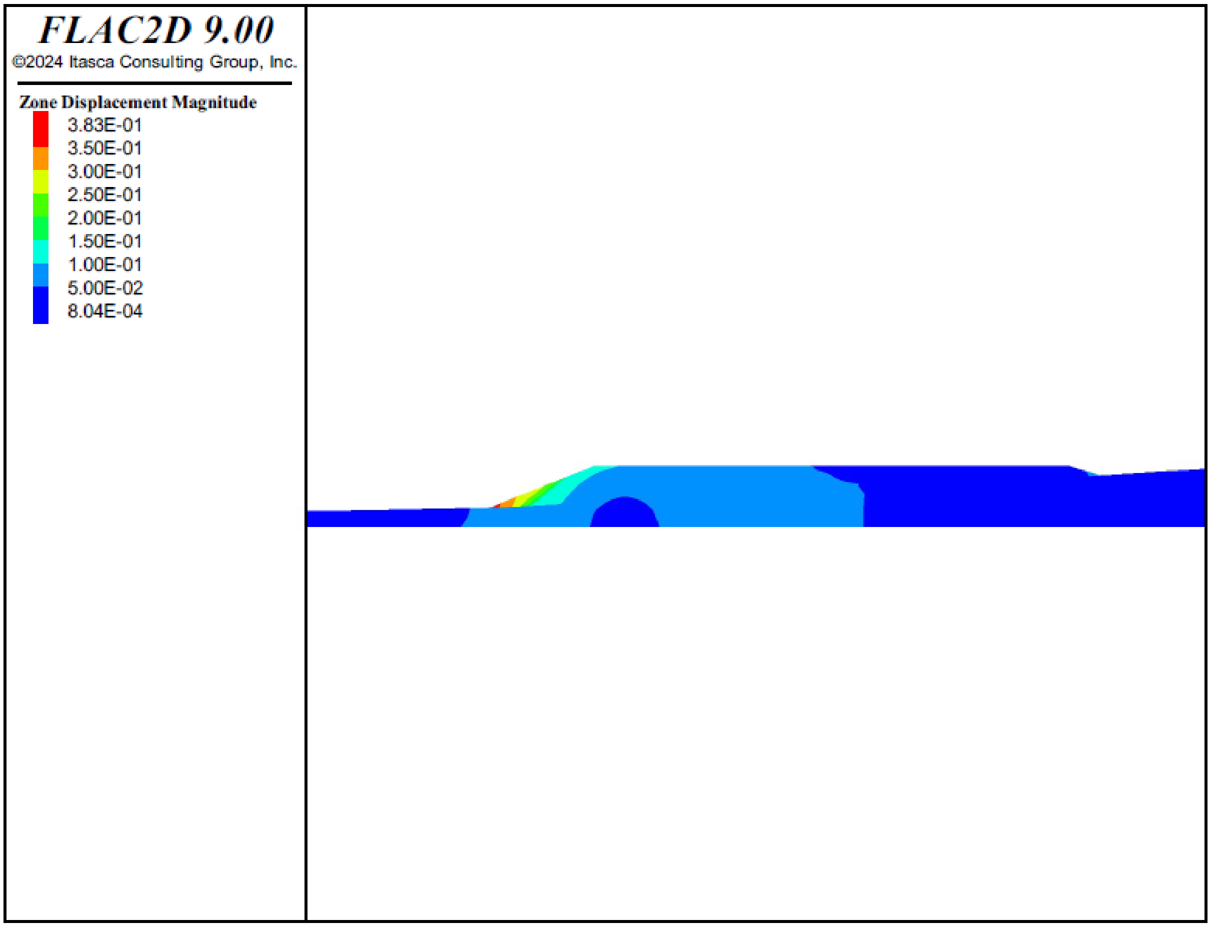


Figure 18-11 Total Displacement Contours Generated after the WMF has Stabilized Following Seismic Loading in the PM4Sand Model (Displacements in m)

18.1.10 Site Development Sequencing

The buildout of the mine site will occur in three distinct development phases. These phases are closely linked to the water management strategy and are intended to minimize contact water generation throughout the life of the mine. The largest infrastructure element and the one driving all others will be the WMF. Aside from geotechnical stability, the guiding philosophy for its development will be one of phased construction and progressive closure. The first phase of the WMF, the mill facility construction and initial pit development, will involve the most land disturbance. However, they will not require the diversion of or interference with any major creeks. Some crossings will be established for roads, but the creeks will maintain their natural course throughout the first five years of mine development and operation. Best management practices will be followed to limit ground disturbance, erosion, and sediment movement across the project property. As the pit and WMF footprints grow, an upstream diversion facility is planned for Graphite Creek to avoid interfering with the growing mine pit in the highlands and the expanding WMF footprint in the lowlands. The three major development phases are described in more detail below, followed by a description of the closure and post-closure strategy (years listed are based on the current ore processing schedule and associated waste generation forecast and are likely to be refined throughout the LOM to incorporate more accurate operations data).

- Site construction and phase 1 of the WMF (Year 1-5)
    - The initial development phase will include mill site construction, haul road construction, and general water management infrastructure, including stormwater collection and contact water ponds. Initial mining and pit development, primarily to the west of Graphite Creek, will also occur within this first development phase. Access to the western reaches of the pit will entail the crossing of, but not the interference with, Graphite Creek. After establishing the WMP and PP, the land clearing, foundation development, and liner installation for the first phase of the WMF will begin. This first phase of the WMF will cover approximately 30% of the final WMF footprint.
    - This first phase of site development will also include establishing all run-on diversion channels to limit additional contact water flowing into the pit, WMF, and onto the mill pad and roads.
- Phase 2 of the WMF expansion and Graphite Creek diversion (Year 6-12)
    - The second phase of site development will expand the footprint of the WMF into its second cell while sequentially closing and covering the initial phase. This represents increased land disturbance and a net reduction in contact water generation potential, as the first phase cover will only generate non-contact water. Some internal drain down is expected from Phase 1, which will be collected by the WMF base liner and treated with other contact water. Roads and infrastructure will undergo minimal expansion during Phase 2 since most will occur within the already disturbed areas' footprints.
    - Due to the expanding open pit and WMF growth planned during Phase 2, the diversion structures on Graphite Creek will need to be established to intercept the creek above areas of development. The diversion structure and conveyance piping are designed to direct creek flow to the west of mine operations to join Glacier Canyon Creek, approximately 2 km upstream of the current natural confluence with Graphite Creek. This

will entail a permanent water diversion dam and inlet structure to be established upstream of the pit boundary at an elevation of 332 m AMSL. Stream flows will be diverted into two HDPE diversion pipes for conveyance around downstream mining operations.

    - This phase will also include the final buildout of the WMP to achieve the final capacity needed for contact water management. The facility is sized to contain a 100-year 24-hour storm from all exposed facilities and maintain it on site until it can be treated and discharged to Glacier Canyon Creek watershed downstream of all operations.

- Phase 3 of the WMF expansion and full pit buildout (Year 13 - Closure)
    - This last phase of development will include the final expansion of the WMF facility to accommodate the remaining scheduled waste and tailings until closure. This phase also includes the cover and closure of the second phase of the WMF in order to limit additional contact water generation. After the cover is complete for Phase 2, only the third phase of the WMF will be exposed to atmospheric water, as the earlier phases will be covered and shedding stormwater as non-contact water. Some drain-down moisture will continue to be collected from within the first two phases after cover placement, and the water balance will significantly reduce contact water after the covers have been installed. The pit will also expand to its final extent during this last development phase.

18.1.11 Site Water Management

18.1.11.1 Introduction

The project's northern boundary abuts Bering Straits Native Corporation land, which abuts the Imuruk Basin. This shallow tidal estuary connects to the Bering Sea via the Tuksuk Channel, Grantley Harbor, and Port Clarence. The terrain gradually ascends from the Imuruk Basin toward the Kigluaik Mountains, reaching elevations of up to 1190 m AMSL. The proposed project site would be positioned at elevations ranging from 40 m in the northern lowlands to 400 m along the base of the Kigluaik Mountain range. The site straddles Graphite Creek, a small watercourse flowing down the western slopes of the mountains and joining the Glacier Canyon Creek before emptying into the Imuruk Basin.

The project site will occupy a maximum footprint of 4,545,000 m^2 within the Graphite Creek and Glacier Canyon Creek watersheds with no more than 2,300,000 m^2 being disturbed at any given time. Since non-contact water will be diverted around operational areas, the site water balance focuses on the atmospheric water that falls within the active operational footprint at any given time during the mine life.

Rain falls throughout the year, mostly occurring between July and November with the peak typically in August. The average snowfall within the project area is around 1,200 mm per year, but its accumulation and water content are largely determined by less predictable wind and snowdrift behavior. Snow generally falls between October and April with the peak typically occurring in December with recorded drifts as high as 2.1 m (Kuna Engineering, 2024). For water balance purposes, average rainfall and snow water equivalent were combined to model the atmospheric water contribution to the site water balance.

Geochemistry

The geochemical characterization of the mine site reveals significant potential for acid generation and metal leaching. Waste rock samples predominantly show PAG characteristics with 73% classified as PAG. Humidity cell tests indicate rapid onset of acidic conditions in some samples, while others with higher carbonate content show longer lag times (SRK Consulting Inc., 2022). Tailings samples exhibit low-sulfide concentrations but limited neutralization potential with some classified as PAG. Both waste rock and tailings contain elevated levels of several metals compared to crustal averages. Synthetic flocculation extraction and humidity cell tests demonstrate the potential for metal mobilization under acidic conditions, particularly for elements such as aluminum, cadmium, copper, and zinc. While some samples show buffering capacity, the overall geochemical profile suggests careful management and monitoring will be necessary to mitigate potential environmental impacts during operations and closure. Ongoing testing is essential for accurate long-term predictions and to validate the selected mitigation strategies.

18.1.11.2 Water Balance

A LOM water balance model was developed for the mine site using GoldSim® software. The model incorporated climate time series inputs developed by SRK Consulting, Inc., using Daymet to incorporate meteorological data from a station located at Mosquito Pass with historical data obtained from NOAA stations situated on the Seward Peninsula. The climate time series used in the water balance analysis spans from 1980 through 2022 (Tundra Consulting LLC., 2024). Climate data collection at the site began in April 2024 and, at the time of writing, did not yet provide meaningful meteorological insight for this water balance model.

The water balance model is based on the current water management plan, including the WMFs progressive development and cover strategy. The model was used to predict water use, surpluses, deficits for the site, and to size the mine water management infrastructure. The water-related infrastructure included a WMP, WTP, ore processing plant and PP, and WMF. The sizing and sequencing were projected over the 23-year mine life through closure and post-closure, including the eventual filling of the mine pit with atmospheric water contribution.

All operation phases are expected to generate contact water from the mill infrastructure and precipitation falling directly to the WMPs. Variable inputs to the water balance will come from the increasing size of the open pit and the contact water generated from the active footprint of the WMF (both runoff and captured drain down from the stored mine waste). The first phase of the water balance will include core infrastructure runoff, the active pit, additional contact water, and drain down from the first phase of the WMF. The second phase of the water balance considers the core infrastructure, the enlarged active pit surface, and runoff from the second phase of the WMF (the first one being covered and shedding rainfall only as non-contact water with limited drain down continuing). In the final stage of development and operation, the water balance considers all core infrastructure, the final pit footprint, and the final stage of the WMF (the first two being covered and shedding only non-contact water with only limited drain down). The three phases of the WMF development were incorporated into the model according to the mine plan schedule based on exposed open-pit and generated mine waste, in addition to dewatered tailings generation.

The closure configuration of the water balance model represents the removal and remediation of all mine infrastructure with the WMF being completely covered and remediated. Only the pit will remain open and exposed to precipitation after mining. The water diversion structure on Graphite Creek will remain in place in perpetuity, preventing additional contribution to the post-closure water balance. Beginning in year five, construction of the upstream diversion structure will begin on Graphite Creek to prevent the surface water flow from coming in contact with the ground disturbance and waste placement associated with mining in the watershed below.

The schematic in Figure 18-12 identifies all sources of contact water entering the water management system leading to the WMP prior to treatment and final discharge point into the Graphite Creek watershed downstream of the WTP. The contact water within this schematic boundary was the basis for the GoldSim water balance model (Figure 18-13). The largest water input to the water balance is the atmospheric contribution, which generates increasing stormwater runoff from the pit and WMF as their footprints increase throughout the mine life. Lesser contributions are generated from the process pad and road runoff with a relatively small contribution from pit wall groundwater seepage.

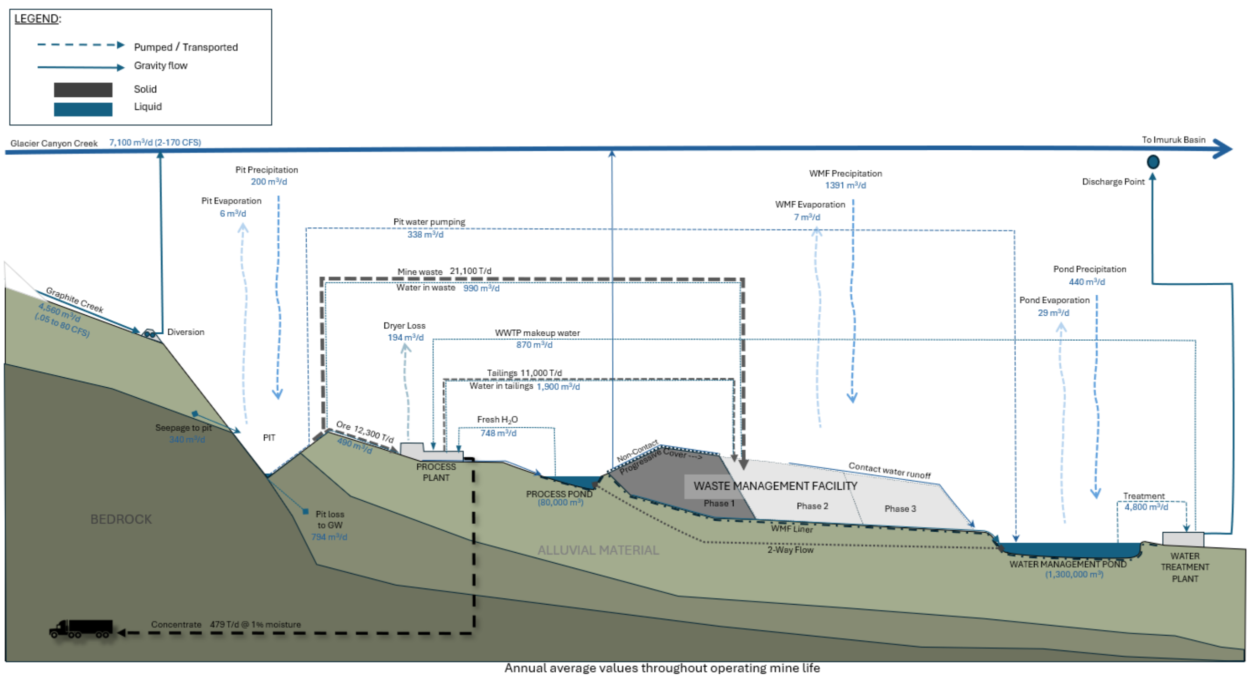


Figure 18-12 Graphite Creek Project Water Balance Schematic

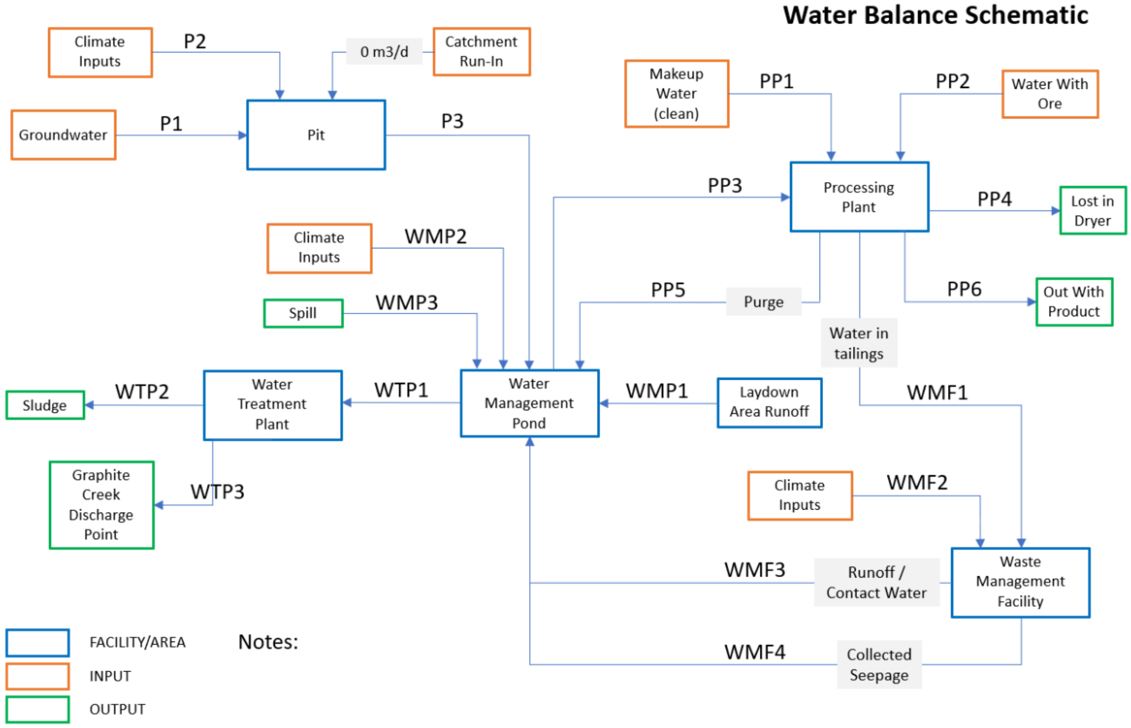


Figure 18-13 GoldSim Water Balance Model Schematic

18.1.11.3 Site Water

All water management infrastructure will be established on the northern slope of the Kigluaik Mountains and into the lowlands, descending north toward the Imuruk Basin. With the exception of the access road, all facilities will be located within the Graphite Creek watershed, a subunit of the Glacier Canyon Creek watershed. The primary facilities are the open mine pit, mill and associated facilities, and a WMF. Stormwater will be managed to minimize contact with infrastructure and ground disturbance. Water that comes in contact with the operation will be collected and retained until it can be adequately tested and/or treated before release to the environment. The exposed contact water-generating surfaces will be minimized through the progressive development of the minimum footprint necessary for each construction and operation stage, followed by a sequential covering of each area as soon as practical. This includes a progressive closure approach to the WMF in which only one-third of the total footprint will operate at any given time and will be closed and covered as the next phase comes online. While there will be some periods of expanded exposed liner during the transition between phases, this approach will significantly reduce WMF contact water generation over the LOM.

The key non-contact water management infrastructure will include upstream Graphite Creek diversion (around mining activities) and stormwater run-on intercept channels for all active ground disturbances. Contact water collection will be established for the pit, the WMF, and all roads and hardened surfaces. The contact water storage system will include a process water pond adjacent to the process plant and a large WMP downstream of all mine-related activities. The ponds will be sized to contain all contact water on site until treatment and discharge back to the watershed downstream of all facilities.

18.1.11.4 Surface Water

The two existing surface water features requiring active management are Graphite Creek and Glacier Canyon Creek (Figure 18-14). Both creeks flow north and west out of the Kigluaik Mountains and into the lowlands, where they combine and flow another 2.6 km before discharging into the Imuruk basin. Though Graphite Creek flows directly through the pit final footprint and the WMF final footprint, neither immediately interrupt the creek's flow or require significant alteration in the early stages of development.

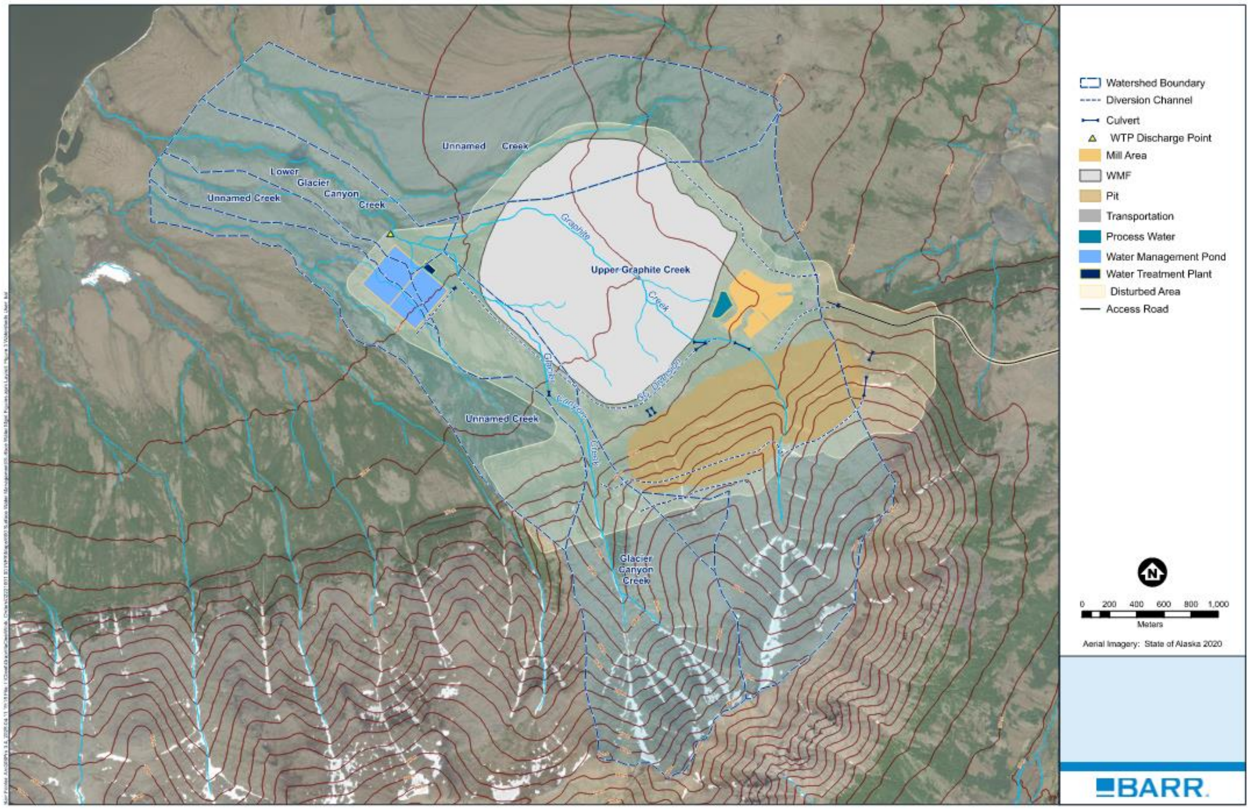


Figure 18-14 Graphite Creek Regional Watersheds

The mine's 23-year development plan begins in Year 1 with early development works. This initial development through Year 4 of operation will only require surface water management and avoidance but no outright diversion of existing streams (Figure 18-15). The mill site, the initial pit excavation, and the first phase of the WMF will avoid existing creeks and rely on best management practices to limit any erosion or sediment generation. According to the mine plan, Graphite Creek will not need to be diverted until near the end of Year 5 of the mine life.

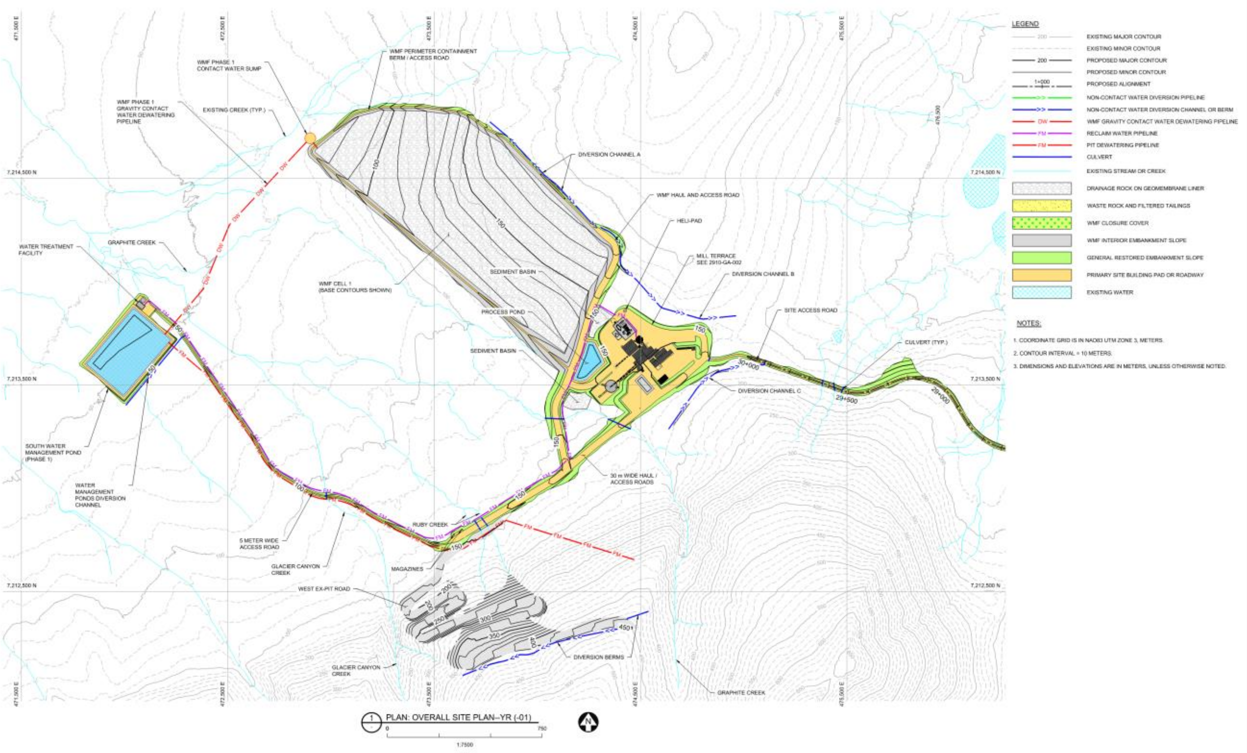


Figure 18-15 Initial Site Development (Years -01 to 04)

By the beginning of the sixth year of mine development (end of Year 4), land preparation for the second stage of WMF expansion will begin in the lowlands, and the deepening mine pit will start to interfere with the flow of Graphite Creek (Figure 18-16). This will initiate the diversion of Graphite Creek around active construction areas in the lowlands. Later in this second development phase, the pit will physically extend across the natural course of Graphite Creek. This second phase of pit and WMF development will require establishing a permanent creek-diversion structure above (upstream from) the pit to minimize the contact water that must be managed. Graphite Creek diversion will serve to convey all creek flows to the west, around the pit or other land disturbance, and into the existing channel of Glacier Canyon Creek upstream of its existing confluence with Graphite Creek. Immediately upstream of the WMF, a smaller diversion structure will remain in place to capture the remnants of Graphite Creek that continue to collect below the permanent diversion structure and any fugitive flows that could otherwise affect WMF construction. This lower diversion ditch will serve to intercept potential run-on to the WMF from springs or sheet flow entering the lowlands from the south.

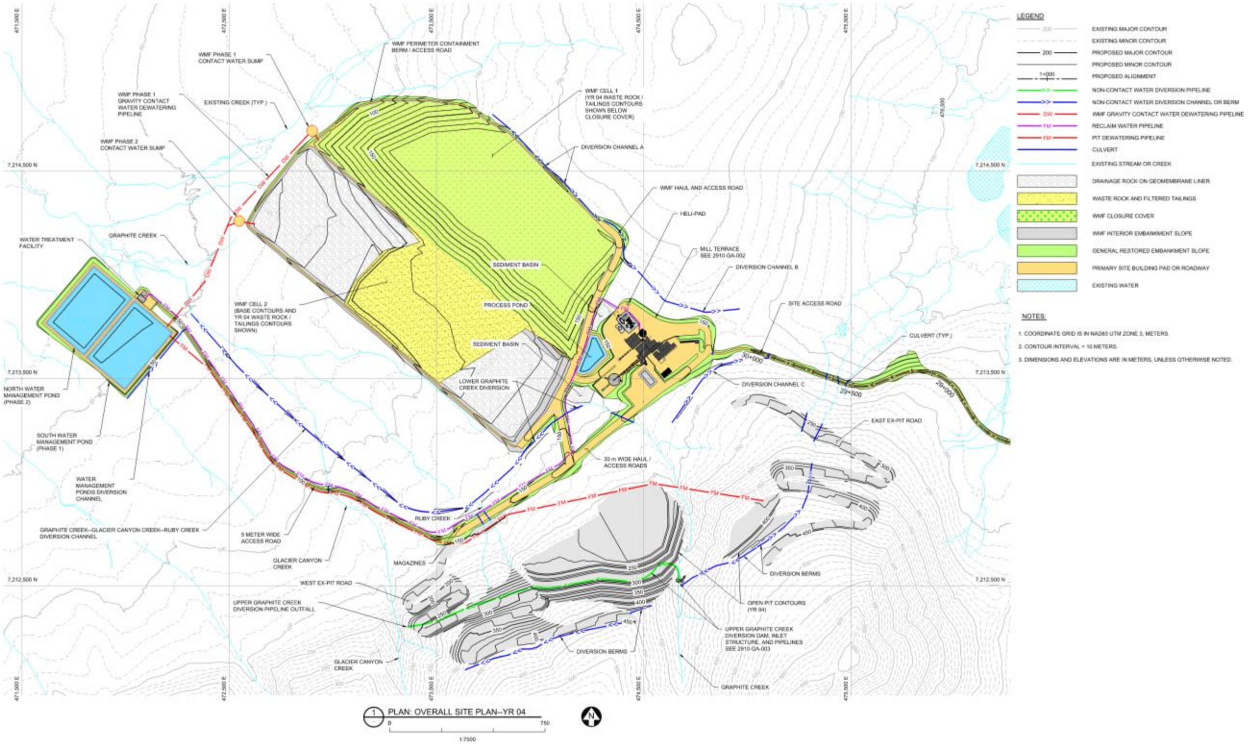


Figure 18-16 Phase Two WMF Development with Graphite Creek Diversion (Years 04 to 11)

The second and final configuration of the surface water management system will include the permanent diversion of Graphite Creek. The main creek-diversion structure will be established just upstream and immediately south of the final pit excavation with a crest elevation of 332 m AMSL. Ruby Creek and other minor drainages from the highlands either go subsurface upon entering the lowlands or will be intercepted by the WMF perimeter channel and diverted to the west into Glacier Canyon Creek.

In the later years of mining when the WMF reaches its full, final footprint (Final WMF footprint, Figure 18-17), the original water course of Glacier Canyon Creek may need to be redirected to the west around the toe of the facility to ensure WMF structural integrity and creek water quality. This minor diversion of Glacier Canyon Creek is designed and planned for, but since tailings characteristics and waste rock expansion factors may be conservative enough to avoid this modification. The most conservative mine plan indicates that the western toe of the WMF will begin to extend across the current creek path in year 13 of mining. If necessary, at this time, the Glacier Canyon Creek channel will be redirected approximately 200 m to the west of its current course to prevent interaction.

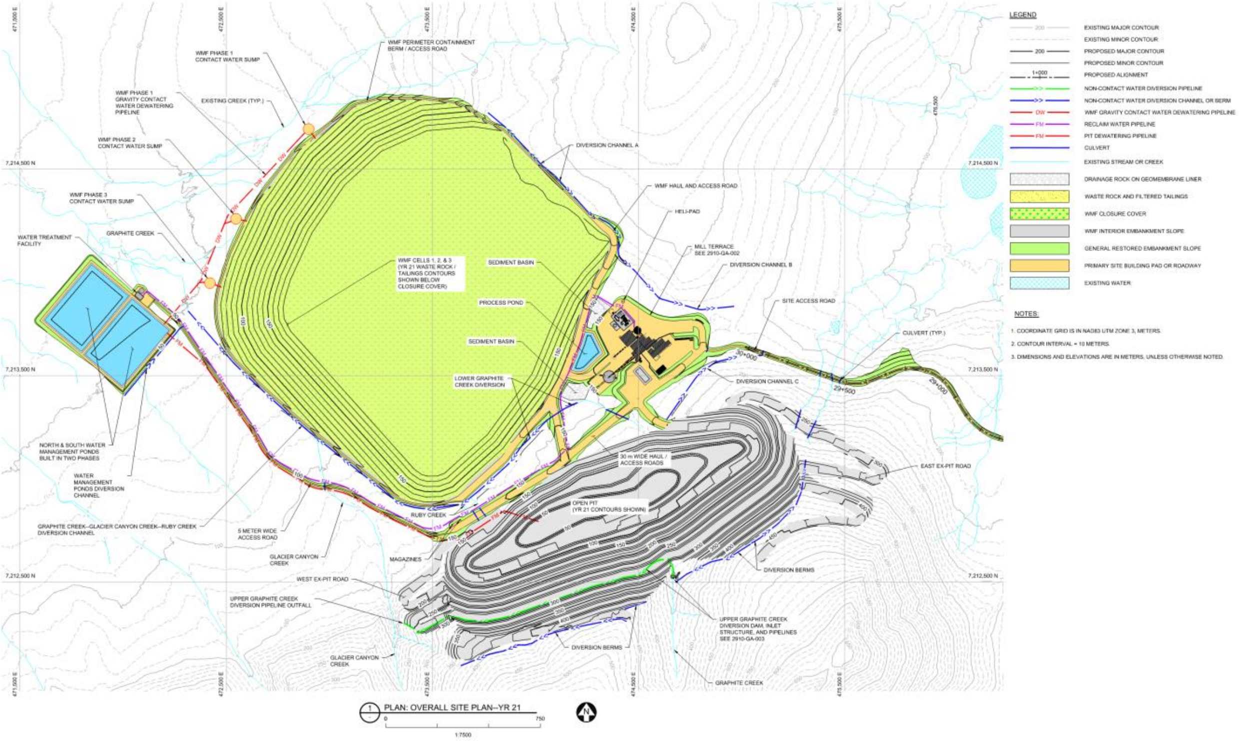
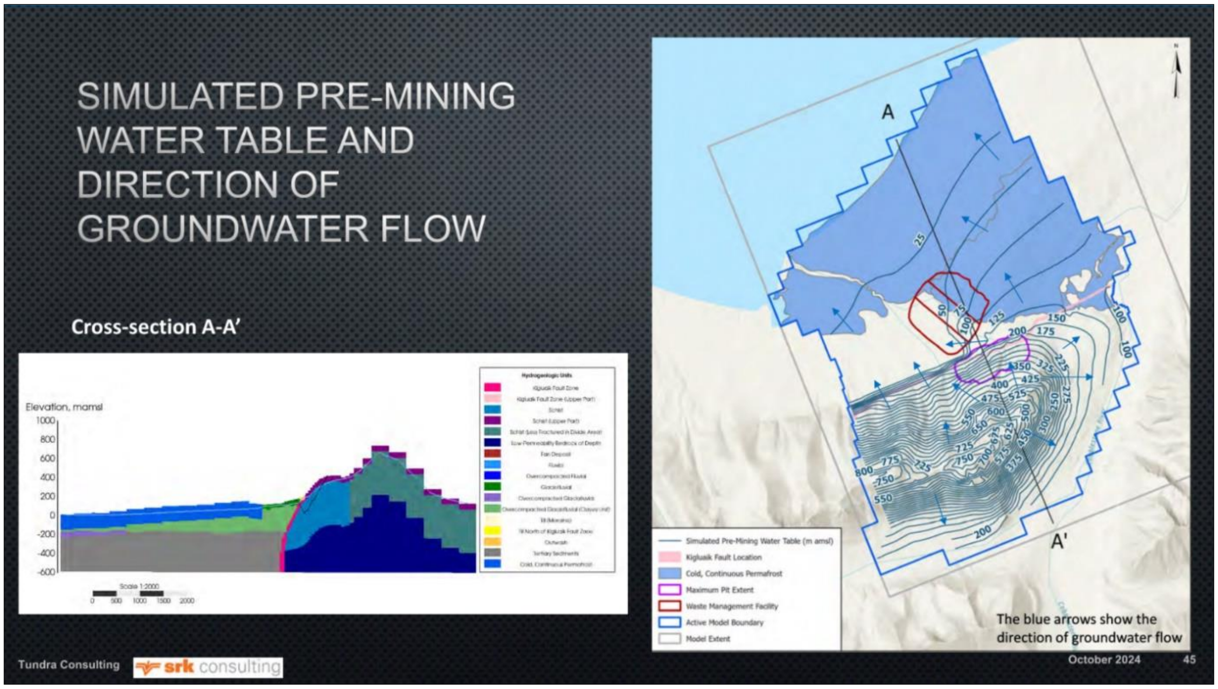


Figure 18-17 Final Buildout and Water Management (Year 21)

18.1.11.5 Groundwater and Permafrost

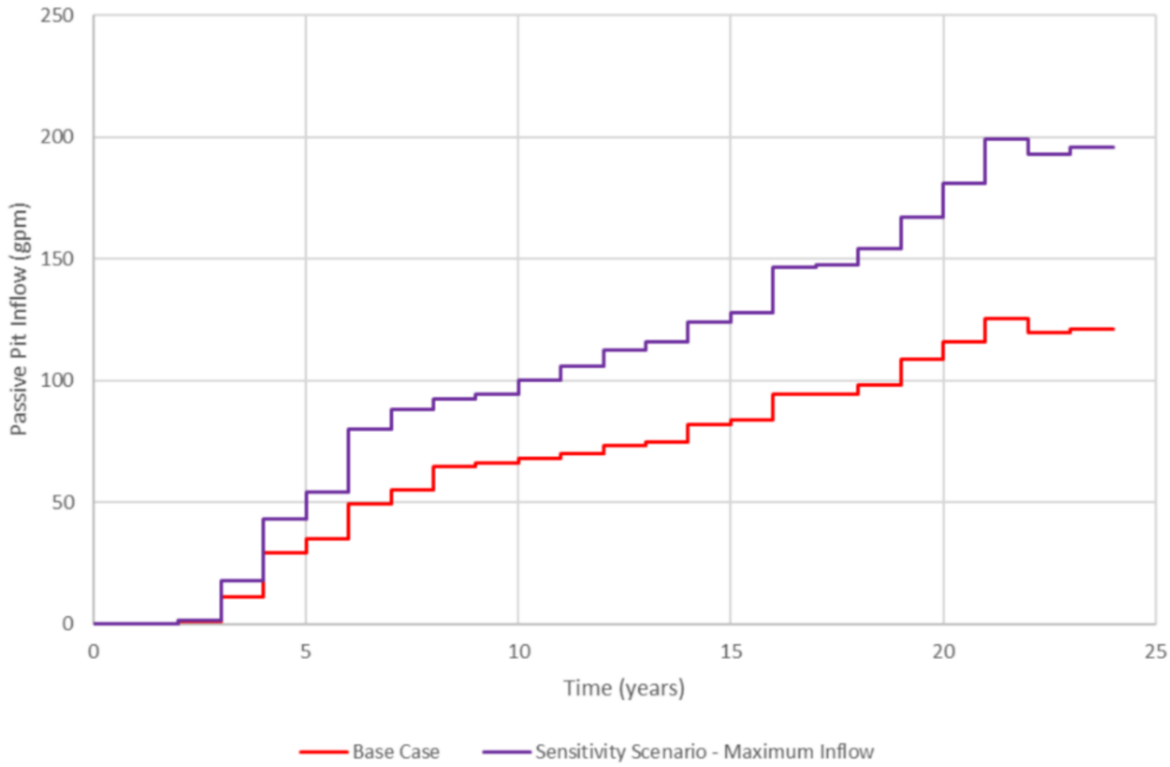
Using available wells and borings, groundwater has been assessed, monitored, and modeled to determine its likely behavior and impact on the water management strategy at Graphite Creek (Tundra Consulting LLC., 2024). The groundwater gradient is generally from the highlands in the south down into the glacial till of the lowlands in the north with inconsistencies across the Kigluaik Fault running laterally (east-west) through the open pit. The fault tends to restrict flow from the bedrock into the glacial till of the lowlands, leading to some lateral and vertical flow patterns in this zone. The current groundwater model (Tundra Consulting LLC., 2024) provides visualization of the groundwater flow gradients and identifies permafrost across the project site (Figure 18-18).



Source: Tundra Consulting LLC. (2024)

Figure 18-18 Regional Groundwater Gradients and Permafrost Mapping

The regional hydrogeologic model was also used for groundwater inflow from pit walls throughout the LOM. Groundwater is present at varying depths across the mine site but will only be operationally encountered within the pit footprint. When pit excavation begins, groundwater seepage is predicted to increase in relation to the surface area of exposed water-bearing rock layers. Figure 18-19 indicates the expected groundwater production within the pit throughout the mine life with a maximum inflow of approximately 682 m^3/d (125 gpm) near the end of mining as the pit footprint reaches its maximum extent.



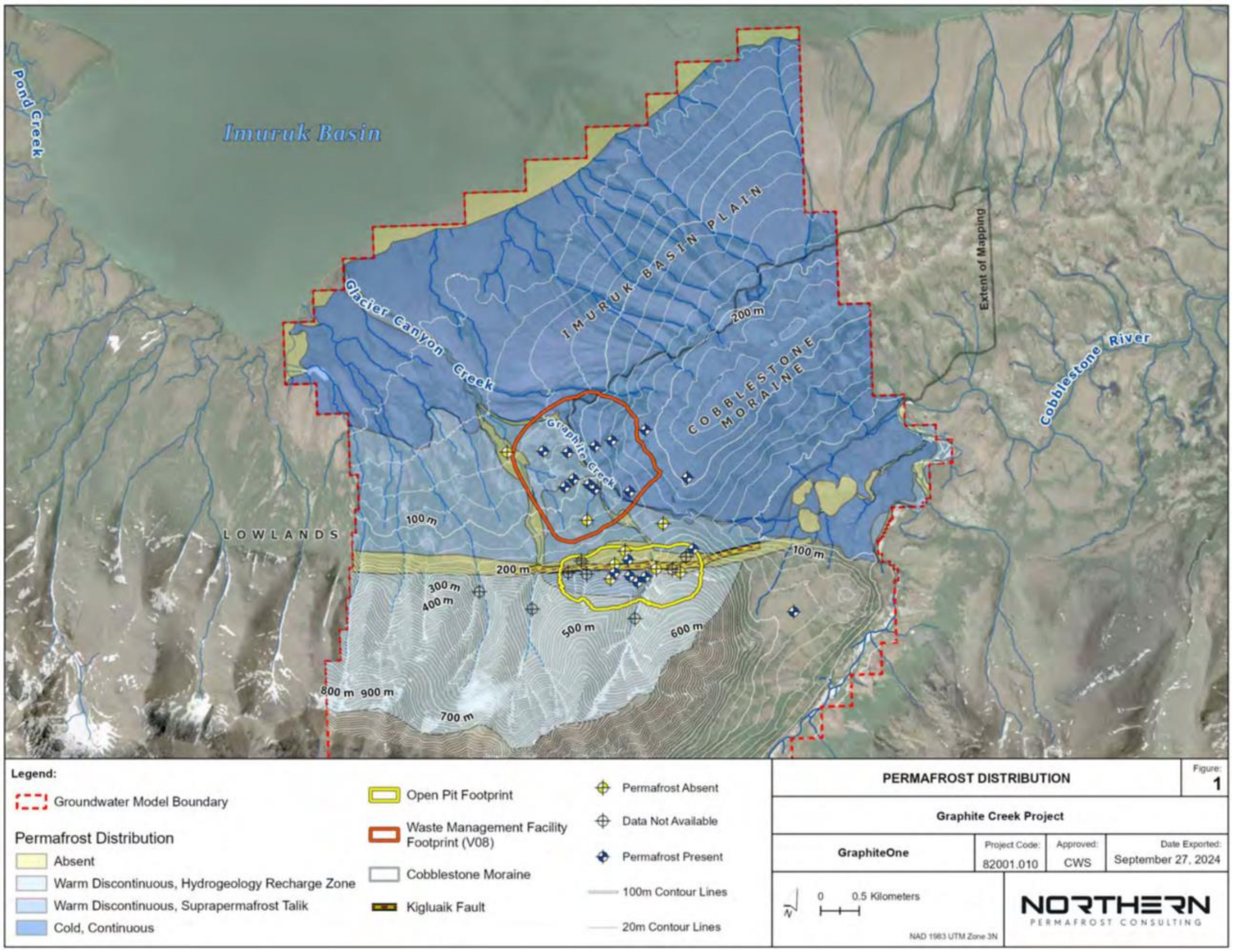
Source: Tundra Consulting LLC. (2024)

Figure 18-19 Pit Pumping Projection

This groundwater inflow represents a relatively minor contribution to the overall water balance compared to the annual precipitation that falls within the project footprint. For the purpose of water balance modeling, all potential run-on flows will be intercepted by diversion berms and ditches and conveyed around all land disturbances. Only atmospheric water and groundwater inflows will contribute to the contact water inventory. All water collected in the pit is considered contact water and will be directed by gravity or pump to the WMP prior to treatment throughout the mine operation. At closure, water pumping from the pit will cease, and a pit lake will form over time. Given current permeability data within the pit, regional groundwater modeling indicates that the pit surface will find equilibrium with the groundwater infiltration and precipitation at a pit lake elevation of 128.5 m AMSL, or 19.5 m below the pit's spill elevation (Tundra Consulting LLC., 2024). GoldSim water balance modeling considers a wide range of possible storm conditions with a fixed outflow to groundwater of 2,539 m^3/d (466 gpm). These parameters suggest that there are scenarios in which the pit could continue to fill above this predicted equilibrium elevation. Due to freeze-thaw cycles, uncertain permeabilities at the pit's extents, and climate change, overflow of the pit is a possibility in the post-closure period but is not considered to be the base case. A closure strategy was developed to manage a pit lake over the long term and accounts for either the equilibrium elevation at 128.5 m or one of gradual filling over the next 75 years. This flexible approach allows for the likelihood that a better understanding of the geology and the climate will emerge over the course of mine operation. Section 18.1.12.1 provides more detail on the pit closure strategy.

