Carlin Vanadium Project
Nevada, USA
NI 43-101 Technical Report on Preliminary Economic Assessment

Prepared for:
First Vanadium Corp..

Prepared by:
Dr. Antonio Peralta Romero, P.Eng., Wood
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Effective Date:
11 May, 2020

Project Number:
205676

CERTIFICATE OF QUALIFIED PERSON

I, Dr. Antonio Peralta Romero, P.Eng., am employed as a Principal Mining Engineer with Wood Canada Limited ("Wood"), with a business address at 400-111 Dunsmuir Street, Vancouver, British Columbia V6B 5W3.

This certificate applies to the technical report entitled "Carlin Vanadium Project, Nevada, USA, NI 43-101 Technical Report on Preliminary Economic Assessment", that has an effective date of 11 May, 2020 (the "technical report").

I am a Professional Engineer with Engineers and Geoscientists BC and Professional Engineers Ontario. I graduated from the University of Guanajuato in 1984 with a B.S. in Mining Engineering, from Queen's University in 1991 with a M.Sc. in Mining Engineering, and from Colorado School of Mines in 2007 with a Ph.D. in Mining and Earth Systems Engineering.

I have practiced my profession for 35 years. I have been directly involved in mine planning and design, ore control, production forecasting and management, and slope stability monitoring, mainly for open-pit precious, base metal and iron ore mines.

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

I have not visited the Carlin Vanadium Project.

I am responsible for Sections 1.1, 1.3, 1.13, 1.18, 1.19, 1.22.3, 1.24; Sections 2.1 to 2.3, 2.5, 2.6.1; Section 3.1 to 3.3; Section 15; Section 16; Sections 18.6 and 18.7; Sections 21.1, 21.2.1, 21.2.2, 21.2.5 to 21.2.9, 21.3.1, 21.3.3, 21.3.4, 21.4; Sections 25.1, 25.7, 25.12, 25.13, 25.15.3; Sections 26.1, 26.3.3, and Section 27 of the technical report.

I am independent of First Vanadium Corp. as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the Carlin Vanadium Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

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 scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 25 June 2020

"Signed and sealed"

Dr. Antonio Peralta Romero, P.Eng.

CERTIFICATE OF QUALIFIED PERSON

I, Susana Gonzales, P.Eng., am employed as a Mining Engineer with Wood Canada Limited (“Wood”), with a business address at 400-111 Dunsmuir Street, Vancouver, British Columbia V6B 5W3.

This certificate applies to the technical report entitled “Carlin Vanadium Project, Nevada, USA, NI 43-101 Technical Report on Preliminary Economic Assessment”, that has an effective date of 11 May, 2020 (the “technical report”).

I am a Professional Engineer with Engineers and Geoscientists of British Columbia (#210669). I graduated from the Pontificia Universidad Catolica del Peru in 2013 with a B.S. in Mining Engineering. I received a Graduate Certificate in Finances from the Universidad de Piura in 2015.

I have practiced my profession for seven years. My experience includes the development of mine designs, mine plans, cost estimations, reserve audits, and financial and economic models for mines producing gold, copper, silver, zinc, lead, and tin in South and North America.

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

I have not visited the Carlin Vanadium Project.

I am responsible for Sections 1.1 to 1.3, 1.20, 1.21, 1.23; Sections 2.1 to 2.3, 2.5, 2.6.1; Section 3; Section 22; Section 24; Sections 25.1, 25.14, 25.16; and Section 27 of the technical report.

I am independent of First Vanadium Corp. as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the Carlin Vanadium Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

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 scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 25 June, 2020

“Signed and sealed”

Susana Gonzales, P.Eng.

CERTIFICATE OF QUALIFIED PERSON

I, Alan Drake, Eng.L., am employed as the Manager, Process Engineering with Wood Canada Limited ("Wood"), with a business address at 400-111 Dunsmuir Street, Vancouver, British Columbia V6B 5W3.

This certificate applies to the technical report entitled "Carlin Vanadium Project, Nevada, USA, NI 43-101 Technical Report on Preliminary Economic Assessment", that has an effective date of 11 May, 2020 (the "technical report").

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

I have practiced my profession for 27 years. I have been directly involved in metallurgical plant operations, process design, construction and commissioning of minerals processing and hydrometallurgical facilities for base and precious metals.

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

I have not visited the Carlin Vanadium Project.

I am responsible for Sections 1.1, 1.3, 1.10, 1.14, 1.18, 1.19, 1.22.2, 1.22.4, 1.22.8, 1.22.9, 1.22.12, 1.24; Sections 2.1 to 2.3, 2.6.1; Section 3.1 to 3.3; Section 13; Section 17; Sections 21.1, 21.2.1, 21.2.4 to 21.2.9, 21.3.2 to 21.3.4, 21.4; Sections 25.1, 25.5, 25.8, 25.12, 25.13, 25.15.2, 25.15.4, 25.15.8, 25.15.9, 25.15.12; Sections 26.1, 26.2.2, 26.2.3, 26.3.1, 26.3.5, 23.3.7, and Section 27 of the technical report.

I am independent of First Vanadium Corp. as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the Carlin Vanadium Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

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 scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 25 June, 2020

"Signed"

Alan Drake, Eng.L.

CERTIFICATE OF QUALIFIED PERSON

I, Paul Baluch, P.Eng., am employed as the Technical Director, Civil/Structural/Architectural with Wood Canada Limited ("Wood"), with a business address at 400-111 Dunsmuir Street, Vancouver, British Columbia V6B 5W3.

This certificate applies to the technical report entitled "Carlin Vanadium Project, Nevada, USA, NI 43-101 Technical Report on Preliminary Economic Assessment", that has an effective date of 11 May, 2020 (the "technical report").

I am a Professional Engineer with Engineers and Geoscientists British Columbia, Professional Engineers Ontario, The Association of Professional Engineers, Geologists and Geoscientists of Alberta, The Association of Professional Engineers and Geoscientists of Saskatchewan, and am a Professional Engineer in the State of Idaho. I graduated from the Slovak Technical University in Bratislava, Slovakia with a Diploma from Civil Engineering in 1980.

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

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

I visited the Carlin Vanadium Project from 6–7 November 2019.

I am responsible for Sections 1.1, 1.3, 1.15; Sections 2.1 to 2.4, 2.6.1; Sections 3.1 to 3.3; Section 18; Section 21.2.3; Sections 25.1, 25.9; and Section 27 of the technical report.

I am independent of First Vanadium Corp. as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the Carlin Vanadium Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

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 scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 25 June, 2020.

"Signed and sealed"

Paul Baluch, P.Eng.

CERTIFICATE OF QUALIFIED PERSON

I, Steven Truby, P.E, am employed as a Senior Associate–Geotechnical with Wood Environment & Infrastructure Solutions, Inc. (“Wood”), with a business address at 2000 S Colorado Blvd Ste 2-1000, Denver, CO, 80222-7931.

This certificate applies to the technical report entitled “Carlin Vanadium Project, Nevada, USA, NI 43-101 Technical Report on Preliminary Economic Assessment”, that has an effective date of 11 May, 2020 (the “technical report”).

I am a Professional Engineer registered with the Department of Regulatory Authorities, Colorado, the Alaska State Board of Registration for Architects, Engineers, and Land Surveyors and the Nevada State Board of Professional Engineers and Land Surveyors. I graduated from the University of the Witwatersrand, Johannesburg, South Africa in 1991 with a B.Sc. in Civil Engineering, and from the University of the Witwatersrand in 1996 with a M.Sc. in Civil Engineering.

I have practiced my profession for 27 years. I have been directly involved in the design, construction and permitting of mine tailings storage facilities, water management infrastructure and leach pads.

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

I have not visited the Carlin Vanadium Project.

I am responsible for Sections 1.1, 1.3, 1.16, 1.22.5, 1.22.6, 1.24; Sections 2.1 to 2.3, 2.6.1; Sections 3.1, Sections 18.6 to 18.9; Section 20; Section 21.2.9; Sections 25.1, 25.10, 25.15.5, 25.15.6; Section 26.3.8, 26.3.9; and Section 27 of the technical report.

I am independent of First Vanadium Corp. as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the Carlin Vanadium Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

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 scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 25 June, 2020

“Signed and sealed”

Steven Truby, P.E.

CERTIFICATE OF QUALIFIED PERSON

I, Dr. Gregory Gosson, am employed as the Technical Director Geology & Compliance with Wood Canada Limited ("Wood"), with a business address at 400-111 Dunsmuir Street, Vancouver, British Columbia V6B 5W3.

This certificate applies to the technical report entitled "Carlin Vanadium Project, Nevada, USA, NI 43-101 Technical Report on Preliminary Economic Assessment", that has an effective date of 11 May, 2020 (the "technical report").

I am a Professional Geoscientist with Engineers and Geoscientists BC (#136504) and Professional Geoscientists Ontario (#3003). I graduated from the Queen's University, Kingston, Canada, in 1979 with a B.Sc (Honours) degree in Geological Science, and from the Victoria University of Wellington, New Zealand, in 1986 with a Ph.D. in Geology.