Characteristic of an arctic tundra ecosystem, the area features intermittent permafrost covered with low-lying vegetation primarily consisting of shrubs, grasses, and lichens. Groves of low-growing alder tree cover tend to indicate a lack of underlying permafrost, but the correlation is not consistent. Some exposed areas were noted as having deep permafrost, and others showed very little. It is inferred to be absent along the mid and upper stretches of Graphite and Glacier Canyon Creeks.

Permafrost encountered within the mine development footprint is expected to continue warming over the LOM due to climate trends and direct land disturbance associated with land development (Figure 18-20). This potential meltwater could contribute to impacted water that needs to be accounted for and managed as part of the site water management plan. If permafrost thaw does occur beneath the WMF, the sub-drainage layer below is designed to direct excess subsurface flows to a downstream testing point where they can be evaluated for either capture in the WMP or released to the watershed, depending on quality.



Source: Tundra Consulting LLC. (2024)

Figure 18-20 Permafrost Distribution at Graphite Creek

18.1.11.6 Water Management Ponds

The water management system is developed to provide enough storage capacity to contain runoff from all operations (pit, mill, WMF, and all site roads) for treatment. The storage facilities are split into two separate ponds—one primarily to feed operational needs and one to collect all contact water before treatment.

The PP is located adjacent to the mill and has sufficient capacity (80,000 m^3) to provide all source water needed to operate the mill facility. The PP is also sized to maintain the freeboard necessary to receive all runoff from the mill area and drain the entire mill facility's capacity during a full shutdown.

The WMP is the larger of the two contact water containment facilities and is located near the toe of the WMF, downstream of all operational facilities. Its total capacity is 1,300,000 m^3. The WMP is sized to receive contact runoff flow from the facility during the 100-year 24-hour storm event, including a 1.0 m freeboard, sized according to water balance calculations for a seven-month treatment and discharge period. Future studies will confirm WTP operating months and adjust storage requirements accordingly. An emergency spillway will be constructed in the natural ground at the pond's southern end.

18.1.11.7 Graphite Creek Diversion

The open pit will eventually extend across Graphite Creek's existing flow path. To mitigate flooding risks and reduce dewatering requirements within the pit, the creek will be diverted around the open pit after the footprint begins to encroach on the creek's natural watercourse (expected around Year 4 of mining). The diversion will be accomplished using a concrete headwall structure and two buried 1.2 m (48 in) HDPE pipelines. The headwall structure will be situated above the pit's southern highwall at an elevation of 340 m AMSL, as illustrated in Figure 18-21. The diversion pipes will be located on a designed safety bench in the southern and western highwalls of the pit, maintaining a minimum grade of 1%. The bench will also have an adjacent open overflow ditch to manage extreme storm flows that may temporarily exceed the pipe capacity. To maintain its capacity and preserve slope integrity, the overflow ditch will remain empty except during extreme weather events. At the downstream terminus of the diversion pipeline, the flow will receive energy dissipation prior to discharge into an undisturbed portion of Glacier Canyon Creek.

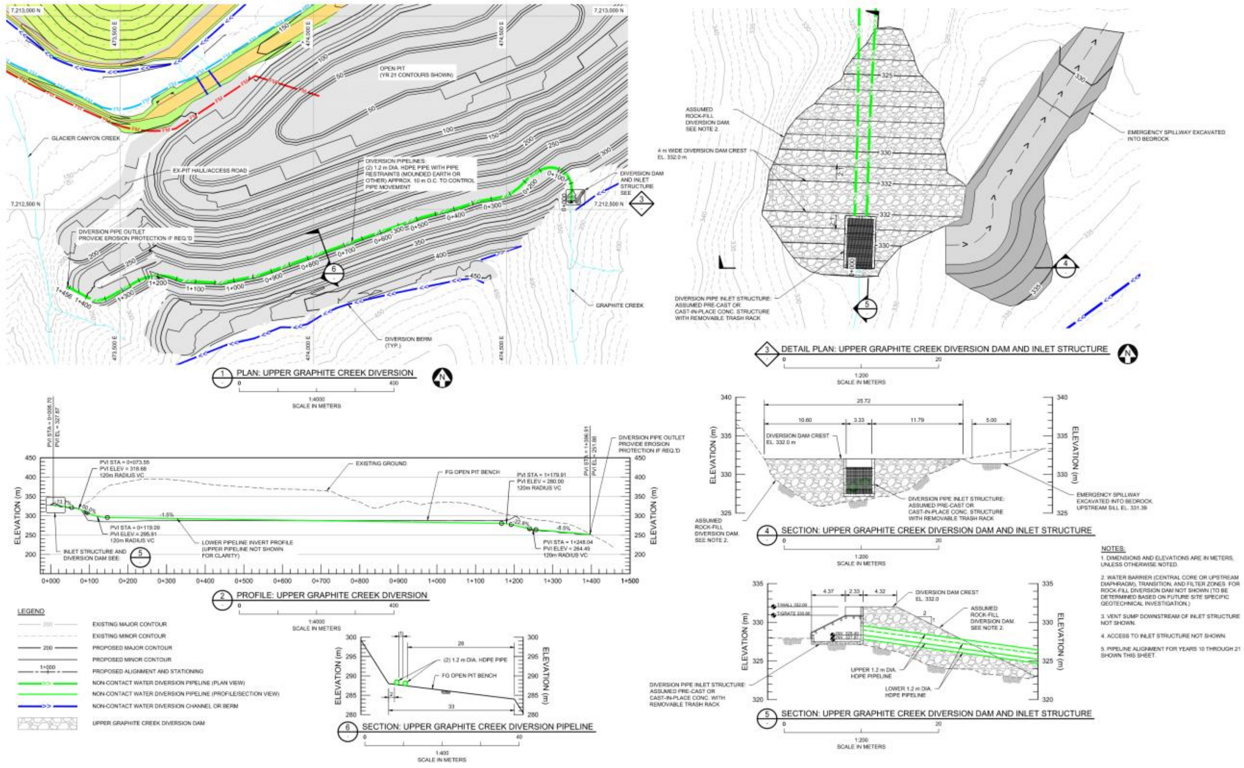


Figure 18-21 Graphite Creek Diversion

18.1.11.8 Diversion Channels and Collection Ditches

Smaller non-contact water flows and sheet runoff will be managed through a network of berms and diversion channels designed to route upgradient surface runoff around site facilities (pit, mill and facilities area, major roads, and WMF). These channels will redirect clean water away from operational areas to minimize the volume of water requiring active management and treatment. Diversion channels for the WMF will be positioned upslope and graded at a minimum 0.3% slope toward north and south to divert upslope non-contact water around the WMF.

Collection ditches will be established downgradient from all disturbed or operational areas to collect potentially impacted runoff and convey it to the PP or the WMP. The WMF collection ditch will be located downslope of the active face along the toe to collect runoff and direct it to the WMP. This water management system handles contact water properly, minimizes environmental impact, and optimizes water treatment processes.

18.1.12 Erosion Management and Sediment Control Strategies

Erosion and sediment management strategies will be implemented to control surface water runoff, stabilize disturbed areas, and restore vegetation after stabilization. Progressive vegetation clearing, topsoil stripping, and storage will be practiced during the development and operation of all mine facilities. Sediment-control measures will be installed before construction minimizing disturbances and reducing water velocities on exposed surfaces, and standard stormwater best management practices will be employed throughout the operation.

18.1.12.1 Topsoil Stockpiles

Topsoil stockpiles will be strategically positioned within or near the final footprint of the WMF to expedite contemporaneous capping and closure of the WMF. These piles will preserve topsoil material excavated from the facilities and mill areas, roads, pit, WMF, and WMP. The topsoil piles will be seeded for effective topsoil management.

18.1.12.2 Material Borrow Sources

An alluvial material borrow source and stockpile will be established and maintained within the final footprint of the WMF and will be used to balance excavated material from the WMF, pit, and infrastructure construction. This engineered stockpile facility is designed for temporary, secure confinement of overburden and topsoil. The stockpiles will serve as a source for suitable alluvial material to be managed selectively and utilized during operations as construction material as well as reclamation and cover material during closure activities. Key design functions incorporate runoff management through the implementation of berms and diversion channels to maximize runoff diversion around any exposed materials as well as control and collection systems for sediment-laden runoff during operations. Upon closure, the exposed disturbed footprint of the overburden stockpile will undergo revegetation as part of the site's reclamation plan.

18.1.13 Water Treatment and Discharge

The LOM water balance model, geochemical modeled source terms (Volden, 2022), and the estimated environmental discharge criteria (treatment goals) were used to develop a treatment strategy for milling and site contact waters.

The water balance included modeling with various wastewater treatment flow rates and indicated that a treatment flow of 4800 m^3/day would be necessary to maintain the WMPs below the freeboard elevations. Considering a maximum operation of 355 days per year and 95% availability, the design influent flow rate for the mine WWTP was set at 5,200 m^3/day. After treatment, water discharge will be to the Glacier Canyon Creek watershed immediately downstream of the WTP as shown just inside the project's northwestern boundary (Figure 18-22). Water will be discharged at the treatment rate through an HDPE pipeline with the flexibility to divert elsewhere for land discharge if necessary.

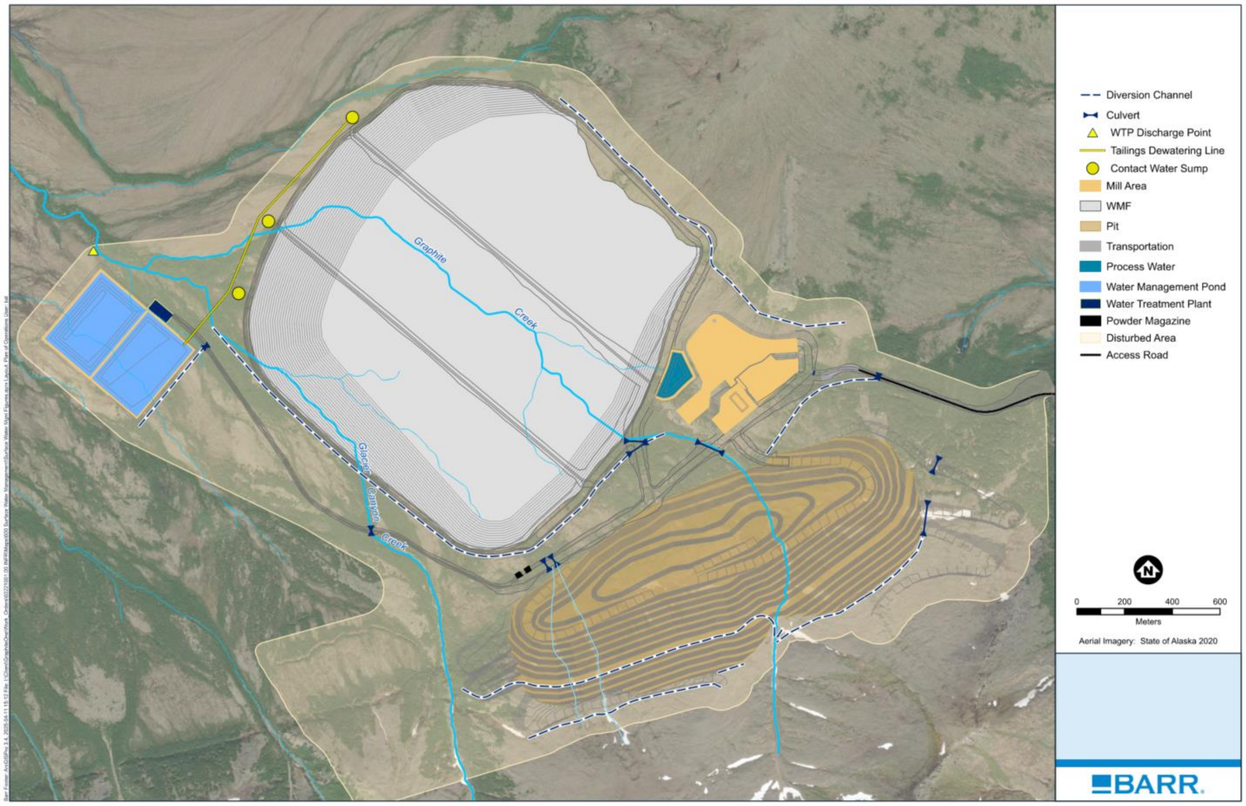


Figure 18-22 Project Boundary

WWTP influent water quality was based on geochemical modeling source terms (assuming 30% talus on the pit benches), which included pH, nitrate, nitrite, and 31 major ions and metals (Volden & Herrell, 2024). The source terms included both base-case and high-case annual concentration estimates for the WMPs during mine operations and after closure. The maximum high-case concentrations were used for the preliminary design of the WWTP equipment. The annual base-case concentrations for the WMPs were utilized to calculate yearly chemical consumption and sludge production rates.

The treatment goals for all anticipated constituents were assumed to be the most stringent of all standards provided in the Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances, dated September 8, 2022, or the 18ACC70 Water Quality Standards, dated November 13, 2022. For hardness-based parameters, the WWTP discharge was assumed to have a hardness of 25 mg/L as $CaCO_3$.

The treatment goals were screened against the maximum high-case WMPs water quality to identify 16 parameters that were above (or outside) the treatment goals for discharge, including pH, metals (aluminum, cadmium, cobalt, copper, iron, lead, manganese, nickel, silver, thallium, zinc), sulfate, selenium, and nitrate/nitrite. The WWTP processes were defined based on these 16 parameters, which may be above the treatment goals at peak concentrations in the WMPs.

Key aspects of the selected water treatment approach include:

- Providing a single WWTP for management of excess water from the WMPs
- Setting all water quality parameters to concentrations below the treatment goals is anticipated for the WWTP, which will include the following processes:
  - A lime high-density sludge (HDS) treatment system for pH adjustment, bulk removal of metals and sulfate, and membrane pretreatment. This process includes aeration and the addition of lime into mixed reactor tanks. Polymer is added to facilitate the settling out and removal of solids in a clarifier. The clarifier overflow is directed through multimedia filters for suspended solids polishing prior to pH neutralization with sulfuric acid. The liquid chemicals will be stored in totes, and the lime will be stored in a silo with a slaker for lime hydration
  - Membrane filtration is used to remove selenium and nitrogen species and to polish metals and sulfate
  - Remineralization of RO permeate with a calcite contactor tank prior to surface water discharge to increase the hardness and mitigate potential toxicity concerns of the permeate water quality

The WWTP would be temporarily idled when the WTPs reached a minimum level and resumed when sufficient volumes of water were available for treatment. WWTP idling would be more frequent and have longer durations early in the mine life and decrease as the footprint of the pit and WMF increases over time until closure.

WWTR residuals—including the lime HDS and the RO reject—will be conveyed to the tailings thickener during mine operations.

The WMF will be covered during closure, and the pit will be allowed to fill until it reaches steady state conditions below the surface water outfall.

18.1.13.1 Long-Term Water Management Approach

During operation, all contact water will be collected and held in lined ponds until treatment, prior to discharge to the Glacier Canyon Creek watershed downstream of the treatment plant (Figure 18-17). At closure, all mill facilities and site infrastructure will be removed and reclaimed. The surface area of the pond footprint will be covered with topsoil and revegetated to resemble the natural terrain at the project site.

The WMF will be progressively covered and reclaimed throughout the mine life such that its surface runoff will no longer be considered contact water or require treatment by the time of closure. Seepage collected from the WMF will be captured and treated during operation and will continue to collect at diminishing levels for several years after mine closure. During this time, the water treatment system will continue to be maintained and operated to treat the reduced flows.

The one piece of infrastructure intended to remain in perpetuity is the Graphite Creek diversion structure upstream of the mine pit. Water balance modeling and regional geologic groundwater modeling (Volden & Herrell, 2024) indicate that the pit will fill with seepage and direct precipitation to a level of 128.8 m AMSL (19.5 m below the pit edge) before it reaches equilibrium with subsurface groundwater. This filling is predicted to take between 50 and 75 years at currently understood precipitation and groundwater outflow seepage rates.

18.1.14 Concentrate Transportation Logistics

The supply chain for concentrate transport consists of multiple modes of transportation covering approximately 8,000 km from the mine site to the STP in Ohio. The chain will include year-round trucking to Nome, seasonal holdover at a storage facility in Nome, a container vessel from Nome to the Port of Prince Rupert in British Colombia, and finally, by unit train from Prince Rupert to the STP in Niles, Ohio.

18.1.14.1 Mine Site to Port of Nome

Dry (<1% moisture) graphite concentrate will be loaded directly into prefabricated, lined, 20-foot-long shipping containers at a rate of 22 containers each day. Containers will be loaded onto and offloaded from transport trucks using diesel-powered mobile-reach stacker container handling units. The site access road is envisioned to be maintained to allow for steady concentrate transport throughout the year. Design allocations have been made to store containers on site for two weeks to account for periods of inclement weather. A single truck and trailer will haul two containers per trip to the storage facility in Nome, near the port. This can be accomplished by having three trucks operating full-time. The trucks will also bring back two empty containers on each return trip.

A 24-acre container storage facility in Nome will facilitate the storage of concentrate containers for the entire year. Due to the seasonal freezing of the Nome port (October 1 to May 30), ship transport from Nome is limited to 124 days per year. During this time, all 8,200 full concentrate containers will be loaded onto ships, transported south, and exchanged for empty containers returning from the STP.

18.1.14.2 Marine Transportation from Nome to Prince Rupert, BC

The concentrate transportation plan assumes that the currently suspended USACE Port of Nome Expansion Project is restarted and completed. Completion of this project will allow for the use of self-loading container ships with a capacity of 875 full concentrate containers. Eight round trips with these ships will be required each season. During the shipping season, ships will transport the containers to Prince Rupert harbor in British Colombia (23-day round trip) for unloading, storage, and transfer to trains for the final rail leg of the supply chain. Two such ships will be required to operate during the shipping season to transport the necessary containers.

18.1.14.3 Rail Transportation from Prince Rupert, BC to Niles, Ohio

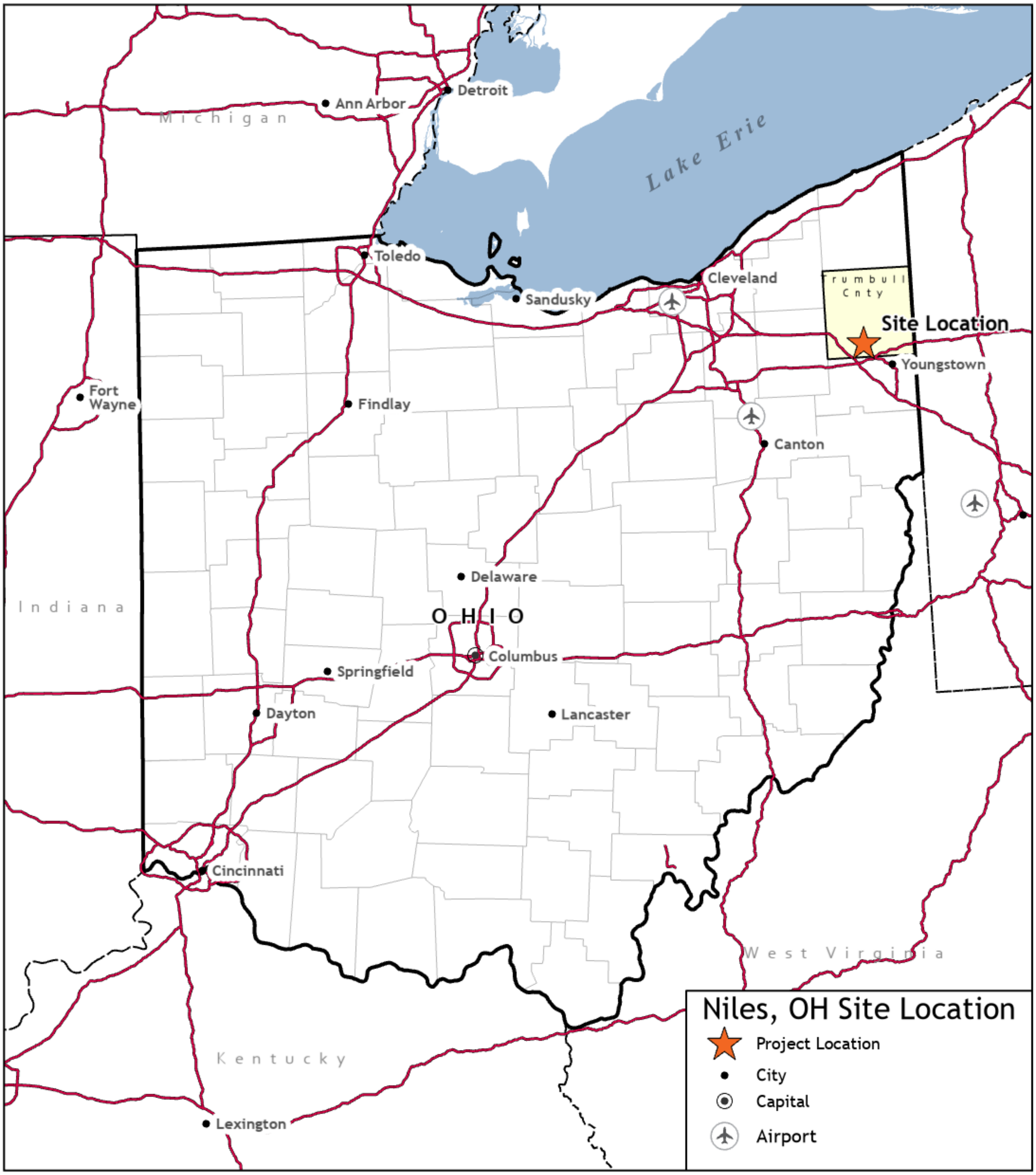
Unit trains from Prince Rupert will pull a maximum of 75 well cars with a capacity of three concentrate containers per car. This limit of 225 concentrate containers per train will require a minimum of 36 rail trips each season from Prince Rupert to Niles, Ohio. Each train will return from Ohio with an equal number of empty concentrate containers returned from the STP. These empty containers will be temporarily stored in Prince Rupert until a full shipment (1,650 containers) can be accumulated and loaded for return to Nome, where they will remain in storage through the winter freeze.

To maintain sufficient empty-container capacity at the mine site and full-container supply at the STP throughout the winter, a minimum of 5,400 containers must be maintained above and below the freeze line at all times. With the potential for delays throughout this concentrate supply chain, a total inventory of 12,500 concentrate containers needs to be maintained at all times.

18.2 Secondary Treatment Plant Infrastructure

18.2.1 Project Location

The project is expected to be located in Niles, Trumbull County, Ohio, approximately 7 miles SSE of the city of Warren, as shown in Figure 18-23. The site is located at 1590 Warren Avenue, Niles, Ohio, at approximately 41º 11’ North and 80º 47’ West, as shown in Figure 18-24. The Ohio site, shown in Figure 18-25, where improvements are being proposed, is approximately 34.4 ha (85 ac). Initially, two 25 ktpa modules are planned to be built at the Ohio site and is expected to occupy 34.4 ha (85 ac) and consist of 18 buildings. At the full 175 ktpa capacity, seven (7) 25 ktpa modules are planned to be built and expected to occupy 89.8 ha (222 ac) (which exceeds the current allocated plot) and consist of 88 buildings.



Source: Graphite One (2024)

Figure 18-23 Secondary Treatment Plant Location – Geographic

Source: Graphite One (2024)

Figure 18-24 Secondary Treatment Plant Location-Satellite

18.2.2 Means of Access

The proposed site is bounded to the east by railroad tracks owned by Norfolk Southern (previously by Penn Central/Conrail) Railroad, a manmade lake to the north by WCI Steel, and by the Mahoning River to the west and south. The proposed site is accessible by paved roadways and contains usable rail spurs. A site location map is presented in Figure 18-25.

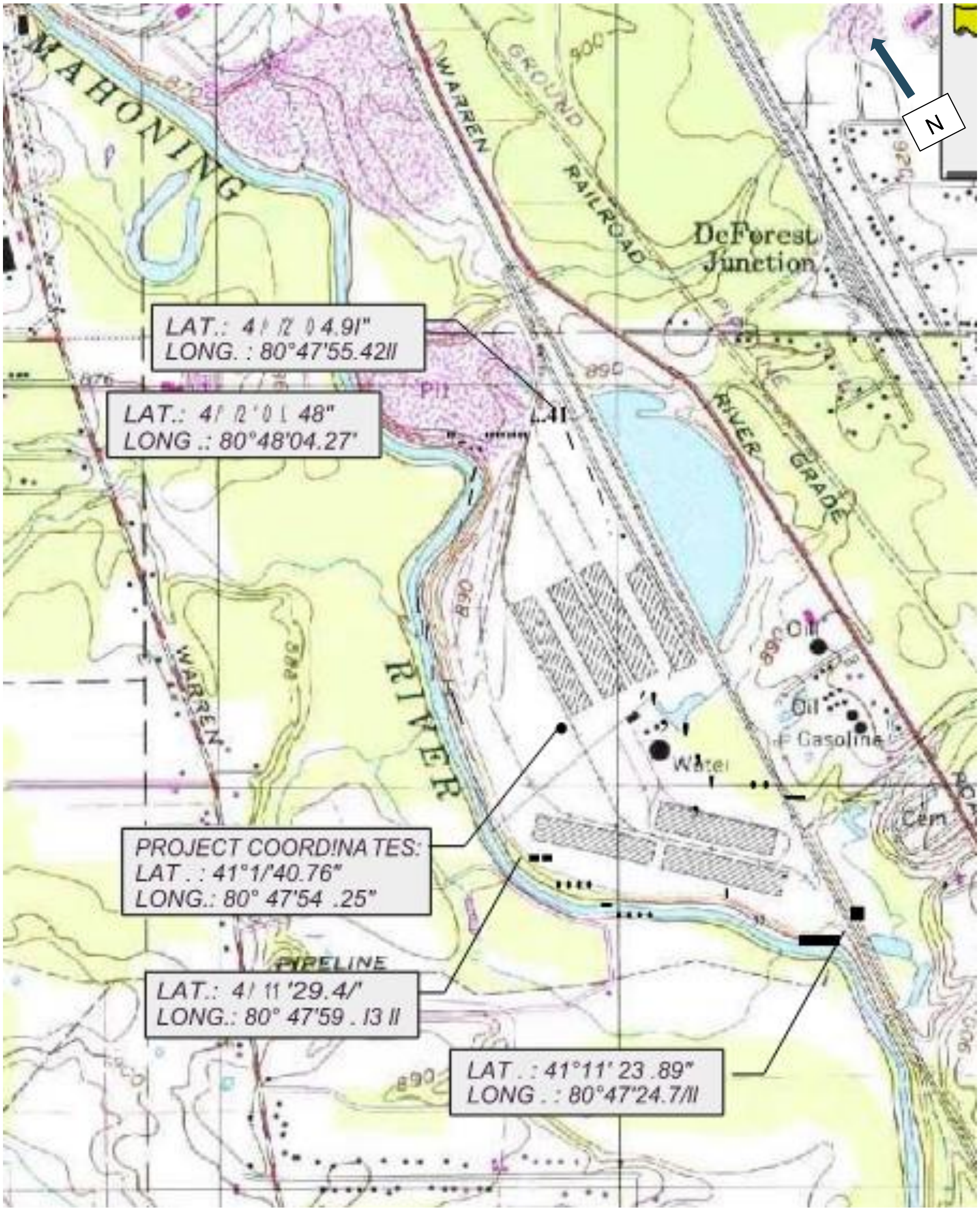
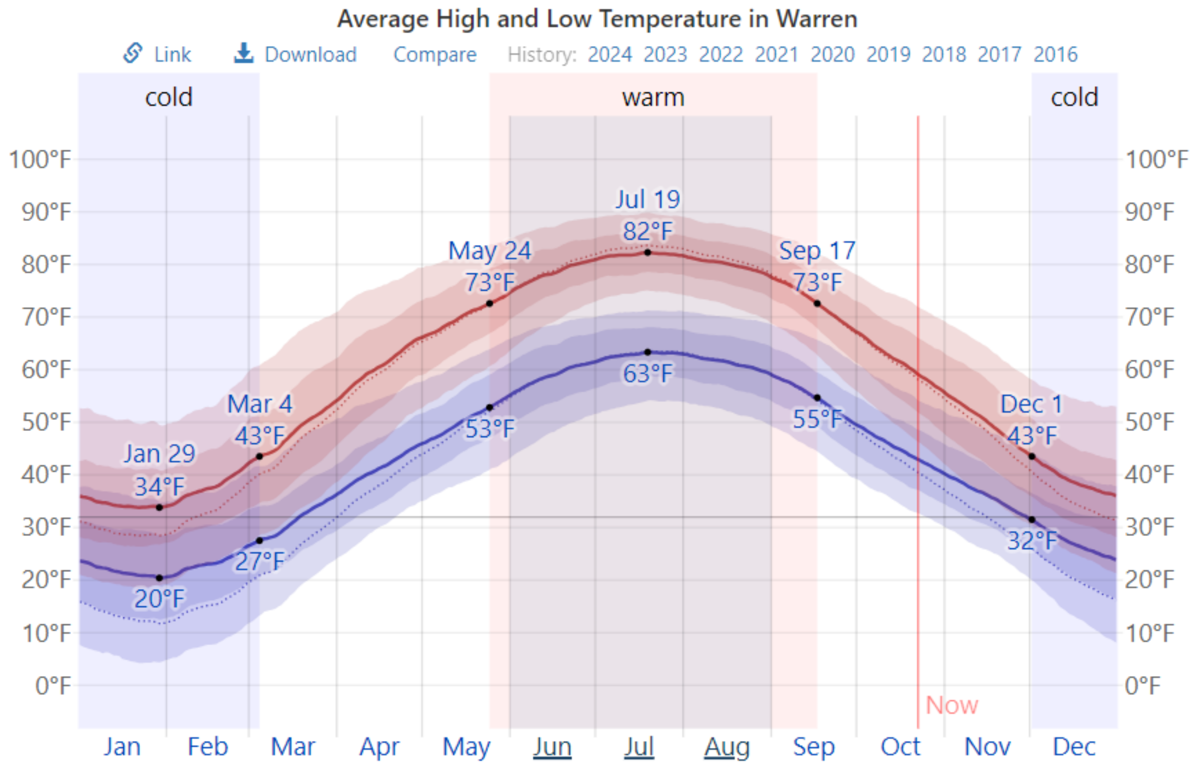


Figure 18-25 Location Map-Topographic

18.2.3 Climate

The climate at the proposed project site is typical of northeastern Ohio. The northeastern Ohio climate is described as humid continental with distinct seasons, characterized by hot summers and cold winters. The average annual temperature from 1893 through 1996 was 9.2 °C (48.7 °F), ranging from a January mean temperature of -4.4 °C (24°F) to a July mean temperature of 21°C (71°F).

The average annual precipitation in northeast Ohio is 914.4 mm (36 in) based on rainfall data from 1938 through 1971. Precipitation is highest in July with a mean value of 99.06 mm (3.9 in) and lowest in February with a mean value of 43.18 mm (1.7 in). Data on climatic conditions was taken from Weather Atlas: Yearly and Monthly weather – Trumbull County, OH (Figure 18-26).



The daily average high (red line) and low (blue line) temperature, with 25th to 75th and 10th to 90th percentile bands. The thin dotted lines are the corresponding average perceived temperatures.

Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	34°F	38°F	48°F	61°F	70°F	78°F	82°F	80°F	73°F	61°F	50°F	39°F
Temp.	27°F	29°F	38°F	50°F	60°F	68°F	72°F	70°F	63°F	52°F	43°F	32°F
Low	22°F	23°F	31°F	41°F	50°F	59°F	63°F	61°F	55°F	45°F	36°F	27°F

Source: Weather Atlas: Yearly and Monthly weather – Trumbull County, OH

Figure 18-26 General Temperature Statistics by Month

18.2.4 Battery Limits

The following expected battery limits define the boundaries of the scope that is included in the capital and operating cost estimates:

- Input of natural gas to the connection point at the plant fence line
- Input of raw water and potable to plant fence line
- Input of high-voltage power to substation inlet terminals
- Input of reagents and raw materials (pitch, pet coke, etc.) to storage/warehouse or reagent tanks/vessels located on-site
- Input of inert and reactive gases to storage (pressure) vessels located on site
- Connection to the local road at the security entrance of the proposed site
- Unloading of feed from rail and/or truck; rail car, feed container, and truck will be by a third party
- Output of graphite product in bulk storage bags to storage facility on site for shipment to market
- Output of solid waste to bins for collection and disposal that will be handled by a third party
- Discharge of treated effluents (if required) to the local water body in the vicinity of the plant site
- Output of treated gas emissions to the environment
- Output of sewage to a connection at the plant fence line
- Output of treated stormwater to the local environment or stream in the vicinity of the site

18.2.5 Scope of Facilities

The scope of the STP is expected to include:

- Concentrate receiving and storage
- Micronizing, shaping, and carbonization
- Agglomeration
- Purification and graphitization
- Final product packaging, storage, and loadout
- Natural gas
- Raw water receipt and distribution
- Cooling water system and distribution

- Potable water receipt and distribution
- Nitrogen gas generation, storage, and distribution
- Chlorine gas storage and distribution
- Compressed air services (instrument and plant air)
- High-voltage power receipt, transformers, and distribution, including power stabilization (filters and harmonics)
- Reagents
- Fire detection and protection
- Emission control systems
- HVAC systems
- Maintenance systems, such as furnace lining and insulation materials, including possible reconditioning
- Heat recovery and utilization (where possible/economical)
- Temporary storage areas of products (for shipment to market) and waste materials (for third-party disposal)
- Process buildings
- Non-process facilities, including an administrative building, warehouse, maintenance workshop, and technical building (containing control room, laboratory, and engineering offices)
- Site infrastructure, including a security fence and access control, roads, paving and area lighting, sewage management (lift stations, wet wells, etc.), and stormwater management (drainage) systems

18.2.6 Exclusions

The following project facilities were excluded from Hatch’s scope as others are developing them:

- High-voltage power feed line to the plant’s receiving structure
- Freshwater feed line to the plant fence line
- Residue storage facility (note, it is assumed residue will be stored at a third-party facility)
- Natural graphite feed intermodal containers
- Off-site infrastructure including:

- Utilities outside the fence line, such as water, sewage, communications, and natural gas
- Site access road and bridge upgrades/modifications
- Rail extensions
- Operational plant workers' camp (assumed not required)

18.2.7 Power Supply and Distribution

The STP will be connected to Ohio's state power grid. The STP is expected to have an onsite substation with a 115 kV switchgear for onsite distribution. The power is expected to be distributed across the plant site and reduced using localized switchgear. Incoming power characteristics were provided by CJL Engineering, a third-party consultant onboarded by Graphite One to interface with the local utility.

18.2.8 Waste and Water Management

The STP is expected to be connected to the municipality's water source. Water is expected to be purchased from a water utility company and used as required. Meander Water Supply, the local water utility, confirmed municipal water quality. There will be an onsite WTP for treatment, monitoring, and discharge from the local municipality. In addition, sewage will be connected to the local municipal sanitary sewer system.

18.2.9 Natural Gas

Natural gas will be received by pipeline and distributed to afterburners for carbonization and agglomeration off-gas treatment. The layout ensures proper routing and connections of the natural gas pipelines, adhering to safety standards and facilitating efficient heating of the respective equipment.

18.2.10 STP General Layout

Figure 18-27 below is an isometric snapshot of the STP (25 ktpa), showcasing the overall layout. The site is expected to be comprised of multiple process buildings dedicated to anode material production as well as reagent and utility service buildings. The STP is expected to occupy approximately 34.4 ha (85 ac) of land.

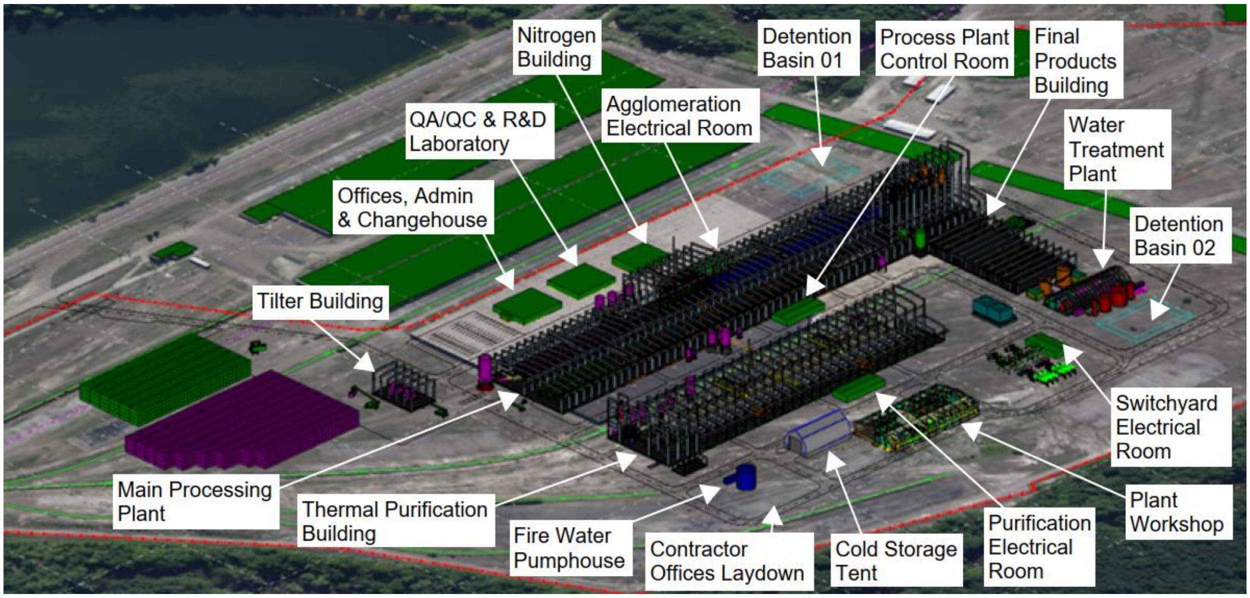


Figure 18-27 General Plant Layout

18.2.11 Description of Major Buildings and Facilities

The STP (25 ktpa) is expected to be comprised of multiple buildings, which are tabulated in Table 18-5 with preliminary sizing.

Table 18-5 STP Major Buildings

No.	Building Description	Estimated Length (ft)	Estimated Width (ft)	Estimated Height (ft)
01	Main Mill Plant	1140' Agglomeration High-bay: 181'6" De-Ironing High-bay: 201'6"	197' Agglomeration High-bay: 93'6" De-Ironing High-bay: 56'6"	55' Agglomeration High-bay: 96'6" De-Ironing High-bay: 128'
02	Mill Plant Control Room	110'	40'	12'
03	Thermal Purification Building	725'	Furnace Area: 78' Rectifier Area: 52' Blanketing Storage Area: 130' Blanketing Material Handling": 30'	Furnaces Area: 72'6" Rectifier Area: 34'6" Blanketing Storage Area: 75' Blanketing Material Handling": 85'
04	Final Product Packaging, Storage Building	257'	159'	26'
05	Chlorine Building	61'6"	32'6"	19'
06	Tilter Building	103'	65'	47'
07	Laboratory, QA/QC, and R&D	98'6"	82'	12'
08	Nitrogen Building	85'	69'	15'
09	Plant Workshop, Maintenance, and Warehouse	217'6"	110'	34'6"

No.	Building Description	Estimated Length (ft)	Estimated Width (ft)	Estimated Height (ft)
10	Cold Storage Tent	116'6"	60'	49'
11	Offices, Administration, and Change House	112'	97'6"	24'
12	Contractor Offices and Laydown	120"	60'	50'
13	Security Gatehouse	18'	18'	10'
14	Water Treatment Plant	172'	67'	29'
15	Switchyard Electrical Room	80'	40'	12'
16	Agglomeration/Anode Precursor/Carbonization Electrical Room	110'	34'3"	12'
17	Micronizing/Final Products Electrical Room	100'	40'	12'
18	Water Treatment Plant Electrical Room	40'	8'	9'6"
19	Purification/Graphitization Electrical Room	100'	40'	12'
20	Fire Water Pumphouse	28'	12'	12'

18.2.11.1 Main Processing Plant

The main processing plant building is expected to be a single-story steel frame, metal-clad, pre-engineered structure constructed on a concrete pad. It will be equipped with three 5-ton and one 10-ton overhead cranes.

The following facilities are expected to reside within the main processing plant. Refer to Figure 18-27.

- Concentrate receiving and storage:
  - Screens
  - Racked bulk bag storage area with approximate capacity for 1300 1 t bags of pet coke, precursor materials, and pitch
  - Bulk bag unloading stations for pet coke, precursor materials, and pitch
  - Pitch, pet coke, and precursor anode preparation
- Micronizing, shaping, and carbonization:
  - Micronizers per line equipped with classifiers, cyclones, and baghouses
  - Shaping mills equipped with classifiers, cyclones, and baghouses
  - Carbonization kilns equipped with sagger handling systems

- Agglomeration:
  - Vertical agglomerators
  - Anode A mixing – vertical cone mixers
  - Anode B mixing – vertical cone mixers
- Final product packaging, storage, and loadout
- Environmental protection facilities (off-gas, effluents):
  - Off-gas treatment systems equipped with stacks for agglomerators and carbonization kilns

18.2.11.2 Process Control Room

The process control room building is expected to be a single-story, prefabricated modular structure constructed on piers.

18.2.11.3 Thermal Purification Building

The thermal purification building is expected to be a single-story, steel-frame, metal-clad, pre-engineered structure constructed on a concrete pad. The building will be equipped with three 100-ton multifunction cranes and two 5-ton overhead cranes. The building will also be equipped with a bay containing rails to support the two Acheson furnace traveling rectifiers.

The following facilities are expected to reside within the thermal purification building. Refer to Figure 18-30.

- Purification and graphitization:
  - Acheson furnaces equipped with chlorine injection and nitrogen purge
  - Racked bulk bag storage area with an approximate capacity for 160 1 t bags of blanketing material
  - Laydown areas for crucible loading, unloading, and management
  - Bulk bag unloading station equipped with bag breaker and delumper
  - Bucket elevator equipped with screens
  - Screw cooler for blanketing material recycling
- Environmental protection facilities (off-gas, effluents):
  - Off-gas treatment systems equipped with a stack

18.2.11.4 Final Product Packaging and Storage Building

The final product packaging and storage building is expected to be a single-story, steel-framed, metal-clad, pre-engineered structure constructed on a concrete pad.

The following facilities are expected to reside within the final product packaging and storage building. Refer to Figure 18-29.

- Final product packaging, storage, and loadout:
    - Ultrasonic screening
    - De-ironing
    - Anode A&B de-agglomeration
    - Anode A&B rejects milling
    - 1 t bulk bagging machine equipped with palletizer
    - 22.7 kg (50 lb.) bagging machine equipped with palletizer
    - Racked storage area with an approximate capacity for 14,500 22.7 kg (50 lb.) bags and 530 1 t bags of final product
    - Truck loading bay
    - Rail car loading bay

18.2.11.5 Chlorine Building

The chlorine building is expected to be a single-story, steel-frame, metal-clad, pre-engineered structure constructed on a concrete pad. The building will be equipped with two 2-ton overhead monorails.

The following facilities are expected to reside within the chlorine building. Refer to Figure 18-31.

- Chlorine gas storage and distribution:
    - Chlorine cylinders will be supplied by a third party and stored within this building. The building will be equipped with piping distribution to supply the thermal purification building.

18.2.11.6 Tilter Building

The tilter building is expected to be a single-story, steel-frame, metal-clad, pre-engineered structure constructed on a concrete pad.

The following facilities are expected to reside within the tilter building. Refer to Figure 18-32.

- Concentrate receiving and storage:

- Reach stackers load intermodal freight containers onto two tilters where natural graphite is then pneumatically conveyed to the main processing plant

18.2.11.7 Laboratory, QA/QC, and R&D Building

The laboratory, QA/QC, and research and development (R&D) building are expected to be a single-story, modular structure housing the staff and equipment to conduct product quality assurance, product quality control, and research and development work.

18.2.11.8 Nitrogen Building

The nitrogen building is expected to be a single-story, steel frame, metal-clad, pre-engineered structure constructed on a concrete pad. The following facilities are expected to reside within the nitrogen building.

- Nitrogen gas generation, storage, and distribution:
    - Nitrogen is expected to be stored within this building. The building is expected to be equipped with piping distribution to supply the thermal purification building

18.2.11.9 Plant Workshop, Maintenance, and Warehouse

This plant workshop, maintenance, and warehouse building is expected to be a two-story, steel-frame, metal-clad, pre-engineered structure constructed on a concrete pad. The building is expected to be equipped with one 2-ton overhead crane, one 10-ton overhead crane, and two 5-ton jib cranes. Refer to Figure 18-33.

This building is expected to be multipurpose and will be used for upkeep and operations of the STP, heated/unheated storage areas for reagents and consumables, and maintenance. It is expected to be equipped with a workshop, machine shop, and welding shop. There are also expected to be offices, washrooms, storage areas for the local workforce, and space for spare parts and materials.

18.2.11.10 Cold Storage Tent

The cold storage tent is expected to be a single-story fabric tent on a lock-block, prefabricated structure constructed on a concrete pad.

18.2.11.11 Offices, Admin, and Change House

The offices, admin, and change house building is expected to be a two-story, steel-frame, metal-clad, pre-engineered structure constructed on a concrete pad.

18.2.11.12 Contractor Offices and Laydown Area

The contractor offices and laydown area are expected to be a gravel pad area equipped with power and communications to support temporary contractor trailers.

18.2.11.13 Security Gatehouse Building

The security gatehouse building is expected to be a single-story, prefabricated modular structure constructed on piers.

18.2.11.14 Water Treatment Plant Building

The WTP building is expected to be a single-story fabric tent on a lock-block, pre-fabricated structure constructed on a concrete pad.

The WTP is expected to be a pre-manufactured package. It will be associated with a freshwater tank and process water tank. The freshwater tank will receive freshwater from the municipality and distribute it for regular and fire-fighting use, as well as topping off the process water systems. In addition, the WTP will collect water from the off-gas scrubber system and treat all process water from the property prior to it being discharged to the local municipality.

18.2.11.15 Switchyard Electrical Room Building

The switchyard electrical room building is expected to be a single-story, prefabricated, modular structure constructed on piers.

18.2.11.16 Agglomeration/Anode Precursor/Carbonization Electrical Room Building

The agglomeration/anode precursor/carbonization electrical room building is expected to be a single-story, prefabricated, modular structure constructed on piers.

18.2.11.17 Water Treatment Plant Electrical Room Building

The WTP electrical room building is expected to be a single-story, prefabricated, modular structure constructed on piers.

18.2.11.18 Purification/Graphitization Electrical Room Building

The purification/graphitization electrical room building is expected to be a single-story, prefabricated, modular structure constructed on piers.

18.2.11.19 Fire Water Pumphouse Building

The fire water pumphouse building is expected to be a single-story, prefabricated, modular structure constructed on piers.

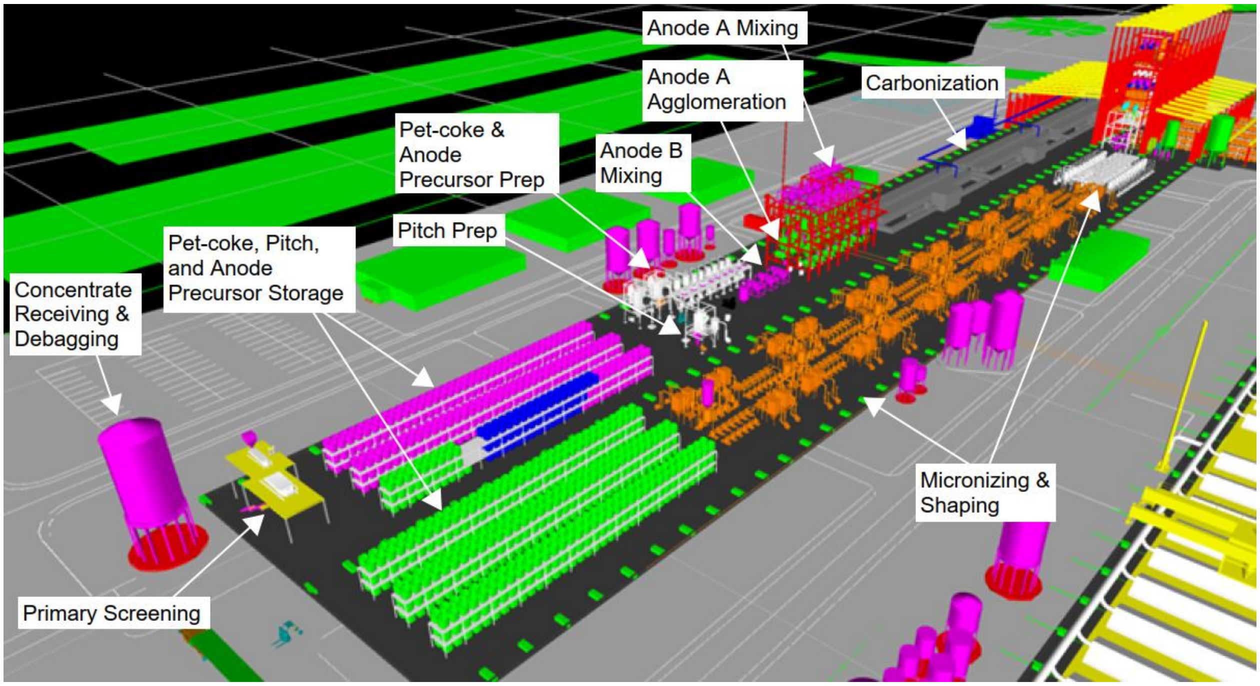


Figure 18-28 Main Processing Plant – Isometric

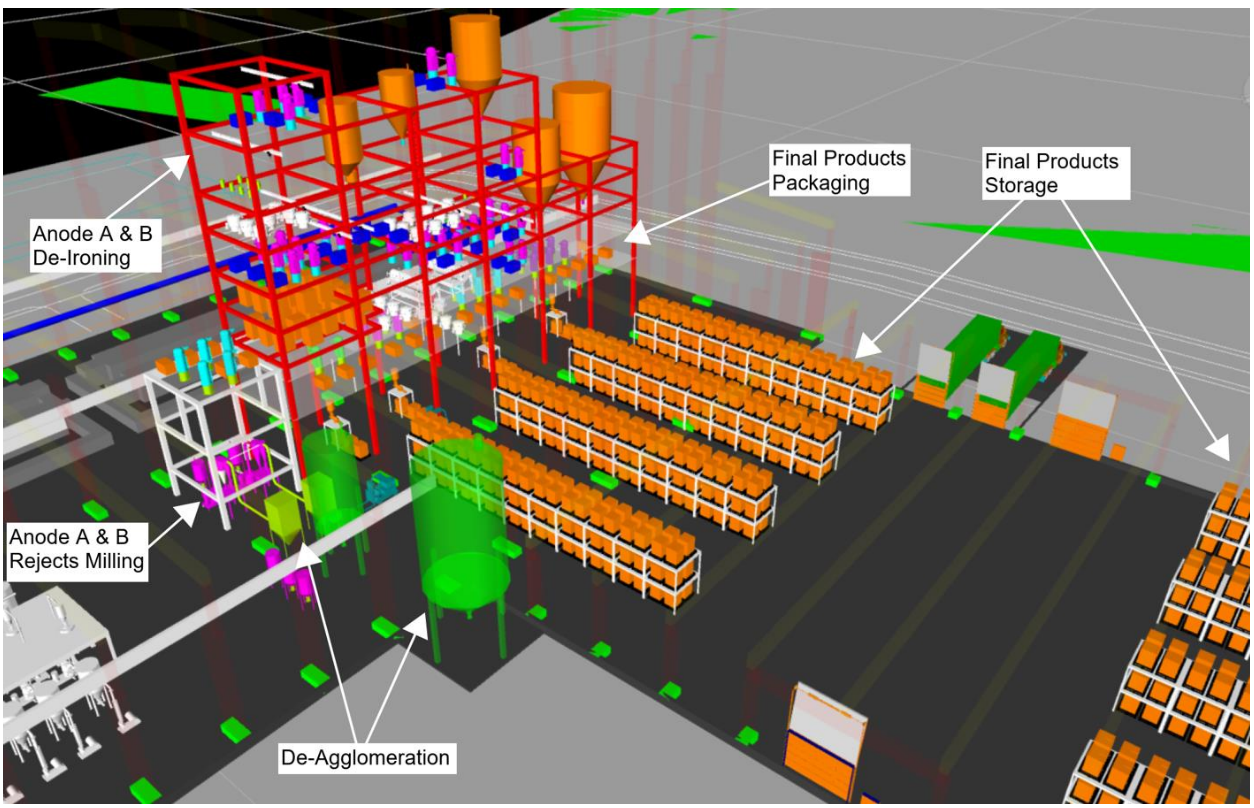


Figure 18-29 Main Processing Plant – Final Product Packaging Area - Isometric

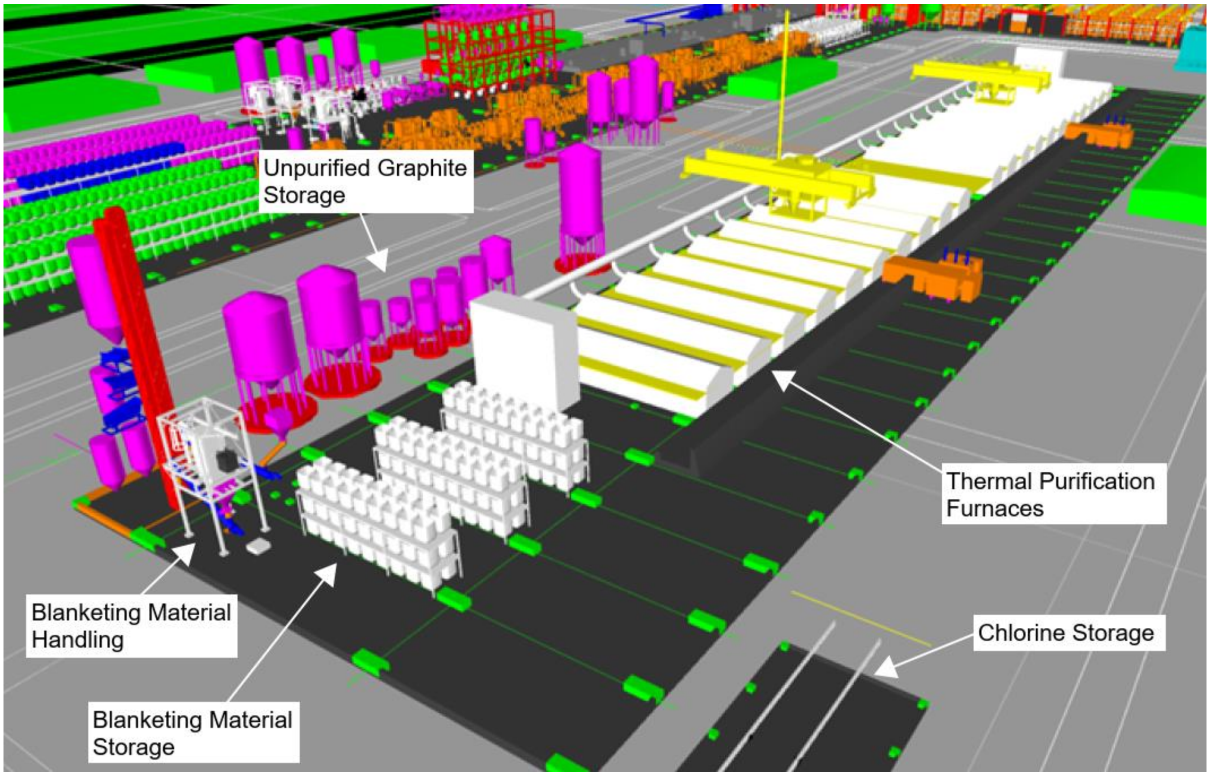


Figure 18-30 Thermal Purification Building Isometric

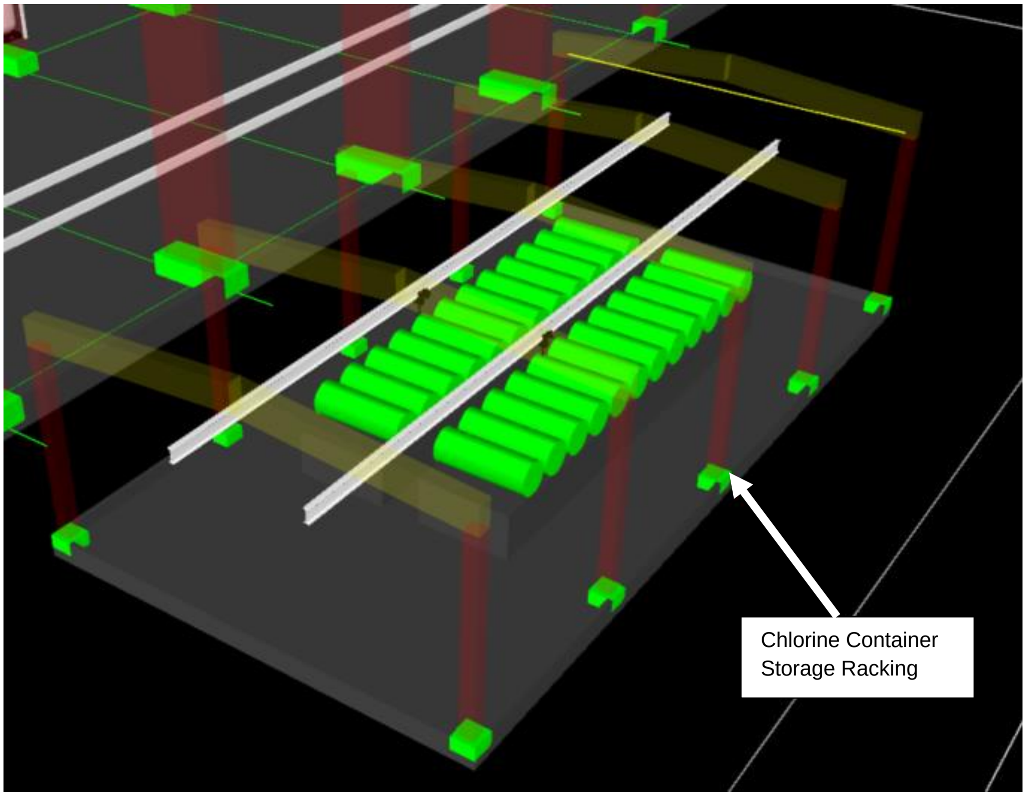


Figure 18-31 Chlorine Building Isometric

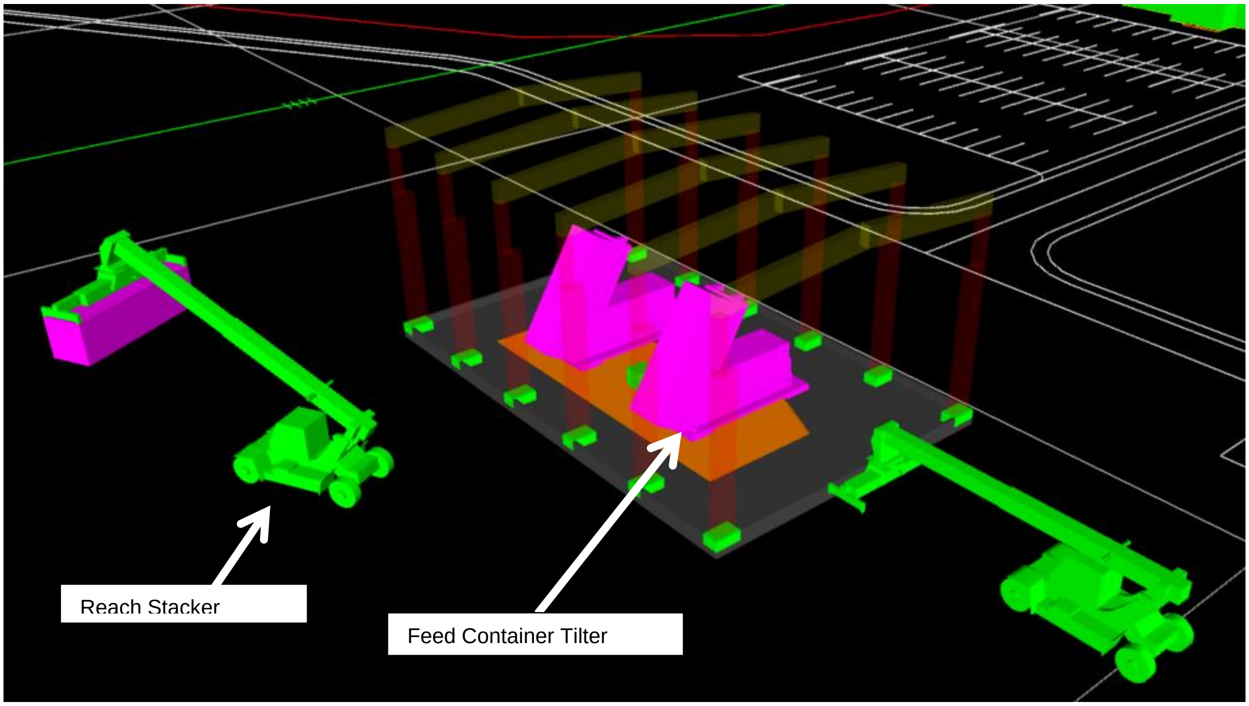


Figure 18-32 Tilter Building Isometric

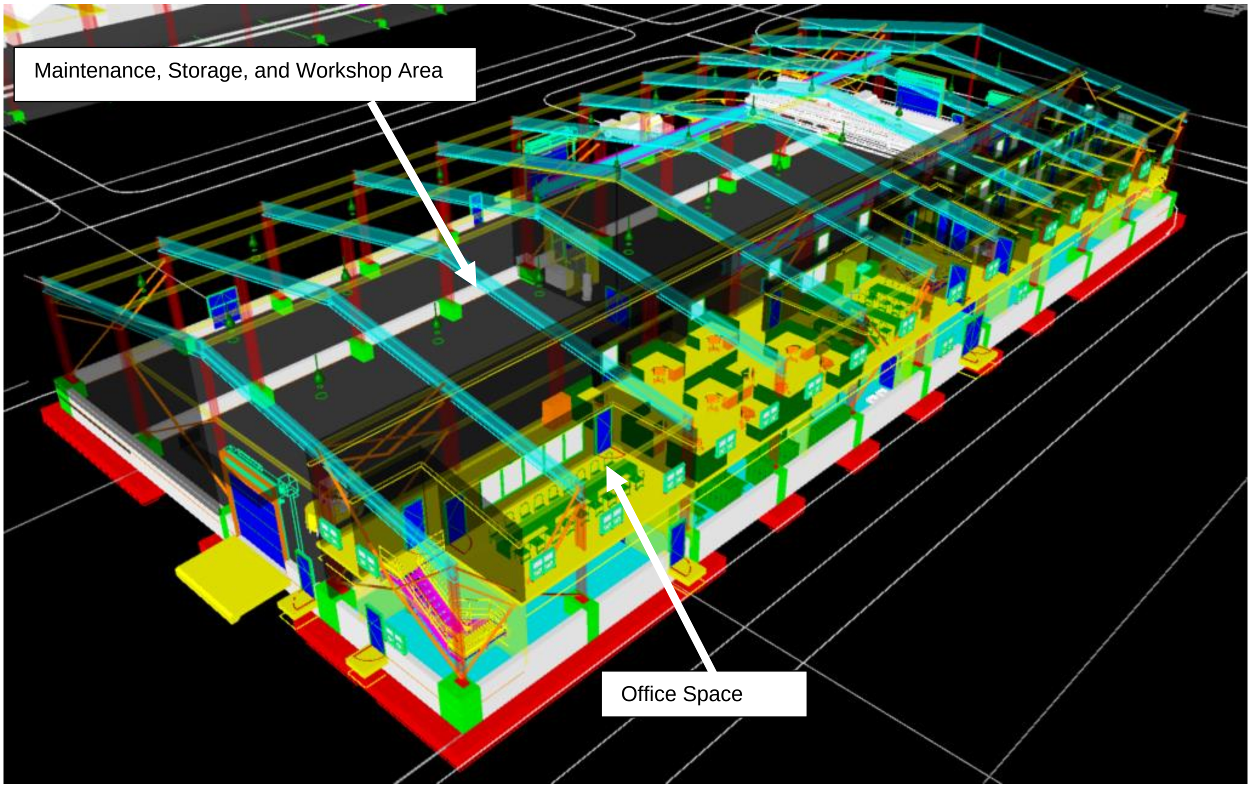


Figure 18-33 Plant Workshop, Maintenance, and Warehouse Isometric

18.2.12 Secondary Treatment Plant Expansion to 175 ktpa

18.2.12.1 Project Location

The Ohio location was used as the basis (assuming the same existing 'brownfield' infrastructure) with expansion from the 25 ktpa module to a 175 ktpa, 7-module facility. The layout performed was limited in scope to establishing the quantities of commodities and was not specifically adopted or optimized to fit the plot space.

18.2.12.2 Means of Access

No changes from the 25 ktpa basis and/or assumptions.

18.2.12.3 Climate

No changes from the 25 ktpa basis and/or assumptions.

18.2.12.4 Battery Limits

No changes from the 25 ktpa basis and/or assumptions.

18.2.12.5 Scope of Facilities

No changes from the 25 ktpa basis and/or assumptions.

18.2.12.6 Exclusions

No changes from the 25 ktpa basis and/or assumptions.

18.2.12.7 Power Supply & Distribution

No changes from the 25 ktpa basis and/or assumptions.

18.2.12.8 Waste & Water Management

No changes from the 25 ktpa basis and/or assumptions. Wastewater treatment facilities are expected to be scaled up by 7.

18.2.12.9 Natural Gas

No changes from the 25 ktpa basis and/or assumptions.

18.2.12.10 STP General Layout (175 ktpa)

Figure 18-34 below depicts the plot plan of STP expansion to a 175 ktpa, 7-module facility. The site is expected to comprise multiple process buildings dedicated to anode material production and reagent and utility service buildings. The STP is expected to occupy approximately 89.8 ha (222 ac) of land. Generally, the 25 ktpa module design was assumed to be 'fixed' (i.e., scaled by 7) while site-wide infrastructure and utilities were optimized (i.e., 'factored').

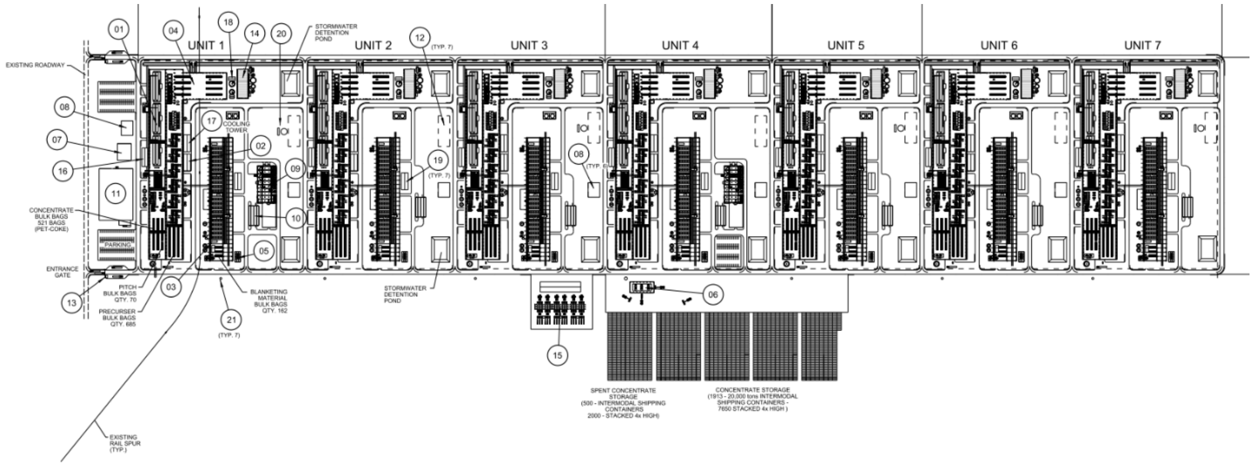


Figure 18-34 General Plant Layout for 175 ktpa Facility

18.2.12.11 Description of Major Buildings and Facilities

The 175 ktpa STP facility is expected to be comprised of multiple buildings, which are tabulated in Table 18-6 with preliminary sizing.

Table 18-6 STP 175 ktpa Major Buildings

No.	Building Description	Estimated Length (ft)	Estimated Width (ft)	Estimated Height (ft)	Building Quantity
01	Main Processing Plant	1140' Agglomeration High-bay: 181'6" De-Ironing High-bay: 201'6"	197' Agglomeration High-bay: 93'6" De-Ironing High-bay: 56'6"	55' Agglomeration High-bay: 96'6" De-Ironing High-bay: 128'	7
02	Process Plant Control Room	110'	40'	12'	7
03	Thermal Purification Building	725'	Furnaces Area: 78' Rectifier Area: 52' Blanketing Storage Area: 130' Blanketing Material Handling: 30'	Furnaces Area: 72'6" Rectifier Area: 34'6" Blanketing Storage Area: 75' Blanketing Material Handling: 85'	7
04	Final Product Packaging, Storage Building	257'	159'	26'	7
05	Chlorine Building	61'6"	32'6"	19'	7
06	Tilter Building	135'	60'	47'	1
07	Laboratory, QA/QC, and R&D	98'6"	82'	12'	1
08	Nitrogen Building	85'	69'	15'	7
09	Plant Workshop, Maintenance, and Warehouse	217'6"	110'	34'6"	2
10	Cold Storage Tent	116'6"	60'	49'	7
11	Offices, Administration, and Change House	336' Second story length: 140'	200' Second story width: 115'	14' Second story height: 24'	1
12	Contractor Offices and Laydown	120"	60'	50'	7
13	Security Gatehouse	36'	36'	10'	1
14	Water Treatment Plant	172'	67'	29'	7
15	Switchyard Electrical Room	240'	60'	12'	1
16	Agglomeration/Anode Precursor/Carbonization Electrical Room	110'	34'3"	12'	7
17	Micronizing/Final Products Electrical Room	100'	40'	12'	7
18	Water Treatment Plant Electrical Room	40'	8'	9'6"	7
19	Purification/Graphitization Electrical Room	100'	40'	12'	7
20	Fire Water Pumphouse	28'	12'	12'	4

19 Market Studies and Contracts

19.1 Introduction

Natural and synthetic graphites are used to make products for many applications that can generally be grouped into the following categories.

- Energy storage: anode materials for lithium-ion (Li-ion) batteries for EVs and electrical grid storage applications, and Li-ion and other batteries for consumer, communications, aerospace, medical and military applications
- Thermal management: applications requiring graphite's properties as a thermal conductor or insulator, including refractories, crucibles, steel and foundry additives, hot metal toppings, and geothermal grouting systems
- Engineering products: products manufactured using graphite powder additives such as fire retardants, powder metallurgy, foils, friction materials (brake linings, clutch facings), carbon brushes, and synthetic diamonds
- Lubricants: applications relying on graphite's natural lubricity, such as lubricants (wet, dry, rail, nuclear grade, aerospace, agriculture, MIL-SPEC, food grade), drilling fluids, coatings, and dispersions
- Plastics and polymers – applications using graphite's properties in plastics and polymers to make gaskets, seals, anti-static materials, and coatings

In some cases, only synthetic (also known as artificial) or only natural graphite can be used to make a particular product. In others, the two are used as a blend or processed together, depending on the product's goals.

19.2 Market Reports

The information in this section is based on the following studies either commissioned or purchased by Graphite One and augmented by information from Graphite One's direct contacts (the market reports).

- Flake Graphite Forecast Report – Q4 2024, Benchmark Mineral Intelligence
- Synthetic Graphite Forecast Report – Q4 2024, Benchmark Mineral Intelligence
- Anode Forecast Report – Q4 2024, Benchmark Mineral Intelligence
- Graphite Product Historical Pricing - Q4 2024, Lone Star Tech Minerals USA

19.3 Market Review Conclusions

- China is and will continue to be the dominant global producer of advanced graphite products. It has abundant natural graphite resources, synthetic graphite production capacity, coated spherical graphite production capacity, advanced anode production capacity, related technology and experience, and the capital to expand

- Graphite use, all types, in all applications, is forecasted to increase to 9.2 Mtpa in 2050 from about 2.85 Mtpa in 2020. Of this, synthetic increases to 5.9 Mtpa from about 1.8 Mtpa and natural to 3.35 Mtpa from about 1 Mtpa
- Flake graphite in battery use is forecast to peak at 2.41 Mtpa in 2043, increasing from 0.28 Mtpa in 2020, and gradually drop to 2.17 Mtpa in 2050
- An increase in demand for natural flake graphite for batteries of over 2 Mtpa by 2043 requires existing operations to reach their maximum capacities and new projects to commence production

19.4 Summary of Graphite Products

A wide range of products depend on using natural graphite to take advantage of graphite's unique properties. These properties include:

- Low density
- Low hardness
- Chemically inert
- High lubricity
- High electrical conductivity
- High thermal conductivity
- Magnetic permeability
- High sublimation temperature
- Low thermal expansion

Characteristics of a particular flake graphite, such as types and quantities of its impurities, flake size and thickness, and particle size distribution, are also important in its selection for applications.

19.4.1 Energy Storage Products

The energy storage product category has become the most important market sector for graphite, taking advantage of its high electrical conductivity and ability to store energy. In lithium-ion battery anodes, high purity, and particle size are critical. This can avoid side reactions in the batteries and shuttle the lithium ions quickly. It is also used in rechargeable and non-rechargeable batteries, fuel cells, and capacitors designed for many energy storage applications. This report mainly focuses on its use in Li-ion battery anode materials.

19.4.2 Thermal Management Products

Natural flake graphite's high thermal conductivity is critical in this category, and particle size (typically greater than 20 µm) is a more important parameter than higher purity.

19.4.2.1 High Thermal Conductivity Graphite Blocks

High thermal conductivity graphite blocks are used to dissipate heat in the electronics industry by taking advantage of graphite's high thermal conductivity in the plane direction.

19.4.2.2 High Thermal Conductivity Graphite Film

High thermal conductivity graphite film dissipates heat in electronic devices where space is limited. Films made with natural graphite have an advantage over those made with synthetic graphite because natural graphite film has a greater continuous hexagonal crystal structure resulting in greater thermal conduction.

19.4.2.3 Porous Graphite Composites with Phase-Changing Materials

Natural flake graphite that is made into a porous composite material and combined with a phase-changing material is used to drive a variety of heat transfer applications. The system absorbs or releases heat by changing phases (e.g., paraffin solid ⇔ liquid).

19.4.2.4 Graphite Modified Insulation Material

Using polystyrene infused with 1-50 µm graphite powder to manufacture rigid foam insulation results in improved insulation; the resin coated with expandable graphite results in improved flame retardancy, dimensional stability, and R-value. BASF manufactures BASF Neopor® GPS, a polystyrene graphite foam, which it markets to the foam insulation industry.

19.4.2.5 Thermally Conductive Gypsum Board

Natural graphite powders are added to traditional gypsum wallboard to improve its thermal conductivity and enhance the effectiveness of radiant cooling and heating technologies.

19.4.3 Engineered Products

The engineered products group encompasses a wide range of applications that use graphite powder additives. These applications include expandable graphite, friction products, powder metallurgy, ceramics, and carbon brushes.

19.4.3.1 Expandable Graphite

Expandable graphite (also known as graphite salt) is manufactured by treating flake graphite with specific compounds that are intercalated between the layers of the flake graphite crystals. When the compounds are exposed to high degrees of heat, the graphite layers expand several hundred times their original flake size and thickness, thereby creating expanded or exfoliated graphite, a critical parameter for fire-stop applications.

Expandable graphite flake is an additive used in materials requiring improved fire-protection characteristics. Some of the many applications include residential, commercial, and industrial building materials; automotive seating; aircraft seating; firestop expandable seals; expandable foams for commercial and industrial buildings; and industrial and consumer fire retardant fabrics. Each application has specific parameters, chemical limits, performance metrics, and mesh size requirements.

Currently, almost all expandable graphite is produced in China from Chinese natural flake mines, creating a domestic manufacturing opportunity. Fire retardants are one of the fastest-growing segments in the graphite industry. The DoD is actively looking for solutions to eliminate polyfluoroalkyl substances (PFAS) from the common aqueous film-forming foams now used to extinguish petroleum-based fires, and this is an opportunity for expandable graphite and graphite oxides.

19.4.3.2 Friction Products

The use of graphite in friction materials such as brake linings and clutch facings has grown, partly as a replacement for asbestos. While amorphous graphite is the preferred type, finely sized flake graphite (minus 200 mesh) is also used as a heat dissipater and a friction modifier.

19.4.3.3 Powder Metallurgy

Both natural and synthetic graphites are used in powder metallurgy with the grade choices being made based on price and availability. Natural graphite accounts for around 65%, and synthetic graphite 35% of the total used. High purity (minimum 99.0%) and small particle size are required.

19.4.3.4 Ceramics

Ceramics is an industry segment with a wide range of applications, including silicon carbide (SiC) parts (optics and body armor), high-wear seals, and solid-oxide fuel-cell components. Graphite’s use in the ceramics market focuses on thermal management and friction management as well as manufacturing of SiC optics for NASA and other aerospace or scientific applications. Ceramic applications also include consumer goods for BBQ grill lighters, industrial bearings, medical devices, and products developed to military specifications (MIL-SPEC).

19.4.3.5 Carbon Brushes

A carbon brush conducts electrical current between the stationary wires (stator) and the rotating wires (rotor) of an electric motor, alternator, or generator. It is typically made up of one or more carbon blocks which can be made with both synthetic and natural graphite. Key parameters include electrical and thermal conductivity, lubricity and hardness, mechanical strength, wear protection, and corrosion resistance.

19.4.3.6 Graphite Foils

Natural flake graphite is the main component of graphite foils. Expandable graphite is heated to produce expanded or exfoliated graphite. The results, called “worms,” can be pressed, calendared, or rolled into sheets. These sheets or foils are then cut into various shapes, sizes, and configurations.

Graphite foils are primarily used in gaskets, valve packings, and seals, which can withstand high temperatures and pressures. They are also used as heat dissipators in electronic applications, which makes them important for the automotive industry.

Graphite foil's ability to remain flexible under high temperatures and pressures and its resistance to chemical attack make it useful in the petrochemical, chemical, and nuclear industries where corrosive or radioactive fluids are common. Natural flake graphite used in foil applications can be either standard flake or high-purity flake (97% to 99.9% LOI) and can be used in +100, +80, +50, and +32 mesh sizes.

19.4.3.7 High-Tech and Emerging Markets

Natural graphite has many emerging high-technology applications beyond lithium-ion batteries, including use in pebble-bed nuclear reactors, ceramic armor tiles, silicon carbide optics and bearings, non-slip paving, and a wide range of graphene products for various applications (e.g., medical devices, sporting goods, aerospace, low-friction paints, conductive coatings, conductive inks, and home security).

19.4.4 Lubricants

This category includes any application that requires reducing or limiting frictional contact between surfaces; graphite's natural lubricity enables it to be used as a lubricant additive. Graphite powder is added to greases, dry films, and dispersions to improve or manage the coefficient of friction in high- or low-temperature applications. Graphite, acting as a solid lubricant film, retains its properties under high temperature and pressure conditions for applications in almost every industry.

Colloidal graphite is another product in which one-micron particles of graphite are suspended in oils and greases. It is used in general lubrication applications and packings.

Dispersions are products in which graphite powder is dispersed in liquids with other additives to improve the dispersion of the graphite powder in the liquid medium. These applications require a fine distribution of graphite on the carrier material's surface. The critical properties of an industrial dispersion include its crystal structure, the dispersion's surface tension, drying time, pH value, ionic polarity, viscosity, adhesion and wetting behavior on different surfaces, and sedimentation stability.

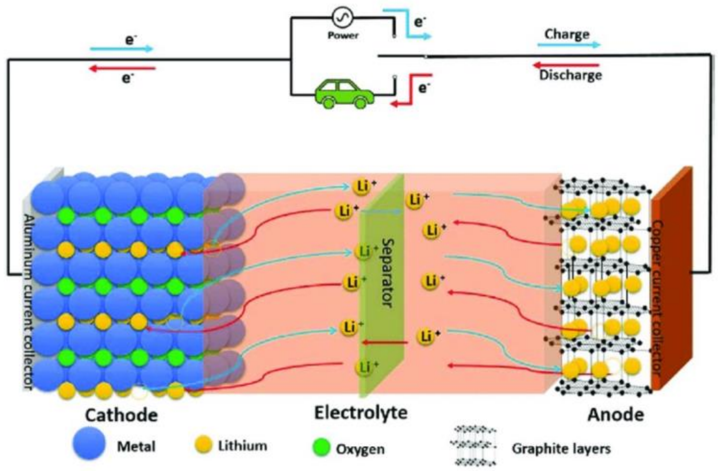
19.4.5 Polymers and Plastics

Polymers are lightweight, easy-to-process, and low-cost basic materials. Their uses increase when their thermal conductivity is enhanced by introducing graphite powders into the polymer matrix. Graphite is chemically inert and does not affect the other properties of the polymer matrix. Additional applications include chemical heat-exchange pipes, LED lamp housings, and heating pipes. Graphite's high electrical conductivity also allows polymers and plastics to be used in applications where static electricity must be minimized.

19.5 Lithium-Ion Batteries

19.5.1 Introduction

Figure 19-1 illustrates the components of a Li-ion battery—an anode, cathode, separator, electrolyte, and two current collectors (positive and negative). The anode and cathode store the lithium ions. On charging, positively charged lithium ions move from the positive cathode through the electrolyte and separator to the negatively charged anode, which is intercalated in the graphite layers. At the same time, electrons move externally from the cathode around the load to the anode. The separator blocks this flow from occurring inside the battery. The battery is fully charged when the anode reaches its finite capacity to store the ions. On discharging, the reverse occurs. The Li-ions move to the cathode through the electrolyte and separator. The electrons move from the anode through the load thereby powering it and to the cathode.



Source: Benchmark Mineral Intelligence (2021)

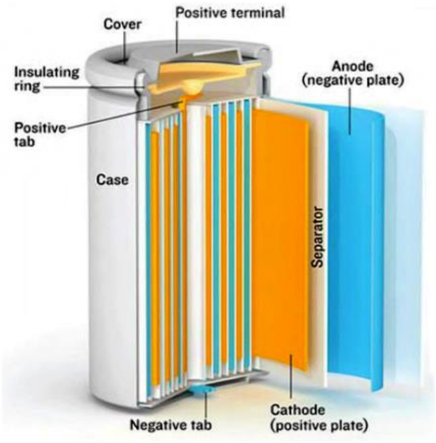
Figure 19-1 Lithium-Ion Battery Schematics

19.5.2 Cell Types

The three main Li-ion battery cell formats are cylindrical, prismatic, and pouch. Each format offers various performance characteristics.

19.5.2.1 Cylindrical

The cylindrical cell (Figure 19-2) offers good cycling ability and longevity and is economical to produce. Two common sizes for EV use are 18650 and 21701 (diameters = 18 & 21 mm; heights = 65 and 70 mm). As there are thousands of cells in an EV, individual cell failure does not affect vehicle performance. Common applications include power tools, laptops, e-bikes, and EVs.



Source: Benchmark Mineral Intelligence (2021)

Figure 19-2 Diagram of Cylindrical Cell

19.5.2.2 Prismatic

For stability, prismatic cells (Figure 19-3) are encased in aluminum or steel. Their rectangular shape provides good space utilization within an EV battery module, allowing for multiple module configurations within a battery pack. The design also allows for some swelling during performance. However, prismatic cells can be relatively expensive to manufacture, less efficient in thermal management, and have the potential for a shorter cycle life than the cylindrical design. Key applications of prismatic cells are for EVs and energy storage systems.

Source: Benchmark Mineral Intelligence (2021)

Figure 19-3 Prismatic Cell

19.5.2.3 Pouch

Pouch cells (Figure 19-4) employ a laminated battery configuration in a bag. The cells are very space-efficient (90–95% packaging efficiency) and relatively lightweight compared to cylindrical and prismatic cells. The cell needs allowance to expand in the battery compartment. Pouch cells are commonly used in portable electronics and EVs.

Source: Benchmark Mineral Intelligence (2021)

Figure 19-4 Pouch Cell

19.6 Graphite

19.6.1 Natural Graphite

Natural graphite occurs in three types of mineral deposits: microcrystalline (amorphous), macrocrystalline (flake), and vein (crystalline vein or lump).

Natural flake graphite is mined, crushed, ground, milled, and screened, then separated from non-graphitic material in a froth flotation process. Depending on its source, the resulting graphite concentrate is about 95% Cg and has a characteristic particle-size distribution. The concentrate is used in many traditional applications (refractories, etc.) or further purified and processed into higher-value products for use in advanced applications (fire retardants, battery anode materials, etc.).

Over the last decade, flake graphite has become increasingly important as a substitute for, or an additive with, synthetic graphite in Li-ion battery anodes. Anode producers look to optimize costs and battery performance with various blends of materials. To be used in a Li-ion battery anode, a flake of the correct sizing (typically minus 100 mesh), is spheronized, purified (to at least 99.95% Cg), then coated with a carbon coating and carbonized to ensure consistent quality and optimal conductive properties. The resulting coated spherical graphite is an ingredient in a battery anode. A cell producer will combine the anode material with the other battery components in the casing of choice to produce a battery cell. The cell can be in either a cylindrical, prismatic, or pouch configuration. The original equipment manufacturer (OEM) will then purchase the cells from the battery producer for use in its various powered applications.

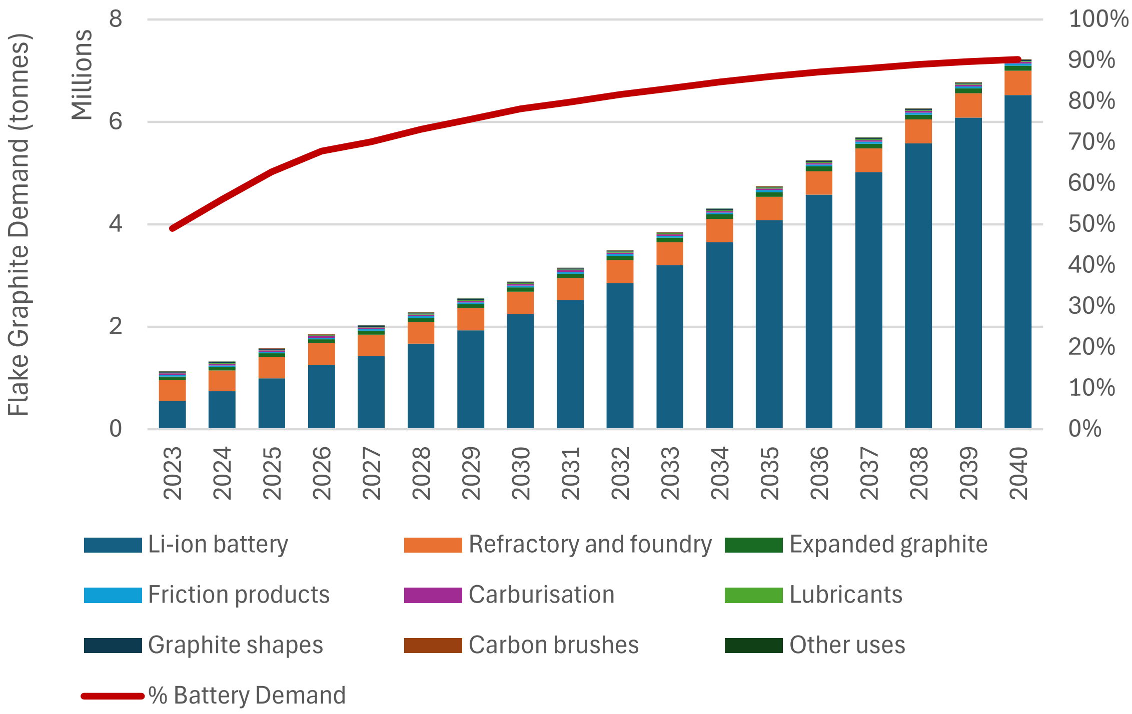
19.6.2 Synthetic Graphite

Synthetic graphite is produced by graphitizing a precursor material in high-temperature furnaces (2,800°C to 3,000°C). The precursor is made from needle coke and pitches that are first milled and mixed then carbonized. Synthetic graphite powders are used in various applications including making Li-ion battery anode materials.

19.7 Graphite Demand

19.7.1 Flake Graphite Demand

The battery anode market is the largest consumer of graphite, accounting for 49% (0.55 Mt) of graphite demand in 2023, and is projected to increase to 78.3% (2.25 Mt) by 2030 and 90.3% (7.23 Mt) by 2040. See Figure 19-5 and Table 19-1.



Source: Benchmark Mineral Intelligence (2024b)

Figure 19-5 Flake Graphite Demand Forecast by Market

While flake graphite demand is expected to increase, use in non-battery products is expected to remain steady in terms of amounts of product required but will represent a much lower percentage of the total flake graphite demand as the Li-ion battery market increases year-on-year (Table 19-1).