I have practiced my profession for 40 years. I have been directly involved in mineral exploration, mining project evaluation, and mine operations. Over the past 10 years I have been directly involved in advanced project evaluations of mineral properties that were located in Nevada involving specialty metals, including vanadium deposits.

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

I have not visited the Carlin Vanadium Project.

I am responsible for Sections 1.1, 1.3, 1.17, 1.22.7, 1.22.10, 1.22.11, 1.22.13, 1.22.14, 1.24; Sections 2.1 to 2.3, 2.6.1; Sections 3.1, 3.3; Section 19; Sections 25.1, 25.11, 25.15.7, 25.15.10, 25.15.11, 25.15.13, 25.15.14; Sections 26.1, 26.3.6; and Section 27 of the technical report.

I am independent of First Vanadium Corp. as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the Carlin Vanadium Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

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 scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 25 June 2020

"Signed and sealed"

Dr. Gregory Gosson, P.Geo.

CERTIFICATE OF QUALIFIED PERSON

I, Dr Bart Stryhas, CPG, am employed as a Principal Associate Resource Geologist with SRK Consulting (U.S.), Inc., ("SRK"), with a business address at 1125 Seventeenth Street, Suite 600, Denver, CO, USA, 80202.

This certificate applies to the technical report entitled "Carlin Vanadium Project, Nevada, USA, NI 43-101 Technical Report on Preliminary Economic Assessment", that has an effective date of 11 May, 2020 (the "technical report").

I am a current member of the American Institute of Professional Geologists (# 11034). I graduated with a Doctorate degree in Structural Geology from Washington State University in 1988. In addition, I have obtained a Master of Science degree in Structural Geology from the University of Idaho in 1985 and a Bachelor of Arts degree in Geology from the University of Vermont in 1983.

I have worked as a Geologist for a total of 31 years since my graduation from university. My relevant experience includes minerals exploration, mine geology, project development and resource estimation. I have conducted resource estimations since 1988 and have been involved in technical reports since 2004.

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

I visited the Carlin Vanadium Project on 10 February 2010.

I am responsible for Sections 1.1, 1.3 to 1.9, 1.11, 1.12, 1.22.1, 1.24; Section 2; Sections 3.1, 3.2; Section 4; Section 5; Section 6; Section 7; Section 8; Section 9; Section 10; Section 11; Section 12; Section 14; Section 23; Sections 25.1 to 25.4, 25.6, 25.15.1; Sections 26.1, 26.2.1. 26.3.2, 26.3.4; and Section 27 of the technical report.

I am independent of First Vanadium Corp. as independence is described by Section 1.5 of NI 43–101.

I have authored or co-authored the following technical reports on the Carlin Vanadium Project:

- Stryhas, B., 2010: NI 43-101 Technical Report on Resources, EMC Metals Corp., Carlin Vanadium Project. Carlin, Nevada: report prepared by SRK Consulting (U.S.), Inc. for EMC Metals Corp., effective date 9 April, 2010.
- Stryhas, B., and Cooper J., 2017: NI 43-101 Technical Report on the Carlin Vanadium Project Carlin, Nevada: report prepared by report prepared by SRK Consulting (U.S.), Inc. for Cornerstone Metals Inc., effective date 25 October, 2017.
- Stryhas, B., Miller Clarkson, B., and Wright, F., 2019: NI 43-101 Technical Report, Carlin Vanadium Project Carlin, Nevada: report prepared by SRK Consulting (U.S.), Inc. for First Vanadium, effective date 31 January, 2019.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

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 scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 25 June, 2020

"Signed and sealed"

Dr Bart Stryhas, CPG.

IMPORTANT NOTICE

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1.0 SUMMARY

1.1 Introduction

First Vanadium Corp. (First Vanadium) requested that Wood Canada Limited, a Wood company (Wood), and SRK Consulting (U.S.) Inc (SRK), compile a technical report (the Report) on a preliminary economic assessment (PEA) study (2020 PEA) for the Carlin vanadium project (the Project), located in Nevada, USA.

1.2 Key Outcomes

The results of the 2020 PEA include:

- Life of mine (LOM) of 11 years of mining plus five years of stockpile feed. The annual production rate is envisaged at 1 Mst grading 0.71% V_2O_5, and average process recovery rates of 78%, resulting in an annual average payable production of 11 Mlb of V_2O_5 flake
- A four-year extension, once the stockpiles have been treated, where the acid plant will produce sulphuric acid and energy for direct sale
- Total LOM payable production of 180 Mlb of V_2O_5 flake
- The LOM average cash operating cost per payable V_2O_5 pound is US$5.17/lb V_2O_5
- Pre-production capital requirements, excluding royalty and option payments, total US$535 M
- The undiscounted cashflow pre-tax is US$356 M, and the after-tax undiscounted cashflow is US$301 M
- The pre-tax net present value (NPV) at 6% is US$56 M, and the after-tax NPV (6%) is US$29 M
- The pre-tax internal rate of return (IRR) is 7.9% and the after-tax IRR is 7.0%
- The pre-tax payback period is 7.5 years, and the after-tax payback period is 7.7 years
- The 2020 PEA assumed a commodity price of US$10.65/lb V_2O_5.

1.3 Terms of Reference

The Report was prepared to support the outcomes of the 2020 PEA in the First Vanadium news release dated 11 May, 2020, entitled "First Vanadium Announces Positive Preliminary Economic Assessment for the Carlin Vanadium Project in Nevada".

Units used in the report are US customary units unless otherwise noted. The abbreviation "st" is used for US customary tons (short tons). Monetary units are in United States dollars (US$) unless otherwise stated. The Report uses Canadian English. Mineral Resources are reported in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014; the 2014 CIM Definition Standards).

1.4 Project Setting

The Project is situated about six miles due south of the town of Carlin and 22 miles due southwest of Elko, in Nevada. The Project can be accessed from Carlin, via 14.25 miles of paved and gravel roads.

The climate is typical for the high-desert regions of central Nevada, with hot, dry summers and cold, snowy winters. Mining operations in the region are conducted year-round, and it is expected that the proposed Carlin Vanadium operation will also be year-round. Exploration activities can be conducted year-round but may be curtailed for short periods due to high snowfall or rainfall.

1.5 Mineral Tenure, Surface Rights, Water Rights, Royalties and Agreements

The Project consists of 150 unpatented mining claims totaling 2,528 acres (excluding overlaps and portions of claims outside section limits) and approximately 80 acres of fee simple land (referred to as the Cole Creek property) through a Mineral Lease Agreement covering a total of 2,608 acres. The vanadium deposit lies on claims BK 001 through 017, 019 and 021 and Lots 3 and 4 of APN 005-04A-001. All required payments to keep the claims in good standing have been made.

The surface estate is owned by the United States, and administered by the Department of Interior, Bureau of Land Management (BLM). A mining claimant has the right to use the surface estate of the lands to develop the mineral interest of the claim. These lands have guaranteed public access which is governed by United States law. No easements or rights of way are required for access over public lands. The Cole Creek property (Lots

3 and 4), is fee simple land. First Vanadium has an access agreement with the owner of the fee simple land.

There is currently no developed water supply, or grant of water rights attached to the project. Water rights can be granted following application to the State.

A 2% NSR in favor of Golden Predator will be incurred when First Vanadium acquires 100% property ownership. This royalty can be bought out at the time of option exercise for US$4 million. A 5% NSR in favour of the property owner of the Cole Creek property will be incurred in the event that First Vanadium commences mining operations on the Cole Creek property.

1.6 Geology and Mineralization

1.6.1 Vanadium

The Carlin Vanadium deposit is interpreted to be a syngenetic-type vanadium deposit.

The Project is located on the western flank of the Piñon Range, a block faulted horst of the Basin and Range tectonic province. The Project is underlain primarily by a generally north-trending sequence of Permian to Mississippian sedimentary rocks composed of siltstones, mudstones, sandstones, conglomerates and limestones. Mineralization is primarily hosted within the lowermost black mudstone units of the Devonian-age Woodruff Formation. The upper portion of the Woodruff Formation is a variably calcareous, light grey–brown siltstone that can also host vanadium mineralization. A hematite-oxidized conglomerate, the Diamond Peak Formation, overlies the mudstone–siltstone sequence. Alluvium, primarily derived from the Cole Creek watershed, locally covers parts of the Woodruff Formation.

The Woodruff Formation is flat to gently dipping, forming a broad north-oriented anticline with local east and west dipping flanks. On a local scale in some exposures, there are broad rolls and small-scale open folds.

In the southern part of the deposit there is a clear mappable curvilinear vertical fault separating the northern generally flat-lying terrain (Central Zone), which hosts most of the deposit, from a northwest-trending southwest-dipping (30°) terrain that hosts the small South Zone.

Drilling to date has defined multiple zones of vanadium-enriched mineralization (>0.2% V_2O_5) both in the grey–brown siltstone and the black mudstone unit. The most persistent, thickest, and highest-grade vanadium unit lies in the black mudstone unit and averages approximately 115 ft (35 m) thick, striking north–south over 6,000 ft (1,800 m) of length and 2,000 ft (600 m) wide in the east–west direction. The mineralization is locally exposed at surface at both the Central and South Zones, but mostly at a shallow depth less than 200 feet (60 m) from surface. Above and below the high-grade zone are other vanadium zones within the black mudstone unit that are generally less persistent laterally, which are of moderate grade (0.2–0.5% V_2O_5) but are thinner (30–75 ft thick). There is a relatively persistent, flat-lying, high-grade vanadium-enriched bed averaging 115 ft thick within the upper grey–brown mudstone unit to the west of the Central Zone. Other vanadium zones within the grey–brown siltstone are generally less persistent laterally, of moderate grade (0.2–0.4% V_2O_5), and are thinner (30–60 ft thick).

Mineralogical studies by First Vanadium and UCC show the vanadium is present in the form of metahewettite ($CaV_6O_{16}\,3(H_2O)$), and corvusite ($(Na,Ca,K)V_8O_{20}\bullet 4(H_2O)$, which are finely and evenly disseminated throughout the host lithologies with grain size from a few micrometers to almost 100 µm, averaging about 10–20 µm.

The vanadium is believed to have originally formed in a deep, restricted marine basin associated with the depositional environment of the western assemblage lithologies. As the marine basin filled, sub-basins formed. Organisms likely in the form of algae, bloomed on the shallow flanks of the sub-basins. As these organisms died, they contributed to carbon input into the basin. It is interpreted that the vanadium was concentrated into laterally relatively continuous mudstone/siltstone units by precipitation, absorption aided by carbon accumulation and evaporation processes as the restricted basin filled, evaporated, and concentrated the seawater into salts.

1.6.2 Gold

The Project is located within the Carlin Trend, an area that hosts the largest concentration of gold deposits in North America. Carlin-style deposits are typically sediment-hosted, low-grade disseminated and high-grade collapse breccia gold deposits associated with large structural breaks. First Vanadium retained Mr. David Mathewson to review the Project area for gold mineralization potential. Mr. Mathewson reviewed the Project structural setting to identify areas where structures are co-incident with geophysical gravity highs, in particular focusing adjacent to faults that have north–south, northwest–southeast, and northeast–southwest orientations. A key feature of the interpretation is a nine-mile-long north–south structure that sub-parallels the Bullion Fault that is associated with gold deposits on the Gold Standard Ventures-owned property to the east of the Carlin Vanadium Project area. The Project area covers a two-mile strike extent of the interpreted nine-mile-long structure. The structure is co-incident with a regional linear gravity high. In the Rain area of the Carlin Trend, gravity highs are coincident with large hydrothermal alteration systems at depth and coincident with gold deposits such as Emigrant, Rain, Tess and Saddle.

Mr. Mathewson has postulated that surface outcrops of silicification and elevated gold and trace element values at the Black Kettle prospect within the Project as expressions of hydrothermal fluid leakage from a high-grade gold target at depth where these key north–south, northwest–southeast, and northeast–southwest oriented structures are projected to intercept favourable lithologies known to host gold deposits elsewhere on the Carlin Trend. The Black Kettle prospect was drill tested to shallow depths in the 1980s and 1990s, and encountered some elevated gold and mercury grades but the depth potential of the prospect area was not tested. This area retains significant gold exploration potential.

1.7 History

Exploration activities for vanadium conducted prior to First Vanadium's project interest have included road building, surface mapping, trenching and sampling, auger, rotary, and core drilling, metallurgical testwork, and resource estimation. Companies included Union Carbide Corporation (UCC), U.S. Dept. of Interior, Bureau of Mines, Teck Cominco/Great American Minerals Corporation (GAM), Golden Predator U.S. Holding Corp., EMC Metals Corp. (EMC), and Americas Gold Exploration Inc. (AGEI).

Exploration activities for gold conducted prior to First Vanadium's project interest have included soil and rock chip sampling and reverse circulation (RC) drilling, and a scalar controlled-source audio-magnetotelluric resistivity (CSAMT) geophysical survey. Companies included Santa Fe Pacific Mining (Santa Fe) and Cambior USA Inc (Cambior).

First Vanadium, formerly named Cornerstone Metals Inc. (Cornerstone), and its subsidiary Copper One USA, Inc. (Copper One), have conducted aerial surveys, RC and core drilling, Mineral Resource estimation, metallurgical testwork, and mining, process, and environmental studies in support of vanadium project development. Work conducted in support of gold exploration has included historical data review and regional targeting.

1.8 Drilling and Sampling

UCC completed a total of 127 rotary drill holes (31,095 ft or 9,478 m) as part of their vanadium exploration efforts; data from this program are referred to as legacy data. First Vanadium completed 20 core holes (5,346 ft or 1,629 m) during 2017–2018. An additional 69 RC drill holes were completed in 2018, for 15,175 ft (4,625 m).

Original drill logs are available for the legacy drilling. The UCC drilling results were all recorded on standard handwritten drill logs which were later transcribed to typed final manuscripts. The drill logs contain specifics information pertaining to; hole no., local x, y coordinates, elevation, claim location, orientation, date started, date completed, total depth, logged by and summary of results. Each 5 ft interval is described by; from-to, interval length, % V_2O_5, anomalous % Zn values and comments. Typical comments relate to rock types, colour and drilling conditions.

The core program completed by First Vanadium was performed using HQ diameter core (2.5 inch). Geological logs recorded lithology, colour, grain size, hardness, and oxidation state. Graphic records were made of features such as bedding, contacts and structures/fracture density. Geotechnical logging was undertaken digitally on an Excel spreadsheet by a trained technician. Geotechnical logs recorded recovery, rock quality designation (RQD), fracture density and dip, rock strength, fracture conditions including persistence, aperture, roughness and infill. Core was photographed both wet and dry.

The First Vanadium RC program recorded drill hole ID, sample number and depth, oxidation state, colour, lithologies, carbonaceous enrichment, carbonate reaction with acid and siliceous enrichment. A representative interval sample was placed into pre-labelled plastic RC chip trays. Chip trays were photographed.

There is no available information on recovery statistics during the UCC campaigns. Core recovery during the First Vanadium campaign averaged 85.6%. No recovery issues were encountered during the First Vanadium RC program.

Original legacy drill logs contained surveyed UTM collar coordinates. Several drill collars are still evident in the field with open holes or chip piles. Numerous drill pads on unreclaimed roads are also evidence of the legacy drill holes. The legacy dataset with collars were verified by recent collar surveying. Surface drill collar locations for the First Vanadium core and RC programs were picked up by licenced surveyors using Trimble global positioning system (GPS) equipment. Existing on-site control points were used in the survey.

No downhole surveys were done on the legacy drill holes due to their short length and vertical orientation of the drill holes. No downhole surveys were completed on the core holes, as First Vanadium was of the opinion that vertical HQ-size drill holes would display nominal deviation. A gyroscopic downhole survey tool was supplied to First Vanadium by International Directional Services (IDS) and operated by the RC drilling contractors. Measurements were taken typically at the bottom and top of each drill hole and at 50 ft increments. Deviation on the vertical 2018 RC drill holes was less than 0.5º, over about 200 ft drilled.

First Vanadium sited the 2017–2018 program drilling to offset the legacy drill holes in areas of known vanadium mineralization, and to provide twin checks on the legacy drilling. The legacy drill holes were twinned using both diamond core and RC drilling. The core and RC programs provided material for assay, density, and metallurgical testing, and confirmed the location and tenor of vanadium grades defined by the legacy drilling and testwork.

The drill cuttings in the legacy drill programs were collected at the collar in 5 ft increments. Each 5 ft sample was referred to as the regular sample. An additional grab sample was also collected from every alternate 5 ft interval. The First Vanadium core samples were generally 1.5 m long. A minor number of samples taken were less than 1.5 m in length due to poor recovery. Sampling was carried out immediately below the overburden and all the way down to the base of the drill hole. RC samples were collected on 5 ft intervals.

The two laboratories used in the legacy programs were located in Carlin, NV, and in Grand Junction, CO. The Carlin laboratory and Grand Junction laboratories were both in-house, UCC facilities. MS Analytical was the primary laboratory used by First Vanadium. MS Analytical is independent of First Vanadium and holds both ISO 17025 and ISO 9001 accreditation for laboratory testing and calibration, and Quality Management Systems, respectively. Check assays on the First Vanadium drilling were performed by ALS Global in Vancouver, BC., which is an independent, third-party laboratory and holds ISO 170125 accreditations for selected analytical techniques.