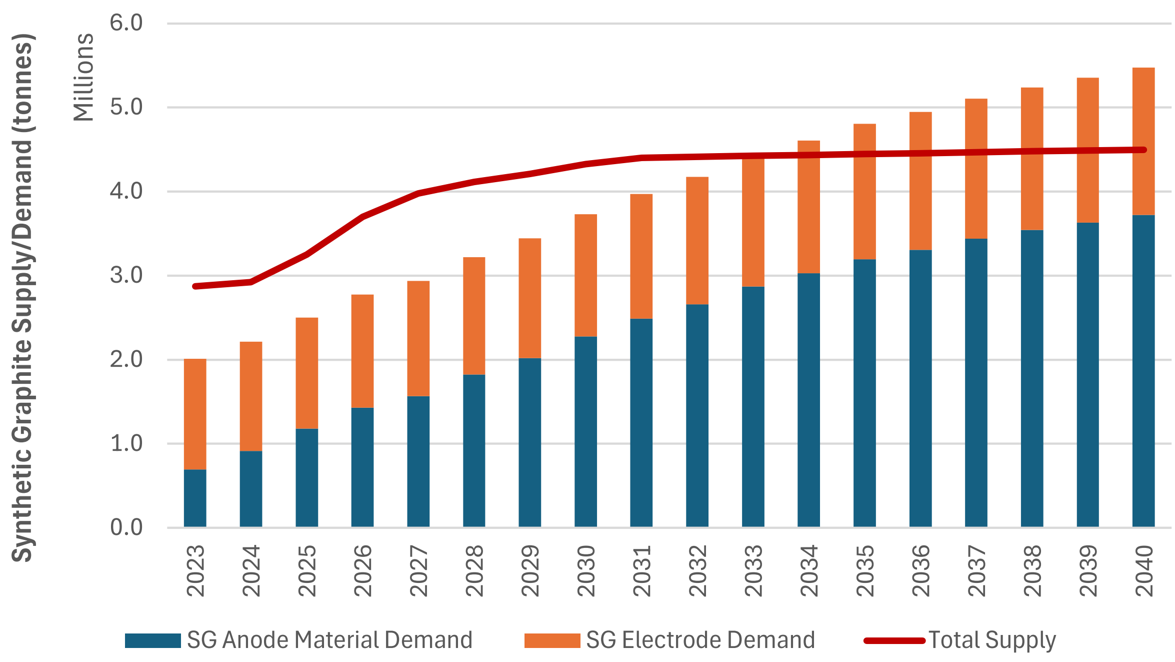
Table 19-1 Flake Graphite Demand by Market

Market	2023		2030		2040	
	Mt	% of Market	Mt	% of Market	Mt	% of Market
Refractory and Foundry	0.41	36.0%	0.43	15.1%	0.48	6.6%
Expanded Graphite	0.07	6.2%	0.08	2.9%	0.10	1.4%
Friction Products	0.03	2.5%	0.03	1.2%	0.04	0.6%
Carburization	0.03	2.7%	0.03	1.1%	0.03	0.5%
Lubricants	0.01	1.3%	0.02	0.6%	0.02	0.3%
Graphite Shapes	0.02	1.4%	0.02	0.6%	0.02	0.2%
Carbon Brushes	0.01	0.5%	0.01	0.2%	0.01	0.1%
Other Uses	0.00	0.3%	0.00	0.2%	0.01	0.1%
Non-Battery Demand	0.58	51.0%	0.63	21.7%	0.70	9.7%
Li-Ion Battery	0.55	49.0%	2.25	78.3%	6.52	90.3%
Total Demand	**1.13**	**100.0%**	**2.88**	**100.0%**	**7.23**	**100.0%**

Source: Benchmark Mineral Intelligence (2024b)

19.7.2 Synthetic Graphite Demand

Synthetic graphite is used in two primary uses—battery anode material and electrodes for the steel industry. Global demand for these two products was 2 Mt in 2023, with battery anode material accounting for 34% (692 kt) and electrodes accounting for 66% (1.3 Mt). Battery demand is forecast to drive a 228% increase in demand over 2023 for synthetic battery anode material by 2030 and 437% by 2040 (Figure 19-6). This will increase demand for synthetic graphite battery anode material to 2.5 Mt in 2030 and 3.7 Mt by 2040. The electrode market is forecast to see demand for 1.45 Mt and 1.75 Mt in the aforementioned years. Supply is expected to be in surplus until 2033 when demand will exceed supply.

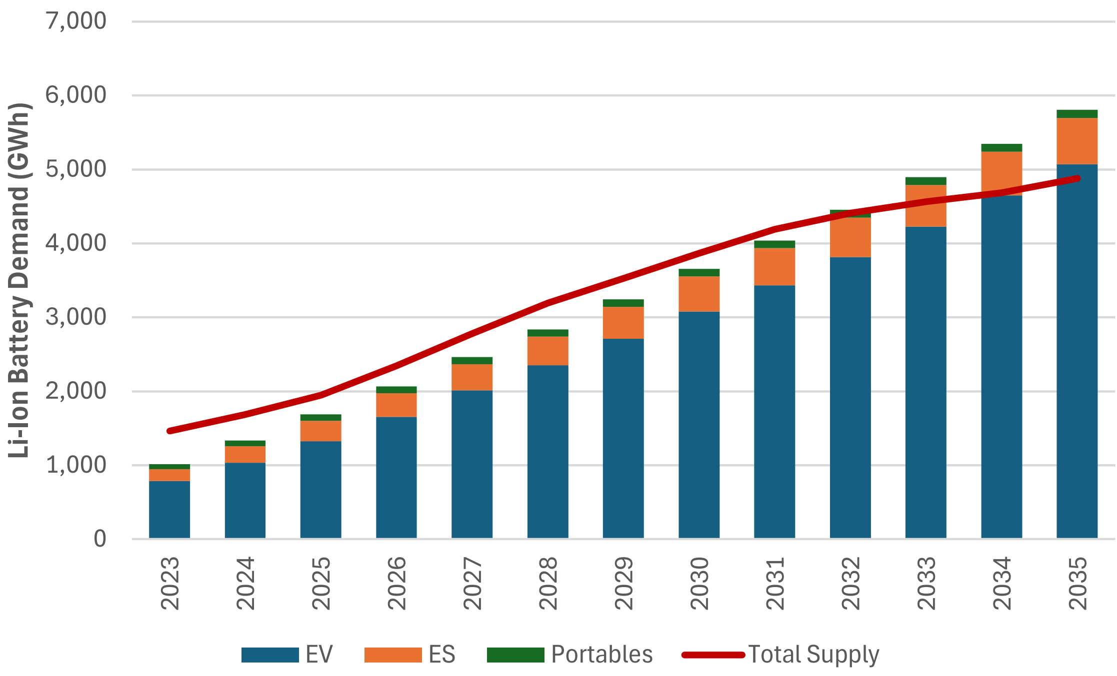


Source: Benchmark Mineral Intelligence (2024c)

Figure 19-6 Synthetic Graphite Demand by Use

19.7.3 The Battery Market

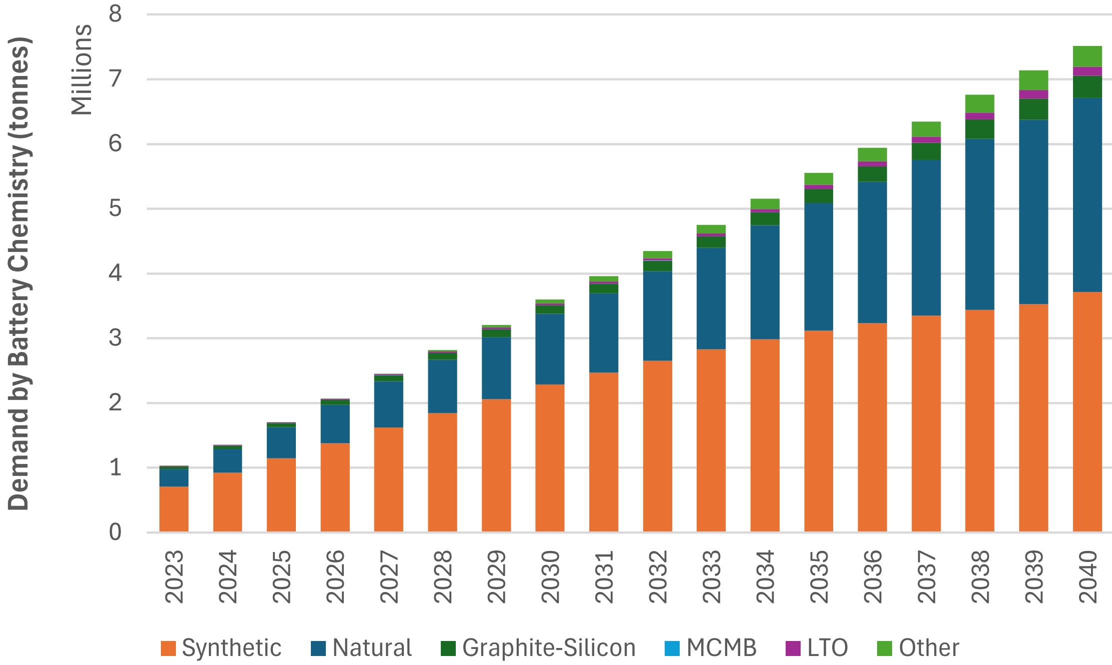
Driven by the EV sector, demand for AAM is expected to reach 6.3 Mt by 2030 and 7.5 Mt by 2040, a 249% increase and 630% increase vs. 2023, respectively. Although energy storage systems and portable batteries will continue to see demand increase, their market share is expected to diminish as EVs dominate demand (Figure 19-7).



Source: Benchmark Mineral Intelligence (2024d)

Figure 19-7 Battery Anode Demand by Application

In 2023, 1.03 Mt of graphite materials were used in the battery industry, 26.6% (274 kt) from natural graphite and 68.8% (707 kt) from synthetic graphite (Figure 19-8). Demand for natural graphite for battery anode materials is expected to grow, with an expected demand of 1.1 Mt forecast in 2030 and 3.0 Mt required by 2040. Demand for synthetic graphite is expected to grow at even faster rates, with demand forecasts of 2.3 Mt in 2030 and 3.7 Mt by 2040. Other battery anode chemistries such as graphite-silicone, mesocarbon microbeads, and lithium-titanate will make up the balance totaling 219 kt in 2030 and 803 kt by 2040.



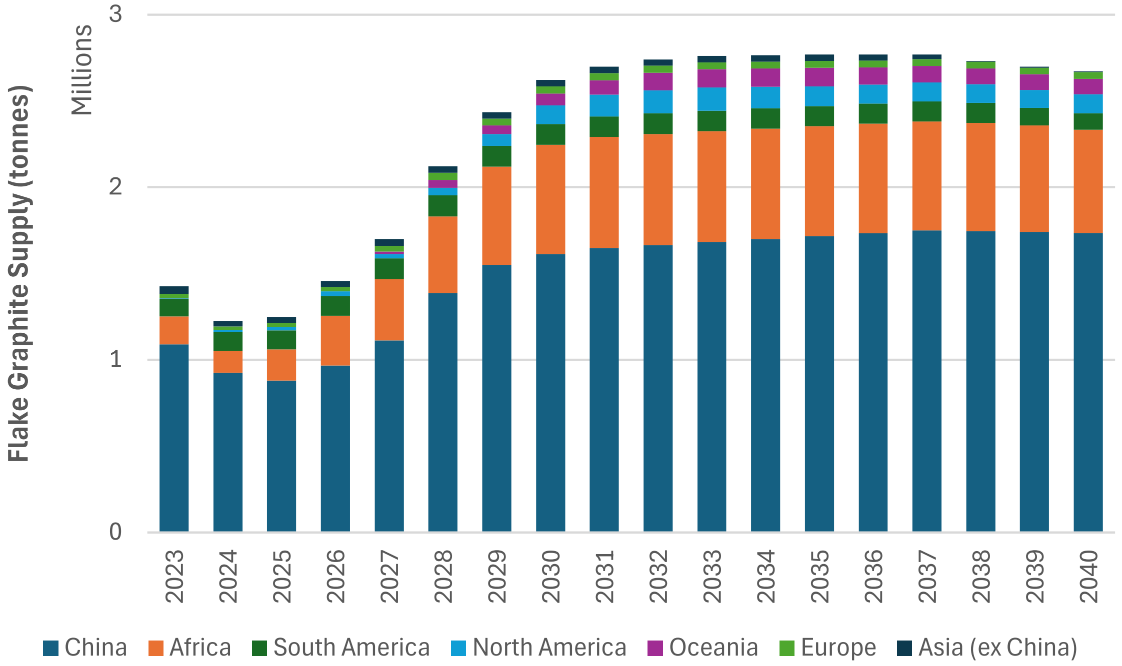
Source: Benchmark Mineral Intelligence (2024d)

Figure 19-8 Anode Material Demand by Battery Chemistry

19.7.4 Natural Graphite Supply

Figure 19-9 summarizes the forecast of natural graphite supply to 2040 for flake graphite concentrate.

China continues to dominate the supply of flake graphite by increasing production from 1.1 Mt in 2023 to 1.6 Mt in 2030 and 1.7 Mt annually by 2040. Despite an increase in forecast production, China’s market share is expected to decrease from 77% in 2024 to 62% by 2030 as African countries increase their market share from 11% in 2023 to 24% in 2030. Africa’s supply is forecast to increase production from 161 kt in 2023 to 634 kt in 2030 and 596 kt by 2040. Africa’s production comes primarily from Mozambique and Madagascar with Tanzania expected to increase its contribution to global supply by 2027. South American production, fully from Brazil, will increase from 105 kt in 2023 to 121 kt in 2030, then down to 97 kt by 2040. Benchmark forecasts North American production to increase from 4.4 kt in 2023 to 106 kt in 2030 and 108 kt by 2040. The North American forecast includes Canadian operations only, so the Graphite Creek contribution, as defined in this feasibility study, would more than double the North American forecast.



Source: Benchmark Mineral Intelligence (2024b)

Figure 19-9 Natural Graphite Supply by Region

Table 19-2 summarizes the supply quantities by source forecast for selected years from Figure 19-9. China continues to dominate the supply throughout the forecast period. By 2030, Mozambique is forecast to produce 372 kt of natural flake graphite annually. Tanzania, Brazil, and Canada are expected to produce 191, 121, and 107 kt in 2030, respectively.

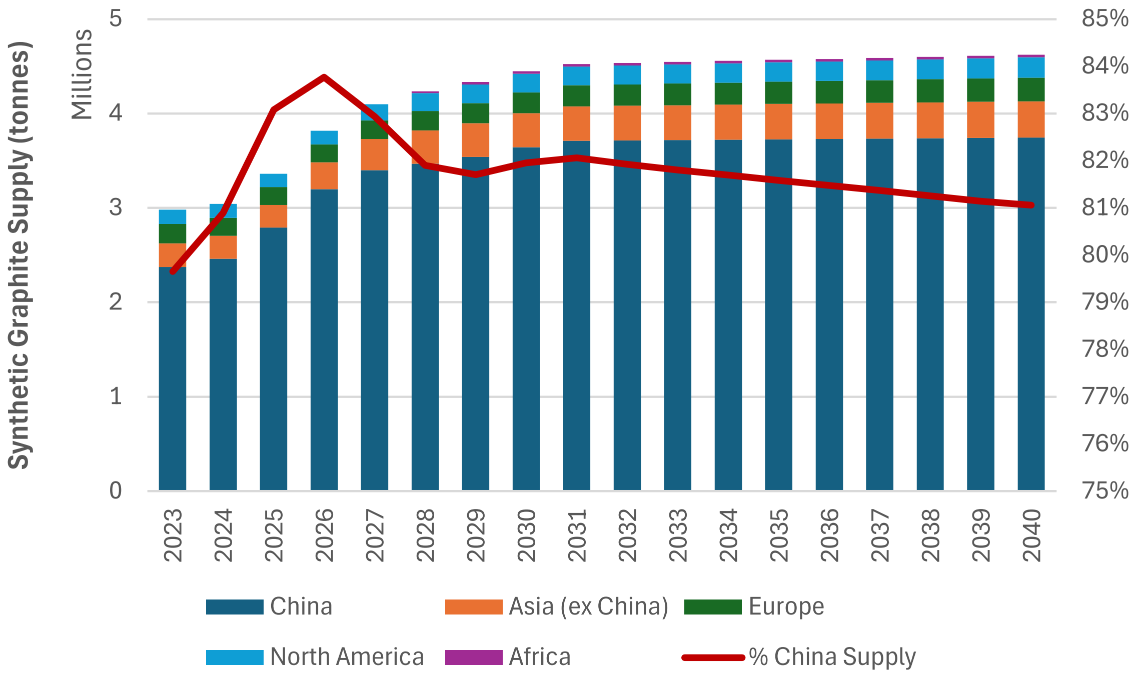
Table 19-2 Flake Graphite Supply by Region (kt)

Flake Graphite	2023	2030	2040
Total Demand	1,129.4	2,880.9	7,225.3
Total Supply	1,426.5	2,621.0	2,672.2
- China	1,089.4	926.0	879.7
- Africa	160.9	126.3	179.8
- Other Areas	176.2	1,568.8	1,612.8

Source: Benchmark Mineral Intelligence (2024b)

19.7.5 Synthetic Graphite Supply

Figure 19-10 presents the global supply of synthetic graphite. China is expected to continue its dominance of the industry, with production increasing from 2.4 Mt in 2023 to 3.6 Mt by 2030 and 3.7 Mt in 2040. India is expected to maintain its position as the second largest producer of synthetic graphite by increasing production from 155 kt in 2023, 219 kt in 2030, and 232 kt by 2040.



Source: Benchmark Mineral Intelligence (2024c)

Figure 19-10 Global Synthetic Graphite Supply by Country

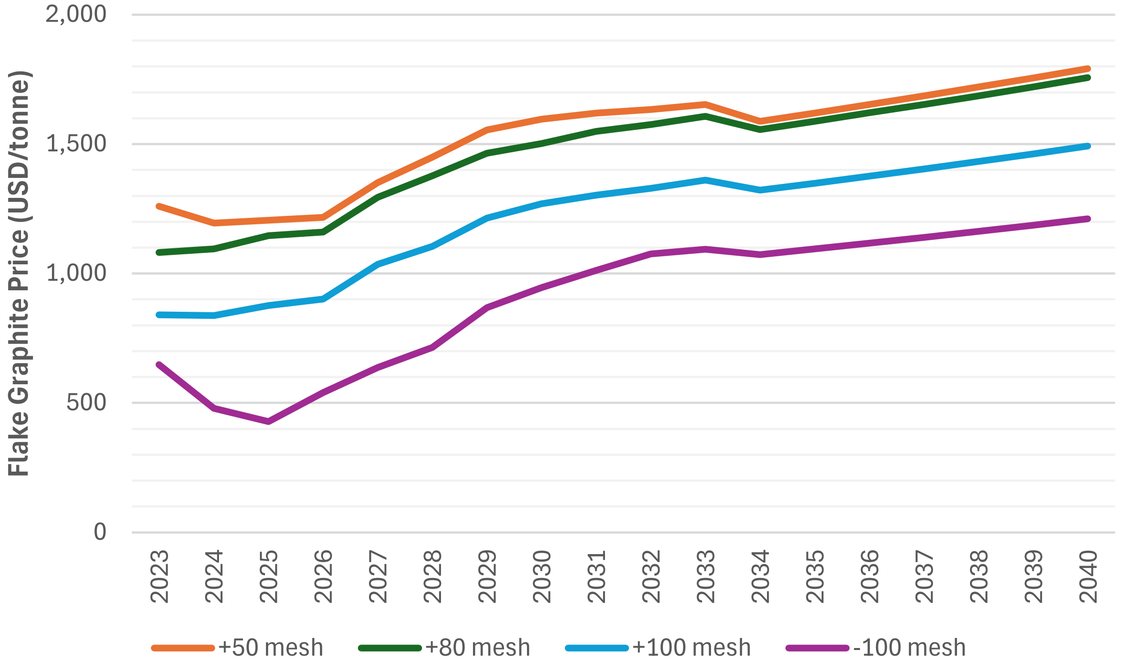
19.8 Products, Prices, and Contracts

Prices in the graphite industry are tightly held, particularly for advanced graphite products. This is a result of the proprietary nature of some of the products and manufacturing processes, the fact that the industry is concentrated amongst relatively few entities, and the associated high capital costs, particularly in the anode sector. Graphite One has used industry forecasts of Benchmark Mineral Intelligence and Lone Star Tech Minerals USA to provide category pricing at representative qualities. Other consultants with direct industry marketing experience have been used to get an understanding of the potential variations within product categories due to quality parameters, potential contract quantities, and shipping and packaging requirements for commercial-scale production.

19.8.1 Flake Graphite Concentrate Prices

Flake natural graphite is priced depending on purity and flake size with larger flake size demanding higher prices.

In the medium term (through 2034), several new natural graphite projects are expected to come online, but due to long lead times for project development, supply is not expected to meet demand resulting in price increases (see Figure 19-11 and Table 19-3).



Source: Benchmark Mineral Intelligence (2024a)

Figure 19-11 Flake Graphite Price Forecast (FOB China)

Table 19-3 Flake Graphite Price (FOB China) for Select Years

Flake Size	2023 Price ($/t)	2030 Price ($/t)	% Difference from 2023	2040 Price ($/t)	% Difference from 2023
+50 mesh	$1,194	$1,597	34%	$1,792	50%
+80 mesh	$1,095	$1,502	37%	$1,757	60%
+100 mesh	$838	$1,270	51%	$1,492	78%
-100 mesh	$479	$946	97%	$1,211	153%

Source: Benchmark Mineral Intelligence (2024a)

Benchmark's flake graphite pricing as of Q4 2024 has been used for the purposes of pricing material transfer from Graphite One's mining entity, Graphite One (Alaska) Inc., to Graphite One Manufacturing (Ohio) Inc.'s STP. Because Benchmark's pricing is forecast as free on board (FOB) China, a $250/t ocean freight to the United States has been included. A 20% allowance has also been applied to account for a U.S. tariff on Chinese graphite products in effect as of March 2025. Applying these economic factors to the Graphite Creek concentrate flake size distribution yields an aggregate price of $964/t of concentrate (Table 19-4).

Table 19-4 Base Case Flake Graphite Concentrate Pricing Q4 2024

Mesh Size	% Concentrate by weight	Forecast Price[1] ($/t)	20% Tariff Allowance ($/t)	Shipping Cost ($/t)	Product Price ($/t)	Equivalent Value ($/t Concentrate)
+32	0.6%	$1,194	$239	$250	$1,683	$10
+50	5.4%	$1,194	$239	$250	$1,683	$91
+80	6.0%	$1,095	$219	$250	$1,564	$94
+100	10.0%	$838	$168	$250	$1,256	$126
-100	78%	$479	$96	$250	$825	$644
Total Concentrate Price ($/t)				**$964**		

[1]Free on Board (FOB) China.
Source: Benchmark Mineral Intelligence (2024a)

19.8.2 Refined Product Pricing

Table 19-5 summarizes the Project's planned products and their respective prices as of Q4 2024. U.S.-based customers are the target market, and the prices are derived from price information in the Market Reports and assessed against competitive imported products, some of which may attract United States import duties. The prices are considered "Ex Works." Prices in the graphite industry are tightly held, particularly for advanced graphite products. This is a result of the proprietary nature of some of the products and manufacturing processes, the fact that the industry is concentrated amongst relatively few players and the associated high capital costs, particularly in the anode sector. Graphite One has used the industry forecasts from Benchmark to provide category pricing at representative qualities, and a $250/t ocean freight to the United States has been included. A discrete 48.7% and 20% allowance has also been applied to account for a U.S. tariff on Chinese artificial graphite products and refined natural graphite, respectively, in effect as of March 2025. Other consultants with direct industry marketing experience have been used to get an understanding of the potential variations within product categories due to quality parameters, potential contract quantities, and shipping and packaging requirements for commercial-scale production.

Table 19-5 Graphite One Project Products, Annual Quantities, and Product Pricing[1]

Category	Name & Description	Purity (% Cg)	Annual STP Production (tpa)	Price DDP China ($/t)	Tariff Allowance ($/t)	Shipping ($/t)	Price ($/t)
Anode Material	CPN: Coated, Spherical NG	99.95	39,639	6,811	1,362	250	8,424
	BAN: Blended AG and NG	99.95	75,502	7,608	3,705	250	11,563
	SPN: Secondary Particle NG	99.95	12,160	7,210	3,511	250	10,971
	SPC: Secondary Particle Composite	99.95	42,085	7,210	3,511	250	10,971
Subtotal - Anode Material			**169,386**				**10,369**
Purified[2]	3299	99+	386	3,599	720	250	4,569
	599	99+	3,480	3,028	606	250	3,884
	899:00:00	99+	3,866	2,347	469	250	3,066
	199	99+	6,446	1,914	383	250	2,547
	Battery Conductor	99.9	4,580	4,256	851	250	5,357
	Synthetic Diamond Precursor	99.99	6,278	4,770	954	250	5,974
Subtotal – Purified			**25,035**				**4,218**
Unpurified	3295	95+	630	1,194	239	250	1,683
	595	95+	5,670	1,194	239	250	1,683
	895	95+	6,297	1,095	219	250	1,564
	195	95+	10,502	838	168	250	1,256
	Carbon Raisers & Lubricants[3]	95+	30,948	1,560	312	250	2,122
	Coke Reject[3]	95+	8,043	300	60	250	610
Subtotal – Unpurified			**62,089**				**1,679**
Total Annual Production & Average Price per Tonne			**256,510**				**7,843**

Sources: [1]Benchmark Mineral Intelligence (2024a); [2]Lone Star Tech Minerals (2025a); [3]Lone Star Tech Minerals (2025b)
DDP = Delivered duty paid

19.8.3 Contracts

Unlike most mined commodities, there are limited open markets for graphite products. Contracts will need to be negotiated to sell products generated by the STP. While Graphite One has had preliminary discussions with several potential customers under confidentiality agreements, the only supply agreement currently in place is a non-binding AAM supply agreement with Lucid Motors, a U.S.-based electric car manufacturer.

Graphite One signed technology license and consulting agreements with Hunan Chenyu Fuji New Energy Technology Co. Ltd. (Chenyu), an AAM manufacturer headquartered in China. Chenyu currently supplies qualified AAM to Li-ion battery producers. The Chenyu agreement grants Graphite One exclusive North American license to certain AAM technologies in return for the payment of royalties applied to net revenues received by Graphite One from the sale of AAM products manufactured using the technology and applies only to synthetic graphite. The agreement provides for Chenyu's advice and guidance during the design, construction, commissioning, and operation of the STP for the production of natural graphite and provides Graphite One with the right of first negotiation for next-generation products and right of first negotiation for additional markets such as Europe, the United Kingdom, and Saudi Arabia.

20 Environmental Studies, Permitting, and Social or Community Impact

20.1 Permitting Requirements and Environmental Assessment

In this section, we'll discuss the environmental permitting requirements associated with the Alaska portion of the project, encompassing the mine, mill, access road, and other related components. Additionally, we will examine the permitting regulations for the STP located in Ohio. Baseline environmental studies supporting the permitting requirements, as well as potential social and community impacts associated with the Project, are also presented. Major environmental resources within the Project area are summarized. This section also discusses the status of environmental baseline data collection completed to date, along with the work remaining to obtain the necessary permits and comply with the National Environmental Policy Act (NEPA) analysis.

20.1.1 Wetlands

20.1.1.1 Alaska

To obtain the USACE permit under Section 404 of the CWA (wetlands permit), the wetland types in the project area must be completely delineated. This is a critical authorization, as it is the only major federal authorization necessary for this project and will trigger the NEPA review.

A desktop wetlands analysis was completed in 2015 for the mine study area and the corridor for the Teller access option. In 2019, the field-supported wetland mapping program was initiated. This effort included mapping wetlands and waterbodies at a finer scale than the 2015 analysis; the mine study area, as well as the Mosquito Pass study area, were included in the more recent study. Mapping of wetlands and waterbodies in these areas was supported through field data collection that occurred during the 2019, 2021, 2023, and 2024 field seasons. Final wetland and waterbody mapping was completed following the 2024 field season. The wetland and waterbody mapping for the mine and Mosquito Pass study areas is of sufficient detail required for a USACE Jurisdictional Determination, which will be necessary for the USACE to make its decisions on the CWA Section 404 permit. Wetlands delineation has been completed on 6,349.5 ha (15,690 ac) of land around the project site and access road corridor.

Table 20-1 summarizes the disturbance acres and shows that less than 1% [1.4 ha (3.4 ac)] of the 640.2 ha (1,582 ac) proposed disturbance area are jurisdictional wetlands or water bodies.

Table 20-1 Project Jurisdictional Wetland and Waterbody Impact

Project Component	Wetlands (ha; ac)	Waterbodies (ha; ac)	Uplands (ha; ac)	Total (ha; ac)
Access Road & Material Sites[1]	0.08; 0.2	0.53; 1.3	102; 252	103; 254
Mine Site[1]	0.04; 0.1	0.73; 1.8	537; 1,326	537; 1,328
Total Disturbance	0.12; 0.3	1.25; 3.1	639; 1,578	640; 1,582
% of Total	**0.02%**	**0.20%**	**99.78%**	**100.0%**

[1]Jurisdictional acreages are based on HDRs interpretation of the Sackett v. EPA (598 U.S. 651, 2023) court decision as well as the recent memorandum from the EPA Administrator (dated March 12, 2025). Impact totals do not include 232.1 ha (573.5 ac) of impacts to non-jurisdictional wetlands and 0.8 ha (2.0 ac) of non-jurisdictional waterbodies. Future rulemaking by the EPA and USACE may alter the total area of jurisdictional wetlands and waterbodies impacted within the project footprint.

Interpretation of the aerial imagery, supported by data from four seasons of field investigations, suggests that most of the wetlands in the study areas have a saturated water regime. This hydrologic regime is common on moderate slopes where relatively shallow permafrost was often encountered during field soil investigations. Most of the wetlands in the mapping area appear to be co-dominated by broad-leaved deciduous shrub species and sedges or grasses (persistent emergent vegetation; PSS1/EM1 Cowardin types).

20.1.1.2 Ohio

A USACE wetlands permit is not anticipated to be required for the facility in Ohio. Two aquatic resources are mapped within the anticipated site area on the USFWS NWI. One mapped resource is likely a stormwater facility and is not regulated under the CWA. The other is a tributary to the Mahoning River, which is not proposed to be impacted by the site's development. The USDA NRCS has classified the STP site area as Urban Land. Based on preliminary studies, the site soils/sediments are composed of weathered slag fill ranging in depth from ten feet to thirty feet deep. No natural wetlands are mapped by the NWI, and mapped soils, vegetation, and lack of hydrology do not indicate wetlands are present.

20.1.2 Hydrology and Water Quality

Understanding the baseline hydrology, water quality, and the potential impacts of the proposed activity to water in the project areas are fundamental parts of the NEPA analysis.

20.1.2.1 Surface Water

Alaska

Baseline water quality sampling of streams in the project area began in 2014. Ten monitoring sites in six streams in the project area have been sampled for most of this period. Two sites were added on a seventh stream in 2024. This program will continue into the foreseeable future. Water quality sampling indicates that streams in the project area have elevated acidity (lower pH) and content of some metals, including Al, Cd, Fe, and Ni. Some streams, including Graphite Creek, have naturally occurring aluminum sulfate precipitate in their upper reaches and iron oxide/hydroxide precipitate in their mid-reaches.

Streamflow measurements have been taken at five gauging stations: two on Glacier Canyon Creek, two on Graphite Creek, and one on the Cobblestone River.

The Imuruk Basin is the receiving water body of streams traversing the project area and potentially of treated water from the project area. The Imuruk Basin is a potential aquatic, wildlife, and subsistence resource and will be part of a NEPA analysis. Ongoing studies of the Imuruk Basin indicate that it is a tidal lake with slightly brackish water. During incoming tides, a more brackish wedge of water is seen in the outlet area at depth. Studies begun in 2024 indicate that there is a high discharge rate of water from the basin through the Tuksuk Channel. The flow in the channel is typically downstream but may reverse with incoming tide, dependent on storm tides, wind direction, and other factors. The downstream discharge rate reaches very high levels when these conditions reverse.

Ohio

Before vacating the site in 2012, the DoD performed a Voluntary Action Program assessment and cleanup project to receive “No Further Action” and “Covenant Not to Sue” letters from the OEPA. The recorded Covenant Not to Sue for NFA Letter No. 14NFA596 indicates: “No surface water or sediments are present on the property”.

According to the 2024 Integrated Report, which fulfills Ohio’s reporting obligations under Section 305(b) (33 U.S.C. 1315) and Section 303(d) (33 U.S.C. 1313) of the Federal Clean Water Act, the Mahoning River segment (Mahoning River Mainstem – Eagle Creek to Pennsylvania Border; Assessment Unit ID: OHLR050301039001) adjacent to the STP site is a CWA Section 303(d) listed, impaired waters (Category 5). Category 5 refers to the list of impaired waters that require the development of a Total Maximum Daily Load. The Aquatic Life-Warmwater Habitat parameter includes the following impairments: flow regime modification, habitat alterations, organic enrichment, pollutants in urban stormwater, sedimentation/siltation, and cause unknown. The Human Health-Fish Consumption parameter is impaired for polychlorinated biphenyls in fish tissue. The Recreation-Primary Contact parameter is impaired for Escherichia Coli.

20.1.2.2 Groundwater

Alaska

Hydrogeology quantifies baseline conditions, predict impacts to surface water resources during mining and post-mining, and provide input to operational considerations such as water handling and treatment. A preliminary program was conducted in 2019, followed by more comprehensive, ongoing studies since 2021.

Hydrogeologic studies indicated that bedrock in the deposit area has very low primary permeability and that most of the groundwater is in faults and fractures. Relatively small quantities of groundwater are expected to enter the pit during mining. Studies and modeling indicate that the majority of the water that will need to be removed from the pit will be from rain and snow melt.

A pit lake is expected to form post-mining. Modeling indicates that the pit lake will reach a maximum depth in 15 to 20 years and not overflow.

Streams in the lowlands lose water to groundwater to varying degrees. Activities that may decrease groundwater levels are unlikely to affect stream flow levels, and activities that may affect groundwater chemistry are also unlikely to affect surface water resources.

Groundwater in the deposit area has elevated acidity (low pH), Al, Fe, Ni, sulfate, and TDS. The concentration of these constituents rapidly decreases north of the mountain front. The groundwater in the lowlands north of the pit area has background levels of these constituents.

Ohio

No known groundwater quality concerns exist at the STP site. Before vacating the site in 2012 the DoD performed a voluntary action program (VAP) assessment and cleanup project to receive “No Further Action” and “Covenant Not to Sue” letters from the Ohio EPA. According to the VAP Property Summary: “The uppermost water-bearing zone, typically ranged from 10 to 20 ft below ground surface, was part of the Site Assessment. Potential chemicals of interest in uppermost water-bearing zone meet unrestricted potable use standards (UPUS).”

20.1.3 Air Quality

20.1.3.1 Alaska

Air quality may be impacted by power plant emissions (diesel generating set) and fugitive dust control. The ADEC requires a year of baseline meteorological data before applying for a minor air permit or a PSD permit. A PSD permit also requires data on background air pollutants in the area. In addition to baseline data collection, modeling and permit preparation can require another six months, and ADEC can require roughly a year to process a PSD application. The air quality information required for ADEC should be adequate for NEPA. A meteorological tower was installed in the project area in October of 2019. The instrument package on the tower will continue to measure several parameters necessary for modeling. The location of the tower and the instrument package were both approved by ADEC.

20.1.3.2 Ohio

The STP is located in an air quality control region that is in attainment (maintenance area) as identified in the EPAs Ohio Eight-Hour Ozone Nonattainment Areas map for Trumbull County. Air emissions from the facility would require an Air Pollution Control Permit–PTIO from the OEPA for new emissions. The PTIO process covers various types of air permits, but a PSD permit is anticipated for the site. Meteorological data is available through various sources in Ohio to support the background air pollutant data requirements of the permit process. Similar to Alaska, the modeling and permit preparation would require roughly three to six months with the processing through the OEPA requiring another nine to twelve months.

20.1.4 Aquatic Resources

20.1.4.1 Alaska

Aerial reconnaissance surveys of project area streams were initiated in August 2018 to identify streams with likely suitable fish habitats and to document those used by adult Pacific salmon. In 2019, Graphite One initiated an aquatic baseline data collection program anticipating project planning and environmental evaluation. Data collection was designed to establish baseline conditions of aquatic communities and water quality while quantifying the natural variability of both, and to evaluate the overall health and productivity of the drainage. The sampling program included establishing long-term biomonitoring sites and conducting aerial and ground-based fish surveys. The goal of the aquatic baseline study is to collect data to establish the aquatic resource baseline, support NEPA evaluation, federal permitting, and ADFG Fish Habitat Permit review and issuance.

Seven long-term biomonitoring sites were established in 2019, and an additional two sites were included in the sampling plan beginning in 2021. These nine sites have been sampled annually since 2021. Seven of the nine sites are within areas potentially impacted by project-related activities, while two sites, one in Fall Creek to the west and one in Oro Grande Creek to the south, are located outside the project boundary and serve as control sites. Biomonitoring sites were sampled for water quality, periphyton standing crop, aquatic macroinvertebrates (invertebrates), and juvenile fish for abundance and whole-body elemental analysis.

In-situ water quality parameters and aquatic invertebrate sampling results indicate that most systems surveyed had relatively good water quality and little evidence of disturbance. The exception is Glacier Canyon Creek (to which Graphite Creek is a tributary), which has historically been a highly mineralized stream with poor water quality and sparse aquatic life. However, water quality and biotic parameters have been improving in the stream in recent years. Potential hydrogen (pH) was measured at 4.91 in 2019 at the biomonitoring site located closest to the ore body (GLA 2) and increased to a high of 6.87 in 2023 and 6.45 in 2024. Aquatic invertebrate communities have become more diverse at the site, and in 2023, a slimy sculpin fish was captured at the site for the first time since biomonitoring began in 2019.

Downstream, another biomonitoring site known as GLA 1 has also shown improving water quality parameters, with a pH of 4.65 in 2019, increasing to 6.49 in 2023 and 6.3 in 2024. No fish have yet been captured at GLA 1, but invertebrate biota have become more diverse at this site, similar to GLA 2, with both sites hosting Ephemeropterans in 2023 for the first time. Taxa of the order Ephemeroptera are considered sensitive to poor water quality, and their presence suggests that Glacier Canyon Creek may become more hospitable to aquatic life over time. The stream will continue to be monitored to document this change. Other highly mineralized streams and seeps exist in the area and in the headwaters of the Nome River, though these are not continually monitored as part of the biomonitoring sampling plan.

Across all nine sites monitored during 2019–2024, a total of 1,293 fish representing ten species were captured during a sampling effort that totaled approximately 1,024 hours of minnow trapping and 9,784 m of stream electrofished. Anadromous fish were found at all sites except for the two sites in Glacier Canyon Creek. Dolly Varden was the most abundant species captured, comprising 37.5% of the total catch over the years. Slimy sculpin was the second most abundant at 28.8%, and juvenile Coho salmon were third at 23.0%. Other species captured made up less than 10% of the total catch combined and consisted of juvenile Pink salmon, juvenile Chum salmon, Alaska blackfish, Arctic grayling, Ninespine stickleback, juvenile Sockeye salmon, and Burbot.

Aerial surveys have been conducted in July, August, and/or September of each year to describe the extent and distribution of adult Pacific salmon and Dolly Varden within and near the project area. Twenty-five total streams have been surveyed, and Pacific salmon have been found in all but seven of them. All five species of Pacific salmon have been documented in the project area, although Chinook salmon have not been observed since 2019. With the exception of small numbers of Pink salmon occasionally at the mouth, Pacific salmon are absent in Glacier Canyon Creek, while the highest concentrations occur in the Cobblestone River. Pink salmon are the most abundant and widely distributed species, followed by Chum salmon. Compared to Pink salmon, relatively few Coho and Sockeye salmon are observed. Of streams surveyed near the project site, the Cobblestone River is used most heavily for spawning by Pacific salmon and Dolly Varden.

As part of evaluating aquatic resources in the project area and to aid in road design and alignment, all potential road crossings of area streams have been investigated. Aerial reconnaissance of all streams crossed by potential roads has been conducted, and all streams with adequate flow and gradient to support fish have been sampled using electrofishers in the vicinity of potential road crossing locations. Most small streams with potential fish habitat are not used by fish, and of those that are used, they have been used primarily by Slimy sculpin and/or juvenile Dolly Varden and Coho salmon.

20.1.4.2 Ohio

No unique aquatic habitat is known to exist at the STP site, as no natural waterways or wetlands are located on-site.

20.1.5 Marine Environment

20.1.5.1 Alaska

The project area is within five miles of Imuruk Basin, a body of tidally influenced water. Imuruk Basin is connected to Grantley Harbor to the west by the narrow 10-mile-long Tuksuk Channel. Numerous freshwater rivers flow into Imuruk Basin, including the Kusitrin, Kaviruk, Aqiapuk, and Cobblestone Rivers and Graphite Creek.

The ADNR land-use plan for Imuruk Basin describes the resources in the basin as follows: “Shoreline consists of intertidal wetlands with extensive salt and brackish-water marshes of fine sands and organic muds to moderately sloping mixed sand and gravel beaches. Eel grass is present along the shores. High value habitat exists for waterfowl, shorebirds, and seabirds. Anadromous and resident fish, bivalves, and crab are present. There are known or a high probability of heritage resources. Hunting, fishing, camping, bird watching, and boating occur in this unit.” (Subunit ST-02, Northwest Area Plan, classified for Habitat and Harvest).

All rivers and streams proximal to the mine site flow into the Imuruk Basin. If the project pursues discharge of treated water into the basin, characterization of basin bathymetry, current flow, water and sediment quality, and aquatic life are necessary for Alaska Pollutant Discharge Elimination System (APDES) permitting.

Bathymetry and Current Measurements

In order to characterize the Imuruk Basin, measurements were taken to better understand the bathymetry and water flows within the basin. A single-beam hydrographic survey was conducted in 2023 to determine the bathymetry of the Imuruk Basin. In addition, three Acoustic Doppler Current profilers were installed on the basin floor to collect 3-D current profiles, 2-D wave data, salinity, and water temperature data. One Acoustic Doppler Velocity Meter was placed in the Tuksuk Channel to measure inflow and outflow from the basin.

Water Quality Sampling

To characterize the existing water quality in the Imuruk Basin, in-situ water conditions were measured at 0.5 m depth intervals at 12 sites, and water quality samples were collected at two depths at two of the sites. Monitoring indicates that the basin water is slightly brackish, and a more saline layer is occasionally seen at the bottom near the outlet.

Aquatic Sampling

Fish sampling with fyke and gill nets was instituted in 2022 focusing on the southern shore of the basin between the western edge of Windy Cove to near the mouth of the Cobblestone River to the east. Fish sampling and in-situ water quality monitoring have been conducted for seven-day periods since 2022, once after break-up in June of 2022, and then twice annually beginning in 2023, once in June and once in August each year.

Sampling results indicate a mixed assemblage of freshwater and marine/brackish water fish species use the southern shores of Imuruk Basin throughout the season, likely based on salinity fluctuations and fish life history. Fish are diverse and abundant in Imuruk Basin. From 2022 to 2024, 11,475 fish of 25 unique species were captured from 2,840 hours of fyke net fishing and 137 hours of gillnet fishing. The most abundant fish species captured were threespine stickleback, comprising 49.8% of the total catch. Saffron cod and longnose suckers were the second most abundant, at 15.1% each, and rainbow smelt were third at 5%. All other species, such as northern pike, humpback whitefish, least cisco, Dolly Varden, fourhorn sculpin, starry flounder, pacific herring, pond smelt, and all species of Pacific salmon except for Chinook salmon, made up less than 3% of the total catch individually.

The diversity of fish species varies by location and season in Imuruk Basin. Threespine sticklebacks are more abundant in June, while saffron cod dominate the catch in August. More marine-oriented species, such as starry flounder and fourhorn sculpin, are caught on the western side of the basin which is closer to Tuksuk Channel and likely saline influence, while freshwater species such are caught further east near the mouth of the Cobblestone River. Accordingly, salinity values tend to be slightly higher in western Windy Cove area sites, up to 3.5 practical salinity units, and host more salinity-tolerant species.

20.1.5.2 Ohio

No marine environments exist in the vicinity of the STP site.

20.1.6 Wildlife

20.1.6.1 Alaska

Though the project site may not be in a particularly sensitive area for wildlife, the impact of the project on wildlife may be an important issue because of the reliance on subsistence resources by the local residents.

There are three species listed as ‘threatened’ under the Endangered Species Act (ESA) that are known to use coastal habitats in the vicinity of the project area: polar bear, Steller’s eider, and spectacled eider. Polar bear critical habitat technically includes Imuruk Basin, but their use of this inland estuary is expected to be very unlikely. Steller’s and spectacled eiders are known to use coastal habitats in Port

Clarence during spring and fall migrations but do not breed on the Seward Peninsula. The lead permitting agency, USACE, will determine whether it is necessary to conduct Section 7 ESA consultation for polar bear critical habitat, Steller's Eider, and spectacled eider.

Since 2022, annual raptor nest surveys have been conducted in the project area and have identified several nests, including those of golden eagles. Baseline information on the species of birds, terrestrial mammals, and marine mammals that may use the project area and adjacent migratory locations should be collected and analyzed for data gaps. This information will be necessary to ensure compliance with the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act. Construction activities will be required to comply with timing restrictions for vegetation clearing during migration and nesting season.

20.1.6.2 Ohio

No significant wildlife concerns exist at the STP site. Based on the USFWS Information for Planning and Consultation tool results for the STP site, Indiana bats (Myotis sodalis), eastern massasauga rattlesnakes (Sistrurus catenatus), eastern hellbenders (Cryptobranchus alleganiensis), and monarch butterflies (Danaus plexippus) may exist in the general vicinity; however, none are anticipated to occur due to lack of suitable habitat within the previously developed industrial site. Additionally, no critical habitats are located within the STP site boundary. Limited building demolition may require presence/absence surveys for Indiana bats; however, if any Indiana bats are present, they can be excluded from buildings during periods specified by the ODNR, prior to demolition.