There is no information currently available which describes the sample preparation methods by UCC. The samples were analyzed using a two-stage approach. First, the alternate grab samples were analyzed by XRF for V_2O_5 at Carlin. If a particular grab sample or run of grab samples produced anomalous results, then the original sample for that interval and the two adjacent intervals were sent to Grand Junction, CO. for V_2O_5

and zinc analysis. It is unknown what analytical procedures were used at the Grand Junction laboratory.

For the First Vanadium program, sample preparation involved crushing to 70% passing 2 mm, followed by pulverizing to 85% passing 75 µm. An ultra-trace level 48 multi-element determination was completed on all samples, using four-acid digestion and inductively-coupled plasma (ICP) atomic emission spectroscopy (AES) or mass spectrometry (MS) analysis. The method detection limit range for vanadium is 1–10,000 ppm V_2O_5 (up to 1%). For samples that returned values of ≥0.3% V_2O_5, the analytical method was a four-acid digestion and ICP-AES analysis. The method detection limit is 0.001% V_2O_5 (10 ppm). On the assay certificates, V_2O_5 results are reported and were determined by converting elemental vanadium results. The conversion formula is $V_2O_5 = V * 1.7852$.

At the time that the exploration drilling by UCC was completed, it was not a common procedure for the exploration department to conduct rigorous QA/QC programs on its in-house laboratories. Each of the in-house laboratories was held accountable for their own QA/QC programs. The nature of the sampling at the Project does, however, provide for an incidental check on results. Since many of the samples originally analyzed at the Carlin laboratory were then rerun at the Grand Junction laboratory, a direct comparison can be made. This shows very good correlation between the two laboratories with no bias from either.

Control samples, as standard reference material (SRM) and blank samples, were included in the core and RC drilling programs conducted by First Vanadium. All SRM and blank sample results from initial analysis were within acceptable ranges. No samples were re-analyzed, nor does the QP recommend re-analysis.

Assay results of control samples and sets of duplicate samples indicate reliable and accurate analytical results from the primary laboratory. The slight high bias apparent in check assay samples is not well understood but is not a cause for concern about the quality and repeatability of the analysis by MS Analytical.

Sample security practices for the legacy programs are not known. During the First Vanadium programs, samples were collected in the field for RC or in the core shed for core. All material was handled by contracted staff independent of First Vanadium. Sample bags were placed in woven rice sacks, which were palletized and wrapped for secure shipment. The required shipment waybill for each batch served as evidence for secure sample chain of custody between First Vanadium's possession and receipt of samples at the laboratory.

1.9 Data Verification

First Vanadium possesses copies of the historical UCC drill logs, most assay certificates, and cross-sections and plan maps used to compile the historical UCC estimation. An electronic database was generated by hand entry of information taken from the UCC drill logs. Drill hole collar locations were compiled into an Excel spreadsheet by x. y, z in the local coordinates as listed on the drill logs. EMC later transformed these locations by conducting a licensed field survey of the local control points and then transforming the historical coordinates to Nevada State Plane using ESRI software.

SRK reviewed assay data for seven of the 89 RC holes completed in 2018. The drill holes were selected to represent the north–south extent of the deposit and comprise 9.2% of the drill hole interval assays. No material issues were noted. Geological logs were not compared to the data table used for modeling; rather, the interpreted geologic solids provided by First Vanadium were compared with drill hole data, and no discrepancies were noted during resource estimation.

The process of data collection, database validation, and data storage used for the Project database ensures that the drill hole data are securely stored and readily available for resource estimation. The information can support Mineral Resource estimation.

1.10 Metallurgical Testwork

Metallurgical research has been conducted on samples from the Carlin Vanadium property beginning in the late 1960s. A substantial campaign was completed by UCC, investigating numerous beneficiation and extractive processes, followed by the U.S. Bureau of Mines which focused on beneficiation and roasting tests. First Vanadium staff and experts retained by First Vanadium reviewed the findings, and performed some additional tests in 2018–2019. As a result, First Vanadium considered that salt roast would not be the preferred route for 2020 PEA purposes

First Vanadium selected an acid pressure oxidation process as the preferred option for 2020 PEA purposes. A testwork program in support of the acid pressure oxidation option was conducted under the direction of First Vanadium, commencing in 2018.

Ten composite samples representative of oxide and non-oxide material types of low, medium, and high vanadium grades were used in the testwork. The composite samples were derived from diamond drill holes across the Carlin Vanadium Mineral Resource and represents the two material types (oxide and non-oxide mudstone) of varying vanadium grades (low, average, and high).

The research targeted process flowsheet development and advancing key unit processes. Testwork has been completed in the following areas: mineralogy, comminution, physical beneficiation, acidulation, pressure oxidation, ion exchange, solvent extraction, ammonium metavanadate precipitation, and calcination. The studies were carried out at eight independent laboratories. Two major programs at SGS Minerals in Lakefield, Ontario (SGS Minerals) and Sherritt Technologies, Fort Saskatchewan, Alberta (Sherritt) were conducted.

ALS Metallurgy conducted comminution tests. The Bond low impact crusher index measured 4.8 kW-hr/t and would be considered very soft in terms of breakage in a crusher. The Bond mill work index test was conducted at a closing screen size setting of 106 µm, which yielded a Bond ball mill work index of 13.7 kW-hr/t. This is considered to be moderately soft in terms of ball milling. Upon review, it was determined that the sample tested at ALS Metallurgy was not a good representation of the non-oxide mineralization. A second composite sample was assembled and sent to Bureau Veritas, and returned a ball mill work index of 9.5 kW-hr/t. The information was not included in the PEA design criteria for the milling circuit and represents an opportunity.

Beneficiation tests were conducted on several oxide composites. Through a series of tests, a front-end flowsheet for oxide upgrading by carbonate rejection was developed including attrition scrubbing followed by a multi-stage hydrocyclone process. Consistent successful laboratory results were achieved using the attrition scrubbing hydrocyclone procedure. However, Wood considered that there were other methods that had greater potential for commercial scale-up.

A test to determine if the use of decanter centrifuges represented a viable solution for physical beneficiation of the Carlin vanadium material was conducted. It was concluded from this preliminary evaluation that it would be worthwhile progressing to small-scale decanter centrifuge tests as a future opportunity.

Non-oxide mudstone composites were evaluated to demonstrate effective upgrading of vanadium and rejection of carbonate in non-oxide material. The test program developed consisted of grinding, attrition scrubbing, de-sliming, and froth flotation steps to concentrate vanadium and reject the carbonate gangue. Test results indicated successful beneficiation of vanadium and rejection of carbonate from the non-oxide composite.

Basic solid–liquid separation tests were conducted to provide information for thickener/clarifier design, and established a baseline underflow density and flocculent dosage rate. Flocculant scoping was performed using a range of anionic, nonionic and cationic flocculants, as well as coagulant–flocculant combinations. The scoping test results indicated that the sample responded well to BASF Magnafloc 919 flocculant, which is an ultra-high molecular weight, anionic polyacrylamide flocculant. Two series of static settling tests were conducted, evaluating solids density and the effect of flocculant dosage. After completion of the static settling tests, an ultimate underflow density measurement was determined by combining all the underflows from the individual static settling tests into a single 1 L graduated cylinder and allowing the underflow to compact to a final settled density overnight. The ultimate underflow density was 35.3%w/w solids.

Standard pressure and vacuum filtration tests were conducted on the physical beneficiation circuit rejects. Pressure filtration was superior to vacuum filtration in both throughput and final cake moisture.

Three phases of pressure oxidation (POX) testwork has been completed:

- Scoping work by Sherritt in order to demonstrate high extraction of vanadium from oxide and non-oxide materials within the deposit. Resulting overall extractions of vanadium increased to 94.5% and 95.5% when processing pre-roasted material, and 95.6% and 96.0% under total POX conditions of 220°C temperature and 700 kPa oxygen pressure
- Variability study work by Sherritt to examine a range of nine samples taken from recent drill core from the deposit. The preliminary extractions of vanadium from the nine variability samples ranged from 92.1% to 97.8%. This variability work provided a good indication of the expected average and range of vanadium extractions across the deposit
- Autoclave processing by SGS Minerals of both drill core samples and concentrates derived from mineral processing of various samples. The drill core samples and the concentrate were treated by acidulation prior to autoclave oxidation. The SGS Minerals acidulation and POX testwork confirmed the efficiency of these two unit operations in producing a vanadium-containing solution to advance to downstream

recovery. The acidulation process was highly efficient with +98% carbonate destruction under all conditions with significant vanadium extraction. High overall extractions (90–95% vanadium extraction) were obtained from both drill core samples and concentrates produced at SGS Minerals by the combination of acidulation and pressure oxidation.

Evaluation of ion exchange with two strong base resins indicated that minor impurities such as uranium and molybdenum may be removed from the vanadium leach solution via that method.

SGS Minerals carried out a series of oxidation and solvent extraction tests. A McCabe–Thiele isotherm was developed for the vanadium extraction process. The diagram indicates that two stages of extraction would be required to achieve approximately 1.5 g/L V in the organic solution and recover ~ 90% of the vanadium. It appeared that higher initial pH levels would be expected to improve the vanadium recovery; the pH of the solution from acidulation is approximately 2.25, so this appears feasible within the current process design.

The precipitation of ammonium metavanadate was tested on a sample of strip solution obtained through sequential stripping of loaded organic. Vanadium precipitation was 97% and iron co-precipitation was 69%, while molybdenum did not precipitate. The final solid was filtered but not washed before calcining at 500°C for two hours to convert ammonium metavanadate to vanadium pentoxide.

The purity of the final product was low due to co-precipitation of sodium carbonate and sodium sulphate by "salting out" upon addition of ammonium sulphate solution; the amount of precipitate was small, exacerbating the issue. Washing of sodium carbonate and sodium sulphate away from the vanadium pentoxide product was tested at a small scale and increased the grade of vanadium pentoxide. The impurity content was significantly reduced by washing.

The basic elements of the acidulation, pressure oxidation, uranium removal by ion exchange, oxidation, solvent extraction, scrubbing and stripping, iron removal, AMV precipitation and calcination have been demonstrated. There is a requirement to optimize the conditions to refine the process design. Nevertheless, it is possible to process Carlin oxide or non-oxide material for production of a vanadium pentoxide final product.

There are four unit processes that will contribute to the overall vanadium extraction in the oxide material, namely hydrocycloning, acid pressure oxidation, solvent extraction, and calcination. The overall recovery of V_2O_5 through the process flowsheet for oxide material is calculated at 78.6%

The non-oxide material will be processed through five units that contribute to the overall vanadium extraction, including hydrocycloning, flotation, acid pressure oxidation, solvent extraction, and calcination. The overall recovery of V_2O_5 for non-oxide material is calculated at 77.4%.

Iron and low concentrations of uranium and molybdenum are the three elements that must be controlled in the process in order to ensure a quality vanadium pentoxide product for the market. All these elements are co-extracted with vanadium in the acidulation and pressure oxidation processes. Uranium and molybdenum can be removed from the acidulation liquor by ion exchange prior to oxidation and solvent extraction. In addition, molybdenum is not precipitated with the ammonium metavanadate product after solvent extraction stripping. The primary rejection of iron is by oxidation (to ferric ion) and precipitation (to ferric oxy-hydroxide) during acidulation. The secondary control of iron is via the solvent extraction scrubbing process. It is expected that the small amounts of iron that are co-extracted with vanadium on the Alamine 336 organic may be washed from the organic by scrubbing with weak sulphuric acid solution. This will be confirmed in the next stage of development.

1.11 Mineral Resource Estimation

The block model was constructed within the NAD83 UTM Zone 11US Survey feet coordinates. A 20 ft cubic block size was chosen as an appropriate dimension based on the current drill hole spacing and the smallest mining unit of a conceptual open pit mining scenario. A topographic surface generated from 2 m LiDAR data provided by First Vanadium and was used to flag the top of bedrock in the block model.

SRK constructed trend planes for the highest-grade zones of mineralization by digitizing lines of continuity in sections spaced 100 ft apart and then combining these into a three-dimensional surface. These surfaces were then used to guide the construction of grade shells for each domain of mineralization. The domains are essentially the fault blocks. Grade shells were constructed using commercially-available Leapfrog software, based on a grade threshold of 0.1% V_2O_5. These grade shells were used to constrain the resource grade estimation. Three fault-bounded domains were also established, constrained by the SW Fault that strikes northwest–southeast with a near vertical dip, and the North Fault that strikes north–south, with a near vertical dip. The North Fault merges into the SW Fault.

The raw assay V_2O_5 data were first plotted on histogram and cumulative distribution graphs to understand the basic statistical distribution. The raw assay data were capped at 2.5%, resulting in six assays ranging from 2.61% to 3.34% being reduced to 2.5% prior to compositing.

The original assay sample lengths are predominately 5 ft in length. For modeling purposes, these were composited into 10 ft run length composites with no breaks at geological contacts. This length was chosen to provide initial smoothing and for approximately two composites to intersect the 20 ft vertical length blocks. Where analyses were only available for every other sample interval, the missing intervals were ignored, and the composites were generated from the data available

Average densities were used for each of the two predominant lithologies based mainly on oxidation state.

Variography studies of the capped and composited data did not return very good results. In general, weak variogram structures were obtained, which reflected the average drill hole spacings. The results are interpreted to be related to the varied orientations of the mineralized horizons as well as the variability of the original mineralized horizons.

Grade estimation was run using an inverse distance squared (ID^2) algorithm considering only the composites and blocks within the grade shell. The grade estimation considered all blocks with centroids within the grade shell. A dynamic search orientation was used based on the same trend plane used to construct the grade shells. A three-pass search estimation was used.

Model validation consisted of: visual checking on sections and bench plans for comparison to the composite assay grades; review of estimation parameter results to evaluate the performance of the grade estimation; comparison of the estimated block grades from the ID^2 estimation to the composite drill hole data in each of the three fault domains; comparison of the estimated average block grades to the composites using east–west swath plots. The results of all of the model validation tests provided good confidence in the resource estimation.

Mineral Resources are classified as Indicated and Inferred based primarily on the average drill hole spacing. All Mineral Resources are supported by the areas of infill drilling with an average spacing of 200 ft or less were classified as Indicated Mineral Resources. No areas of the deposit are drilled to a sufficient density to support a Measured Mineral Resource.

Mineral Resources are confined within a conceptual open pit shell that uses the following input parameters:

- Pit slope angle: 45º
- Metal price: US$12.50/lb V_2O_5 flake
- Mining cost of US$2.50/t
- Processing cost of US$52.50/t
- General and administrative (G&A) costs of US$1.50/t
- Product transport costs of US$2.00/t
- Metallurgical recovery of 85%.

Mineral Resources are reported using a 0.3% V_2O_5 cut-off grade.

1.12 Mineral Resource Statement

Mineral Resources are reported using the 2014 CIM Definition Standards in Table 1-1, and have an effective date of 31 January, 2019. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

The QP for the estimate is Dr. Bart Stryhas, CPG, an SRK employee.

Factors that may affect the Mineral Resource estimate include: changes to commodity price assumptions; changes to metallurgical recovery assumptions and assumptions that the proposed metallurgical recovery process will operate as envisaged; changes to interpretations of geological continuity due to changes in lithological, weathering or structural interpretations; changes to assigned density values in the estimation domains; changes to the input assumptions in the conceptual open pit shape that constrains the estimate; and changes to environmental, permitting and social licence assumptions.

Table 1-1: Mineral Resource Statement

Classification	Cut-off (% V_2O_5)	Tons (M)	Grade (%V_2O_5)	Contained Metal (V_2O_5 Mlb)
Indicated	0.3	24.64	0.615	303
Inferred	0.3	7.19	0.520	75

Notes to Accompany Mineral Resource Table:

1. Mineral Resources are reported with an effective date of 31 January, 2019. The Qualified Person for the estimate is Dr. Bart Stryhas, CPG, an employee of SRK Consulting (U.S.) Inc.
2. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Mineral Resources are reported using a 0.3% V_2O_5 grade, based on the following assumptions: Open pit mining methods; constrained within a pit shell with a 45° pit slope, metal price of US$12.50/lb V_2O_5 flake, mining cost of US$2.50/t, processing cost of US$52.50/t, general and administrative (G&A) costs of US$1.50/t, product transport costs of US$2.00/t, and a metallurgical recovery of 85%.
4. Figures have been rounded.

1.13 Mining Methods

The 2020 PEA is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the 2020 PEA based on these Mineral Resources will be realized.

The pit shells that define the ultimate pit limit, as well as the internal phases, were derived using a Lerchs–Grossmann (LG) pit optimization algorithm. This process considers the information stored in the geological block model, pit slope angles, commodity prices, mining and processing costs, process recovery, and the sales costs for the metals produced. The geotechnical assumptions used in the pit design may vary in future assessments and could materially affect the strip ratio, or mine access design.

The subset of the Mineral Resource estimate included in the 2020 PEA mine plan is provided in Table 1-2.

The 2020 PEA assumes conventional open pit mining using a conventional Owner-operated equipment fleet. The mining operations will have an 11-year life, with one year of pre-production. A stockpiling strategy is planned, which will provide process plant feed after the cessation of mining operations.