20.1.7 Cultural Resources

20.1.7.1 Alaska

Pedestrian and aerial cultural resources surveys were conducted in 2023 and 2024 around the project site as well as along the access road corridor. A number of historic and prehistoric sites have been documented by the survey crew, led by a Secretary of Interior-qualified archaeologist. Additional background research and cultural resource surveys of the project area, within areas to be disturbed by the project, will need to be conducted. As the project resides on the state of Alaska land, it is subject to compliance with the Alaska State Historic Preservation Act.

Once a CWA Section 404 permit is applied for, USACE will initiate the Section 106 consultation process. As the lead federal permitting agency, USACE, in consultation with the SHPO, will determine whether the cultural resources surveys performed meet a reasonable and good faith effort, which is required under Section 106 of the National Historic Preservation Act (NHPA). USACE will identify parties that should be consulted for their input on the cultural resource information collected, determine whether any sites in the project area are eligible for listing under the National Register of Historic Places, and whether any of these sites would be affected by the project. Efforts should be made to avoid or minimize impacts to eligible sites, where possible. Where avoidance and minimization are not possible, mitigation may be required in order to complete the Section 106 process.

20.1.7.2 Ohio

No previously recorded archaeological sites, historic resources, cemeteries, or National Register of Historic Places properties or districts are located within the proposed STP site. Two previously recorded archaeological sites are within one mile of the proposed project site (33TR0024 and 33TR0221);

however, neither is located within the project boundaries. Two previously recorded cultural resources surveys were conducted within one mile of the proposed project site (17450 and 18848), though neither intersects the project boundaries. One state-listed historic property is located within one mile of the proposed project site (TRU0242523, also known as the Austin J. Fulk House), but the property is not located within the proposed project boundaries. Two cemeteries are located within one mile of the proposed project site (Saint Stephens and Sand Pit Road cemeteries). Neither cemetery overlaps with the proposed project boundaries. There are no known records of existing potential Traditional Cultural Properties located within one mile of the proposed project site based on a records review of the Ohio History Connection's Archaeological and Historic Inventory database. If NEPA is required for the STP site, then consultation under Section 106 of the NHPA will be required.

20.1.8 Visual Resources

20.1.8.1 Alaska

The project is located in a remote part of the state with few anthropogenic visual features other than the two communities and related infrastructure (such as roads and transmission lines). Once constructed, portions of the operation may be visible from near the two communities, especially during dark periods. A visual resource assessment, including visual simulations from key observation points may be needed to provide detail on potential visual impacts and potential mitigation measures.

20.1.8.2 Ohio

The STP site will be located on a previously developed industrial site. Except for the presence of the Mahoning River on the western boundary of the site parcel there are no scenic vistas within the site or in the immediate vicinity. The site is surrounded by mature trees that obscure the view of the site from adjacent properties. There is no existing aesthetic landscaping at this site.

20.1.9 Noise

20.1.9.1 Alaska

The project is located in a remote part of the state, characterized by relatively low ambient-sound levels. Noise impacts from the operation are not anticipated for the community of Nome, due to the distance. The two nearby communities, Teller and Brevig Mission, may experience some level of noise impact from the operation.

Federal agencies may require baseline acoustic measurements to characterize the existing environment at important locations. It is unclear whether these would be required for the project, as baseline data collected on National Park Service lands could be used if deemed appropriate. Impacts are estimated through a variety of existing sound propagation models.

20.1.9.2 Ohio

The STP site is in an industrial zone. Minor noise impacts to residential areas within the cities of Niles and Warren are anticipated to result from site development and facility operations; however, noise levels are anticipated to be consistent with previous land use, zoning ordinances, and Occupational Safety and Health Administration (OSHA) standards.

20.1.10 Land Use and Recreation

20.1.10.1 Alaska

The project area is located primarily on land owned by the state of Alaska and managed by ADNR. There are no federal lands within the project area. The area where the mine and mill are envisioned is classified for mineral development in ADNRs land-use plan for the area. Subunit S-05 in the northwest area plan has the primary designation of Minerals and Dispersed Public Recreation. This designation indicates that ADNR expects mineral development but indicates it should be managed in a manner that minimizes harm to dispersed public recreation. This is a helpful designation for the project.

In Alaska, new access is always a controversial issue. Access was the major issue at the True North and Pogo Mines and is usually a state rather than a federal issue. Major discussion often revolves around Alaskans' access to hunting and fishing. It is unknown whether hunters would view either road option to the mine as a way to get to previously inaccessible areas, and new roads can bring in out-of-area hunters, which may compete with local subsistence hunting. The major area of controversy is whether the road to the project becomes a public road open to the public and whether it will be reclaimed at the end of the project's life. Given the remote location of the project, recreational use of this area is limited. There is some limited recreational use of the Mosquito Pass area by Nome residents and occasional use by sport fishermen flying to the Cobblestone River.

20.1.10.2 Ohio

The STP site is located on a previously developed industrial site. No recreation potential exists at this location, and the proposed facility is congruous with existing zoning. No adjacent recreational facilities are present to be affected by the redevelopment of the site.

20.2 Environmental Authorizations and Permits

This section provides a list of the authorizations that will be required for the construction and operation of the Graphite Creek mine.

20.2.1 Existing Permits and Authorizations

The project currently holds the following authorizations and permits.

- Miscellaneous Land Use Permit No. APMA 2299, which authorizes hard rock exploration activities on the project site. This permit is issued by the Alaska Department of Natural Resources (ADNR) Mining Section and is valid through 12/31/2026
- Four Temporary Water Use Authorizations (Nos. F2022-077, -078, -079, -080), which authorize water removal from surface waterbodies for exploration activities. These authorizations are issued by ADNRs Water Section and are valid through 12/31/2026
- Land Use Permit No. LAS-34100, which authorizes the use of two staging areas along the Kougarok Highway

- Land Use Permit No. LAS-34054, which authorizes the placement of a communications repeater and a meteorological station
- Land Use Permit No. LAS-34053, which authorizes geotechnical drilling along the proposed access corridor
- APDES General Permit for Storm Water Discharges for Multi-Sector General Permit Activity (MSGP), permit authorization no.: AKR06H00N v1.0
- Fish Habitat Permit # FH22-III-0125, which authorizes activities in fish bearing waters, primarily for water withdrawal structures. This authorization is issued by ADFGs Habitat Division and expires on 12/31/2026.

20.2.2 ADNR Plan of Operations, Reclamation Plan Approval, and Millsite Lease

The plan of operations approval balances the applicant's right to extract the minerals with the mine's effect on public resources. ADNR has the authority under the plan of operations to stipulate changes in the design and operation of the mine to protect public resources. In this balancing, it is useful that the mine-area itself is classified for mineral development in ADNRs land-use plan for the area. Subunit S-05 in the northwest area plan has the primary designation of Minerals and Dispersed Public Recreation. This designation indicates that ADNR expects mineral development but indicates it should be managed in a manner that minimizes harm to dispersed public recreation. This is a helpful designation for the project.

The reclamation plan provides ADNR authority to review operations for compliance with the state law AS 27.19.20: "A mining operation shall be conducted in a manner that prevents unnecessary and undue degradation of land and water resources, and the mining operation shall be reclaimed as contemporaneously as practical with the mining operation to leave the site in a stable condition." For hard rock mines, implementing ADNRs authority under the law typically requires them to review the mine's plan of operations.

The law, AS 27.19.040, directs ADNR to require a reclamation bond: "an individual financial assurance in an amount not to exceed an amount reasonably necessary to ensure the faithful performance of the requirements of the approved reclamation plan." The bonding requirement overlaps ADECs authority to require financial assurance under its waste management plan. ADNR and ADEC typically figure the bond jointly, and the bond is administered by ADNR (ADNRs Dam Safety Program may also require a bond for any dam within its jurisdiction).

A millsite lease provides a surface authorization for mine facilities that are not located on the upland mining lease or mining claim. In the Graphite One project, like other mines in the state, the mine facilities will be located on mining claims. Therefore, a millsite lease is not required. Nevertheless, most similarly situated hard rock mines in Alaska have opted to request a millsite lease. The reason is that the lease solidifies the legal authorization for facilities. A mining claim is only valid if the claimant has a valid discovery. Most facilities are located specifically to avoid being over a mineable ore body. This location could theoretically provide a legal loophole where the facilities are not authorized by the mining claim. For that reason, most mines have opted for a millsite lease to confirm their legal right to the use of the surface. The department has the authority to include stipulations in the lease to protect public resources.

The department's authority to impose these stipulations is no different than its authority under the plan of operations approval, so requesting a millsite lease does not cede additional authorities to ADNR. A millsite lease requires an annual lease payment equal to the fair market value of the land.

All three of these authorizations give ADNR authority to stipulate mining operations to protect public resources (or the very similar prevention of "undue degradation of land and water resources"). While neither the plan of operation nor the reclamation plan have statutorily required public notice, draft authorization and public comment period is always provided for an operation the size of this project. For these reasons, the authorizations are typically considered together, concurrent with the EA/EIS.

The authorizations may consider the breadth of issues presented by a hard rock mine, but the major issue is almost always water quality during and after mining, specifically, the extent of acid rock drainage and metals leaching. These authorizations also consider the related issue of whether post-mining water quality treatment will be required and the required duration.

20.2.3 Reclamation Bond

The reclamation bond is not a separate authorization. ADNR requires it under its Reclamation Plan and Dam Safety authorities and ADEC under the authority of the solid waste permit. However, it is processed on a different schedule from the other authorizations, so it is considered separately.

ADNR and ADEC jointly calculate the financial assurance necessary to reclaim the site and to complete post-mining water quality treatment, water quality monitoring, and site maintenance. ADNR typically administers the bond for both agencies. The size of the bond is usually driven by any required water quality treatment. If post-mining water quality treatment is required, the issue will be the annual cost and the length of time such treatment will need to be continued. While environmental groups have disputed the size of reclamation bonds in Alaska, the issue driving most of the disagreement is the need for post-closure water treatment. Environmental groups typically advocate that the bond includes more treatment for a longer period than the applicant believes necessary.

20.2.4 ADEC Air Quality Permit

The construction, modification, and operation of mining facilities that produce air contaminant emissions require a state Air Quality Control (AQC) Construction Permit, and a separate Air Quality Control Operating Permit. The applicant must demonstrate the ability to comply with the Alaska Ambient Air Quality Control requirements found in 18 AAC 50 and additionally with federal emission standards most notably found in 40 CFR 60 (New Source Performance Standards) and 40 CFR 63 (National Emission Standards for Hazardous Air Pollutants) among others.

Based on the diesel power generation for Graphite Creek contemplated in the FS, Graphite One could trigger the requirement to obtain an AQC construction permit with PSD review before beginning certain construction activities. Requirements for a PSD application include:

- Preparation of an emission inventory for stationary combustion sources, nonroad engines, and fugitive emission sources

- A determination of whether the mine would be a major source of hazardous air pollutants thereby triggering the requirements for a major source of hazardous air pollutants
- Demonstration that the applicant will implement the best available control technology for stationary and fugitive emission sources
- Demonstration that the project, if constructed, would comply with the National Ambient Air Quality Standards (NAAQS) and PSD increments
- Collection of one year of PSD-quality preconstruction ambient air quality data for air contaminants above significant emission rates
- An analysis of Air Quality Related Values

The demonstration of compliance with the NAAQS requires ambient air quality modeling using at least one year of representative PSD-quality meteorological data. PSD-quality meteorological data are currently being collected at Graphite Creek along with one year of representative ambient air quality data currently being collected on behalf of the project in Nome.

Air permit processing is typically independent of the NEPA schedule and other permits. It may occur initially or at a later stage, depending on the circumstances. However, ADEC will not allow construction of mine facilities of a permanent nature to begin before the air permit is issued. Therefore, it is important to ensure that there is enough time to get the air permit before the expected time of construction.

The air permit requires roughly a year to acquire the baseline data, and it takes roughly 18 months to two years to prepare the permit application and for ADEC to process the permit.

The applicability of other federal requirements, such as those found in 40 CFR 60 or 63, is determined external to the AQC construction permitting process. A thorough review of federal requirements should be conducted prior to the final mine design to ensure that federal emission standards are identified and designed for the mine facilities.

20.2.5 ADEC APDES Permit

ADEC authorizes effluent discharges under its APDES Permit. ADEC requires characterization of the discharge and receiving water. The characterization requires water quality and flowrate information.

The APDES permit is often the focus of agency discussion during mine permitting. It can be a complex and difficult permit to obtain. The nearby presence of marine waters—the Imuruk Basin—could provide an option for a discharge to marine waters, which have less stringent water quality standards, no fish spawning issues, and opportunities for a mixing zone. However, recognizing the ecological and subsistence values of the Imuruk Basin, it may not be possible to permit a marine discharge in the basin. To prepare for this possibility, the project has been conducting geotechnical investigations to determine a location for a land application discharge system, whereby the treated effluent would be discharged in an infiltration gallery located within suitable ground conditions. Either option for effluent discharge will require an ADEC APDES permit.

To comply with regulations, the baseline environmental studies will include hydrologic studies and the presence and identification of fish in the receiving waters.

20.2.6 ADEC Solid Waste Management Permit

The major issue with respect to tailings and waste rock is the potential for acid rock drainage and metals leaching. Geochemistry and hydrologic investigations will be required before ADEC issues these permits. A solid waste permit is required for the tailings facility, whether it is a dry-stack tailings facility or a wet TMF. ADEC has the authority under the solid waste permit to require financial assurance from the company. This requirement overlaps ADNRs authority to require a reclamation bond under its reclamation authorities and a dam maintenance bond under its Dam Safety Program. ADNR and ADEC jointly determine the bond, and ADNR typically administers the bond.

ADEC also has authority but not the mandate to require a solid waste permit for the placement of waste rock. ADEC typically only requires a solid waste permit for waste rock if the rock has the potential to generate acid rock drainage or significant metals leaching. If these do not occur, ADEC may determine that ADNRs Plan of Authorization approval provides adequate oversight for the waste rock placement. For the True North Gold Mine and the much smaller Lucky Shot Gold Mine, ADEC declined to require a solid waste permit for these reasons. For other mines, they have required it. ADEC also requires a solid waste permit for the disposal of inert wastes from construction, ash from incineration, and so on. This is likely to be a separate permit from the tailings and waste rock permits and is typically neither controversial nor is compliance difficult.

20.2.7 U.S. Army Corps of Engineers Wetlands Permit

The USACE permit under Section 404 of the CWA requires authorization (wetlands permit) before allowing discharge of fill into waters of the United States, including wetlands. The wetlands permit is likely the only major federal permit for the Graphite One Project.[1] Activities that may require a wetlands permit include road or bridge construction, construction of dams for tailings or water storage, and stream diversion structures. The USACE is responsible for determining consistency of the proposed action with CWA, Section 404 guidelines. Under Section 404(c), the EPA has review authority over the USACE 404 permit decisions. The USACE provides detailed methodology for identification of wetlands under federal jurisdiction. ADEC must certify that the USACE permit meets state water quality standards. ADEC typically does not get involved in the wetlands mapping methodology.

Over the last decade, the USACE also requires potentially expensive mitigation for wetlands impacted during mine development, even if the reclamation plan will restore the wetlands after mining. Mitigation is proportional to the wetland disturbance area. The USACE uses a hierarchy of mitigation strategies, beginning with restoring affected wetlands, then repairing nearby wetland impacts or enhancing low-functioning wetlands, and finally providing monetary compensation. Unfortunately, the USACE has required mitigation be a multiple of the affected acreage. Unlike projects in the lower 48 states, projects in relatively untouched Alaska rarely have damaged wetlands nearby that can be restored or enhanced. Therefore, the USACE has required expensive monetary compensation. While this system may make sense for the lower 48 states, monetary compensation makes no sense for Alaska where 43% of the state is wetlands. Fortunately, the USACE is re-evaluating its mitigation/compensation strategy. However,

[1] This assumes that the state-selected land in the road right-of-way is conveyed to the state of Alaska.

because of the potential expense, it is important to allow adequate time during the permitting process for discussion/negotiation with the USACE over this issue. The identification of wetlands and methods to minimize impacts are rarely the time-consuming wetlands issue. The issue is more likely to be the extent of off-site mitigation and compensation.

20.2.8 Right-of-way

A right-of-way will be required for the access road to the site in Alaska. The conceptual route is entirely on state-owned and state-selected lands, and if the state receives ownership of the state-selected lands soon, only an ADNR right-of-way will be required. If the state does not receive ownership of the state-selected lands, then a federal right-of-way from the U.S. Bureau of Land Management (BLM) will be required for that portion of the road. There is also a short alternative start to one of the conceptual road routes as it leaves the Nome-Teller Highway that is on Native Village Corporation land, and a right of access will be needed if this alternative is chosen. A state right-of-way requires an annual payment equal to the fair market rent for the land.

20.2.9 ADNR Tidelands Lease

The project will require a tidelands lease from ADNR if it uses a pipeline for a discharge outfall into the Imuruk Basin. A tidelands lease is for the use of land beneath the marine waters of Imuruk Basin. The issue will be the pipeline's effect on marine habitat. The ADNR land-use plan for the Imuruk Basin provides: "Authorizations within this unit may be appropriate but must consider the impacts of the proposed use on the resources that occur within this unit." Given the lack of impact that a pipeline should have on the resources of the area, the tidelands lease should be obtainable, but ADNRs process will require approximately two years. Like the right-of-way, ADNR must make a public interest finding, and the authorization requires public notice. A tidelands lease also requires payment of fair market value, though the market value of submerged land may not be great.

20.2.10 ADNR Water Right or Temporary Water Use Authorization

A water right or temporary water use authorization from ADNR is required before taking a significant amount of water. ADNR conditions those permits to protect other water right holders (not likely to be a problem for the Graphite One Project), other water users (not likely to be a problem), or the presence of fish habitat (also not likely to be a problem). A water right is a long-term or permanent property right to the water. A temporary water use authorization is for a duration of less than 5 years. Typically, a mine will require water rights for its permanent use of water, such as for processing, and temporary authorizations for some other uses, such as road building or other construction uses.

A significant amount of water is defined in regulation (11 AAC 93.970) as more than 5,000 gal/day from a single source; recurring use of more than 500 gal/day for more than 10 days per year from a single source, or the non-consumptive use of more than 30,000 gal/day of water from a single source, or any water use that might adversely affect the water rights of other appropriators or the public interest.

A water right requires public notice, but a temporary water use authorization does not. If the water use is likely to be controversial, it should be processed concurrently with the EIS. Otherwise, it may be processed afterward. Detailed hydrologic information is not typically required unless the surface use is a significant percentage of a surface source. Unless some specific issue is raised or a very large amount of water use is proposed, groundwater wells typically do not require significant prior investigation. The hydrologic investigation required for the APDES permit and plan of operation will typically be adequate for any water use authorizations in the area of the mine site.

Given the lack of other water users and the fact that ADFG only lists one stream near the project in its Catalogue of Anadromous Fish Waters (Cobblestone River), the volume of water used in the project is unlikely to be a significant issue.

20.2.11 ADNR Materials Sale

Most sand and gravel for building the access road will likely be sourced from the nearby state land. Material from the road right-of-way and from the mining claims may be used within the mining claims or road without a sale and payment to ADNR. Material from outside mining claims and outside the right-of-way requires a materials sale and payment to ADNR. A material sale on state land requires public notice.

20.2.12 ADNR Mining Lease

A mining lease consolidates mining claims into a single lease. It is not a permit or authorization; it differs from the authorizations in this report in that it only consolidates the private property rights of the multiple mining claims into a single legal vehicle, the mining lease. It does not change the underlying property right. The reason companies use a mining lease is two-fold. First, it cleans the chain of title. That is, after a mining lease is issued, no one can protest that there was an error in the title of the mining claim in previous years (staking error, missing statement of annual of labor, etc.). Second, if there is an error in payment for the lease—a late payment or similar issues—the lessor gets a notice of the problem and an opportunity to cure it. Claim owners do not get a notice and can lose their claim to an intervening claimant if they have made an error. A mining lease requires public notice.

20.2.13 ADEC Stormwater Plan

The CWA requires control of stormwater. The project will be required to have a stormwater plan to control the discharge of stormwater. Stormwater includes runoff from roads and other locations within the operation that are not a part of the active mine area and should not have mine leachate or other chemicals. Water from adits, tailings piles, mine areas, and so on is classified as process water and may only be discharged under the APDES discharge program. A stormwater plan has less stringent requirements than does an APDES permit. ADEC administers the program under the supervision of the U.S. EPA. These plans are not public noticed, but ADEC may review the proposed stormwater plan and may inspect the facility for compliance with an approved plan.

20.2.14 ADFG Fish Passage Permits

The ADFG issues fish passage permits under AS 16.05.841 for work within the ordinary high-water mark of fish streams that are not listed in ADFGs Anadromous Fish Stream Catalog. The criterion for the permit is to ensure that the work does not block fish passage. For road crossings, the agency will require some basic hydrologic information to ensure that a bridge or culvert is appropriately sized.

ADFG also requires a fish habitat permit for any activity in waters that are listed in the Anadromous Fish Stream Catalog (AS 16.05.871). The only water close to the project currently listed in the catalog is the Cobblestone River, although the aquatic baseline program may result in additional waterbodies being listed in the catalog. A fish habitat permit will be required for any activity, such as a water withdrawal in the Cobblestone River or any other waterbodies where anadromous fish are discovered.

For most mines, these have not been significant permits. An application is not typically made until the centerline of a potential road is staked. ADFG maintains a quick turnaround on these permits, and an application is often made during the construction process.

20.2.15 NOAA Fisheries Essential Fish Habitat

The NOAA Fisheries, under authority of the Magnuson-Stevens Act, may require that federal agencies condition their permits to protect essential fish habitat. The act requires cooperation among NOAA Fisheries and other federal agencies to protect, conserve, and enhance essential fish habitat. Congress defined essential fish habitat for federally managed fish species as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." NOAA Fisheries performs the essential fish habitat consultation as a part of a federal permit evaluation. Thus, NOAA Fisheries-recommended stipulations would be applied to the USACE wetland permit.

20.2.16 USFWS Bald and Golden Eagle Protection Act, Migratory Bird Treaty, and Threatened and Endangered Species Act

The USFWS, under the authority of the federal Bald and Golden Eagle Protection Act, will require identification of eagle nests, roosts, and perches. This Act should not have a significant effect on the mine site because there are no trees in the project area suitable for nesting bald eagles. Construction and operation of the Mosquito Pass access road may be affected by this Act due to known golden eagle nests in the vicinity of the corridor.

Under the authority of various migratory bird treaties, the USFWS may advise federal agencies to condition their permits to ensure that a project is consistent with various treaties concerning migratory birds. With bald eagles, the fact that the area is above the tree line limits the likelihood of significant changes due to the treaty.

Finally, the USFWS has authority over certain threatened and endangered species. USFWS mapping shows that the proposed Graphite Creek Project is within the range of polar bears, which is a threatened species. The project is within polar bear range, which includes most of Northern and much of western Alaska. Imuruk Basin is within a designated polar bear critical habitat, but polar bears are very unlikely to use the basin or inland areas near the mine site. The ADNR land use plan that includes the Graphite Creek Project area is more accurate than the more general USFWS mapping and does not list polar bears as species that use the area. Baseline information for the NEPA analysis will likely be adequate for this authorization and may show that polar bears do not use the area.[2]

[2] The Port Clarence area is also within the range, but not the critical habitat of the threatened spectacled eider and the Steller's Eider. USFWS mapping indicates that the Eiders' range does not extend inland to the Imuruk Basin.

Like the NOAA Fisheries Essential Fish Habitat, a separate authorization is not required. However, federal agencies have the authority to require conditions on the USACE wetlands permit. These consultations occur as a part of the NEPA process, and the information generated for the NEPA analysis should be adequate.

20.2.17 USACE or ADNR Cultural Resources

The cultural resource analysis will be required for ground disturbance that could damage archaeological artifacts. The state and federal governments have overlapping jurisdiction over the protection of cultural resources. For activities authorized by the state of Alaska, jurisdiction lies with the SHPO within ADNRs Division of Parks and Outdoor Recreation. Because a wetlands permit will be required, the lead federal agency is the USACE. The USACE will coordinate the evaluation of cultural resources with SHPO. The agencies will require a cultural resources analysis and possibly an on-the-ground survey if they determine the likelihood of historic or pre-historic cultural resources affected by the project.

20.2.17.1 National Historic Preservation Act

Section 106 of the National Historic Preservation Act requires review of any project funded, licensed, permitted, or assisted by the federal government for impact on significant historic properties. The agencies must allow the SHPO and the Advisory Council on Historic Preservation, a federal agency, to comment on a project. Following that review, the USACE has the authority to require stipulations on federal permits—generally, the Wetlands Permit—to protect cultural resources. The stipulation may require that an applicant protects the physical integrity of the cultural resource, or that the applicant ensure that the information from cultural resources are gathered before an effect takes place, or that other means are used for protection. If there were no wetlands permit, there would be no USACE jurisdiction over this issue and the cultural resources would be regulated by the state.

20.2.17.2 Alaska State Historic Preservation Act

The Alaska Historic Preservation Act, AS 41.35, contains a provision similar to Section 106, which mandates that any project with state involvement be reviewed in a similar manner. It gives the SHPO similar jurisdiction to the USACE for state permits.

Through the permit review process, SHPO staff work with federal and state agencies during the early stages of project planning to protect cultural resources. They do this by providing information on the location of known sites and information from cultural resources surveys previously conducted in an area. If the potential to discover unknown sites is high, an on-the-ground survey may be required. If so, the applicant must contract and pay for the survey. When there are sites in a project area, SHPO staff determines National Register eligibility, the project's effect on sites, and methods to minimize or mitigate unavoidable damage.

The state mitigation required under the cultural resource authorizations will most likely be applied to the ADNRs plan of operations. State mitigation should satisfy both state and federal governments. However, it is possible that some mitigation may be applied to the USACE Wetlands Permit.

20.2.18 Other ADEC Wastewater Permits

ADEC must authorize the discharge of wastewater into or upon all waters and land surfaces of the state. Any discharge for which an APDES permit is not required (such as a land application of mine wastewater) will require a separate permit from ADEC.

20.2.19 ADNR Dam Safety Permit

Dam safety permits can be technically complex and will be required for a tailings storage dam and a water supply dam.

ADNRs Division of Mining, Land and Water must issue a Certificate of Approval to Construct and a separate Certificate of Approval to Operate a dam. These authorizations are required for dams that are greater than 10 feet high and hold back more 50 acre-feet of water, any dam more than 20 feet high, or any dam that the department determines may pose a threat to lives or property. The certificates are typically required for tailings facilities or a water supply dam. These certifications involve a detailed engineering review of the dam's design and operation.

The background information needed—the same as is needed for a competent dam design—focuses on relevant hydrology and geotechnical information. Public notice is not required. Application for this authorization may be made during the EIS processing period or after the major permits are signed, but typically the dam designs are reviewed concurrently with ADECs waste management permit and ADNRs plan of operations approval.

20.2.20 Alaska's Large Mine Permitting Process

Federal requirements under NEPA provide the structure for Alaska's large mine permit process. This section outlines the NEPA procedures and expected schedule as they likely apply to the Graphite Creek Project.

20.2.20.1 NEPA Overview: EA or EIS?

The NEPA requires federal agencies to incorporate environmental considerations into decision making. All major federal actions require a NEPA analysis, and the wetlands permit from the USACE constitutes a major federal action under the law. Consequently, the Graphite Creek Project will require a NEPA analysis—either an environmental assessment (EA) or the longer, more expensive environmental impact statement (EIS).[3]

An EA must determine whether the project, the mine, road, and mill would significantly affect the environment. If the answer is no, the agency issues a Finding of No Significant Impact (FONSI). The FONSI may address measures that an agency will take to mitigate potentially significant impacts. On the other hand, if the EA determines that the environmental consequences of a proposed federal undertaking

[3] Technically, there is a third category of environmental analysis in addition to an EA or EIS. There are small-scale activities which qualify for a categorical exclusion from NEPA analysis. Graphite Creek will not qualify for a categorical exclusion, and so this category is ignored in this report.

may be significant, an EIS is prepared. Thus, to avoid an EIS, the federal agency must conclude that the mine would have no significant impact on the environment as mitigated.

Most hard-rock mines in Alaska have required an EIS, including Red Dog Mine, Greens Creek Mine, Pogo Mine, and Kensington Mine. The Fort Knox Mine was authorized under EA in 1996, though a mine of that size would be unlikely to be authorized without an EIS today. The Nixon Fork and Rock Creek mines were authorized under an EA. The Illinois Creek Gold Mine and the True North Gold Mine did not require any significant federal permit (no wetlands); consequently, there was no major federal action and no NEPA analysis were required or performed.

The Graphite Creek project is roughly similar in size to the Nixon Fork and Rock Creek Mines that were authorized under an EA. The ideal permitting pathway for the Graphite Creek project would involve the preparation of an EA, leading to a FONSI without the need to prepare an EIS. Early in the project, owners should have early discussions with the USACE to gauge its willingness to take this pathway. If the USACE believes that the EA is unlikely to lead to a FONSI, then it would be beneficial for the project to start with the EIS process without spending extra time preparing for the EA.

There is a large difference in time and cost between an EA and an EIS. Both typically require two rounds of public notice. The first round is for scoping (identifying issues specific to that project for analysis by the EA/EIS), and the second round is for the draft document.

Lead Agency

The lead federal agency prepares the NEPA analysis, EA, or EIS usually using a third-party NEPA contractor paid for by the applicant. Since the USACE is the only federal agency with permit authority in the Graphite Creek project, it will be the lead federal agency—the agency that supervises the NEPA analysis and makes the decision about whether an EA or EIS is required.

Cooperating Agencies

A federal, state, tribal, or local agency having special expertise with respect to an environmental issue or jurisdiction by law may be a *cooperating agency* in the NEPA process. A cooperating agency has the responsibility to 1) assist the lead agency by participating in the NEPA process at the earliest possible time, 2) participate in the scoping process, 3) develop information and prepare environmental analyses including EIS portions in the cooperating agency’s area of special expertise, and 4) augment the lead agency's interdisciplinary capabilities as requested.

The EPA and the state of Alaska are usually cooperating agencies in hard-rock mine project EISs and would likely serve in this role for the Graphite Creek Project NEPA process. More and more, the USFWS has been a cooperating agency in Alaska EISs, and there is a high likelihood that they will be cooperators here as well. In recent years, the lead federal agency has typically invited potentially affected tribal governments to be cooperating agencies. Recent efforts indicate that the USACE may instead consult with the tribes separately but not integrate them into the process as cooperating agencies. The state of Alaska is a particularly critical cooperating agency. The state’s participation is coordinated by ADNRs Office of Project Management and Permitting (OPMP), which will represent all the relevant state agencies during the process.

State Agency Process

Alaska state agencies use the Alaska large mine permitting process (LMPP) to work with the federal agencies and to issue state decisions on a mine. LMPP is a voluntary process, paid for by the applicant, and led by ADNRs OPMP. The process has significant advantages, and every hard-rock mine project in Alaska has used it. Using the LMPP for mine permitting, rather than relying solely on individual permitting staff, will ultimately decrease permitting costs by making the overall permitting process more efficient.

After the applicant begins the process, OPMP assigns a project coordinator and creates a permitting team with members from all the pertinent state agencies. Frequently, federal agencies use the LMPP to coordinate their involvement as well. The USACE is familiar and supportive of the state process. Other federal agencies that may use the process include the USFWS, NOAA Fisheries, and EPA. Also, the project coordinator works with the applicant to coordinate the public process, and so the public can go to one point-of-contact for the project.

The advantage of Alaska's LMPP is that it is more efficient for the agencies, the public, and the applicants. This is especially true for a project with a significant public process component, significant technical issues, and involving an EIS. The advantages for a company are:

- There is a lead state official who is responsible to the company for an efficient process. If there is a problem, this official is responsible for seeing that it is solved
- The team approach should minimize contradictory direction from different agencies
- The team approach should minimize overlapping data requirements (i.e., one data program should satisfy all team members)
- By using the team to work through mine design questions, negative interactions are minimized between mine design and permitting
- The public has a single point-of-contact—the project coordinator

For projects involving an EIS, there is often another advantage as well. The federal EIS team frequently involves people who do not know Alaska. An LMPP project team has enough respected expertise to eliminate odd or impractical ideas quickly without derailing the process. The LMPP project team provides an avenue to help control rumors that can otherwise become "officially sanctioned" by repetition from unknowledgeable agencies.

In the state's LMPP, the project bears the cost of state agency participation. The applicant must agree to pay for agency personnel time.

It is not always obvious when to start the LMPP, pay for a coordinator, and pay for agencies' personnel time. In most cases, the process needs a coordinator in the year leading up to permitting, when the project expects coordinated state input on final company decisions about mine design. In any case, it does not appear that Graphite One is ready to start the process yet, because baseline and mine design are net yet ready for detailed, coordinated agency scrutiny.

NEPA Schedule

With a good quality application based on adequate environmental baseline data, an EA can frequently be completed within a year. Hard-rock mine EIS processes in Alaska have taken significantly longer than that. Pogo required three and a half years from the time of application (i.e., excluding the time to collect baseline environmental information); the Kensington Supplemental EIS required slightly more than three years from the time of the application to the record of decision.

Permitting Schedule

The USACE must wait at least 30 days after finalizing the EA or EIS before it can issue its record of decision and then issue the Section 404 wetlands permit (the only major federal authorization necessary for the Graphite Creek project). For planning purposes, 120 days should be budgeted for the issuance of the wetlands permit after the EA or EIS is finalized.

A major focus of Alaska's LMPP is to coordinate the processes for all the state permits so that they can be issued concurrently with or as soon as possible after the completion of either the EA or the EIS. It is expected that all state authorizations should be issued prior to, or concurrently with, the federal wetlands permit.

20.2.21 Ohio Environmental Protection Agency Permits

20.2.21.1 Hazardous Waste Permit

The Resource Conservation and Recovery Act (RCRA) is administered, in Ohio, by the OEPA and regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. The STP could potentially generate toxic waste, from the scrubbing system, which would be treated in a wastewater treatment facility. Solid waste would be disposed of under USEPA - RCRA Subtitle C, VSQG status to an appropriate facility.

20.2.21.2 NPDES Stormwater Permits

In Ohio, the OEPA regulates industrial stormwater discharges under the National Pollutant Discharge Elimination System (NPDES). A NPDES Construction Stormwater General Permit is required for clearing, grading, and excavation activities that disturb one or more acres of land. Additionally, a NPDES Industrial Stormwater Permit to Install is required for facilities conducting industrial activities that collect, store, and treat stormwater, or wastewater, prior to release in a surface waterbody or to a storm sewer system that drains to a surface waterbody. Both of the above NPDES permits are anticipated to be required for construction and operation of the STP.

20.2.21.3 Air Pollution Control Permits

In Ohio, the OEPA regulates air pollution under the Clean Air Act. The STP site is located in Trumbull County, Ohio which is currently designated as in attainment (Maintenance Area) for all current National Ambient Air Quality Standards. Therefore, the project will be subject to review under New Source Review. Emissions during normal operation that would consist of 1) particulate matter emissions from material handling activities, carbonization and graphitization process activities, and cooling towers; 2) carbonization and graphitization process emissions controlled by cyclonic separation, venturi water scrubbing, packed bed tower caustic scrubbing, and thermal oxidation; 3) combustion emissions from emergency generators; and 4) natural gas combustion emissions from air handling units providing building heat. Detailed potential emission calculations from the facility would be included with the Permit to Install (PTI) or PTIO application to the OEPA Northeast District Office. The project would comply with applicable control and review requirements, such as Best Available Technology for criteria pollutants and Air Toxics Risk Assessments for toxic air pollutants, as required under applicable sections of the Ohio Administrative Code 3745. The project would install cyclonic separators, venturi water scrubbers, packed bed tower caustic scrubbers, and thermal oxidizers to control process emissions, dust collectors to control particulate matter emissions from material handling, and drift eliminators to reduce particulate matter emissions from cooling towers.

20.2.22 NHPA and Ohio SHPO

Section 106 of the NHPA requires federal agencies to consider the effects of federally assisted undertakings on historic properties. If a federal permit or funding is required, then consultation under the NHPA would be led by the lead federal agency. The Advisory Council on Historic Preservation administers the Section 106 review process in partnership with the state's historic preservation office. Development of the STP site would be conducted in accordance with the NHPA Section 106 compliance, Secretary of the Interior's Standards and Guidelines for Identification (36 CFR §61; 48 CFR §44720-23), the Ohio Revised Code (ORC) Section 149.53, and applicable Ohio History Connection (OHC) regulations. The STP site will be located on a previously developed industrial site, and no previously recorded archaeological sites, historic resources, cemeteries, or National Register of Historic Places properties or districts are located within the proposed STP site. Consultation is anticipated to be limited to desktop review and coordination; field surveys are not anticipated for the STP site.

20.2.23 County, Municipal, and Private-Entity Permits

A variety of local permits are anticipated to be required for development and/or operation of the STP site.

Anticipated county permits include a Utility Permit, County Right-of-Way Permit, Demolition Permit, Commercial Building Plan Approval, Mechanical Inspection Permit, and Electrical Inspection Permit. Applications for these permits would be reviewed/authorized by Trumbull County Engineering or Trumbull County Building Inspection.

Anticipated municipal permits include Zoning Permit, Fence Permit, and Construction Permit. The agency responsible for these permits is the Weathersfield Township Zoning Commission.

Additionally, a Railroad Track Encroachment Permit is anticipated to be required through Norfolk Southern Railway for work within the railroad right-of-way for utility connections.

20.3 Consultation

20.3.1 Local Consultation

The communities of Brevig Mission, Mary's Igloo, and Teller are closest to the project area in Alaska. Brevig Mission has a population of 462 residents, and Teller has a population of 237 residents. Both communities have high unemployment and poverty rates. Most work is seasonal, and the majority of the residents depend on subsistence harvests each year. The primary employers in remote rural villages are the school and the local government entities such as the tribe and city. There is also no running water in Teller. Mary's Igloo residents have mostly relocated to Teller and other nearby communities. There is currently no active town site for Mary's Igloo, but they have maintained their private land ownership, which was established through the Alaska Native Claims Settlement Act (1971) and their federally recognized tribal government status. Mary's Igloo shareholders and tribal members have been included in Teller outreach meetings. Nome has also been included in community outreach because it is the hub in the Seward Peninsula region of Alaska, and this project would certainly have an economic and social impact in Nome as well as the nearby villages. Residents of Nome also use a portion of the project transportation corridor and project area for subsistence hunting and fishing as well as recreational activities.

The first round of meetings with the communities of Nome, Brevig Mission, Mary's Igloo, and Teller were in the fall of 2014. Since then, project staff have met every year for six consecutive years with these communities and have met six times with residents of Nome. Staff also held "community leadership roundtables" in the communities during the first two years, with elected leaders in one collective meeting. These meetings were helpful in establishing the main questions and issues from the local leadership directly with project leadership. The community leaders have been receptive to these meetings, and each meeting has been well attended.

Project staff have also maintained communication with various regional entities and organizations and entities based in Nome such as: The City of Nome, Bering Straits Native Corporation, Nome Eskimo Community, Nome Chamber of Commerce, Kawerak, Sitnasuak Native Corporation, University of Alaska Fairbanks – Northwest Campus, Northwestern Alaska Career and Technical Center, and the Norton Sound Economic Development Corporation.

Project staff have also regularly engaged with the Subsistence Advisory Council (Council), a group comprised of residents from the region that are appointed by their respective city government, tribal government, or village corporation to serve on the Council. The purpose of the Council is to provide guidance and advise the project team through recommendations on the following issues.

- Helicopter/equipment activities
- Wildlife interaction
- Subsistence resources
- Serve as a liaison between the council and the community as appropriate

Member organizations of the Council include. The Native Village of Brevig Mission, Brevig Mission Native Corporation, City of Brevig Mission, The Native Village of Teller, Teller Native Corporation, City of Teller, The Native Village of Mary's Igloo, Mary's Igloo Native Corporation, Nome Eskimo Community, Sitnasuak Native Corporation, King Island Native Corporation, Kawerak, and Bering Straits Native Corporation. Generally, meetings are held biannually, with occasional site visits. A total of four in-person meetings and two site visits have occurred since the Council was founded in 2018.

The following is a list of issues of concern brought up by community members during the outreach meetings since 2014.

- Critical subsistence areas need to be protected for anadromous fish, reindeer, moose, caribou, berries, Canadian geese, pike, walrus, and whitefish
- There is concern about increasing algae in Imuruk Basin
- Residents want to know about the project's wastewater discharge, and if the graphite floatation agent is harmful
- Some residents say they have seen black trout in Tisuk River
- Residents want to know if there are smelts in Graphite Creek
- Imuruk Basin is a key subsistence area, and needs to be protected
- Training and workforce development, employment opportunities, and local benefits
- How will the project be accessed?
- What will be the water sources for the project during exploration and production?
- What will be the project by-products and waste materials?
- Will there be any airborne contaminants?
- What will noise levels be during construction and operation?
- Can work be avoided during hunting seasons?
- Are there any naturally occurring toxins?
- Need to describe how the graphite will be processed
- Heavy snowfall and water drainage is a concern
- Need to prevent trespass on Native Corporation lands
- Can the project provide assistance with local programs and projects – like seawall in Teller?
- Will the project have carbon pollution standards?
- Employees will need hazmat training
- Community safety is a concern as an influx of construction workers and mine employees will be in close proximity to Teller and Brevig Mission
- What will the impacts be to marine life in the Imuruk Basin if vessel traffic were to increase in the Basin?

- Will the access road to the mine site be open to the public or closed for commercial use only?
- Increased access to the area leading to more competition from outside hunters and fishers is a concern
- Need water quality monitoring
- Dust control is a concern, and the toxicity of graphite dust

20.3.2 Agency Consultation

Graphite One staff have conducted preliminary consultations with state and federal agencies. These consultations have included meetings with ADFG on fisheries issues, ADEC on water and air quality issues, BLM on land use issues, ADNR on mine permitting and land use issues, and the USACE on wetlands permitting and NEPA issues. Graphite One intends to initiate full discussions with these agencies to brief them on baseline data collection efforts and to prepare for permitting and NEPA.

20.4 Factors for Consideration

20.4.1 Subsistence

One of the biggest concerns for the residents of the communities near the project in Alaska is their ability to access fish, game, and other resources necessary for their subsistence way of life. These small communities of Teller, Brevig Mission, and Mary's Igloo are similar to all other small, rural Alaskan communities where the importation of food and other commodities can be extremely expensive, so residents rely heavily on the harvest of local food. This project is taking all the necessary steps to protect the community subsistence resources.

In addition to gathering baseline data on water, air quality, fish, and wildlife abundance, the project is also gathering data on the subsistence resources used by the local residents and where they gather those resources. To assist in this effort, the project created a Subsistence Advisory Council (SAC), composed of leaders from each of the communities who are familiar with the subsistence use patterns of the communities.

The purpose of the SAC is to provide guidance and advise the project team through recommendations on issues of helicopter activities, wildlife interactions, and a subsistence resource database. The SACs additional roles are to participate in an annual meeting, attend site-visits as needed, and serve as liaison between the project team and the community members when appropriate.

In 2018, the SAC was initiated with a project site visit in August and a meeting in Nome in October. The community entities appoint their own representatives to the SAC. The following entities have appointed a primary and alternate representative.

- City of Brevig Mission
- Brevig Mission Traditional Council
- Brevig Mission Native Corporation

- Mary's Igloo Traditional Council
- Mary's Igloo Native Corporation
- City of Teller
- Teller Traditional Council
- Teller Native Corporation

The subsistence director of the regional Native non-profit organization Kawerak has also been asked to serve as an honorary member of the SAC, due to his extensive knowledge of subsistence-related issues in the entire region.

20.4.2 Geochemistry, Acid-Rock Drainage, and Metals Leaching

The permitting issue which takes up the most agency time and which influences mine design and costs the most, is usually the mine's ability to control and discharge water. The way in which the agencies require the mine to control water and its ability to obtain an authorization to discharge water is usually an issue of the water quality of the mine runoff. In turn, water quality is a function of the mine's water budget and geochemistry, specifically, the potential for acid-rock drainage and metal leaching.

The difficulty in resolving these issues varies significantly from mine to mine. For example, when permitting the Illinois Creek Mine, there was little concern about the quality of the waste rock leachate, and the waste rock pile was placed so that it did not collect water. The lack of water and lack of geochemical problems made this a non-issue and decreased the time for permitting. However, discussions of the post-closure water quality that will discharge from the Rock Creek Mine pit delayed the permits for some time.

The streams in the Graphite Creek project area are naturally high in aluminum and iron, as evidenced by a white precipitate in the upper reaches (aluminum sulfate), and red staining and precipitate (iron oxides and hydroxides) in mid-reaches. This is likely from naturally occurring metal leaching and acid rock drainage (ML/ARD).

Baseline sampling indicates that streams fall into two groups – streams that drain the deposit and adjacent mineralized area, and the Cobblestone River and some minor tributaries. The latter have typical chemistry for most naturally occurring fresh water, though they have low alkalinity. The streams draining the deposit area are generally slightly to moderately acidic (low pH); have low alkalinity; and often have concentrations of Al, Cd, Fe, and Ni that exceed regulatory standards. Less often they have exceedances in Co, Cu, sulfate, and TDS. This signature is consistent with naturally occurring ML/ARD.

Groundwater is monitored in bedrock at various locations in the proposed pit area and to the north in the area of the proposed WMF. Groundwater chemistry in the pit area is variable, with water in the central pit area near the Kigluaik Fault showing moderately low pH, and elevated Al, Fe, Ni, sulfate, and TDS. Co, Mo, Zn, and F may also exceed regulatory limits. The concentration of these constituents rapidly drops north of the Kigluaik Fault with lower-level exceedances immediately north of the fault and generally good quality water seen in wells in the central and northern WMF area, though data is limited. Similar to surface water, these results are consistent with naturally occurring ML/ARD in bedrock.

The results from ongoing geochemical testing indicate that some of the waste rock appears to be PAG, with potential for some metals leaching. One tailings sample was classified as non-PAG, with some potential for metals leaching (also discussed in Chapter 18). Testing is ongoing and will be used to develop a water model.

The Graphite Creek design components will help resolve water discharge issues. Water will be removed from the tailings, and they will then be mixed with the waste rock. The combined waste will be stored in a fully lined and covered WMF. All water that potentially contacts mining activities will be collected and treated prior to discharge. The treated water will be discharged to Glacier Canyon Creek, a creek that is affected by naturally occurring metal leaching and acid rock drainage (ML/ARD) and does not currently support fish.

20.4.3 Groundwater

As stated in the previous section, the permitting issue which takes up the most agency time, and which most influences mine design and costs is usually the mine's ability to control and discharge water. Groundwater inflow to the pit is potentially a major source of water that must be managed. Potential impact to receptors from groundwater affected by mine activities is another area of potential concern.

The Kigluaik Fault, located at the base of the mountain slope, has a major influence on groundwater flow. It separates two hydrogeologic regimes and is a barrier to groundwater flow. On the south side of the fault (where the deposit is located), the rock has very low permeability due to the very high metamorphic grade. Groundwater flow in these rocks is confined to faults, fractures, and joints. Glacial till, fluvial, and glaciofluvial sediments are found on the north side of the fault. The sediment has a range of permeabilities from low (till) to high (fluvial) with glaciofluvial sediment having a broad range in between.

Modeling indicates that up to 28.4 m^3/h (125 gpm) (base case) to 45.4 m^3/h (200 gpm) (high scenario) of groundwater will flow into the pit. This is expected to be less than a third of the total amount of water that must be removed from the pit, the remainder being from direct rain and snowfall (up to approximately 90.8 m^3/h (400 gpm)). Water from pit dewatering will be pumped from the pit and sent for treatment prior to discharge.

A pit lake will form post-mining. Based on current data, the pit lake is not expected to overflow. The Kigluaik Fault passes through the north pit wall and the pit lake will discharge into the sediment above the fault.

The groundwater north of the fault (in the sediments) is deep (40 m to 70 m where measured, or deeper due to permafrost) until near the Imuruk Basin. Therefore, the streams flowing from the mountain front to the Imuruk Basin lose water to the groundwater. Conversely, there is little chance that groundwater will enter the streams. Any post-mining impacts to groundwater north of the Kigluaik Fault is unlikely to impact surface resources.

20.5 Closure

At the end of mine life, the mine will be closed and reclaimed in accordance with state laws and regulations. The primary authorities that set closure requirements are 1) ADNR Reclamation Plan

Approval, 2) ADEC Waste Management Permit, and 3) ADNR Dam Safety Certification for any jurisdictional dam structures.

20.5.1 Reclamation Plan Approval

The Reclamation Plan Approval provides ADNR authority to review operations to ensure that they comply with state law: "A mining operation shall be conducted in a manner that prevents unnecessary and undue degradation of land and water resources, and the mining operation shall be reclaimed as contemporaneously as practical with the mining operation to leave the site in a stable condition." ADNRs Reclamation Plan Approval will include reclamation stipulations that ensure appropriate recontouring, soil stability, and revegetation. ADNR also has the authority to require financial assurance sufficient to complete the terms of the Reclamation Plan should the miner not be able to do so.

20.5.2 Solid Waste Management Permit

A Solid Waste Permit from ADEC is required for the tailings facility whether it is a dry-stack tailings facility or a wet tailings facility and may be required for the placement of waste rock. This permit will have closure requirements, primarily focused on ensuring that long-term water quality meets state and federal standards. If necessary, this permit will require long-term water treatment and monitoring. ADEC has the authority under the Solid Waste Permit to require financial assurance from the company.

20.5.3 Dam Safety Certification

ADNR will require a dam safety certification for any jurisdictional dams necessary for this project, which in this case would include dams for a wet TMF, or dams necessary for a water supply reservoir. The dam safety certification would include requirements for closure, either complete decommissioning, or provisions for care and maintenance. The certification would include requirements for bonding/financial assurance to cover the costs of closure for the dams.

21 Capital and Operating Costs

Capital and operating costs were developed for the full Project to mine and mill natural graphite (175,000 tpa graphite concentrate), transport concentrate to the STP, and ultimately produce 256,510 tpa of value-added graphite products (battery anodes, purified flake, un-purified flake, etc.).

These capital costs are expressed in U.S. dollars with no escalation or inflation, unless stated otherwise.

Certain portions of the Project's capital costs were developed by Phase Canada Consulting based on material take-offs supplied by Barr.

Mine and mill operating costs were developed by Barr.

STP capital and operating costs were developed by Hatch.

Overall coordination and synthesis of the capital and operating costs was by Barr.

The capital cost estimate described below was prepared according to the guidance provided by CIM regarding feasibility study under the guidelines of Canadian National Instrument 43-101 Technical Reporting. The costs described below represent a singular economic model reflecting the full vertical supply chain from pit to product. The estimates are time-phased, and measures of the economic merit of the investment are estimated utilizing the time value of money concept.

21.1 Capital Costs

Capital cost estimates were prepared for initial, sustaining, and closure capital at Graphite Creek as well as a capital program for the STP bringing seven 25 ktpa trains online in quick succession over the course of seven years.

The total estimated initial capital cost for the design, construction, installation, and commissioning of all facilities and equipment for the Graphite Creek mine is $949.4 M, including a contingency of $94.4 M (11.2%). After the initial capital phase, sustaining capital costs will be expended on the order of $176.1 M, including $74.5 M of closure costs. The anticipated accuracy of the capital costs for Graphite Creek is +15%/-15%.

The initial capital for the phased construction of the STP (175,000 tpa total production capacity) is estimated at $3,919.4 M, including a contingency of $783.9 M (25%). Sustaining capital is included as 5% of the operating maintenance costs. No closure capital costs are called out.

The total estimated capital cost of the project is summarized in Table 21-1 below.

Table 21-1 Estimated Capital Costs

Capital Costs	Initial Capital ($M)	Sustaining and Closure ($M)	Total ($M)
Mining	128.0	33.2	161.2
Milling	221.1	0.0	221.1
Waste Management Facility	72.2	133.2	205.3
Infrastructure	211.5	9.7	221.2
Indirects	136.7	0.0	136.7
Owners Costs	85.5	0.0	85.5
Contingency	94.4	0.0	94.4
Subtotal Graphite Creek	**949.4**	**176.1**	**1,125.6**
Secondary Treatment Plant (STP)	2,389.7	0.0	2,389.7
STP Indirects	745.8	0.0	745.8
STP Contingency	783.9	0.0	783.9
Subtotal STP	**3,919.4**	**0.0**	**3,919.4**
Total Capital	**4,868.8**	**176.1**	**5,044.9**

The basis for each of these line items is described in the subsections that follow.

21.1.1 Alaska Capital Cost Summary

21.1.1.1 Mining

Capital costs for mining are based on the mine design, mine plan, and production schedule. This information was used to estimate all capitalized activities and equipment associated with developing and supporting the mining operation. These include pre-production activities such as access and haul road construction, pre-stripping activities, and pit and stockpile development. The mine's mobile equipment, mobile maintenance fleet, and the facilities supporting the mine and mobile equipment maintenance are also included. Vendor quotes were obtained for most major pieces of mining equipment. Additionally, the closure costs associated with demolishing the various facilities as well as reclaiming the site have also been included. The capital costs for mining are presented below in Table 21-2 below.

Table 21-2 Estimated Mining Capital Costs

Description	Initial Capital ($M)	Sustaining and Closure ($M)	Total Capital ($M)
Pre-stripping & Pre-production	27.7		27.7
Mine Pit Development	4.8		4.8
Mine Stockpiling	3.9		3.9
Subtotal Open Pit Mine Development	**36.4**		**36.4**
Drilling Equipment	6.2		6.2
Loading Equipment	10.4	4.4	14.8
Hauling Equipment	24.8		24.8
Support Equipment	5.9	0.4	6.3
Mine Maintenance Equipment	2.0		2.0
Subtotal Mine Equipment	**49.3**	**4.8**	**54.1**
Mine Roads and Access	7.9		7.9
Dewatering	0.7	7.0	7.7
Mine Maintenance Facilities	32.2		32.2
Emulsion Facility and Explosive Magazine	1.5		1.5
Subtotal Mine Infrastructure	**42.3**	**7.0**	**49.3**
Demolition, Reclamation and Closure		**21.5**	**21.5**
Capital Costs – Mine	**128.0**	**33.2**	**161.2**

21.1.1.2 Milling

Milling facility costs were developed based on material takeoff (MTO) quantities estimated by each major discipline as shown in

Table 21-3. Well above 95% of major equipment cost values were obtained from vendor quotes and represent a high fidelity of purchase price for mill equipment. This is a key item, since the overall capital for the mill depends most heavily on the initial purchase price of the equipment. The numbers reflected in the table represent installed capital cost, including labor hours and materials for the mill equipment, foundations and piers, structural steel, electrical and controls equipment, mill buildings, and related items for a full facility. This includes first fills and installed spares, as well as the mill utility battery. The mill is not expected to carry any sustaining or closure costs. Closure costs for the mill are captured in both the mining and infrastructure capital. In total, the mill facilities represent $221.1 M of the overall capital cost of the Project.

Table 21-3 Estimated Milling Capital Costs

Area	Initial Capital ($M)	Sustaining and Closure ($M)	Total Capital ($M)
Primary Crushing	10.9		10.9
Crushed Ore Stockpile and Reclaim Systems	18.9		18.9
Crusher Building	20.1		20.1
Subtotal ROM Handling, Crushing, and Storage	**49.9**		**49.9**
Primary Grinding (Closed Circuit)	19.2		19.2
Secondary Grinding and Classification	3.2		3.2
Flash Flotation	2.4		2.4
Cyclonic Classification	0.4		0.4
SAG Mill Building	11.5		11.5
Subtotal Primary Grinding and Classification	**36.7**		**36.7**
Rougher Flotation	3.9		3.9
Polishing Mill	2.9		2.9
Cleaner Flotation and Regrind	13.7		13.7
Concentrator Process Building	17.2		17.2
Subtotal Flotation Separation	**37.7**		**37.7**
Tailings Thickening and Filtration	20.4		20.4
Dewatered Tailings Storage and Loadout	5.6		5.6
Tailings Thickening, Filtering, Storage and Transport	12.5		12.5
Subtotal Tailings Thickening and Filtration	**38.5**		**38.5**
Concentrate Thickening, Filtration, Drying	12.4		12.4
Concentrate Storage and Loadout	11.6		11.6
Dryer Building	14.4		14.4
Subtotal Concentrate Thickening, Filtration, Drying, and Loadout	**38.4**		**38.4**
Reagents and Grinding Media	**6.1**		**6.1**
Mill Utilities	**13.9**		**13.9**
Total Milling Capital Costs	**221.1**		**221.1**

21.1.1.3 Waste Management Facility

WMF capital costs are summarized in Table 21-4. Capital costs associated with the WMF were developed using the WMF stage development plan. A phased civil bill of materials (BOM) was developed to estimate earthwork (cut and fill) quantities, site surfacing, drainage structure requirements and liner installation. Given the Alaska site's remote location, these activities will be a collaborative effort between owner (self-performed) and contractors. Most of the equipment fleet and workforce used for the self-performed portion of these activities will be integrated into the mine operations, after full-time production begins. Additionally, the capital costs for the WMF account for contemporaneous and final grading, liner placement, closure, and reclamation of the facility.

Table 21-4 Estimated Waste Management Facility Capital Costs

Area	Initial Capital ($M)	Sustaining and Closure ($M)	Total Capital ($M)
Waste Management Facility (WMF)	13.4	0.3	13.7
WMF Drainage System	7.6		7.6
WMF Liner	43.5	58.4	101.9
WMF Area Development	**64.5**	**58.7**	**123.2**
Initial Tailings Deposition	7.6	1.4	9.0
WMF Reclamation and Closure		73.1	73.1
Total Waste Management Facility	**72.2**	**133.2**	**205.3**

21.1.1.4 Infrastructure

Table 21-5 presents the capital costs for the infrastructure at Graphite Creek as well as in Nome.

Table 21-5 Estimated Infrastructure Capital Costs

Area	Initial Capital ($M)	Sustaining and Closure ($M)	Total Capital ($M)
Power Generation (3 Diesel 7.5 MW Gensets)	37.7		37.7
Drainage And Wastewater Treatment	50.2		50.2
Other Utilities	9.8		9.8
Subtotal Utilities	**97.7**		**97.7**
Ancillary Buildings (Office, Warehouse, Lab, Etc.)	**8.5**		**8.5**
Transportation (Access Road, Guard Shack, Helipad)	**22.5**		**22.5**
Control, Communications and Monitoring System	**14.2**		**14.2**
Plant Site Preparation	**11.0**	**8.3**	**19.3**
Road Maintenance Equipment	1.9		1.9
Small Fleet	6.0	1.5	7.5
Initial Construction Equipment Fleet	20.6		20.6
Concentrate Transport Containers	25.7		25.7
Subtotal Non-Fixed Plant and Equipment	**54.2**	**1.5**	**55.7**
Total On-Site Infrastructure	**208.2**	**9.7**	**217.9**
Off-Site Infrastructure	**3.3**		**3.3**
Total Off-Site and On-Site Infrastructure	**211.5**	**9.7**	**221.2**

21.1.1.5 Indirects

Indirect capital costs apply across the project and include items like temporary facilities and utilities, travel, construction camp operations, engineering, procurement and construction management (EPCM) services, freight, and warehousing. There are no sustaining or closure costs considered in the indirects category. In total, the estimated indirect costs for the Project are $136.7 M with the individual contributors listed in Table 21-6.

Table 21-6 Indirect Capital Costs

Area	Initial Capital ($M)	Sustaining and Closure ($M)	Total Capital ($M)
Temporary Site Facilities	2.7		2.7
Temporary Utilities	14.1		14.1
On-Site Services	2.6		2.6
Pre-Commissioning & Check-Out	2.1		2.1
Vendor Reps Construct/ Pre-Comm	1.4		1.4
Vendor Reps Commissioning	1.1		1.1
Construction & (Start-Up) Spares	1.6		1.6
Air Travel Transportation	7.2		7.2
Ground Transportation	3.4		3.4
Camp Operation and Maintenance	27.9		27.9
Pre-Mob Medicals, Recruitment	0.2		0.2
EPCM Services - Home Office	28.0		28.0
EPCM Services - Field Office	22.6		22.6
EPCM Services - Fee	4.3		4.3
EPCM Services - Basic Engineering	3.2		3.2
T&L Services, Warehousing, Freight Forwarding	11.1		11.1
Third Party Consultants	3.2		3.2
Total Indirect Costs	**136.7**		**136.7**

21.1.1.6 Owner's Costs

Owner's costs include materials, services, and personnel costs associated with site administration, which includes land purchase in Nome to construct a subdivision for employee housing, mobile equipment, Kougarok Road improvement and maintenance, office tailers, and light vehicles. The owner's costs were estimated by gathering data from vendors and suppliers, mining operations in the same region, Costmine Intelligence, and existing databases. The items contributing to the owner's costs are listed in Table 21-7.

Table 21-7 Owner's Costs

Area	Initial Capital ($M)	Sustaining Capital ($M)	Total Capital ($M)
Owners Team	2.8		2.8
Legal, Permits, Licenses & Fees	2.8		2.8
Insurance	8.5		8.5
Financing Costs and Interest	1.0		1.0
Land Purchases – Off-Site	5.0		5.0
Preproduction Team	21.2		21.2
Wet Commissioning & Ramp-Up	1.0		1.0
Capital Spares	6.4		6.4
Two Years Operating Spares	5.1		5.1
First Fills	0.8		0.8
Operational Readiness	0.5		0.5
Operator Training	0.3		0.3
Precommercial Production Operations and Maintenance	30.0		30.0
Total Owners Costs	**85.5**		**85.5**

21.1.1.7 Contingency

For the total estimated value to represent the most likely outcome, a contingency has been provided in the estimate to cover anticipated variances between the specific items allowed in the estimate and the final actual project cost. The contingency sum is not intended to cover changes from the stated design, performance base, or the assumptions and exclusions list below.

Contingency has been included at the aggregate rate of 11.2% of the total base estimate. This was arrived at by considering the level of development for quantity derivation, from definitive (highest definition) to allowance (lowest definition). A weighted average of these levels across the disciplines was calculated to arrive at the applied aggregate contingency.

21.1.1.8 Assumptions and Exclusions

Assumptions

The estimate has been based on the following assumptions and is therefore qualified by them.

- The estimate is expressed in United States dollars and includes no provision for exchange rate fluctuation that might impact costs
- The estimate is deemed to reflect prices and market conditions ruling as of 25 March 2025, with no provision for forward escalation beyond this date
- All fuel required for the works will be readily available at the stipulated rate of $3.67 gallon
- Sufficient labor will be available to perform the works for the costs assumed in the estimate
- Suitable quarries and borrow pits for aggregates and sand are located within 15 km of the required location
- Sufficient space is available for laydown areas adjacent to contractor work fronts
- Engineering design and subsequent procurement of materials shall be conducted in a timely fashion, allowing for sufficient availability of materials at the work face despite the brief window for inward goods delivery each year
- A traditional EPCM contracting strategy will apply
- The project will seek to maximize pre-assembly and modularization of the facilities to reduce on-site labor requirements and costs. The current designs do not reflect a modularized plant and have been estimated as largely stick-built
- No constructability reviews have been undertaken during the preparation of this estimate
- No lifting or logistics studies have been undertaken during the preparation of this estimate
- Owner's costs have been included as a simple 3.5% of Total Direct Costs in line with industry norms

- Mechanical completion will be achieved by end Year 1 (2029), commissioning will take three months, and the project will ramp up to full production by mid-Year 2 (2030)
- Two years of maintenance spares is sufficient

Exclusions

The following items are specifically excluded from the estimate:

- Sunk costs (activities of previous phases)
- Escalation of equipment, material, and labor costs beyond the estimate base date
- Resale or salvage value of temporary equipment and materials provided to support the construction
- Resale or salvage value realized for permanent facilities at end of plant life
- Geotechnical investigations, topographical survey, and data purchases relating to the acquisition of data such as: seismic data; geophysical data; weather data; satellite photographs and the like
- No significant encounters with permafrost shall occur, resulting in onerous mitigation measures such as mass removal of permafrost-impacted soil and replacement with structural fill
- No piling is included in the estimate or any form of ground underpinning
- Permanent operations camp facility (a land subdivision project is included and detailed above)
- Road sealing
- Labor bonuses or incentive programs
- Extended warranties on equipment beyond the base date assumptions
- Variations in currency exchange rates or provision for hedging of foreign currency
- Finance charges
- Exploration
- Research and development
- Capitalized depreciation
- Public relations
- Project accounting audits
- Community relations
- Community projects and social development

- All taxes, duties, and tariffs on imported equipment and materials
- All taxes except for those included in construction labor rates
- Royalties for technology licensing or extractive rights (royalties are included in the economic model only to the extent detailed therein)
- Cost of environment- and ecology-related items
- Cost for testwork
- Cost or schedule impacts due to abnormal delays or shutdowns of any nature in construction, design, or procurement, such as those caused by:
    - Unexpected site conditions or latent conditions including permafrost
    - Labor relations and labor stoppages other than the modest provision for unproductive time included in contractor distributables
    - Permit application rejection or delays
    - Abnormal weather outages
    - Acts of God (natural disasters including earthquakes, floods, hurricanes, tornadoes, severe storms)
    - Acts of terrorism, riot, sabotage, acts of war, economic collapse, revolution, theft, fraud
    - New government regulations
    - Political or other civil disruptions

21.1.2 STP (Ohio) Treatment Plant Capital Cost Summary

Capital cost estimate represents the costs estimated to construct the facility in the state of Ohio, which upgrades the natural graphite concentrate into final products for distribution. The cost estimate is primarily based on material and equipment costs from MTOs and detailed equipment lists for one 25 ktpa module. For the full-scale facility, this 25 ktpa module cost is then scaled/factored to a full capacity of 175 ktpa (7 x 25 ktpa module). Pricing for key equipment was primarily determined from quoted sources. Bulk material costs are based on historical pricing and in-house data. The total capital cost estimate is expected to be $3,919.4 M, including a contingency of $784 M. The capital cost estimate is consistent with the definition of a standard quality Association for the Advancement of Cost Engineering (AACE) Class 4 estimate. The anticipated accuracy of the estimate is +25%/-15%.

The base currency is United States dollars (USD). The estimated base date is Q1 2025 with no provision included for escalation beyond the base date.

21.1.2.1 Direct Cost Estimates

A summary of the STP estimated capital direct costs is outlined in Table 21-8.

Table 21-8 STP Direct Capital Cost Estimate—175 ktpa

Area	Estimated Cost ($M)
Main Processing Plant	376.1
Storage Area	23.8
Feed Preparation, Sorting & Micronizing	401.0
Graphite Purification & Carbonization	550.5
Anode A & B	181.9
Final Product Packaging and Storage	70.2
Off-Gas Handling and Scrubbing	23.0
Reagents	29.2
Plant Services	734.2
Estimated Sub-Total	**2,389.7**

The basis of direct capital costs is defined in Table 21-9.

Table 21-9 STP Direct Capital Cost Estimate—175 ktpa—Cost Basis

Area	Basis
Civil Works	Preliminary Drawings, Conceptual MTO
Concrete	Conceptual MTO and Allowance
Steel	Conceptual MTO and Allowance
Architectural	Building List, Conceptual
Demolition	Crew Size x Duration (Estimated)
Mechanical Equipment	Budgetary Quotations, In-House Data, Escalated PFS Data, Allowances
Mechanical Platework	Conceptual MTO
Piping/Duct	MTO Based on Conceptual 2D Line Lengths with Assumed Complexity; Historical
Electrical	Bulk MTO was Calculated Using SLD and MEL Quantities; Distances Estimated from Power Distribution and Load Locations
I & C	Factored from Mechanical Costs

21.1.2.2 Indirect Capital Costs

A summary of the STP estimated capital indirect cost is outlined in Table 21-10.

Table 21-10 STP Indirect Capital Cost Estimate—175 ktpa

Area	Estimated Cost ($M)
EPCM	358.5
Spare Parts	32.0
Vendor Assistance	8.0
Commissioning	71.7
Freight	40.0
Site Services and Facilities	119.5
First Fills	32.0
Construction Indirects	Included in labor rates.
Owners Costs	Excluded
Scaffolding	53.5
Third-Party Services and Consulting	23.9
Construction Equipment	Included in labor rates.
Heavy Cranes	6.8
Subtotal Indirects	**745.8**
Contingency	783.9
Total Indirects and Contingency	**1,529.7**

Indirect capital costs have been factored in as defined in Table 21-11.

Table 21-11 STP Indirect Capital Cost Estimate—175 ktpa—Costs Basis

Description	Factor
EPCM	15% of Direct Cost
Spare Parts	4% of Mechanical Equipment Supply Cost
Vendor Assistance	1% of Mechanical Equipment Supply Cost
Commissioning	3% of Direct Cost
Freight	5% of Equipment Supply Cost
Site Services and Facilities	5% of Direct Cost
First Fills	4% of Mechanical Equipment Supply Cost
Scaffolding	10% of Total Labor Cost
Third-Party Services and Consulting	1% of Direct Cost
Heavy Cranes	84 Months 250 Ton 42 Months 400 Ton
Overall Indirect Cost Ratio	31% of Direct Cost

21.1.2.3 Assumptions (STP – 175 ktpa)

The following assumptions were made in preparation of the 175 ktpa STP facility capital costs:

- Site is fully fenced
- Site has adequate existing rail spurs to offload feed container
- All sewage/wastewater can be sent offsite to local municipality
- Flat undeveloped site with no need for grubbing
- Same environmental conditions as Ohio site

- Same above/ground utility method as the 25 ktpa module
- Same demo as the 25 ktpa module
- Same cut/fill as the 25 ktpa module
- Adequate truck access to site
- Final product will be mainly trucked offsite
- Same existing utilities and corridor as the 25 ktpa module
- The 25 ktpa modules' process design and process buildings are 'fixed'
- Non-union labor rates
- Contingency of 25% has been applied to the STP capital costs

21.1.2.4 Exclusions (STP – 175 ktpa)

The following are excluded from the 175 ktpa STP facility capital cost:

- Costs outside the STP battery limits (see Section 18.2.4 - Battery Limits)
- Escalation of equipment, material, and labor costs beyond the estimated base date
- Variations in currency exchange rates from those specified in this document
- All taxes and duties except for those included in construction labor rates
- Costs due to labor relations and labor stoppages
- Owner's costs, including anticipated testwork, studies, and permitting costs
- Force majeure
- Cost of environment- and ecology-related items
- Financing costs
- Costs for testwork
- Costs for vendor basic engineering
- Tariffs
- Any cost that occurs after pre-operational testing (cold commissioning):
    - Capital/process improvement projects
    - Costs to sustain the process during ramp-up and operation, including dealing with extraordinary waste generation or additional resource requirements

- There are no sustaining capital costs identified at this phase as these are typically covered under the maintenance costs of the operating cost estimate
- Cost of facility closure
- Cost due to abnormal delays or shutdowns of any nature in construction, design, or procurement

21.2 Operating Costs

21.2.1 Alaska Operating Cost Summary

The total and average operating cost over the LOM for the Alaska facilities is presented in Table 21-12. These costs include civil development and earthwork, mine operations and reclamation, mill operations, general and administrative costs, tailings handling and management, water treatment, road construction and maintenance, and other operational support services. The estimates for these costs were developed from various assumptions, vendor/supplier sources, and experience, which are described in the sections below.

Table 21-12 Overall Operating Cost Summary

Cost Area Description	LOM Total Cost ($M)	LOM Average ($M/yr)	Unit Operating Cost ($/t Concentrate)	Operating Percent (%)
Mining	840.1	41.7	238.5	39.1
Milling	1,014.0	50.4	287.9	47.2
General and Admin	294.4	14.6	83.6	13.7
Operating Cost	**2,148.5**	**106.8**	**610.0**	**100**

The operating cost breakdown for the Alaska site is based on a mill design ore feed rate of roughly 3.6 Mtpa and concentrate production of 175,000 tpa. Ore feed rate and concentrate production rate vary year-by-year based on the mine's production schedule. The resulting total LOM ore mill feed is 71.2 Mt, producing a total of 3.5 Mt of concentrate. The average total LOM mine production (ore and waste) is 14.1 Mtpa with a total LOM material movement of approximately 301 Mt (ore and waste).

21.2.1.1 Mining Operating Cost Estimate

The mine operating cost is presented below in Table 21-13, which includes costs related to mine production (drill, blast, load, haul), mine maintenance, technical services, labor, and other direct mining-overhead costs. The data used to estimate these costs was derived from vendors, current equipment performances, operational experience, and historic data. Key factors for estimating these costs include expenses for consumables (e.g., fuel, parts, tires, blasting supplies, etc.), tails handling, equipment maintenance, labor, and overhead costs associated with mining and mobile equipment maintenance activities. The unit costs in the table below are presented on two different basis—$/t mined accounts for the costs associated with removing ore and waste from the pit only, while $/t moved accounts for all material movement (ore, waste, tailings, stockpile, rehandle).

Table 21-13 Mining Operating Costs by Cost Activity

Cost Activity	Total LOM Operating Cost ($M)	Operating Cost Mined[1] ($/t mined)	Operating Cost Moved[2] ($/t moved)
Drilling Cost	28.0	0.09	0.07
Blasting Cost	140.2	0.46	0.37
Loading Cost	61.5	0.20	0.16
Hauling Cost	112.8	0.37	0.30
Support Cost	112.5	0.37	0.30
Mine Operations Labor	341.6	1.12	0.90
Pit Dewatering	0.8	0.00	0.00
Stockpile Rehandling	2.4	0.01	0.01
Tails Handling	40.4	0.13	0.11
Mining Operating Costs	**840.1**	**2.75**	**2.23**

[1] Movement of ore and waste
[2] Movement of ore, waste, stockpile, and mill rehandle

Basis of Mine Operating Cost Estimate

As previously noted, the mine operating cost estimate encompasses all costs typically incurred during the normal course of mining operations. The basis for the mine operating cost estimate is presented below and is organized into the following areas:

- Labor
- Diesel
- Explosives
- Mobile equipment maintenance

Mine Labor

Mine labor costs encompass all direct-labor expenses associated with mining, including mine operations, mine engineering, geology, surveying, maintenance, consultants, contractors, and other related roles. Estimated labor costs were based on salary and wage data from the Bureau of Labor Statistics for Alaska, along with other publicly available salary ranges for mining positions in Alaska. Hourly labor cost was calculated using Alaska's guidelines for overtime rates. The labor rates include a 44% burden and a 12% geographical premium. These rates were applied to the staffing plan to estimate total labor costs. Table 21-14 presents the mine's staffing and typical labor costs for a full-production year.

Table 21-14 Mine Staffing or Labor Summary

Work Area	No. of Staff	Total Cost
	#/yr	$/yr
Drilling	8	795,916
Blasting	6	801,264
Loading	12	1,585,004
Hauling	24	2,850,767
Support	22	2,913,821
Operations Management	4	581,811
Mine Maintenance	35	5,135,651
Tech Services	10	1,456,365
Total Mine Labor	**121**	**16,120,599**

Diesel Fuel

Diesel consumption rates for each piece of mining equipment and for blasting operations were obtained from various vendors and the CAT Handbook Version 50 (Caterpillar, 2022). Diesel consumption rates combined with the usage hours were used to estimate total diesel requirements for both mobile equipment and blasting operations. A diesel price of $3.67/gal was utilized in developing the mining operating costs and was chosen based on information provided to the owner by local fuel distributors.

Explosives and Blasting Accessories

The mine plan involves using explosives for ore and waste fragmentation. The blasting agent is 100% emulsion-gassed with non-electronic detonators and boosters. A multinational explosive service company provided the costs for explosive products information used for the study. Costs include $2,200/t for bulk emulsion-gassed operating fees of $23,000 per month for personnel and $5,100 per month for blasting equipment rental costs. Other blasting equipment and materials, such as a blasting truck and skid steer, were incorporated into the mine’s ancillary support equipment. The cost for the emulsion plant is accounted for as part of the mine’s capital costs.

Mine Maintenance and Repairs

The maintenance and repair portions of the operating costs were estimated using historic information received from mobile equipment vendors and industry data sourced from Costmine Intelligence. The maintenance costs incorporate tires, wear parts, and ground-engaging tools. Costs assume that the owner will manage maintenance and repairs. This project does not include any allocation for mobile equipment replacement due to the short mine life as well as the assumption that proper preventative maintenance will be performed and that major rebuilds will occur at appropriate intervals. Maintenance costs cover expenses for the following:

- Scheduled maintenance
- Major equipment repairs and overhauls
- Tires, tracks, wear parts, and ground-engaging tools
- Other minor maintenance repairs

Other Mining Operating Costs

Other mining operating costs consist of various miscellaneous supplies and materials essential for key operational areas, ensuring sufficient resources and smooth mining operations. These areas include drilling, blasting, loading (both shovels and loaders), hauling, and support services. In general, a 10% miscellaneous cost was applied to each of these areas.

21.2.1.2 Milling Operating Cost Estimate

The costs of milling operations consist of utilities, consumables, and maintenance materials, as shown in Table 21-15.

Table 21-15 Milling Operating Cost Summary

Cost Activity	Total LOM Operating Cost		
	($M)	($/t Ore)	($/t Concentrate)
Utilities	620.3	8.71	176.12
Consumables	131.8	1.85	37.43
Fixed Costs	261.9	3.68	74.36
Total Milling	**1,014.0**	**14.24**	**287.91**

Utilities

All diesel-based utility costs are listed in Table 21-16. Site power will be supplied by onsite diesel-fueled generators as described in Chapter 18, so the operating costs for site power are based on fuel consumption and regular maintenance of the power generators. Maintenance materials are accounted for in the maintenance materials line item in the mill operating cost, and maintenance labor for the power system is included in the staffing estimate for the site. Site power consumption is estimated at 12.5 MW, amounting to roughly 25.7 million liters (6.8 million gallons) of diesel fuel per year. A lower heating value (LHV) of 35,816 kJ/l (128,488 BTU/gal) for low-sulfur diesel was used throughout this study.

Other utilities include fuel consumption for product drying and facility heating.

Product drying cost was estimated using process data (tonnage, moisture content) and vendor-supplied performance specifications, assuming that no waste heat is available from other sources to offset fuel consumption. Diesel consumption for product drying was estimated at nearly 1.5 million gal/yr.

Heat for the mill facilities (including the WTP) will be supplied by a combination of waste heat from the generators and distributed diesel-fired unit heaters. In the case of facility heating, it was assumed that low-grade waste heat from power generation (available as water/glycol at 90 C) would be available to offset heating requirements. Based on vendor input, this waste heat at 90 C is estimated at 6.6 MW (22.5 MMBTU/hr). Net diesel demand for heating was thus estimated at 78,000 l/yr (20,608 gal/yr) based on waste heat utilization, the site building sizes, mill building control temperature of 7 C (45 F), and a degree-day heating evaluation based on available temperature patterns for the mill location.

Table 21-16 Milling Utility Costs

Cost Activity	Total LOM Operating Cost		
	($M)	($/t Ore)	($/t Concentrate)
Diesel: Power	490.3	6.89	139.23
Diesel: Product Dryer	107.6	1.51	30.54
Diesel: Mill Facilities Heating	20.9	0.29	5.93
Diesel: WTP Heating	1.5	0.02	0.42
Total Utilities	**620.3**	**8.71**	**176.12**

Consumables

Reagent consumption was estimated for the mill and WTP as shown in Table 21-17 and described below.

- Flotation agent (fuel oil) and frother consumption rates are based on the flowsheet mass balance, the metallurgical testwork conducted at SGS (for fuel oil), and standard industry dosing (for frother)
- Flocculant consumption (tailings thickener, concentrate thickener) is based on the flowsheet mass balance and SLS testwork conducted by Pocock Industrial on concentrate and tailings samples
- Lime and sulfuric acid consumption values are based on the WTP design and mass balance
- Flocculant usage at the WTP was considered negligible compared to the mill usage

The unit cost of each reagent was obtained from recent vendor quotes, and a 6% freight adder was included in the operating cost estimate.

Grinding media represent the primary consumables for the mill. Predicted wear rates (based on abrasion index testing conducted by SGS) were used along with the mass balance material flows to estimate grinding media attrition rates for the SAG mill, ball mill, and the two stirred-media mills. Media costs were obtained from vendor quotes. The cost of periodic mill liner replacement is included in the general maintenance materials budget.

Table 21-17 Milling Consumables Costs

Cost Activity	Total LOM Operating Cost		
	($M)	($/t Ore)	($/t Concentrate)
Flot Agent (Fuel Oil)	11.7	0.16	3.31
Frother (MIBC)	5.3	0.07	1.50
Flocculant (Dry)	8.0	0.11	2.28
Lime (Dry)	8.0	0.11	2.26
Sulfuric Acid (95%)	0.0	0.00	0.01
SAG Media	59.9	0.84	17.01
Ball Mill Media (Regrind #1)	13.9	0.20	3.96
SMM Media (Regrind #2)	10.5	0.15	2.99
SMM Media (Regrind #3)	6.6	0.09	1.87
Freight on Consumables	7.9	0.11	2.25
Total Consumables	**123.9**	**1.74**	**35.18**

Fixed Costs

Fixed costs for the Alaska milling operations consist of mill labor, mobile equipment, and maintenance materials, as shown in Table 21-18.

Table 21-18 Fixed Costs

Cost Activity	Total LOM Operating Cost		
	($M)	($/t Ore)	($/t Concentrate)
Mill Labor	202.0	2.84	57.35
Mobile Equipment	3.8	0.05	1.06
Maintenance Materials	56.2	0.79	15.95
Total Milling Fixed Costs	**261.9**	**3.68**	**74.36**

Labor Cost

Milling labor costs encompass all direct labor expenses associated with operating and maintaining the mill, the power plant, the HVAC systems, and the WTP, including operations, engineering, maintenance, consultants, contractors, and other related roles. These estimated labor costs were based on salary and wage data from the Bureau of Labor Statistics for Alaska, along with other publicly available salary ranges for mining positions in Alaska. Hourly labor cost was calculated using Alaska's guidelines for overtime rates. The labor rates include a 44% burden and a 12% geographical premium. These rates were applied to the mill staffing plan shown in Chapter 17 to estimate the total labor costs. A summary of these labor costs is provided in Table 21-19 for a typical full-production year.

Table 21-19 Mill Staffing Summary

Work Area	No. of Staff #/yr	Total Cost $/yr
Mill Manager	**1**	**247,296**
Salary Employees	6	1,054,056
Hourly Employees	28	3,322,759
Mill Maintenance General Foreman	**1**	**186,739**
Salary Employees	1	145,580
Hourly Employees	30	3,589,995
Lab Supervisor	**2**	**287,120**
Salary Employees	-	-
Hourly Employees	8	949,360
Total Mill Labor	**77**	**9,782,905**

Mobile Equipment

The mill requires a relatively small mobile equipment fleet to support ongoing operations and concentrate container storage and handling. This equipment and the associated operating costs are summarized in Table 21-20 below.

Table 21-20 Mill Mobile Equipment Operating Cost

Equipment	Total LOM Operating Cost ($M)	$/t
Reach Stacker (containers)	0.9	0.24
Forklift - CAT 988 (containers)	1.1	0.31
Skid Steer - S510	0.3	0.10
Forklift - 10 Ton	0.5	0.14
Truck Crane - 40 Ton	-	-
Crane - 100 Ton	-	-
Flatbed Trailer	0.0	0.00
Loader - CAT 980	1.0	0.28
Total Equipment Operating Cost	**3.8**	**1.06**

Maintenance Materials

Maintenance materials for the mill were estimated using a factor of 3.5% times the total purchase price of major equipment. An additional 6% was added to this number to account for freight to the site (a net 3.7% of major equipment purchase). Mill maintenance labor is addressed in the Graphite Creek labor model.

21.2.1.3 General and Administrative Cost Estimate

The G&A operating costs include all materials, services, and personnel costs associated with site administration, which include bussing and transport, employee housing costs, Kougarok Road maintenance costs, Nome office costs, office supplies, software, training, light vehicle expense, miscellaneous expense, mobile equipment, and labor costs. A summary of the G&A operating cost over the LOM is outlined in Table 21-21 below.

Table 21-21 G&A Summary

Cost Activity	Total LOM Operating Cost ($M)	($/t Concentrate)
Personnel Logistics	67.0	19.01
G&A Labor Costs	120.5	34.20
G&A Miscellaneous	107.0	30.38
Total G&A	**294.4**	**83.60**

Personnel Logistics

Personnel logistics includes the categories listed in Table 21-22 below. The most significant cost item associated with personnel logistics is the bussing cost, which is the cost associated with transporting employees from Nome to the Graphite Creek site.

Table 21-22 Personnel Logistics Portion of G&A Expenses

Cost Activity	Total LOM Operating Cost	
	($M)	($/t Concentrate)
Light Vehicle Maintenance	17.8	5.07
Bussing Cost	40.4	11.47
Subdivision Development	6.6	1.88
Building Construction Loan Interest	2.1	0.60
Total Personnel Logistics	**67.0**	**19.01**

Labor Costs

G&A labor costs include administration, finance, safety, environmental, and ancillary services. The contribution of each is shown in Table 21-23

Table 21-23 Labor Portion of G&A

Cost Activity	Total LOM Operating Cost	
	($M)	($/t Concentrate)
Administrative	28.1	7.99
Finance	36.4	10.34
Health & Safety	13.2	3.74
Environmental	10.7	3.04
Ancillary Services	32.0	9.09
Total G&A Labor	**120.5**	**34.20**

G&A Miscellaneous

The contributors to miscellaneous G&A expenses are listed in Table 21-24 The largest contributors are office supplies, employee training, software, and mobile equipment costs. The mobile equipment costs account primarily for the equipment needed to facilitate shipping container handling and transport to the port.

Table 21-24 Miscellaneous Portion of G&A

Cost Activity	Total LOM Operating Cost	
	($M)	($/t Concentrate)
Nome Kougarok Road Maintenance	15.4	4.36
Nome Office Trailers	0.4	0.13
Office Supplies, Software, Training	62.2	17.67
Miscellaneous Expenses	8.0	2.28
Mobile Equipment	20.9	5.94
Total G&A Miscellaneous	**107.0**	**30.38**

21.2.1.4 Logistics Cost Estimate

On-site storage and the transportation of graphite concentrate from Graphite Creek to the STP are described in more detail in Chapter 18.

The methodology for developing and assessing the graphite concentrate transport chain cost involved a comprehensive multi-modal logistics analysis based on standard-sized, reusable, lined shipping containers. Though graphite concentrate is typically transported in 1-ton super sacks for reasons of environmental impact, operational consistency, product protection, and operational simplicity, the decision was made to base the transport supply chain primarily around custom-manufactured, polymer-lined, 20-foot shipping containers with a net capacity of 21 t of graphite concentrate.

After selecting a standardized shipping unit, the transport cost analysis defined the available supply chain options from mine to STP. Due to the remoteness of the mine, multiple modes of transportation were considered to cover the approximately 16,000 km round trip for each container. The transportation cost assessment settled on three main transport legs: truck transport from the mine site to Nome Harbor, maritime transport from Nome Harbor to Prince Rupert Harbor, British Columbia, and rail transport from Prince Rupert to Niles, Ohio. Each leg included handling, storage, and transfer costs. Cost breakdowns were itemized for each transportation leg, including shipping costs, terminal handling charges, land lease, and storage charges.

The evaluation methodology also considered operational constraints, such as seasonal port closures, physical port limitations, shipping route options, intermodal compatibility, and transfer cost tradeoffs. All costs and durations were derived from publicly available information and through direct discussions with current and potential supply chain partners. Finally, as well as the cost estimate, the study also included a recommendation for future transport chain optimization through comprehensive dynamic logistics modeling. Cost estimates are provided in Table 21-25 below.

Table 21-25 Logistics Cost Estimate

Mine site to Nome, AK ($/ton)		Nome to Port of Prince Rupert, BC ($/ton)		Port of Prince Rupert to Niles, OH ($/ton)	
Trucking	$24.30	Ocean Freight	$69.87	Rail Transport	$146.73
Handling	$23.41	Handling	$73.57	Handling	Included
Storage	$0.45	Storage	$33.24	Storage	Included
Segment Total:	**$48.16**	**Segment Total:**	**$176.67**	**Segment Total:**	**$146.73**

Note: Costs to return the container to the site after the product has been delivered to the STP are included with each segment.

21.2.2 STP (Ohio) Operating Cost Estimate

21.2.2.1 Introduction

An operating cost estimate was developed as part of the current study for the STP. The operating cost estimate has been prepared to a level of definition appropriate for an intended level of accuracy of approximately +25/-15%.

The operating cost consists of the following major cost centers:

- Consumables, comprising of:
    - Feed materials
    - Reagents
    - Utilities

- Other consumables
- Labor
- Maintenance materials
- Waste handling
- General & administrative expenses
- Miscellaneous allowances, including growth allowances based on the degree of engineering completed and a comparison to historical experience of the expected quantity

21.2.2.2 Basis of Estimate

The following global model parameters were assumed to prepare the operating cost estimate:

- The operating cost estimate has been developed for the plant for a single year at a steady state and reflects an average over time, given the assumed average feed rate and composition, as per the PDB
- The STP has an overall availability of about 82% or 300 days per year, as per the process design basis (PDB)
- The heat treatment processes operate for 7,200 hours annually (7 days, 24 hours), while the room temperature processes operate for 3,429 hours annually (5 days, 16 hours)
- The annual graphite concentrate feed throughput is estimated to be 27,558 short tpa (for the 25 ktpa scenario) and 192,904 short tpa (for the 175 ktpa scenario)
- The currency of the estimate is USD with a base date of Q4/2024 and a target accuracy of approximately +25/-15%
- For unit prices used from the last phase of the study conducted in 2021, an escalation factor of 20.5% has been applied

21.2.2.3 Qualifications and Exclusions

The following qualifications should be taken into consideration when reviewing the operating cost estimate:

- Consumptions were generally estimated from the approved mass and energy balance. Therefore, the accuracy of the mass and energy balance is critical to ensure the accuracy of the operating cost. The mass and energy balance utilizes inputs from the PDC, which at this stage has not been verified using testwork
- The operating cost estimate was prepared using the unit prices supplied by Graphite One during the last phase of the study (e.g., feed costs and labor rates) and Hatch's in-house data from similar projects

The following have been excluded from the operating cost estimate:

- Pre-operational costs (for example, training)
- Operating costs for facilities outside the battery limits (refer to Section 18.2.4)
- Research and development
- Forward escalation
- Taxes, tariffs, duties, and royalties (royalties for technology licensing are included in the economic model only to the extent detailed therein)
- Executive and senior staff salaries outside the plant operations (corporate costs)
- Sustaining capital. In general, no large sustaining capital expenses are envisioned during the process plant asset life. Maintenance cost estimates have been included, which should cover the normal sustenance of the operation
- Cost of natural graphite purchased from Graphite Creek (cost assumed in the mine operating cost) or on the open market (purchased graphite concentrate is included in the project economics)

21.2.2.4 Operating Cost Estimate Summary

An overall summary of the operating cost estimate for the 25 ktpa scenario is shown in Table 21-26 and Figure 21-1. The operating cost estimate for the 175 ktpa scenario is also presented in Table 21-27 and Figure 21-2.