Table 1-2: Subset of Mineral Resource Estimate Within the 2020 PEA Mine Plan

Classification	Material Type	Cut-off (Block value US$/st)	Tons (Mst)	Grade (%V_2O_5)	Contained Metal (V_2O_5 Mlb)
Indicated	Oxide	10	6.76	0.664	90
	Non-oxide	10	6.94	0.792	110
	Total		***13.69***	***0.729***	***200***
Inferred	Oxide	10	2.57	0.619	32
	Non-oxide	10	0.10	0.684	1
	Total		***2.67***	***0.622***	***33***
Waste	***Total***		***52.68***		

Notes to Accompany Subset of Mineral Resource Estimate within the 2020 PEA Mine Plan Table:

1. Mineral Resources within the 2020 PEA Mine Plan were estimated assuming open pit mining methods and include the dilution resulting from reblocking from a 10 x 10 x 10 ft to a 20 x 20 x 20 ft block size.
2. Input assumptions include metal price of US$12/lb V_2O_5, fixed process recoveries of 70.8% for oxide material and 75.4% for non-oxide material. Mining cost is assumed to be US$2.50/st and reclaim cost is US$1.50/st. Processing operating costs were estimated as US$31.45/st for oxide material and US$43.58/st for non-oxide material. The process cost assumption does not include allocation for acid prices, which are variable. In addition, G&A costs were estimated at US$1.50/st, sustaining capital costs at US$2.00/st and closure costs at US$1.00/st. A fixed royalty percentage of 0.01% was included. Overall slope angle assumptions of 40º were used.
3. Tonnes, grade and contained metal content may not sum due to rounding.

Four pit phases are planned. The design parameters included a ramp width of 82 ft, road grades of 10%, bench height of 20 ft, targeted mining width of 200 ft, berm interval of 40 ft, fix slope angle of 40° and a minimum mining width of 82 ft.

The operating phases were sequenced starting in the south portion of the deposit, then proceeding to mine the north and central portions, and finally to mine to the final pit limit. The scheduling constraints set the maximum mining capacity at 7 Mst per year, with a maximum of 10 benches mined per year per phase. To maximize project value, an elevated cut-off strategy was followed to feed the highest possible grades at the beginning of the life of mine. Material below a set net smelter return value will be stockpiled to be treated primarily at the end of the operating life. The mine life is 17 years, including a year of pre-production.

The waste rock facility (WRSF) design criteria included 76.9 ft berms every three lifts, 2.6H:1V overall slopes, 20-ft lifts, and a 30% swell factor for estimating volumes. The facility capacity is 31 Myd^3.

Medium- and low-grade stockpile areas will have capacity to store 5.4 Mst. Stockpile design criteria included a material repose angle of 37° and a maximum height of 70 ft.

Equipment requirements include:

- Blasting: Heavy ANFO truck
- Drilling: two top head hammer (THH) drills with a 4 ¾ inch bit
- Loading: two 6.5 yd^3 front-end loaders; one 5 yd^3 hydraulic shovel/backhoe
- Hauling: Maximum of fifteen 45 st wet capacity trucks
- Support: track dozers, rubber-tired dozers (RTDs), motor graders, and water trucks
- Auxiliary: fuel/lube trucks, small water trucks, skid steers, flatbed trucks, lighting plants, pickups, mining and geology software, survey equipment, and pumps.

1.14 Recovery Methods

The process flowsheet for vanadium recovery can follow a number of potential processing routes. The most common method used globally includes a salt roast to oxidize the vanadium from its insoluble trivalent and tetravalent states to a soluble pentavalent state. In the case of the Project mill feed materials, the recovery response to salt roasting is inconsistent across the samples tested, with recent testing supporting historical data. An alternative approach with consistent and higher recovery was proposed for the purposes of the 2020 PEA, and is supported by testwork.

The process design assumes mineralization supply from an active mining operation for the first 11 years (plus one year of pre-production), followed by five years of stockpile treatment, then a final four years of acid-plant only operation.

For the purposes of the process plant design, the mudstone-hosted mineralization types are classified as being an oxide and a non-oxide type. The mineralization types have significantly different mineralogical and physical characteristics which results in differences to the front end of the flowsheet for the two mineralization types. Testing showed that it is possible to upgrade the mineralization by cycloning:

- The cyclone underflow from the oxide mineralization type is rejected to upgrade tailings, thus removing a substantial quantity of acid-consuming gangue from downstream processes

- The cyclone underflow from the non-oxide mineralization contains a large proportion of the vanadium-bearing kerogen, so the underflow advances to carbon flotation for kerogen recovery.

The oxide and non-oxide concentrates generated from cycloning and flotation advance to common processes; namely acidulation, high-pressure acid leach, ion exchange, solvent extraction, precipitation, and calcining processes.

A processing facility of this configuration has not been used for recovery of vanadium. However, the individual unit processes selected are common to, and conventional in, the mining industry, each having multiple installations.

The process, including gangue and mineral chemistry, was modelled using METSIM to generate a mass, water, chemical and heat balance. The model provided the ability to test the effects of process configuration changes on mass and volumetric flowrates, recoveries and reagent requirements.

The process plant is designed to treat the mill feed materials separately on a campaign basis using common equipment, assuming 3,200 st/d for oxide material only, and 2,500 st/d for non-oxide material. Higher-grade mill feed material will be processed during the initial years of the Project, while the lower-grade mineralization will be stockpiled close to the processing plant. The oxide and non-oxide mill feed material will be stockpiled separately. The final five years of operation will be fed exclusively from the lower-grade stockpiles.

Plant operation will include a primary jaw crusher, and a secondary cone crusher in closed circuit with the sizing screen. Oxide mineralization will bypass the primary ball mill and report directly to the secondary tower mill which will be configured to do duty as an attrition scrubber. Non-oxide mineralization will feed into a ball mill in closed circuit with a hydrocyclone cluster, classifying the overflow to a P_{80} of 105 µm. The overflow will advance to a tower mill which will be configured as a secondary milling stage. The tower mill will operate in closed circuit with a hydrocyclone cluster, classifying the overflow to a P_{80} -50 µm. The overflow will advance to a fines classification circuit.

Centrifuges will be configured in open circuit, receiving a conditioned cyclone overflow from the tower mill. The coarse rejects will either be sent to the upgrade tailings circuit in the case of the oxide mill feed type, or carbon flotation in the case of the non-oxide mill feed type. The centrate containing the fines fraction will advance to acidulation.

A carbon flotation circuit will only be operated when the kerogen-containing non-oxide mill feed material is treated. When oxide mineralization is treated, the fines from the classification centrifuges will by-pass flotation and advance directly to the pre-acidulation thickener.

The centrifuge centrate and flotation concentrate will combine in the feed to the pre-acidulation thickener. The acidulation tanks will overflow to the pressure leach feed thickener where flocculant will be added to the feed. The thickener overflow will advance to the pregnant leach solution (PLS) pond. Thickener underflow will be pumped to the acid pressure oxidation circuit.

The autoclave will be a six-compartment vessel, and will have concentrated sulphuric acid and oxygen addition. The operating conditions differ between the oxide and non-oxide mineralization types. The oxide mill feed requires super-heated steam to achieve the operating temperature and pressure, whereas the non-oxide mill feed allows for autothermal operation. The autoclave discharge will be cooled using a conventional two-stage flash.

The leached slurry will advance to the pressure oxidation discharge thickener. The thickener underflow will be pumped through a three-stage decanting centrifuge circuit where the slurry will be washed counter-current with solvent extraction raffinate solution. The centrate from the first centrifuge will combine with the leached slurry feed to the pressure oxidation discharge thickener. The thickener overflow will return to acidulation to recover residual acid.

The PLS will be pumped from the PLS pond through a NIMCIX ion exchange extraction circuit to target the extraction of impurities such as uranium and molybdenum. The ion exchange raffinate solution will be filtered to remove suspended solids and will pass through a heat exchanger for temperature adjustment before reporting to the solvent extraction feed tank.

The extraction circuit will consist of four reverse-flow mixer-settler stages in series. The stages will be operated organic continuous. The extraction raffinate will be recycled back to the counter-current washing circuit as wash liquor. A raffinate bleed stream will be diverted to the plant tailings circuit. The loaded organic will advance to a single scrub mixer-settler where the organic will be scrubbed with acidified demineralised water to reduce iron contamination. The scrubbed organic will advance to three-stage strip mixer-settlers. The loaded strip liquor from the first strip stage will advance to the loaded strip liquor tank. The stripped organic will report to the sulphation tank where it will be contacted with sulphuric acid solution to sulphate the organic. The organic will then be returned to the stripped organic tank from where it will again be pumped to the extraction circuit. The solvent extraction process flowsheet as designed deviates from the process flowsheet that was used as the basis for the testwork. The testwork flowsheet used sodium carbonate as a strip solution, forming a sodium vanadate strip liquor containing sodium sulphate. The sodium vanadate strip liquor is treated with ammonium sulphate to precipitate ammonium metavanadate. The ammonium sulphate strip and precipitation process was adopted during the process flowsheet development as it allows for process simplification and potential cost benefits.

The loaded strip liquor will be filtered through a carbon filter to remove entrained organic before being pumped to the ammonium metavanadate precipitation tanks arranged in series. The precipitate slurry will overflow the final tank to the AMV thickener where the precipitate will settle out. A portion of the underflow slurry will be recycled back to the precipitation stage to act as crystal seeds. The remainder will advance to a centrifuge feed tank where demineralised water will be added to the underflow slurry. The diluted slurry will be pumped through a decanting centrifuge to wash the precipitate. The centrifuge solids will discharge to a filtration step to dewater the solids. The filtered cake will advance to the calcination and product handling section. The filtrate will report to the precipitation barren solution tank. A portion of the precipitation barren solution will be recycled back to the third strip mixer–settler as strip solution.