Table 21-26 Overall Operating Cost Estimate Summary–25 ktpa

Cost Component	Total Operating Cost Estimate	
	Annual Operating Cost Estimate ($M/yr)	Unit Cost Estimate ($/t of Graphite Concentrate)[1]
Consumables	46.58	1,863.15
Feed Materials	15.24	609.43
Reagents	4.54	181.74
Utilities	18.41	736.36
Other Consumables	8.39	335.61
Labor	15.01	600.55
Maintenance Materials	14.45	578.01
Waste Handling	1.79	71.50
General and Administrative Expenses	1.88	75.11
Miscellaneous Allowances	6.45	257.89
Total Operating Cost Estimate	86.16	3,446.21

[1] Based on 25,000 t natural graphite feed

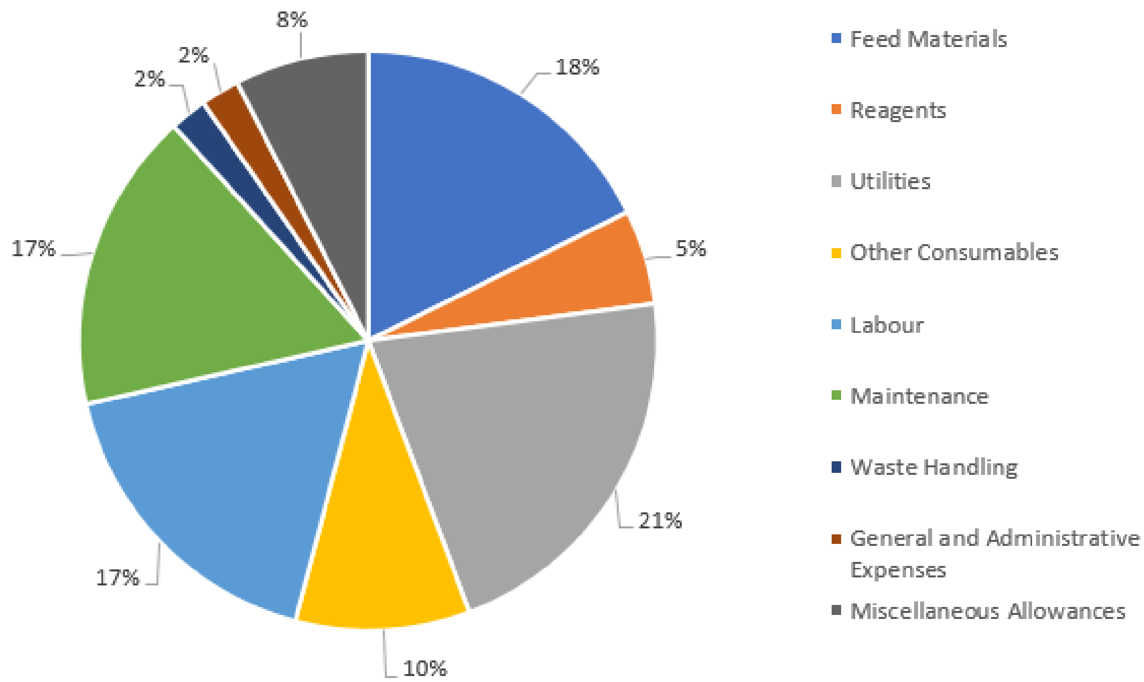


Figure 21-1 Overall Operating Cost Estimate Breakdown–25 ktpa

Table 21-27 Overall Operating Cost Summary–175 ktpa

Cost Component	Total Operating Cost Estimate	
	Annual Operating Cost Estimate ($M/yr)	Unit Cost Estimate ($/t of Graphite Concentrate)[1]
Consumables	325.87	1,862.11
Feed Materials	106.65	609.42
Reagents	35.30	201.72
Utilities	127.60	729.13
Other Consumables	56.32	321.84
Labor	52.20	298.31
Maintenance Materials	109.83	627.61
Waste Handling	12.51	71.50
General and Administrative Expenses	11.81	67.50
Miscellaneous Allowances	40.56	231.76
Total Operating Cost Estimate	**552.79**	**3,158.78**

[1] Based on 175,000 t natural graphite feedstock

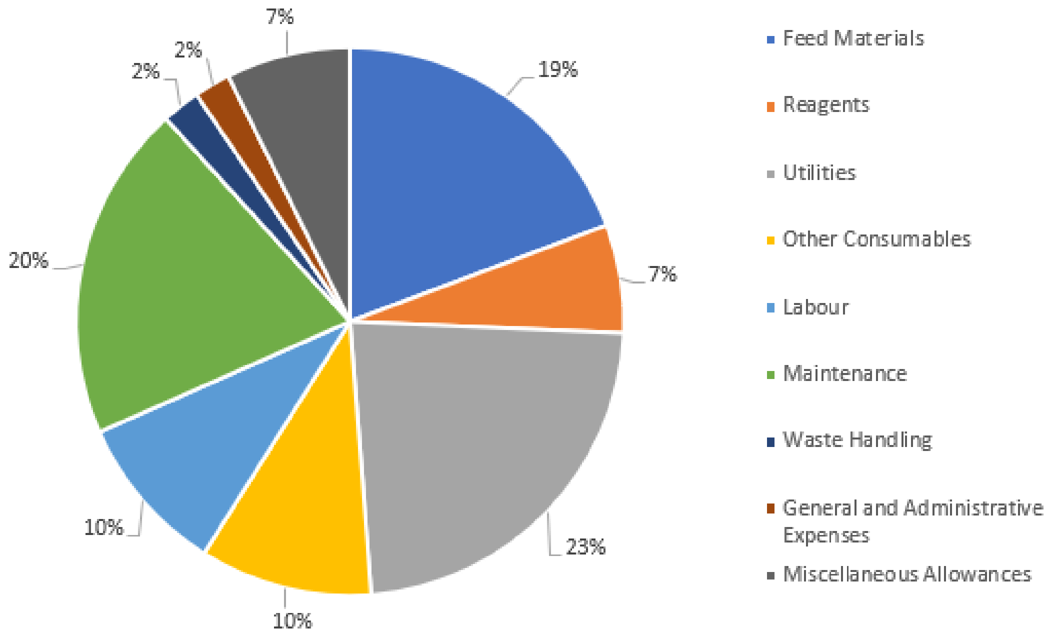


Figure 21-2 Overall Operating Cost Estimate Breakdown–175 ktpa

21.2.2.5 Consumables

Feed Materials

Feed materials consumption was calculated based on the mass and energy balances. For the graphite concentrate, the unit cost is considered to be 0 as it is assumed to be obtained from Graphite One's Graphite Creek property in Alaska. The unit costs of anode precursor material, pet-coke, and pitch were obtained from the last phase of the project (from 2021) and escalated by 20.5%. A summary of the feed materials operating cost estimate for the 25 ktpa scenario is provided in Table 21-28 below.

Table 21-28 Feed Materials Operating Cost Estimate–25 ktpa

Feed Material	Annual Operating Cost Estimate ($M/yr)
Concentrate	0.00
Pet-Coke	4.99
Pitch	2.20
Anode Precursor Material	8.04
Total Feed Materials Cost Estimate	**15.24**

Reagents

The major reagents consumption was calculated based on the mass and energy balances. The unit costs for major reagents were obtained from the last phase of the project (escalated by 20.5%) and Hatch's in-house database. For minor reagents such as cooling tower chemicals and water treatment chemicals, allowances were considered based on Hatch's in-house data and vendor input. A summary of the feed materials operating cost for the 25 ktpa scenario is provided in Table 21-29 below.

Table 21-29 Reagents Materials Operating Cost Estimate–25 ktpa

Reagents	Annual Operating Cost Estimate ($M/yr)
Blanketing Material (Make-up)	1.53
Chlorine Gas	1.69
Sodium Hydroxide Solution (50% solution)	1.25
Cooling Tower Chemicals (Allowance)	0.05
Water Treatment Chemicals	0.02
Total Reagents Cost Estimate	**4.54**

Utilities

Power

The mechanical equipment list (MEL) determined the power load for each work breakdown structure (WBS). For WBS corresponding to heat treatment processes, 7,200 operating hours were considered, while for WBS corresponding to room-temperature processes, 3,429 operating hours were considered. The utilization of each piece of equipment should be considered in further detail in the next phase of the project.

The unit cost for power was obtained from Hatch's in-house database and is valid for the STP location. A summary of the power operating cost for the 25 ktpa scenario is provided in Table 21-30 below.

Table 21-30 Power Operating Cost Estimate–25 ktpa

Power	Annual Operating Cost Estimate ($M/yr)
Concentrate Receiving & Storage	0.09
Feed Preparation, Sorting & Micronizing	0.00
Concentrate Storage & Preparation	0.02
Primary Screening	0.03
Unpurified Graphite Flake Collection & Storage	0.02
Micronizing & Shaping	0.86
Micronized & Shaped Unpurified Graphite Collection	0.04
Petroleum-Coke & Pitch & Precursor Anode Material Storage & Preparation	0.23
Pitch Preparation	0.04
Thermal Purification	4.84
Purified Product Storage	0.03
Anode B - Mixing	0.04
Anode A & B Carbonization	3.19
Anode A & B Deagglomeration	0.34
Anode A - Dosing & Mixing	0.09
Anode A - Agglomeration & Mechanical Fusing	3.15
Anode A - Screening & De-Ironing	0.12
Anode B - Screening & De-Ironing	0.18
Anode A & B Rejects Milling	0.03
Product Packaging and Bagging	0.02
Off-Gas Scrubbing	0.05
Blanketing Material	0.04
Sodium Hydroxide	0.00
Chlorine	0.00
Plant Services	0.05
Nitrogen	0.33
Cooling water	0.26
Raw & Process Water	0.31
Compressed Air	0.65
HVAC	0.17
Total Power Cost Estimate	**18.41**

Diesel

The unit cost of diesel was obtained from Hatch's in-house database. Diesel usage was considered for operating reach stackers and fire water pumps. Diesel usage for shunting vehicles was not considered for the 25 ktpa case as it is included in the third-party fee. The diesel operating cost for the 25 ktpa scenario is $67,958/yr.

Propane/LPG

The unit cost of propane/LPG was obtained from Hatch's in-house database. Propane usage for operating three forklifts was considered. The total propane operating cost amounts to $10,342/yr for the 25 ktpa scenario.

Natural Gas

The afterburners in the off-gas treatment areas and building heating use natural gas. Since sufficient information is not available in the project's current phase to estimate the natural gas demand, an allowance of $482,000/yr for the 25 ktpa scenario was carried forward based on the last phase of the project.

Raw Water

Since sufficient information is not available in the project's current phase to estimate the raw water demand, a volumetric flow rate of 227 m^3/hr (1,000 gpm) was carried forward based on the last phase of the project. The unit cost of raw water was obtained from Hatch's in-house database. The total raw water operating cost amounts to $2,628,000/yr for the 25 ktpa scenario.

21.2.2.6 Other Consumables

Other consumables considered in the operating cost are described below.

Crucibles

Crucibles are used in the purification/graphitization processes. The unit cost of crucibles was provided by Graphite One. Annual consumption of crucibles was estimated based on product throughput from the mass and energy balances, crucible capacity, and assumed number of re-use cycles. Assuming crucibles are replaced after every five cycles, the total crucible operating cost amounts to $3,897,908/yr for the 25 ktpa scenario.

Saggars

Saggars are used in the carbonization process. The unit cost of saggars was obtained from Hatch's in-house database. Annual consumption of saggars was estimated based on product throughput from the mass and energy balances, saggar loading (based on vendor input), and assumed number of re-use cycles. Assuming saggars are replaced after every 30 cycles, with each cycle lasting 18 hours, the total saggar operating cost amounts to $1,399,742/yr for the 25 ktpa scenario.

Product Packaging

As indicated by Graphite One, it is assumed that 90% of the total products will be packed in 589.7 kg (1300 lb) bags while the remaining 10% in 22.7 kg (50 lb) bags. Each pallet is also assumed to hold a stack of 2 x 589.7 kg (1300 lb) bags. The unit cost for packaging-related consumables was obtained from Hatch’s in-house database. A summary of the product packaging operating cost estimate for the 25 ktpa scenario is provided in Table 21-31 below.

Table 21-31 Product Packaging Operating Cost Estimate–25 ktpa

Product Packaging	Annual Operating Cost Estimate ($M/yr)
Packing Bags Unit Price (1300 lb.)	1.84
Packing Bags Unit Price (50 lb.)	0.07
Packaging Bag Pallet	1.05
Total Product Packaging Cost Estimate	**2.96**

Shunting Vehicle

For the 25 ktpa scenario, a third-party fee of $100,000/yr was assumed for shunting vehicles based on rail line tariffs and Hatch's in-house database and calculations. Fuel costs are included in the fee.

Laboratory Consumables

An allowance of $50,000/yr was accounted for laboratory consumables for the 25 ktpa scenario.

21.2.2.7 Labor

The labor operating cost is based on an organizational chart developed in the last phase of the project with some updates to the number of technical personnel. The organizational chart distinguishes positions as technical, maintenance, and administrative. Further, in each of the three categories, the labor includes day-only positions (staff positions) or hourly positions (shift positions at four shifts/day).

The base salaries for each position have been obtained from the last phase of the project with an applied escalation of 20.5%. The STP consists of a total of 123 personnel. A summary of the labor operating cost for the 25 ktpa scenario is provided in Table 21-32 below.

Table 21-32 Labor Operating Cost Estimate–25 ktpa

Labor	No. of Personnel	Annual Operating Cost Estimate ($M/yr)
Technical Services	66	7.55
Day Shift Employees	30	3.48
Night Shift Employees	12	1.42
Cross Shift Employees	24	2.65
Maintenance	29	4.14
Day Shift Employees	25	3.61
Night Shift Employees	4	0.53
Cross Shift Employees	0	0.00
Administration	28	3.32
Day Shift Employees	22	2.94
Night Shift Employees	2	0.13
Cross Shift Employees	4	0.25
Total Labor Cost Estimate	**123**	**15.01**

21.2.2.8 Maintenance Materials

Maintenance costs include the material equipment replacement, repair, and refurbishment costs as well as the maintenance labor. Maintenance costs were calculated by using a factor of 5.0% to the total direct costs for the STP. The maintenance labor cost was subtracted from the total maintenance cost and included in the overall labor estimate, leaving only the maintenance material costs. The maintenance materials operating cost amounts to $14,450,323/yr for the 25 ktpa scenario.

21.2.2.9 Waste Handling

The waste handling operating cost estimate consists of solid waste disposal and effluent disposal costs.

The sources of solid waste include thermal purification solids, blanketing material rejects, wastewater treatment residuals, and entrained metal objects from de-ironing steps. The solid waste generation amount from thermal purification and blanketing material were obtained from the mass and energy balances and the unit costs were obtained from the Hatch in-house database. The wastewater treatment residual generation and disposal unit costs were estimated based on vendor input and Hatch's in-house data for selected WTP design. Since sufficient information is not available in the project's current phase to estimate the entrained metal objects generation amount, an allowance of $50,000/yr for the 25 ktpa scenario was carried forward based on Hatch's in-house data.

The effluent disposal costs were estimated based on vendor input and Hatch's in-house data for the selected WTP design. The effluent disposal operating cost amounts to $367,000/yr for the 25 ktpa scenario.

A summary of the waste disposal operating cost for the 25 ktpa scenario is provided in Table 21-33 below.

Table 21-33 Waste Disposal Operating Cost Estimate–25 ktpa

Waste Disposal	Annual Operating Cost Estimate ($M/yr)
Solid Waste Disposal	1.42
Thermal Purification Solid Waste	0.66
Blanketing Material Rejects	0.71
Entrained Metal Objects	0.05
Effluent Disposal	0.37
Total Waste Disposal Cost Estimate	**1.79**

21.2.2.10 General and Administrative Expenses

G&A expenses include office stationery, telephone, internet access, and other disbursements normally required on a site. Based on Hatch's in-house data, the cost is assumed to be 3.0% of the sub-total operating cost (excluding feed materials, G&A, quantity and price growth allowances, and miscellaneous allowances). The G&A operating cost amounts to $1,877,833/yr for the 25 ktpa scenario.

21.2.2.11 Miscellaneous Allowances

A miscellaneous operating cost allowance of 10% (exclusive of feed materials) was applied to the final operating cost subtotal to account for potential unquantified costs. The miscellaneous allowances have been estimated as $6,447,227/yr for the 25 ktpa scenario.

22 Economic Analysis

The economic assessment for the project is summarized below.

22.1 Principal Assumptions

The financial analysis is based on the sale of the refined graphite products. Although mine revenue is derived from the sale of graphite concentrate to the STP, and the purchase of the same is considered an operating cost for the STP, this intercompany transaction is eliminated for the economic analysis.

This analysis is expressed in U.S. dollars with no escalation or inflation unless stated otherwise.

The economic analysis was based on the following factors:

- Discount rate of 8%
- Nominal 2024 dollars
- Results are based on 100% ownership
- No management fees or financing costs (equity fund-raising was assumed)
- The model excludes all pre-development and sunk costs up to the start of detailed engineering

Table 22-1 outlines the product prices used in the economic analysis. The weighted average product price assumption from this evaluation is $7,843/t. The development and basis of the product pricing are outlined in Chapter 19.

Table 22-1 Graphite One Project Products, Annual Quantities, and Product Pricing[1]

Category	Name & Description	Annual STP Production (tpa)	Price DDP China ($/t)	Tariff Allowance ($/t)	Shipping ($/t)	Price ($/t)
Anode Material	CPN: Coated, Spherical NG	39,639	6,811	1,362	250	8,424
	BAN: Blended AG and NG	75,502	7,608	3,705	250	11,563
	SPN: Secondary Particle NG	12,160	7,210	3,511	250	10,971
	SPC: Secondary Particle Composite	42,085	7,210	3,511	250	10,971
Purified[2]	3299	386	3,599	720	250	4,569
	599	3,480	3,028	606	250	3,884
	899:00:00	3,866	2,347	469	250	3,066
	199	6,446	1,914	383	250	2,547
	Battery Conductor	4,580	4,256	851	250	5,357
	Synthetic Diamond Precursor	6,278	4,770	954	250	5,974
Unpurified	3295	630	1,194	239	250	1,683
	595	5,670	1,194	239	250	1,683
	895	6,297	1,095	219	250	1,564
	195	10,502	838	168	250	1,256
	Carbon Raisers & Lubricants[3]	30,948	1,560	312	250	2,122
	Coke Reject[3]	8,043	300	60	250	610
Total Annual Production & Average Price per Tonne		**256,510**				**7,843**

Sources: [1]Benchmark Mineral Intelligence (2024a); [2]Lone Star Tech Minerals (2025a); [3]Lone Star Tech Minerals (2025b)
DDP = Delivered duty paid

22.1.1 Taxes

The project has been evaluated on an after-tax basis to provide a more indicative (but still approximate) value of the potential Project economics. A tax model was prepared by Mining Tax Planners, an independent tax consultant, and reviewed by Barr and Graphite One personnel. Current tax pools were used in the analysis. The tax model contains the following assumptions:

- Federal Income Tax: 21%
- Alaska State Income Tax: 9.4%
- Alaska Mining License Tax: 7.0%
- Alaska Production Royalty Tax: 3%
- Ohio Property Tax 6.21%
- Ohio Commercial Activity Tax 0.26%
- Advanced Manufacturing Production Tax Credit as applicable
- Total taxes for the project amount to $4,549 M of the project life

22.1.2 Agreements and Royalties Obligations

The mine is subject to production royalties as outlined in Chapter 4. The economic analysis assumes that in Year 1, the company elects to buy out 2% of the production royalties under the Kougarok lease for $4 M. Inclusive of this buy-out election, recouping advanced royalties, and the impact of varied royalty rates based on production location, the mine pays an average of 3.6% in production royalties over the LOM.

Graphite One Inc. holds a technology license agreement and a consulting agreement with Chenyu, an AAM manufacturer, as mentioned in Chapter 1.15.6. Under these agreements, Chenyu granted Graphite One an exclusive license to use leading technology in AAM manufacturing to produce battery materials for the U.S. domestic supply chain in return for the payment of royalties applied to net revenues received from the sale of AAM products manufactured using the technology. The applicable royalty percentage is as high as 3.0% and, using a stair-step method, as low as 0.6% based on the total net revenue and product manufactured.

22.2 Financial Analysis

The Graphite One project is economically viable with a post-tax IRR of 26.8% and a post-tax NPV of $5,029.7 M using an 8% discount rate (NPV 8%) and a payback period of 7.5 years.

The financial results indicate a pre-tax NPV of $6,396.7 M at a discount rate of 8%, an IRR of 29.8%, and a payback period of 7.3 years. Table 22-2 summarizes the financial results of the project.

The total revenue for the integrated project was estimated at $43,561.3 M, and the total operating costs were estimated at $15,618.7 M; in both cases, the intercompany transactions were eliminated.

The total initial capital costs were evaluated at $4,868.8 M, and the sustaining capital requirement was evaluated at $176.1 M, which includes $74.5 M of closure costs.

Table 22-2 Financial Results of Integrated Project

Financial Results of Integrated Project	Unit	Value
Total Revenue, net of Royalties	$M	43,561.3
Total Operating Costs	$M	15,618.7
Initial Capital Costs	$M	4,868.8
Sustaining Capital Costs	$M	101.6
Mine Rehabilitation and Reclamation	$M	74.5
Total Pre-tax Cash Flow	$M	22,897.7
Pre-tax NPV @ 6%	$M	8,677.0
Pre-tax NPV @ 8%	$M	6,396.7
Pre-tax NPV @ 10%	$M	4,740.0
Pre-tax IRR	%	29.8
Pre-tax Payback Period	Years	7.3
Post-tax Cash Flow	$M	18,348.6
Post-tax NPV @ 6%	$M	6,876.0
Post-tax NPV @ 8%	$M	5,029.7
Post-tax NPV @ 10%	$M	3,686.6
Post-tax IRR	%	26.8
Post-tax Payback Period	Years	7.5

22.3 Cash Flow

Figure 22-1 illustrates the project's pre- and post-tax cash flow and cumulative cash flow profile for the base case conditions.

Working capital considerations have been incorporated into the cash flow, assuming a 30-day term for both accounts payable and accounts receivable. The positive cash flow reflected in the final year of Figure 22-1 reflects the recovery of accounts receivable balances, which offsets reclamation costs. Due to seasonal access to the mine, an advance purchase of diesel fuel and consumables covering an 8-month period has also been included in the working capital calculation.

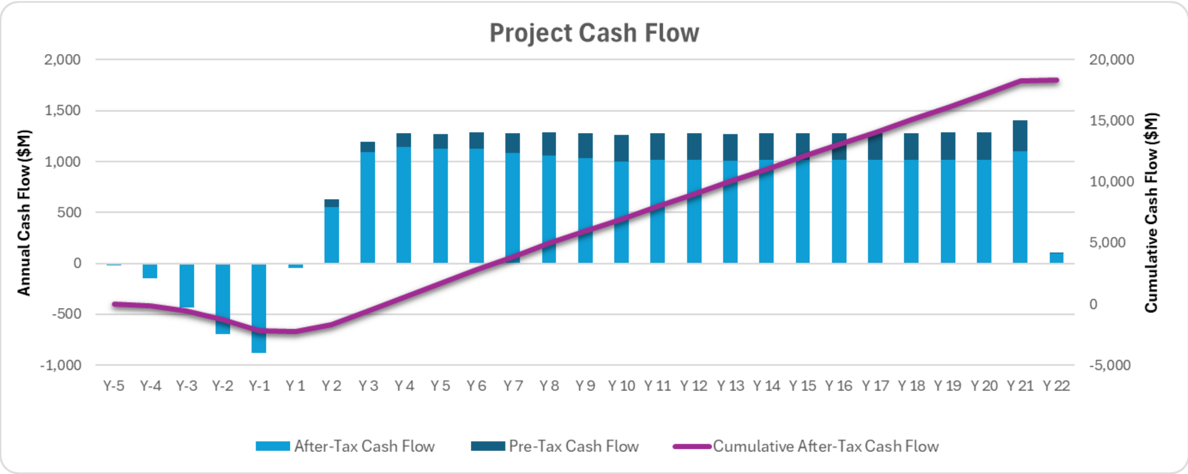


Figure 22-1 Pre- and Post-Tax Cash Flow and Cumulative Cash Flow Profile of the Project

22.4 Sensitivity Analysis

A univariate sensitivity analysis was performed to examine which factors most affect the project economics when acting independently of all other cost and revenue factors. Each variable evaluated was tested using the same percentage range of variation, from -30% to +30%, although some variables may actually experience significantly larger or smaller percentage fluctuations over the LOM. For instance, the product prices were evaluated at a ± 30% range to the base case, while the capital costs and all other variables remained constant. This may not truly represent market scenarios, as commodity prices may not fluctuate in a similar trend. The variables examined in this analysis are those commonly considered in similar studies—their selection for examination does not reflect any particular uncertainty.

Notwithstanding the above-noted limitations to the sensitivity analysis, which are common to studies of this sort, the analysis revealed that the project NPV and IRR are most sensitive to product price, with limited sensitivity to the accuracy of the capital and operating cost estimates, see Figure 22-2 through Figure 22-5. The sensitivity trend lines for pre-tax and post-tax had minimal changes. As expected, the IRR is more sensitive to variations in capital costs than operating costs due to the timing associated with initial capital costs. The NPV and IRR remain positive at the lower limit of the price interval and the upper limits of the capital and operating costs.

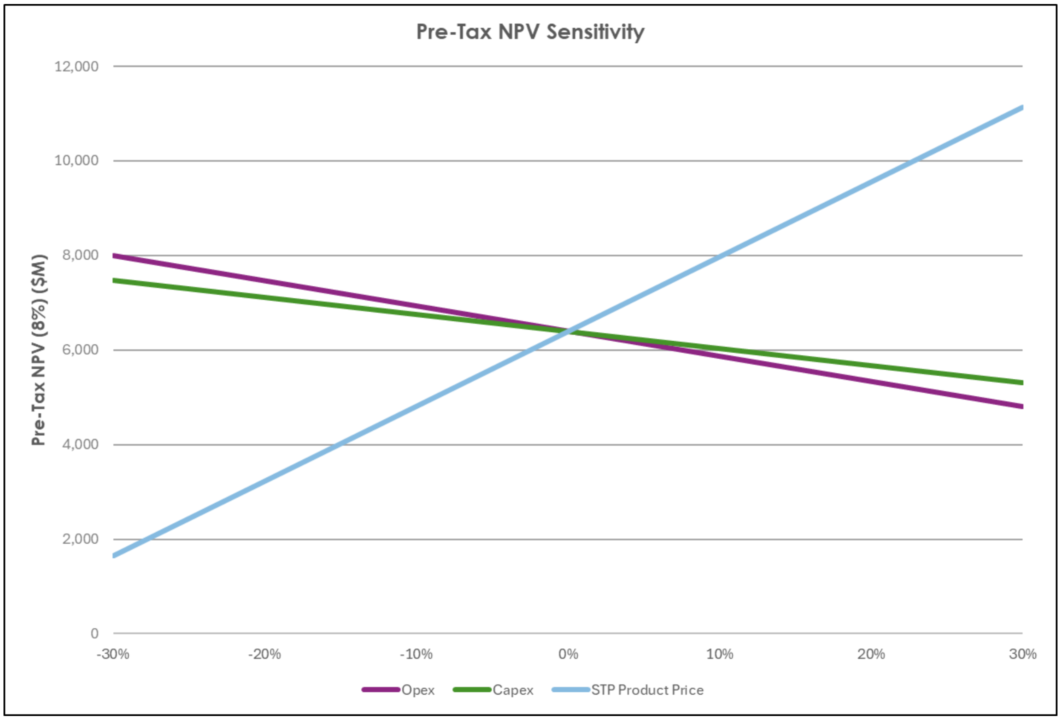


Figure 22-2 Pre-Tax NPV Sensitivity (8%)

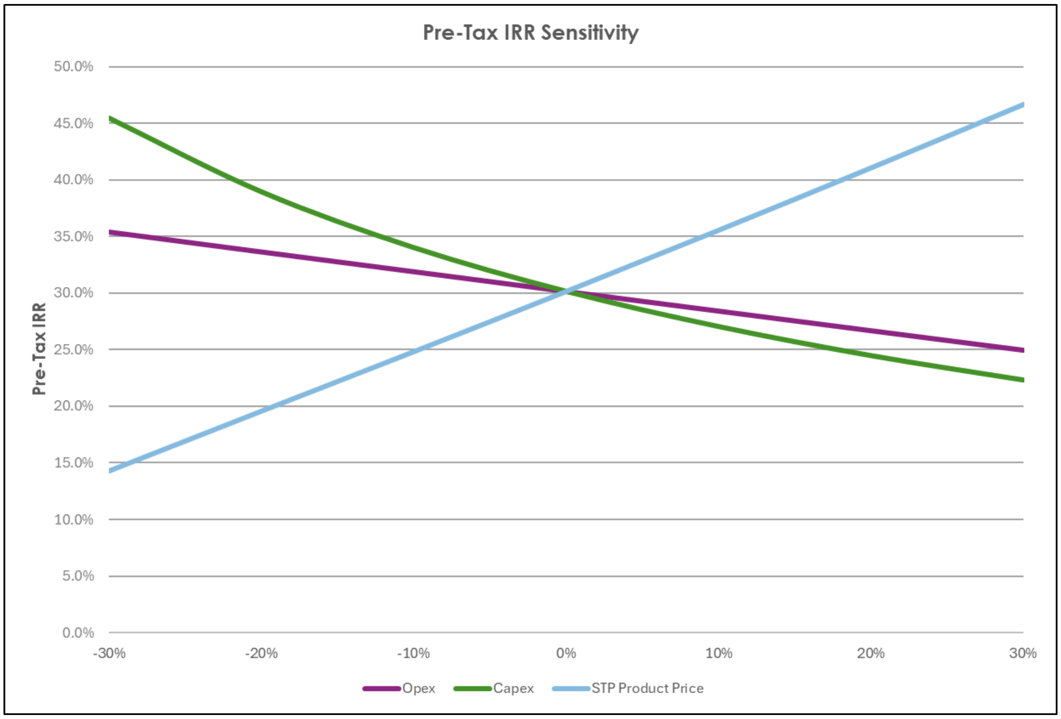


Figure 22-3 Pre-Tax IRR Sensitivity

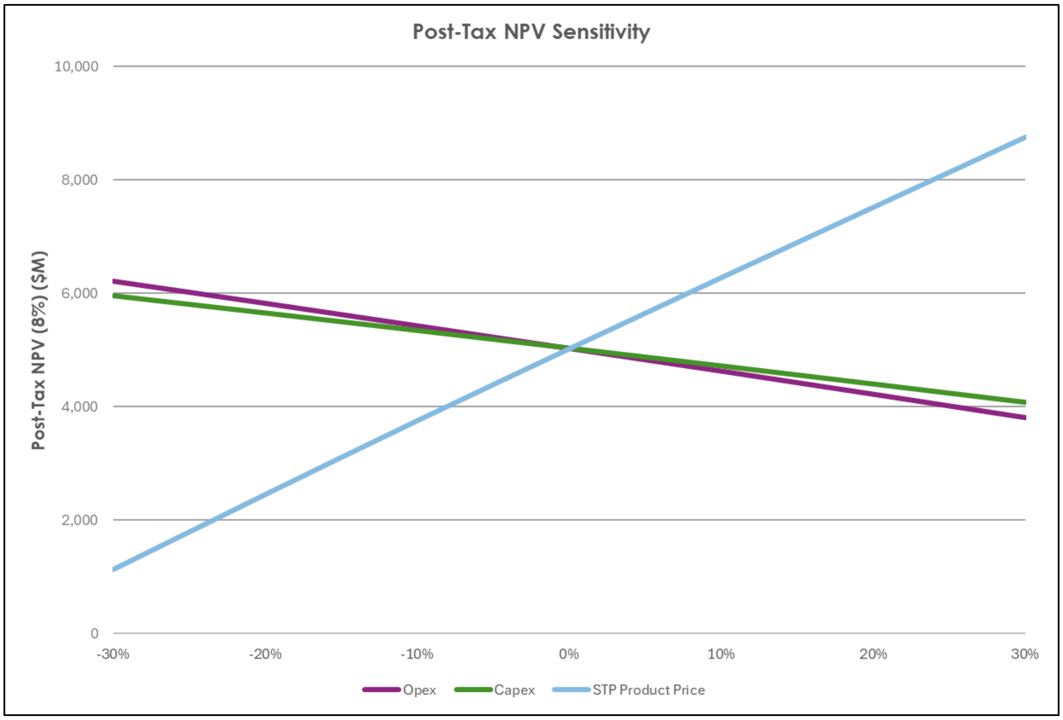


Figure 22-4 Post-Tax NPV Sensitivity (8%)

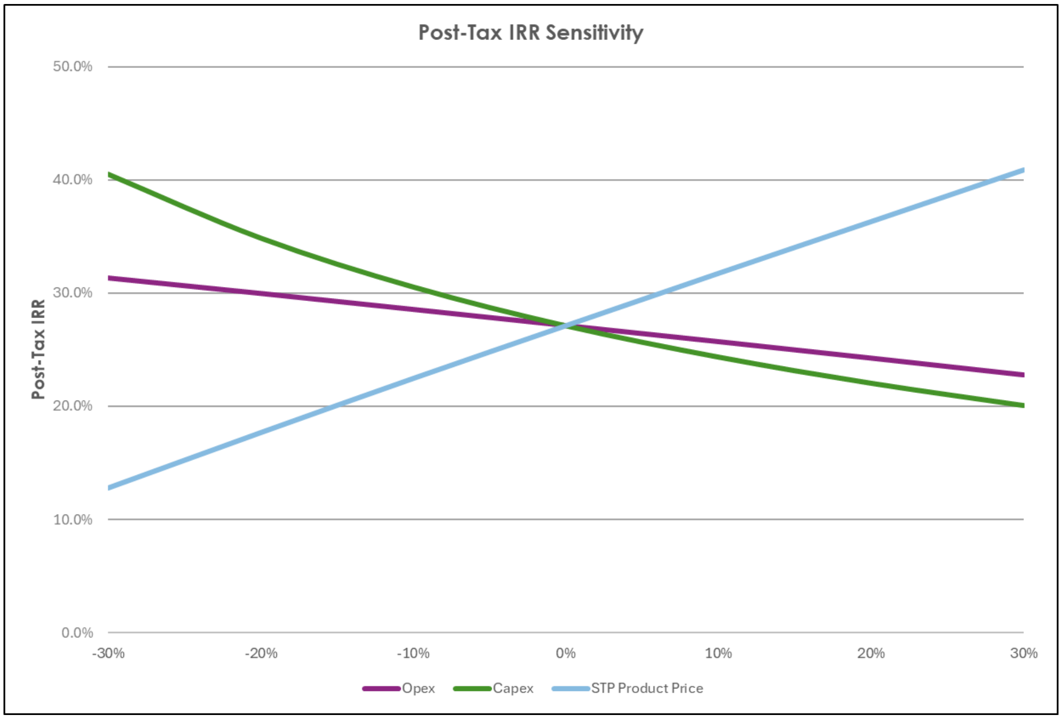
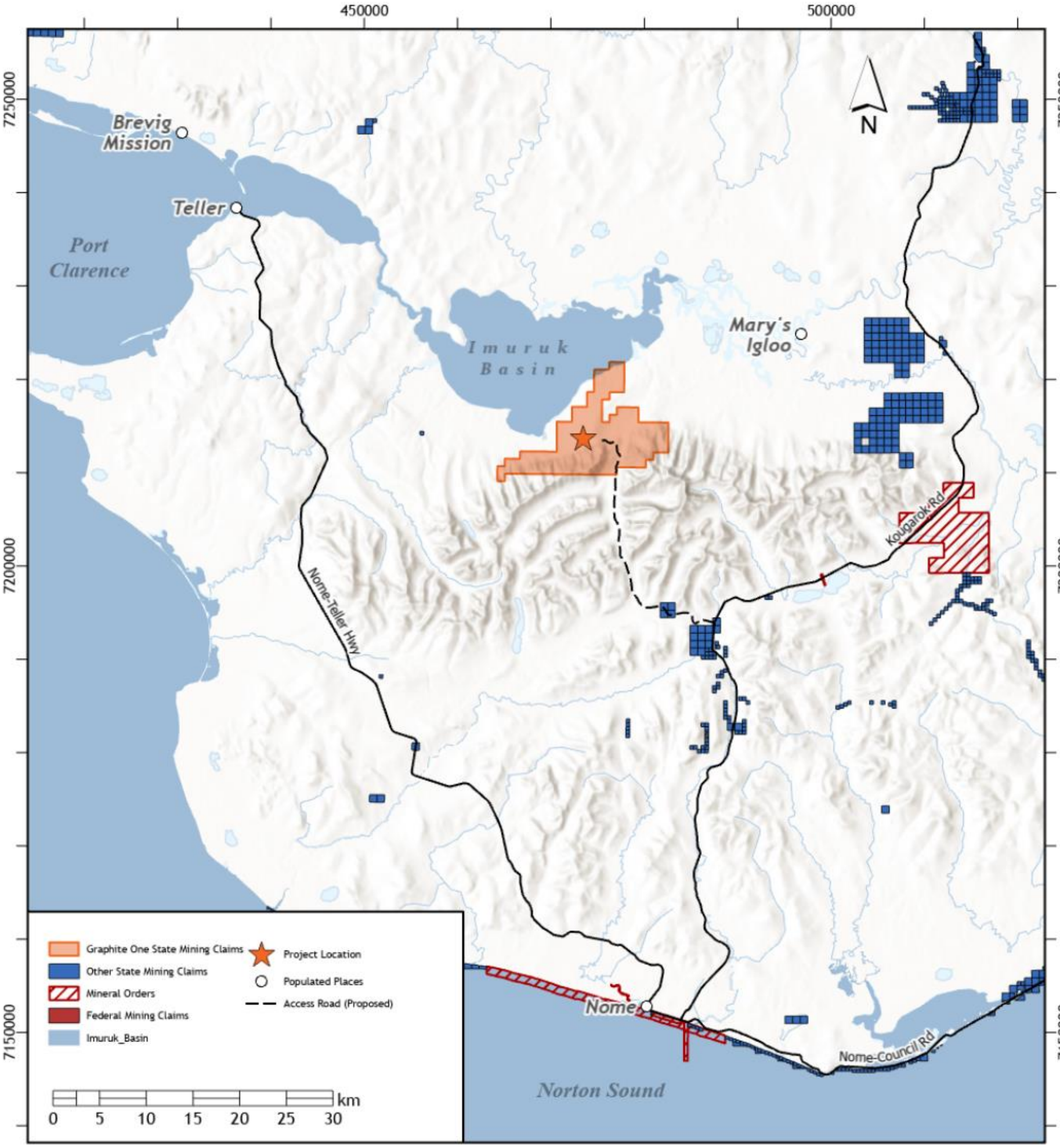


Figure 22-5 Post-Tax IRR Sensitivity

23 Adjacent Properties

The property location map in Figure 23-1 shows the current mineral claims in the Graphite One project property. The nearest claims of other projects relative to the property are some 20 km or more to the east-southeast, with other claims further distant. These claims are focused on commodities other than graphite, primarily gold and gold placer deposits. The property is the only graphite-specific exploration property and/or exploration company currently exploring in the region.



Source: Graphite One, 2024

Figure 23-1 Graphite One Project Property Claims Relative to Other Mineral Claims

24 Other Relevant Data and Information

24.1 Project Implementation and Execution Plan

The following provides a summary and general description of the project execution plan upon which the project schedule and the capital cost estimate were developed. The identified milestones are highly dependent on external factors, including funding/capital availability, permit approvals, weather, and vendor/supplier performance. The schedule does contain risks which should be considered when reviewing these milestones.

24.1.1 Key Project Milestones

The major project milestones are listed in Table 24-1.

Table 24-1 Key Project Milestones

Activity	Estimated Start Date	Estimated Completion Date
Alaskan Facilities		
Permitting	Q1-2025	Q4-2026
Preorder Long Lead Equipment	Q1-2026	Q4-2026
Access Road Construction	Q1-2027	Q4-2027
Mill and Infrastructure Construction	Q3-2027	Q3-2029
Mine Development	Q4-2028	Q3-2029
Waste Management Facility Development	Q4-2027	Q2-2029
Mill Commissioning		Q4-2029
First Concentrate		Q4-2029
Secondary Treatment Plant (STP)		
Site Selection	M1	M1
Permitting	M6	M22
Localization and Wrap Around Engineering (Basic)	M4	M12
Localization and Wrap Around Engineering (Detailed)	M13	M28
Critical/Long Lead Equipment Contract Award	M13	M13
Construction (Module 1)	M22	M44
Commissioning + First Product (Module 1)	M44	M50
First Product (Module 2)	M56	M56
First Product (Module 3)	M57	M57
First Product (Module 4)	M61	M61
First Product (Module 5)	M67	M67
First Product (Module 6)	M79	M79
First Product (Module 7)	M84	M84

24.1.2 Constraints and Interfaces

The Project will be an integrated development, with several consultants contributing to the overall design process. Specialist contractors will likely be engaged for specific packages. It is essential that these parties collaborate to ensure that the data being used is both current and accurate. Data transfer between parties should be strictly controlled and in accordance with document control protocols.

The early design interfaces for the project will include, at a minimum:

- Main access road development
- Construction camp facilities
- WMF
- Mine pre-production
- Water management and treatment
- Site electrical power - both construction and long-term
- Milling facilities
- STP

Interface management procedures will be developed to confirm that services at the battery limits are clearly defined and understood by all parties affected.

24.1.3 Project Organization

Under the supervision of Graphite One, an integrated team of Graphite One personnel, engineering services providers, and a construction manager for each site will design, procure, and construct the Alaskan facilities and STP.

24.1.3.1 Project Management and Control

Under the direction of the Graphite Creek project director, the Alaskan site and STP project management teams will finalize the definitive control budgets and project schedules.

24.1.3.2 Engineering and Procurement

The Alaskan site will have its own engineering and procurement teams split into three main areas.

- Main access road and Nome construction support facilities
- Milling and ore handling facilities, WTP, and facilities site infrastructure
- Mining and WMF

The STP will have its own engineering and procurement teams, split into three main areas.

- Main process plant
- Purification area
- Utilities

24.1.3.3 Construction Management

Separate construction management teams will manage the construction of the Alaskan facilities and STP. Under the direction of the Graphite Creek project director, the two construction management teams will finalize the definitive control budget and schedule for construction and commissioning.

24.1.4 Project Construction Strategy

The mine requires nominally two years of pre-strip operations, TMF pre-development, and water management facilities development before mining operation production can commence. Construction of the site access road, mill, and support facilities is expected to commence as soon as practicable following permit approvals.

24.1.4.1 Alaskan Facilities

Construction of the Alaskan facilities is expected to require approximately 30 months following approval of required permits. Equipment and materials needed for these activities are planned to be pre-positioned at a staging area near the mine site location during the shipping season prior to pioneering the access road into the site. This staging is expected to be accomplished by barge transport from the Port of Nome into the Imuruk Basin for offloading and transport overland to a staging area near the project location.

24.1.4.2 Secondary Treatment Plant

Construction of the STP is expected to require approximately 22 months for the first two modules to be built before being turned over to pre-operational testing and commissioning. Subsequent modules are expected to take less time due to lessons learned and workforce efficiency. Construction is scheduled to be performed in two phases: 1) demolition and early works and 2) main construction works. The contracting strategy is expected to consider three specific phases: site preparation, bulk earthworks, and plant construction. Construction-driven planning is expected to utilize advanced work packages that break down the installation into construction work packages to identify and prioritize necessary engineering deliverables required to support the construction schedule. Construction of all seven modules is expected to be continuous after the first two modules groundbreaking and requires approximately 60 months.

24.2 Operational Readiness and Commissioning

24.2.1 Alaskan Facilities

Commissioning of the Alaskan facilities is expected to occur over several phases. It will require the combined effort and cooperation of many parties, including the Graphite Creek construction and commissioning teams, Graphite Creek maintenance and operating teams, and various equipment suppliers.

Nome construction-support facilities will need to be commissioned as early as possible following project authorization and receipt of necessary permits. The success of the overall construction effort will be critically dependent on identifying and procuring the essential construction workforce housing, construction staging, and fuel-storage facilities for power generation, personnel accommodations, and construction fleets.

The main site access road from Kougarok Road to the mine site is expected to be commissioned in two phases. The first phase will provide a firmly compacted base for transporting construction equipment, materials, and personnel to the site to support early works; the second phase will follow the completion of all permanent surfacing, highway signage, and security controls.

The milling facilities, WTP, and site infrastructure will be commissioned as each reaches substantial completion during construction.

The WMF will be commissioned during the latter stage of mine pre-development activities before commencing mine production.

24.2.2 Secondary Treatment Plant

Commissioning of the STP is expected to require approximately six months for the first two modules before being turned over to operations. Subsequent modules are expected to take less time due to lessons learned and workforce efficiency. The commissioning team involves the combined effort and cooperation of many parties. It is expected to comprise the owner's construction group and commissioning teams, the owner's maintenance/operating teams, and equipment suppliers. Planning for the training of the owner's operators and maintenance personnel is expected to begin after the final selection of equipment and conclude before the start of commissioning.