The filtered cake will be fed into a multi-hearth furnace which will dry and calcine the AMV under oxidizing conditions to produce vanadium pentoxide. The vanadium pentoxide will be crushed, and bagged in one-ton supersacks.

The plant tailings neutralisation tanks will receive tailings from the following sources: fines classification tailings; flotation tailings; counter current washing slurry; ion exchange eluate; ion exchange regeneration solution; solvent extraction raffinate bleed solution; solvent extraction regeneration solution; and precipitation barren solution bleed. Calcium hydroxide slurry will be added to the neutralisation tanks to neutralise the slurry before being pumped to the tailings storage facility (TSF).

Power for the process is assumed to be supplied from a turbine-generator set which will use waste heat from the acid plant in parallel with a new distribution line to be constructed for the Project. The plant will draw an average of 8.7 MW while processing non-oxide feed, and 7.6 MW while processing oxide feed. Energy from the process will be used where applicable. Energy recovery using flash and splash from the autoclave discharge will be used to heat the slurry fed to acidulation. Acidulation feed slurry will pass through a slurry–slurry heat exchanger to recover residual energy to the autoclave feed slurry.

Approximately 14 major reagents have been identified for the planned process.

Raw water will be sourced from a well-field within the Project boundary and stored in a raw water tank within the process area. The raw water requirement is expected to be approximately 660 gpm.

1.15 Project Infrastructure

Given the planned small throughput of the open pit mine and processing facility, the infrastructure has been combined and integrated as much as possible. The project as envisaged in the 2020 PEA will include: One open pit; processing facilities (grinding/classification and extraction process areas, a stand-alone sulphuric acid plant including acid storage and a contracted oxygen plant); specific mining facilities (truck workshop, wash bay, explosives storage facility, diesel storage and distribution); combined mine and process offices (administration, management and engineering, change house, workshop, warehouse); assay laboratory; gate house, first aid facility and induction and training facility; haul roads and commercial vehicle access roads; mineralized material stockpile; WRSF; TSF; water management facilities; well field for fresh water supply; sewage and gray water treatment facility; hazardous waste handling and despatch facility; and an incoming power supply and acid plant turbine generator set.

Access to the site will be provided by a light vehicle road from highway 278 approximately 1.5 miles south of the property. Internal site roads will include a north–south private ranch track, a haul road/commercial vehicle road from the pit to the process plant and the plant feed stockpile area, and a haul road from the pit to the WRSF.

All mine personnel are expected to commute from Carlin or other towns located in the region. No onsite camps or accommodations are anticipated.

The pit will not require dewatering as the water table is below the expected pit base.

An initial hydrology report indicates that 1,750 gpm of water is available from sub-surface waters. The Project as envisaged requires approximately half of this quantity for the process plant and dust control.

The local power supply company Nevada Energy has confirmed that sufficient power (estimated at 1 2MW) is available, and that the planned mine lies within their existing service territory. The supply to the mine will require the construction of a 120 kV switching station and a 9–10 mile-long line extension to the mine site. A new step down/up substation will be constructed on site and will distribute power to the operation at 11 kV.

The sulphuric acid plant will be equipped with a steam turbine generator set which is expected to generate up to 8 MW from the waste energy produced during the acid production process. This will be sufficient to provide the majority of the power to the plant.

1.16 Environmental, Permitting and Social Considerations

1.16.1 Notice of Intent and Plan of Operations

First Vanadium, under its subsidiary Copper One, filed a Notice of Intent (NOI) in November 2017, with the reclamation bond approval provided by the BLM on December 8, 2017. First Vanadium contracted EM Strategies to prepare a Plan of Operations (PoO) for additional exploration activity with a proposed disturbance of up to 100 acres, which would occur in phases. This PoO was prepared in June 2019 and submitted to the BLM in May 2020. Approval of the PoO is pending completion of National Environmental Policy Act (NEPA) compliance.

1.16.2 Environmental Considerations

Surveys conducted during 2018 included vegetation community and habitat assessment, noxious weeds, wildlife, special status species, and Nevada Natural Heritage Program (NNHP) habitats and sensitive species. Additional sensitive species surveys were completed for burrowing owl, bats, pygmy rabbit, Merriam and Prebles shrews, greater sage-grouse and leks, and springsnails. The impacts that the August 2018 County Line Fire had on the Project area were also reviewed, as this fire burned approximately 91% of the Project area. In addition to baseline surveys, eagle and raptor surveys were conducted in 2018 for the Project area and included a four-mile buffer around the Project area. Although no key environmental issues have been identified at this stage in the permitting and planning process, several special status species were observed within or near the Project area.

A cultural resources survey was conducted in support of the PoO modification in April 2019.

One additional threatened and endangered species, the grey wolf, has been added to the register of species that require baseline studies since the Project baseline surveys were completed. It is expected that additional data will need to be collected in support of any planned mining operation. No formal Waters of the US or wetland surveys appear to have been completed. Groundwater depth and water quality will be required for both the Water Pollution Control Permit application and for NEPA compliance. Samples collected during exploration drilling are expected to be tested for acid-generating potential (AGP) and acid-neutralizing potential (ANP). In addition, tailings material is also anticipated to be tested for AGP and ANP.

No environmental monitoring programs associated with the proposed exploration project or future mining project were identified as at the Report effective date. Once final designs are completed, various waste rock management, surface ground water monitoring and other monitoring/sampling programs will be implemented.

In addition to NEPA compliance, numerous federal, state and local permits and approvals will need to be obtained prior to the start of operations.

1.16.3 Stockpiles

A low-grade stockpile area with a total storage capacity of 3.6 Mft3, which is sufficient to meet the maximum stockpile requirements of 5.4 Mt, will be located adjacent to the processing plant. The underlying ground will be built up and sloped such that run-off will be routed towards the TSF. Although no modeling has been completed to confirm the movement of seepage from the stockpile, it is expected to move towards the open pit.

1.16.4 Waste Rock Storage Facility

A WRSF will be established in the Cole Creek valley adjacent to the open pit. A total of 50% of the separated and filtered upgrade tailings will be co-disposed with the waste rock in the Cole Creek valley during the first 11 years of operation. Disposal of this portion of the tailings will be on top of the WRSF after mining is finished in Year 11, and waste rock is no longer being produced.

The WRSF will store about 51 Mst of waste rock and co-disposed dry stack upgrade tailings. A drain will be built to channel any stormwater under the waste rock pile. This water will be released downstream of the WRSF. The waste rock is expected to be non-acid generating and has been designed with this assumption. Additional geochemical characterization of the waste rock will be required to confirm that the waste rock is non-acid generating and does not have the potential to leach contaminants. Best management sediment control practices (BMPs) will be deployed downstream of the WRSF to manage sediment.

1.16.5 Tailings Storage Facility

The TSF will be located to the north of the pit, and will contain 11 years of tailings from the processing plant. This will accommodate all the fine plant tailings and 50% of the upgrade tailings generated over this period. The TSF will be a cross-valley impoundment, with the tailings being stored in the valley upstream of an embankment constructed across the valley. The design assumes staged construction of the TSF, with the first stage providing sufficient volume to store one year's worth of tailings storage, and subsequent raises every year. The tailings are expected to be benign, and at present there is no plan to line the TSF basin. Additional geochemical characterization will be required to confirm that the tailings is non-acid generating and does not have potential to leach contaminants.

During the last four years of operations when the pit is no longer being mined, and stockpiled material is being processed, tailings will be discharged into the open pit. This will accommodate all the fine plant tailings and 50% of the upgrade tailings generated over this period.

Stormwater collected in the pit will be pumped to the TSF from where it will be pumped to the plant for use in the process.

1.16.6 Water Management

As far as practicable, non-contact water will be diverted past mining operations and released downstream of mining operations.

1.16.7 Closure and Reclamation Planning

First Vanadium will need to meet BLM objectives for post mining land uses, which will likely include mineral exploration and development, livestock grazing, wildlife habitat and dispersed recreation. Because neither the PoO for the mining operation nor the NEPA process have been initiated with the BLM, reclamation bonding estimates have not been completed.

First Vanadium will be required to submit updated reclamation plans and surety estimates based on requirement of the BLM and BMRR. As much as practicable, concurrent reclamation will be practiced during operations.

Based on the conceptual mine plan, closure costs are estimated by Wood to be US$30 million. This assumes a mine life of 16 years and production rates of approximately 1 Mst per year. The total disturbed area of the mine, tailings impoundment, waste rock facility, stockpile, processing plant and roads is estimated at 540 acres.