25 Interpretation and Conclusions

The results of this FS demonstrate that the project is economically feasible, considering the various sensitivity analyses performed and the selling price assumptions utilized in the study.

25.1 Mineral Resources

Exploration drilling conducted in 2022-2024 has increased the Measured and Indicated resource by 222% in tonnage and 181% in contained Graphite (tonnes) when compared to the previous PFS. The Measured and Indicated resources within the proposed pit have increased by 187% in tonnage and 157% in contained Graphite (tonnes). Approximately 70% of the pit is currently at Measured or Indicated.

25.2 Mineral Reserves

The mine at Graphite Creek will utilize conventional truck and shovel mining techniques to extract ore and waste material from the open pit. Ore will be transported to the mill, where it will be processed to produce graphite concentrate and the resultant tailings material will be co-mingled with waste rock in the WMF. The mineral reserves for the Project are based on a 21-year mine life and 71.2 Mt of Proven and Probable mineral reserves at an average diluted grade of 5.22% Cg. The mineral reserves are estimated using a raised variable cut-off of 3.0% Cg to maintain the production rate of 175,000 t of concentrate required for the STP.

To access the mineral reserves, 51.6 Mt of overburden and 178.1 Mt of waste rock must be mined, resulting in a strip ratio of 3.2:1. This waste rock includes 17.4 Mt of Measured and Indicated Resources between the raised COG (3.0% Cg) and the economic COG (2.0% Cg) at an average grade of 2.4% Cg. This material could be stockpiled and processed profitably. Due to the mill capacity, processing this low-grade material would reduce the amount of graphite concentrate by half. This material could potentially be converted into mineral reserves if the STP could process at lower rate or blend with concentrate from alternative sources. Within the pit design, waste rock also includes 40.4 Mt of Inferred resources above the economic COG at an average grade of 3.9% Cg. However, there is no certainty that any part of the Inferred resources could be converted into mineral reserves.

25.3 Mineral Processing and Metallurgical Testing

Multiple metallurgical testing programs have demonstrated that the Graphite Creek ore will produce a 95% Cg concentrate at 90% recovery. This testing included a pilot plant test that produced 385 kg of concentrate.

Further testing is required to increase ore characteristic understanding. Cold weather additives to diesel fuel should be further tested to determine the impact on flotation kinetics. Regrind power requirements should be quantified and the impact to concentrate grade determined. Mineralogical analysis of regrind mill feed and product should be conducted to determine the graphite liberation.

Three of the eighteen variability samples showed poor flotation response. These areas of the pit should be modeled to determine the volume of ore that could be impacted. Additional testing on these ore types should be conducted to determine the cause of the poor flotation performance and remedies to improve the performance. Due to the wide range of ore harnesses determined in the variability samples, additional comminution testing on variability samples is also warranted.

Ore blending based on hardness and flotation performance may be a viable option to achieve consistent mill production. Additional variability testing could include compositing select samples to determine the overall impact.

25.4 Secondary Treatment Plant

A preliminary design was completed for a 25 ktpa module. The module was then scaled/factored to estimate the requirements for a 175 ktpa (7-module) facility. The design requires further optimization, which is recommended to be completed either prior to or during the next phase of engineering. This includes additional testwork to close gaps in the PDC; site investigations to close gaps and assumptions in the discipline design criteria; trade-off studies to optimize the process flowsheet; layout optimization particularly in respect to the expansion strategy to 175 ktpa production; review of the major project risks to ascertain mitigation options, in an attempt to reduce overall project risk. In addition, geotechnical investigations at the project site should be completed.

25.5 Project Risks

25.5.1 Mine and Mill

25.5.1.1 Mine

The mine will operate 365 days per year. The production schedule and cost estimate has allowed for 13 non-operating days due to weather related delays predominantly in the winter season. Mine production may be affected if additional weather events occur. As stockpiling and reclaiming strategies are used to optimize the production schedule, ore will be available to feed the mill during these weather events.

Grade control and ore contact management pose a risk of either excessive dilution or loss of high-grade material during mining. To mitigate this, the effectiveness of grade control practices and mining methods should be regularly assessed and optimized.

The support equipment fleet will handle typical tasks such as road, pit, and WMF maintenance. However, due to anticipated climatic conditions, the fleet will also play a greater role in snow removal and water management. While this adds complexity to operations, it is considered a significant but manageable risk in achieving production targets.

25.5.1.2 Mill

Ore hardness can impact mill throughput if the mill feed hardness is significantly higher than the mill design. The SAG mill was sized based on the hardness data from composite samples. Variability testing showed a large range of hardness, both softer and harder than the composite samples. A geo-metallurgical ore type description has not been developed, which could determine the ore volumes of the softer and harder ore types. Provisions to blend ore types based on hardness, grade, and mineralogical characteristics can help to mitigate these impacts.

Single-stage SAG mills can be more difficult to operate than SAG mill-ball mill circuits as the throughput, pebble recycle rate, cyclone underflow recycle rate, and final product grind size must all be balanced. These factors could lead to a longer ramp up time for the mill to achieve design tonnage rates.

Concentrate grade and recovery appear to be impacted by liberation characteristics, although the regrind mill feed and product mineralogy has not been extensively studied to date. Finer primary grind sizes or regrind sizes may be necessary to achieve concentrate grades and recovery targets.

Concentrate and tailings dewatering rates are generally impacted by particle size. Dewatering testing has been conducted on composite samples at the designed particle sizes. The impact of finer particle sizes on the dewatering unit operations has not been quantified. Vacuum filtration can be particularly impacted by feed characteristics, and an additional tailings filter has been designed for the mill.

Material handling in an Arctic environment is more challenging than in moderate climates. Provisions have been designed for equipment to access the coarse ore stockpile to help mitigate these effects, but material thawing and freezing cycles may still have an impact on production rates.

25.5.2 Alaskan Infrastructure

25.5.2.1 Permafrost

Additional geotechnical boreholes expected to be drilled in the areas where mill and waste management facilities are planned may reveal permafrost conditions requiring additional foundation design measures to mitigate the potential for settling. Permafrost mitigation measures may increase capital construction costs for the facilities requiring concrete foundations.

25.5.2.2 Workforce

Construction of the access road and other site infrastructure will require a rapid buildup of a relatively skilled construction workforce in a remote area as soon as possible following permit approvals. There is risk associated with achieving the proposed schedule if this workforce buildup takes longer than expected. Conversely, it may be necessary to increase staffing costs to secure sufficient numbers of skilled personnel to preserve the schedule, which poses a risk of increased construction costs.

25.5.2.3 Site Power

The large stationary generation units require approximately 10-12 months to manufacture and deliver to site, following order, which aligns well with the lead time required to develop the site for these units. During construction, numerous leased portable generation units of various sizes will be required for both site construction and camp facilities in Nome, and these will need to be secured quickly following permit approvals. There is some risk that the construction schedule may be negatively affected if high usage of these units in other areas creates a temporary shortage of leased generators available for construction.

25.5.2.4 Camp Facilities

Camp facilities for site construction will need to be preordered to ensure these facilities are available when the construction work commences. The lead times may be six to eight months, depending on the configuration and number of personnel expected to be housed. Given the lack of adequate accommodations in Nome, this presents a potential schedule risk for staffing and commencing construction.

Nome camp facilities are assumed to be served by municipal facilities for water, sewerage, and electrical power. If these services are not available when required, additional capital costs may need to be budgeted for providing them.

25.5.2.5 Climatic Conditions

A site weather station was commissioned in the spring of 2024 and sufficient site data was unavailable in establishing reliable climactic basis of design for this study. Comprehensive meteorological data was assembled from records in Nome, Teller, and from the regional high-resolution ERA5-Land dataset to assemble the water balance model and to size water management facilities. It is assumed that a more complete body of site climactic data (wind, precipitation, and evaporation) will be available for final site infrastructure design and for long-term climate change modeling. Early data from site monitoring do show precipitation to be consistent with models, but it is notable that recorded summer and autumn winds have been recorded exceeding 100 kph, well above modeled values.

Crane operation will be necessary for the construction of numerous facilities. Crane operations require steady wind speeds below 40 kph and wind gusts less than 55 kph. Site conditions may exceed these thresholds often enough to impact the construction schedule, especially during the months of September through April with November typically being the windiest month of the year.

25.5.2.6 Availability of Aggregate Materials

Aggregates required for engineered fills and surfacing are expected to be processed from native materials found at and in proximity to the site. Both overall quantities and production rates will need to keep pace with construction requirements. If enough of these materials are not readily available within the greater project area, this may adversely impact both construction schedule and cost.

25.5.2.7 Availability of Construction Equipment

Mine and mill site earthwork construction is expected to be self-performed and will require a preorder of equipment to ensure equipment can be staged ahead of permit approvals to allow construction to commence as soon as possible. Delays in the delivery of equipment may impact the construction schedule.

25.5.2.8 Waste Management Facilities

There may be unknown geologic hazards where the WMF are to be located. These may not be discovered until the area has been cleared and stripped. These hazards may alter the construction schedule and costs if any mitigation is required.

25.5.3 Port of Nome Facilities and Concentrate Logistics

The USACE and the City of Nome are planning a major expansion of the Port of Nome. When this FS was started, the USACE had tendered contracts to complete the expansion project. Late in the FS process, the USACE canceled the tendering process in favor of a phased approach to the expansion. At the time of this report, the contracts have not been retendered.

The transportation methods contemplated in this report assume that the Port of Nome Expansion Project is completed enough so that a dock and breakwater are in place to allow self-loading ships with a 40 ft draft. If the port expansion is not completed, a new marine transportation strategy will be required using Roll On/Roll Off barges. The result will be that more vessels will be required to make more trips each season. As of this writing, the availability of suitably sized, geared container ships from June to October is not in question, but global supply chain instability in recent years has increased competition for internationally flagged vessels. Annual leasing may need to be considered.

The report also assumes that the availability and regularity of six-unit trains (75 cars per train) between the Port of Prince Rupert and the STP in Niles, Ohio will be established such that transfer and storage delays at the port will be minimal. A complete exchange of all full concentrate containers with empty concentrate containers between the Nome port and the STP is expected to be completed each shipping season.

25.5.3.1 Seasonal Shipping

Because the Norton Sound and Bering Sea freeze each year, inventory of all major consumables such as fuel, explosives, grinding media, and reagents must be delivered to Nome by October 1 each year in quantities sufficient to last until the following June. Likewise, all major equipment and components that cannot fit on a C-130 aircraft must also be delivered to Nome by October 1 each year.

25.5.4 Economic Analysis

As of the date of this report, the trade tariff environment remained highly fluid. Tariffs on imported graphite in effect as of March 31, 2025, have been incorporated into the Project's economic analysis through the pricing of refined products. However, tariffs on equipment and supplies have not been factored into the Project's capital and operating cost estimates. Tariffs applied to equipment and supplies for both the mine and the STP are expected to negatively affect the Project's financial performance, while tariffs on imported graphite are anticipated to improve the Project’s overall economics.

25.5.5 Secondary Treatment Plant

There are a number of risks associated with the STP. The major risks identified to date are tabulated in Table 25-1 and are the result from a formal risk review performed for the STP. The risks were ranked by consequence and likelihood, the higher of which have been summarized in the table below.

Table 25-1 Secondary Treatment Plant Major Risks

Risk	Risk Description	Risk Consequence(s)	Risk Treatment Actions/Future Mitigation
Lack of operational and maintenance skills in new technology.	The absence of adequate operational and maintenance skills for new technology can lead to significant issues in production processes.	1. Production delays due to operational inefficiencies. 2. Increased costs from errors and downtime. 3. Compromised product quality. 4. Missed project deadlines and schedules. 5. Challenges in achieving desired ramp-up rates.	1. Implement comprehensive training programs for all relevant staff. 2. Develop detailed documentation and resources for the new technology. 3. Hire or consult with experienced professionals in the new technology. 4. Schedule regular maintenance and operational reviews. 5. Establish a support system for ongoing skill development and troubleshooting.
Inability to procure material that is not compliant with Federal Executive Order Compliance (FEOC) standards on time.	Delays in procuring materials from non-FEOC sources, impacting the production of specification products and overall project timelines.	1. Regulatory non-compliance: Potential legal and financial repercussions for non-compliance with regulatory requirements. Unable to get the tariff benefits - jeopardizing the financial benefits	1. Alternative Sourcing: Identify and qualify multiple non-FEOC suppliers to mitigate dependency on any single source. 2. Inventory Management: Maintain a buffer stock of critical materials to cushion against procurement delays. 3. Consumer Agreement: Transition agreement period from FEOC to non-FEOC 4. Supplier Agreements: Establish robust agreements with suppliers to ensure timely delivery and compliance with quality standards. 5. Risk Assessment and Mitigation: Conduct regular risk assessments and develop mitigation strategies for potential supply chain disruptions. 6. Regulatory Compliance: Stay up-to-date with regulatory changes and ensure all procurement practices comply with current guidelines.
Increased competition in the graphite market.	The graphite market is experiencing increased competition, which may impact market share, pricing strategies, and overall profitability for existing players.	1. Market Share Loss: Potential loss of market share to new and existing competitors. 2. Price Wars: Downward pressure on prices due to increased competition. 3. Reduced Profit Margins: Lower profit margins as a result of competitive pricing. 4. Innovation Pressure: Increased pressure to innovate and improve product offerings.	1. Market Analysis: Conduct regular market analysis to stay informed about competitors and market trends. 2. Innovation and R&D: Invest in research and development to innovate and improve product offerings. 3. Strategic Partnerships: Form strategic partnerships and alliances to strengthen market position. 4. Cost Management: Implement cost management strategies to maintain profitability. 5. Customer Focus: Enhance customer relationships and focus on delivering superior value to retain market share.

Risk	Risk Description	Risk Consequence(s)	Risk Treatment Actions/Future Mitigation
Integration and scope alignment challenges–interface risk between multiple partners.	Graphite One faces significant interface risks when coordinating and integrating efforts between multiple partners, such as engineering teams, Chinese/Japanese/German (or any) vendors, and other stakeholders. These risks can lead to miscommunication, delays, and compliance issues.	1. Project delays and increased costs. 2. Miscommunication leads to errors and rework. 3. Non-compliance with regulatory standards. 4. Strained relationships between partners. 5. Potential safety and quality issues.	1. Clear Communication Protocols: Establish clear and consistent communication protocols, including regular meetings and updates. 2. Unified Documentation Standards: Implement standardized documentation and reporting methods to ensure consistency. 3. Cultural Sensitivity Training: Provide training to all partners on cultural differences and effective communication strategies. 4. Integrated Project Management Tools: Use integrated project management tools to track progress, share information, and manage tasks across all partners. 5. Regular Audits and Reviews: Conduct regular audits and reviews to ensure alignment and address any issues promptly. 6. Dedicated Liaison Teams: Assign dedicated liaison teams to manage and facilitate communication and coordination between different partners. 7. Detailed Project Documentation: Develop and maintain comprehensive project documentation that clearly defines the scope, objectives, and deliverables. 8. Regular Alignment Meetings: Conduct regular meetings with all stakeholders to ensure everyone is on the same page regarding project scope and progress. 9. Change Management Process: Implement a robust change management process to handle any changes in project requirements effectively. 10. Stakeholder Engagement: Actively engage all stakeholders in the planning and decision-making processes to ensure alignment and buy-in.

Risk	Risk Description	Risk Consequence(s)	Risk Treatment Actions/Future Mitigation
Lack of U.S.-based supply chain for crucible.	The absence of a domestic supply chain for crucible products, leading to reliance on international sources for manufacturing and procurement.	1. Supply Chain Vulnerability: Increased risk of disruptions due to geopolitical tensions, trade wars, or global events (e.g., pandemics). 2. Long-Lead Times: Delays in procurement and delivery due to international shipping and customs processes. 3. Increased Costs: Higher costs due to tariffs, shipping, and potential supply chain disruptions. 4. Quality Control Issues: Challenges in maintaining consistent quality standards across international suppliers.	1. Supply Chain Diversification: Develop a diversified supply chain strategy to reduce dependency on any single region or supplier. 2. Domestic Manufacturing Incentives: Advocate for policies and incentives that support domestic manufacturing and reduce production costs. 3. Strategic Partnerships: Form partnerships with reliable international suppliers to ensure consistent quality and supply.
Procurement delays of long lead items.	The risk involves potential delays in the procurement process of items that require long lead times. These delays can negatively impact project schedules and overall timelines, causing a ripple effect on the Project's progress and completion.	1. Project Delays: Extended lead times can delay project milestones and overall completion. 2. Increased Costs: Delays may lead to additional costs, including expedited shipping fees and potential penalties for late project delivery. 3. Resource Allocation Issues: Delays in equipment delivery can cause scheduling conflicts and inefficient use of labor and other resources. 4. Risk of Non-Compliance: Delays in procuring critical electrical equipment can result in non-compliance with project specifications and regulatory requirements.	1. Early Identification and Planning: Identify long lead items early in the project planning phase and incorporate them into the project schedule. 2. Strategic Procurement: Develop a strategic procurement plan that includes early ordering and considering alternative suppliers. 3. Supplier Relationships: Build strong relationships with reliable suppliers to ensure priority in production and delivery schedules. 4. Risk Mitigation Strategies: Implement risk mitigation strategies, such as maintaining a buffer stock of critical components and exploring expedited shipping options. 5. Regular Monitoring and Communication: Continuously monitor the procurement process and maintain open communication with suppliers to address any potential delays promptly.

Risk	Risk Description	Risk Consequence(s)	Risk Treatment Actions/Future Mitigation
Operational readiness–build the entire organization.	The organization may face challenges in achieving full operational readiness, impacting its ability to function effectively and meet strategic goals.	1. Operational Delays: Delays in achieving full operational capacity, affecting project timelines and deliverables. 2. Increased Costs: Higher costs due to inefficiencies, rework, or the need for additional resources. 3. Employee Turnover: Increased turnover due to dissatisfaction or lack of engagement. 4. Reputation Damage: Negative impact on the organization's reputation with stakeholders, clients, and the market. 5. Reduced Competitiveness: Inability to compete effectively in the market due to operational inefficiencies. 6. Compliance Risks: Potential legal and financial penalties due to non-compliance with regulations.	1. Strategic Planning: Develop a comprehensive strategic plan that includes clear objectives, resource allocation, and timelines. 2. Leadership Development: Invest in leadership development programs to ensure strong and effective leadership. 3. Process Optimization: Conduct regular reviews and optimizations of processes and workflows to enhance efficiency. 4. Cultural Alignment: Foster a culture that aligns with the organization's strategic goals through training and engagement initiatives. 5. Regulatory Compliance: Implement robust compliance programs to ensure adherence to industry regulations and standards. 6. Technology Strategy: Develop a technology integration strategy that ensures seamless integration of new systems with existing infrastructure.
Power supply.	Inability to supply power on the project site	1. Technical Failures: Malfunctioning of power generation or distribution equipment. 2. Supply Chain Issues: Delays or disruptions in the delivery of necessary components or fuel. 3. Regulatory Constraints: Compliance issues or delays in obtaining necessary permits. 4. Environmental Factors: Natural disasters or extreme weather conditions affecting power infrastructure. 5. Human Error: Mistakes in planning, installation, or maintenance of power systems.	1. Contingency Planning: Develop and implement a robust contingency plan that includes backup power solutions and alternative suppliers. 2. Regular Maintenance: Schedule and perform regular maintenance checks on all power-related equipment to ensure reliability. 3. Supplier Agreements: Establish strong agreements with multiple suppliers to mitigate the risk of supply chain disruptions. 4. Training Programs: Conduct training sessions for staff to minimize human error and ensure proper handling of power systems. 5. Environmental Monitoring: Implement monitoring systems to anticipate and respond to environmental threats promptly.

Risk	Risk Description	Risk Consequence(s)	Risk Treatment Actions/Future Mitigation
Inadequate plot plan size for planned development.	The risk involves the possibility that the current plot plan size may not be sufficient to accommodate the planned development. This inadequacy could lead to the need for additional space, which may not be available at the estimated model cost, potentially impacting the project's feasibility and budget.	1. Increased Costs: Higher expenses due to acquiring additional land or redesigning the project. 2. Project Delays: Time lost in securing additional space or modifying plans. 3. Regulatory Issues: Potential non-compliance with zoning or building regulations. 4. Reduced Project Scope: Scaling back the project to fit the available space.	1. Thorough Initial Assessment: Conduct comprehensive site assessments and space requirement analyses during the planning phase. 2. Flexible Design Plans: Develop adaptable design plans that can accommodate changes in space requirements. 3. Contingency Budgeting: Allocate a contingency budget to cover potential additional costs. 4. Stakeholder Communication: Maintain open communication with stakeholders to manage expectations and provide updates. 5. Regulatory Review: Regularly review and stay updated on relevant regulations to ensure compliance. 6. Alternative Solutions: Explore alternative solutions such as vertical development or multi-use spaces to maximize the available plot. 7. Maintain the optionality of additional graphite concentrate.

26 Recommendations

Key recommendations for continued development of the Project are provided below, along with estimated costs for the work.

26.1 Geological Setting and Mineralization

Detailed mapping and geologic modeling of the resource and pit area are recommended to constrain further lithology and bench-scale graphite variability for use in detailed mine planning.

26.2 Exploration

Aerial geophysics indicates that graphite extends beyond the proposed pit area. Limited drill tests of this data have demonstrated the presence of graphite coincident with the geophysical anomaly. Further drill testing of the geophysical data to identify and delineate other shallow zones of particularly high grade could benefit mine life extension. The cost of drilling will decrease significantly once a road is in place. It is estimated that $2 M be added to the budget during the first years of operation with further delineation of the ore reserve.

26.3 Drilling

Approximately 70% of the pit is currently identified as Measured or Indicated resources. Any further drilling completed for geotechnical or hydrologic purposes should be mindful of infill spacing so that it has the potential to contribute to upgrading the resource. Conversion of additional resource blocks to Measured and Indicated can potentially affect total tonnage and mill throughput. Additional drilling adjacent to the pit area has the potential to add mine life.

Additional infill drilling is recommended to convert up to 40.4 Mt of Inferred resources above the economic COG at an average grade of 3.9% Cg into Probable reserves or Proven reserves covering all five phases. A pit infill drilling campaign is estimated at about 3,800 m of drilling which can synergize with the proposed geotechnical holes. This drilling is recommended once access roads have been installed and can be completed for $2 M.

26.4 Mineral Resource Estimation

The current mineral resource estimate uses explicit 3% grade shell domains (lodes) to create wireframes. The use of these explicit 3% grade shell domains can create sharp bends or corners that search ellipses cannot accommodate. The use of implicit probability-based grade shells should be investigated to mitigate this effect. This can be accomplished with either probabilistic estimation using grade indicators or implicit modeling software such as LeapFrog Geo.

A higher-grade (10% Cg or greater) population is visible in both the grade distribution curves and along sections. Further domaining of a higher-grade population is recommended to estimate these high-grade lenses or domains better.

The current search ellipse has a static orientation dependent on the lode despite visual evidence of orientation variations. To help accurately place grades in the correct orientation, the use of a locally varying orientation or an unfolding type estimation could be investigated.

The current estimate did not use lithologic controls during the estimation process. A more detailed, consistent, and validated lithologic model should be created to help accurately reflect the resource within specific lithologic units.

It is estimated that resource modelling recommendations can be completed for $60,000.

26.5 Mineral Reserves

The current mineral reserves exclude 17.4 Mt of Measured and Indicated resources between the raised COG (3.0% Cg) and the economic COG (2.0% Cg) at an average grade of 2.4% Cg. An analysis should be done to determine if this material could be stockpiled and processed profitably after mining is done. This should provide improved overall economics for the Project. The analysis would add a 5-year extension to the current LOM. The revised LOM production scheduling, the redesigned WMF, the backfill plan, the revised cost model, and economic evaluation should be included in the scope of work. The cost estimate for the mineral reserve revision is $100,000.

26.6 Mineral Processing and Metallurgical Testing

Composite samples representing mining time frames should be tested for ore hardness and flotation response. These samples should represent the following production windows from the pit:

- Year 1
- Year 2
- Years 3-4
- Years 5-7
- Years 8-21

Hardness testing of these samples should include SAG mill hardness tests.

HPGR testing has indicated reduced power consumption and improved flotation performance. Additional HPGR testing on two samples is recommended, along with a revisiting of the tradeoff between HPGR and SAG milling.

A geo-metallurgical determination of ore types is required to correlate the results of the variability testwork and volumes of ore in each category.

The responses of coarse and fine tailings to other dewatering methods should be examined, as this could significantly decrease tailings filtration footprint, building cost, equipment cost, and operational costs. Options that have not been tested to date include the following:

- Coarse tailings to belt filter or dewatering screen; fine tailings to tailings pond
- Coarse tailings to belt filter or dewatering screen, fine tailings to thickener and centrifuge

Table 26-1 Metallurgical Testing Cost Estimate

Test	Number of Samples	Cost
Yearly Mining Composites	5	$210,000 - $260,000
HPGR Testing	2	$120,000 - $140,000
Tailings Dewatering	2	$40,000 - $50,000

26.7 Recovery Methods

A pilot scale test should be conducted on a representative ore sample. Tailings and concentrates produced from the test should be tested for dewatering, material handling, and product drying tests. Regrind power and mineralogy should be further investigated during the pilot plant test. A robust pilot plant campaign would also provide bulk natural graphite concentrate for subsequent testing related to STP design. Feed to the pilot plant should represent the first three years of the planned pit production which will require a large diameter drilling program.

- The cost estimate for the drilling and pilot plant program is $1.5 M to $2.0 M
- The cost estimate for the pilot plant testing is $400,000 to $500,000

Ore blending may be required to produce consistent mill throughputs and flotation recoveries. Adequate space in the site general arrangement should be reserved for an ore blending stockpile.

Space for product bulk bagging should be incorporated into the design to facilitate sales to third parties.

26.8 Environmental

Long term climate change will accelerate permafrost loss in the region. Continued close ground temperature monitoring and modeling of climate trends will help to avoid unforeseen shallow groundwater generation, potential impacts to the site infrastructure, and downstream environment.

26.9 Water

Validation of the water balance model with data from the site weather station will be crucial to confirm climate basis for design. Site specific precipitation and wind data can vary greatly from regional averages and could affect both water infrastructure sizing and methods of construction.

Engage the ADEC to obtain an APDES permit with finalized discharge criteria to validate the assumed feasibility treatment goals.

Conduct bench and pilot treatability testing using surrogate water spiked to influent design water quality during mine life for the treatment process optimization, including validation of:

- Chemical consumptions
- HDS recycling rate
- Sludge density
- RO operations
- RO reject recycle rate

These tests, estimated at $100,000 to $300,000, can be used to optimize the general arrangement for the WTP as necessary based on the finalized APDES discharge criteria and treatability testing.

Validate post-closure pit lake treatment strategy based on updated precipitation data and on further drilling results.

26.10 Mining

As mining operations progress, a grade control program should be established. This is a standard practice in the industry, aimed at enhancing ore recovery by developing a more accurate and detailed geological model.

A geotechnical drilling campaign is recommended to be carried out in the open-pit area prior to mine development, in order to supplement the geotechnical data collected to date. The drillholes associated with the proposed drilling campaign are summarized in Table 26-2 and Figure 26-1 below. Table 26-2 indicates that the proposed drillholes on the north side of the pit should be drilled for mine development, while those on the south side of the pit could be deferred until later. Consequently, only those on the north side of the pit are included in the cost estimate presented later in this section.

Table 26-2 2025 Proposed Pit Geotechnical Holes

Hole ID	Easting	Northing	Approx. Elevation (m)	Azimuth (deg.)	Plunge (deg.)	Inclined Depth (m)	Location	Timing
25GCT01	473801.2257	7212343.408	319	160	-50	105	Open Pit	Defer
25GCT02	474080.9586	7212404.6	290	160	-50	125	Open Pit	Defer
25GCT03	474336.9054	7212491.887	380	160	-50	145	Open Pit	Defer
25GCT04	474596.2608	7212576.605	371	70	-45	120	Open Pit	Defer
25GCT05	474872.2415	7212726.107	372	160	-50	115	Open Pit	Defer
25GCT06	475079.9756	7212881.985	402	160	-50	170	Open Pit	Defer
25GCT07	474702.6225	7213289.858	196	160	-50	250	Open Pit	Drill for mine development
25GCT08	474332.3099	7213144.225	172	160	-50	250	Open Pit	Drill for mine development
25GCT09	474014.0349	7212962.578	156	160	-50	250	Open Pit	Drill for mine development

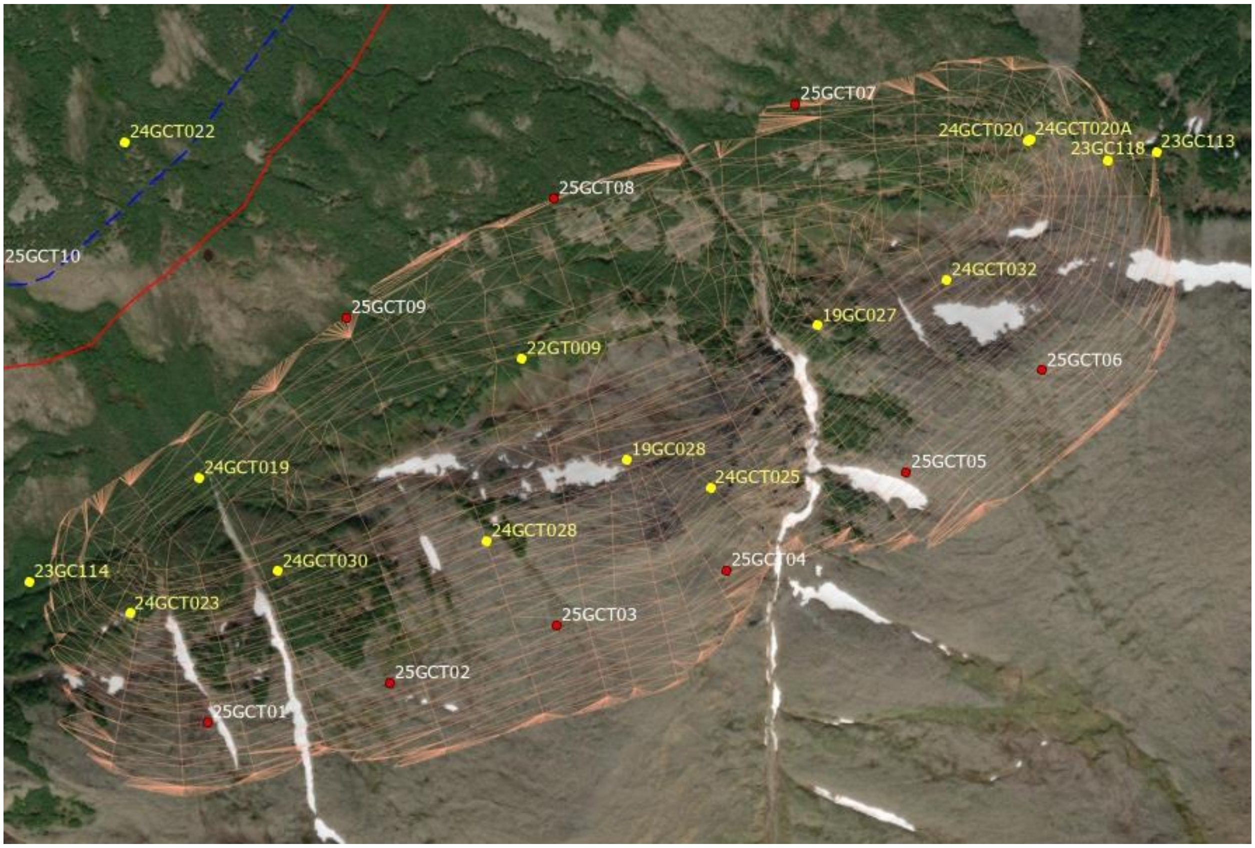


Figure 26-1 2025 Proposed Pit Geotechnical Holes

The south holes will be drilled higher on the mountain to characterize the upper portion of the pit wall in addition to the bench associated with the Graphite Creek diversion. These could be exploration holes as was done in 2024. Hole 25GCT04 is recommended to be oriented to the east to capture the potential north-south fault associated with Graphite Creek and to characterize the area where Graphite Creek will be diverted.

The north holes will be drilled to better characterize the alluvium/till on the north highwall, in addition to the Kigluaik Fault and the underlying bedrock portion of the north highwall.

The cost estimate for the future open-pit drilling program is shown in Table 26-3 below. The total drilling quantity, not including the pit holes on the south side of the pit that can be deferred until later, is $716,670.

Table 26-3 Cost Estimate for 2025 Proposed Pit Geotechnical Holes

Item	Cost ($/m)	Cost for 750 m of planned drilling
Drilling	$450	$337,500
Geotechnical Staff Oversight	$332	$248,756
Downhole Geophysics (Televiewer, Etc.)	$130	$97,247
Laboratory	$44	$33,167
Total	**$956**	**$716,670**

This cost estimate makes the following assumptions:

- Drill roads will be available, so no helicopter support is required
- Skid mounted rig, so no pad building required
- No separate camp costs included

Additionally, the following geologic, hydrogeologic, and operating recommendations related to pit design slopes and pit development should be considered in further project stages.

- Foliation fabric: potential slope instabilities are possible along foliation whose orientation, persistence, and shear strength would control the type, geometry, and scale of instabilities. Also, slope design adjustment is recommended to avoid any convex slope shapes in the open-pit designs.
- Pit crest bench slope configuration: the catch bench width and bench face angle at the pit crest should be adjusted based on the conditions exposed during mining, where the rock is usually weathered.
- Controlled blasting: lack of controlled blasting and effective bench scaling could impact the steepness of achievable bench faces on the south highwalls where the foliation planes dip north between 40° and 70° with a mean of 57.5°.
- Single versus double benching practices: steep inter-ramp slope angles on the south highwalls might not be safely achievable due to locally unfavorable geologic conditions or poor operating practices as the slope height increases. This condition can be mitigated by incorporating haul roads and geotechnical benches within the initially determined inter-ramp slopes.
- Permafrost: slope stability is typically improved where the soil and rock mass are permanently frozen. However, the shear strength parameters for the rock units, especially the soil units, will be weakened in thawing conditions. Permafrost depth, ice content, and moisture content of rocks and soils, and variation of air temperatures should be monitored to evaluate potential impacts to the pit slope stability.
- Groundwater pressures: while the pit slope stability analyses generally indicate acceptable FoS for overall pit slopes, high groundwater pressures could affect the stability of the pit slopes, especially as the pit reaches greater depths.

- Unknown faults: known faults are not expected to control overall slope stability, especially on the south highwall, and the effects of faults on inter-ramp and bench slopes are expected to be local. However, there has been some suggestion that north-south, vertical to subvertical faults perpendicular to the Kigluaik Fault are present, which could adversely impact the stability of the east and west highwalls.

26.11 Additional Geotechnical Investigations

To supplement the geotechnical data collected to date, a geotechnical drilling campaign is recommended to be carried out in the WMF, pond, and mill areas before mine development. The drillholes associated with the proposed drilling campaign for the WMF and pond are summarized in Table 26-4 and Figure 26-2 below.

Table 26-4 2025 Proposed WMF/Pond Holes

Hole ID	Easting	Northing	Approx. Elevation (m)	Azimuth (deg.)	Plunge (deg.)	Depth (m)	Location
25GCT10	473483.8641	7213040.638	122	0	-90	40	WMF
25GCT11	472941.6617	7213472.275	80	0	-90	40	WMF
25GCT12	472831.4706	7214293.779	64	0	-90	40	WMF
25GCT13	473259.5205	7214564.79	110	0	-90	40	WMF
25GCT14	473946.0955	7214039.706	144	0	-90	40	WMF
25GCT15	473920.6667	7213446.868	121	0	-90	40	WMF
25GCT16	472178.8005	7213938.076	46	0	-90	40	Pond

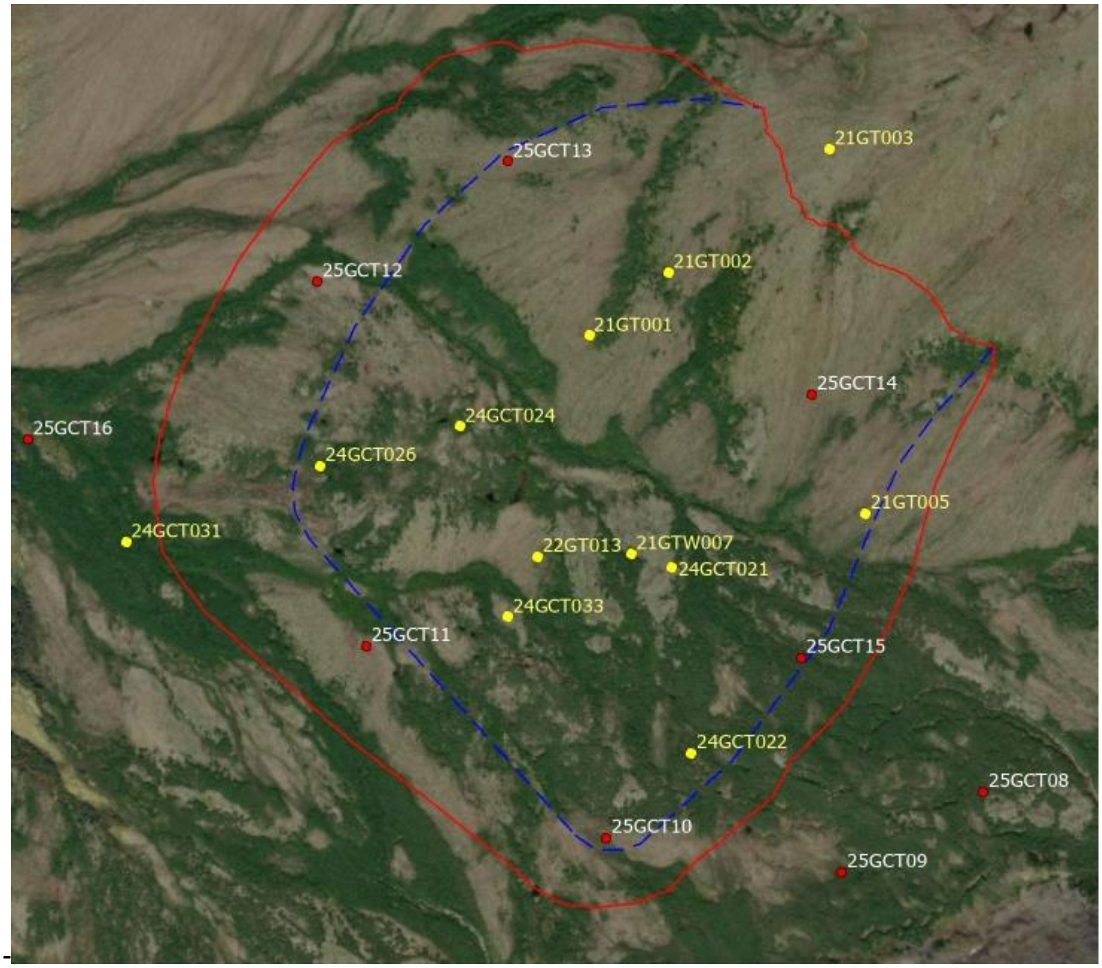


Figure 26-2 2025 Proposed WMF/Pond Holes

The holes are proposed to be drilled in areas of the WMF footprint that were not well characterized in 2024 because the footprint changed near the end of the 2024 drilling campaign. The hole depth of 40 m is governed by an attempt to characterize whether permafrost is present (i.e., tag top of permafrost) and not necessarily to install a DTC all the way to the bottom of the permafrost.

For the mill area, 12 holes are proposed for foundation design, with a typical drilling depth of 30 m. This depth is important to establish seismic foundation design parameters and, ideally, to tag the top of permafrost, if present. One of these 12 holes is recommended to be drilled to a depth of 145 m (similar to the 2024 deep WMF holes) to install a DTC for permafrost assessment. No table indicates hole locations because they would all be in the mill area and defined with a more detailed mill and support facilities layout. For these recommendations, a typical number of holes required, along with their depths for cost estimating purposes, has been established.

The cost estimate for the future infrastructure drilling program, including the WMF, WMP, and mill, is shown in Table 26-5 below. The total drilling quantity is 755 m (240 m for WMF, 40 m for WMP, and 475 m for mill).

Table 26-5 Cost Estimate for 2025 Proposed Infrastructure Geotechnical Holes

Item	Cost ($/m)	Cost for 755 m of planned drilling
Drilling	$450	$339,750
Geotechnical Staff Oversight	$332	$250,415
Laboratory	$44	$33,389
Total	**$826**	**$623,553**

This cost estimate makes the following assumptions:

- Drill roads will be available, so no helicopter support or winter drilling will be required
- Skid mounted or tracked rig, so no pad building required
- No separate camp costs included
- The affected area is based on dry stacking the tailings with waste rock

26.12 Site Electric Power and Heat Generation

An investigation of a small modular reactor (SMR) electric power generation system to provide both electric power for the facilities and steam generation for facilities heating is recommended. The indicative capital cost of the SMR combined heat and power (CHP) system of approximately $80 M to $90 M and the lack of a readily available SMR option led to the inclusion of the proven diesel-fired reciprocating engine generation system for CHP at this stage. SMR has the potential to significantly reduce operating costs associated with both electric generation and supply of heat for facilities. An initial study of this tradeoff should cost less than $50,000.

26.13 Camp Facilities

To refine camp needs in Nome, a detailed assessment of both construction and operational staffing requirements is recommended. This analysis should include a strategy for converting construction camp facilities from construction to long-term operational needs to minimize the LOM capital cost for these facilities. This study should cost no more than $25,000.

26.14 Concentrate Transport Logistics

It is recommended that a full-scale, dynamic, supply-chain simulation be conducted to transport concentrate from Nome, Alaska, to Niles, Ohio. This comprehensive analysis should focus on the following:

- Optimizing multi-modal transportation routes, considering seasonal variations and intermodal transfer points
- Evaluating the cost-effectiveness and reliability of different logistics strategies

- Assessing inventory management and real-time tracking solutions to optimize holdover and transfer costs
- Analyzing economic factors, including detailed cost modeling and transportation risk assessment
- Negotiating with direct transporter to attain updated costs and long-term contracts for sea and rail
- Negotiating with direct storage to determine actual holdover and transfer costs at each port

This study, estimated at $250,000 to $300,000, will enable informed decision-making, potentially leading to significant cost savings beyond this initial assessment, improved operational efficiency, and enhanced reliability in the concentrate supply chain to the STP.

26.15 Secondary Treatment Plant

The following is recommended:

- The STP should complete the process design, much of which is expected to be completed by Graphite One's technology partner (Chengyu). This will allow preferred vendors to be selected for all critical/long-lead equipment packages. Upon receipt of vendor data, e.g., basic engineering, the STP should integrate vendor requirements into the design.
- Review the process design criteria to identify assumptions that require validation, and further studies and/or testwork to close the assumptions, prior to the start of the Execution Phase.

Key objectives of the testwork include:

- Investigation of material handling characteristics of natural graphite, pet-coke, pitch, and precursor anode materials
- Determining reagent requirements and purification extents
- Evaluating candidate materials of construction for each process step
- Assessing carbonization and agglomeration extents
- Confirming the chemical composition and impurities of natural graphite concentrate, pitch, pet-coke, and precursor anode materials
- Validating blanketing material particle size distribution
- Assessing the purity of chlorine gas for natural graphite purification

In addition to these key objectives, performing any other testwork necessary to verify the design criteria outlined in the PDC is recommended.

- Many of the critical equipment supply origins are outside of the U.S. (e.g. China). Early engagement with the vendors to better understand what additional localization measures are necessary for the equipment to comply with local codes, regulations, and standards.

- The risk register, which was compiled following a Hazard Analysis for the STP, should be reviewed in detail on an ongoing basis, particularly as new data is received e.g., critical vendor data.
- Development of a diversified supply chain strategy and/or strategic partnerships to reduce dependency on any single region or supplier for material critical to the process e.g., crucibles.
- Performing full wastewater characterization testing using direct samples from an existing process facility using the same technology is recommended. The characterization would further establish treatment requirements and allow for refinement of the WTP design. After review of the results, tradeoff studies may be performed to determine the optimum water treatment solution e.g., owner-owned and operated versus third-party owned and operated.
- Conducting a technology selection trade-off study due to the rapidly evolving graphite industry and the emergence of new developments. The study should evaluate the state of maturity, commercial availability particularly in North America, safety, emissions, operability, capital and operating costs, and ease of implementation of alternative purification technologies compared to the current design.
- Establish pilot programs to test, evaluate, and adapt the technology prior to its full-scale deployment.
- Geotechnical investigation at the planned site location is recommended. Results from the drilling will provide input into the structural, foundation, roadway pavement design, and mitigate schedule risk in the subsequent phase. This geotechnical work is estimated at $350,000 to $450,000.
- It is recommended that an environmental permitting plan be developed and executed at the beginning of the next phase. To mitigate schedule risk, pre-consultation and pre-application meetings with the responsible regulatory agencies should be initiated.
- Advancement of a request to connect with local utility to bring necessary power to the site.
- At the onset of the next study phase, or during the bridging phase, the project should perform a logistics study for execution, evaluating all aspects of the logistics activities for the project.
- The STP should be reviewed for modularization opportunities, especially given the duplication of the multiunit 175 ktpa facility.

The aforementioned recommendations should be integrated as part of the proceeding design phase with an emphasis on preparing critical path equipment packages to a “ready for award” state and also sufficient engineering definition and preparation of a package for early work construction to “ready for award” status.

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