1.16.8 Permitting Considerations

The review of permit requirements for the project assumes the specific development scenario outlined in this PEA which is based on the following assumptions: new project activities would occur on unpatented claims and public lands administered by the BLM; NDEP concurs that the Project can be operated and closed in a manner protective of human health and the environment.

A preliminary list of the key permits was developed and a more detailed review of the longer-lead permit items undertaken. Long-lead permits include the PoO, NEPA process, Mining Reclamation Permit, and WPCP. Generally, the longest lead items with regard to permitting are the PoO and NEPA compliance.

1.16.9 Social Considerations

First Vanadium will take steps to engage the local community to create awareness regarding the Project. During the NEPA process, the public will have multiple opportunities to comment on the project and express support or concerns.

1.17 Markets and Contracts

1.17.1 Vanadium

First Vanadium sourced a vanadium market study and update by Roskill Consulting Group Ltd (Roskill) to understand vanadium's uses, global and country-by-country supply and demand, pipeline of projects, market outlook and their price forecasts. The primary uses are in infrastructural steel and utility-scale battery storage technology.

Wood and First Vanadium reviewed the Roskill and publicly-available pricing data, and selected a long-term price forecast of US$10.65 per pound of V_2O_5 sold as an appropriate target metal price for the economic analysis. This price selection is bracketed by the peak and low of the five-year trailing average, by the pricing used by peers in publicly-available studies, and by the pricing forecast probabilities from Roskill.

First Vanadium's expectation is that the company will rail bagged product to US-based consumers, primarily to the steel industry on both east and west coasts, and master alloy companies. Due to the early stage of development, no rail or port contracts have been entered into. No off-take agreements are in place. There may be potential to supply vanadium battery manufacturers, but no testwork has been undertaken to determine if this provides a Project upside opportunity. First Vanadium expects that the eventual terms, rates or charges that will be associated with contracts when they are concluded, will be within industry norms for a relatively non-freely traded commodity such as vanadium.

1.17.2 Acid

Wood completed a trade-off study that concluded an acid plant on site would better serve Project needs than purchasing all of the Project acid needs from third-parties. At the end of the mine life, after the process plant has treated stockpiled material, excess acid would be on-sold to a third party.

For the purposes of the 2020 PEA economic model, Wood assumed a sulphuric acid purchase price of US$144/st, and a sulphuric acid selling price of US$104/st. Wood has assumed sulphur prill costs of US$178/st, on a delivered to site, freight-on-board Los Angeles or San Francisco basis.

First Vanadium has had initial discussions with acid providers in the Carlin area, and these providers could meet projected supply shortfalls and would be able to purchase excess acid production. The discussions indicate that that Nevada acid market is volatile, and commodity-cycle dependent, but does have long-term potential. No contracts have been entered into. First Vanadium expects that the eventual terms, rates or charges that will be associated with contracts when they are concluded, will be within industry norms for relatively non-freely traded commodities such as sulphuric acid and prilled sulphur supply.

1.17.3 Electricity

Most of the power requirements for processing will be generated from a turbine-generator set which will use waste heat from the acid plant in parallel with a new distribution line to be constructed for the Project. In the last four years of the projected operating life, the turbines produce excess power, superfluous to operational requirements. The excess power would be on-sold to a third party.

Nevada Energy advised Wood that a realistic power supply cost from an existing power provider to a mining operation in northern Nevada would be about US$0.05/kWh/hr. Given that the residential rate in Nevada is US$0.08/kWh, Wood assumed for 2020 PEA purposes that supply into the existing grid of a Nevada power supplier from the Project turbines would attract a payment of about US$0.05/kWh/hr. No contracts have been entered into for the supply of electrical power. First Vanadium expects that the eventual terms, rates or charges that will be associated with contracts when they are concluded, will be within industry norms for supply of electrical energy in Nevada.

1.18 Capital Cost Estimates

The capital cost estimates fall under the AACE International Class 5 Estimate classification where a Class 5 estimate cost estimate accuracy is defined as within +50%/-30% of the final project cost, including contingency.

The costs were based on an assumption of Owner mining. Mining costs include the purchase of mining fleet, maintenance, and mine support equipment, miscellaneous equipment, and the mine operating cost during pre-production periods. Process costs are based on the mechanical equipment costs multiplied by a factor which accounts for the structural, piping, electrical and instrumentation equipment and the overall construction costs. The acid plant and the solvent extraction plant were considered as stand-alone items. Other capital costs included earthworks and contingency.

The 2020 PEA capital cost estimate is presented in **Error! Reference source not found.**.

1.19 Operating Cost Estimates

The operating cost estimates fall under the AACE International Class 5 Estimate classification where a Class 5 estimate cost estimate accuracy is defined as within +50%/-30% of the final project cost, including contingency.

Mine operating costs average US$2.30/st moved, including stockpile re-handle. Excluding the pre-production period, the average mining cost is US$2.29/st moved or US$9.80/st processed.

Table 1-3: Capital Cost Estimate

Discipline	Area	Value (US$ M)
Mining	Equipment	13.6
	Pre-stripping	14.1
	Sub-total	*27.7*
Process plant directs	Comminution	16.9
	Classification	11.6
	Flotation	3.1
	Rejects	13.1
	Acidulation	16.2
	Pressure oxidation	83.6
	Counter-current decantation and tails	39.2
	Ion exchange	18.0
	Solvent extraction	30.5
	Precipitation and calcine	24.2
	Reagents	3.2
	Acid plant	78.8
	Plant utilities	2.2
	Sub-total	*340.6*
Infrastructure directs	Office equipment	0.2
	Laboratory and workshop equipment	5.4
	Buildings	7.6
	Plant mobile equip	1.3
	Earthworks and access roads	20.2
	Haul roads and pioneer roads	14.7
	Tailings, electrical and communications	17.8
	Sub-total	*67.3*
Indirects	Contractors indirects	8.6
	Freight	8.0
	Spares	5.3
	First fills	3.3

Discipline	Area	Value (US$ M)
	Vendors representatives	1.4
	Owners' costs	16.5
	EPCM	46.6
	Commissioning	2.7
	On site construction facilities	1.4
	Sub-total	*93.8*
Property rights	Royalties, option exercise	5.9
	Sub-total	*5.9*
Total Initial Capital		***535.3***

Note: EPCM = engineering, procurement and construction management.

All process costs excepting acid costs are based on the MT7 and MT4 composite testwork results. Acid costs are based on interpolation of acid-consuming minerals into the resource block model on a block by block basis. To reflect the difference in the base data assumptions, this sub-section reports the acid costs estimated in the block model as a separate item to the process costs that were based on the composite testwork.

Process operating costs, for oxide and non-oxide material over LOM are estimated to average US$44.98/st processed. The average LOM oxide material process cost, excluding acid consumption, is US$27.59/st of processed oxide mineralized material and the average LOM non-oxide material process cost, excluding acid consumption, is US$43.94/st of non-oxide mill feed material.

The average LOM oxide material process cost, including acid consumption, is US$36.74/st of processed oxide mineralized material and the average LOM non-oxide material process cost, including acid consumption, is US$52.74/st of non-oxide mill feed material.

General and administrative costs are estimated at US$2.01/st processed.

Operating cost estimates for the 2020 PEA LOM are provided in Table 1-4.

Table 1-4: Operating Cost Estimate

Item	Units	LOM Base Value
Average mining cost (Owner operation)	US$/st moved	2.29
Average mining cost (Owner operation)	US$/st processed	9.80
Processing oxide cost (excluding acid)	US$/st processed	27.59
Processing non-oxide cost (excluding acid)	US$/st processed	43.94
Sulphuric acid cost	US$/st processed	10.36
G&A cost	US$/st processed	2.01
Total Operating Cost	***US$/st processed***	***56.79***

1.20 Economic Analysis

The 2020 PEA is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the 2020 PEA based on these Mineral Resources will be realized. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.

The results of the economic analyses discussed in this section represent forward-looking information as defined under Canadian securities law. The results depend on inputs that are subject to a number of known and unknown risks, uncertainties and other factors that may cause actual results to differ materially from those presented here. Information that is forward-looking includes:

- First Vanadium's ability to meet its obligations and the conditions required to exercise in full its option to acquire the Project
- Mineral Resource estimates
- Assumed commodity prices. The commodity price assumptions are based on market analyses and benchmarking with recent studies; however, future pricing could vary due to the volatile pricing nature of the commodities included in the cashflow analysis
- The proposed mine production plan and projected mining rates
- First Vanadium's ability to sell sulphuric acid and energy for the four years after the conclusion of the processing plant operation

- Metallurgical samples may not be representative and metallurgical recovery assumptions may not be achievable
- A processing facility of this configuration has not previously been used for recovery of vanadium
- Capital and operating cost estimates
- Assumptions as to closure costs and closure requirements
- Assumptions as to environmental, permitting and social risks, and the ability to permit the type of project envisaged in Nevada.

The economic analysis was carried out using a discounted cashflow (DCF) approach. This method of valuation requires projecting yearly cash inflows, or revenues, and subtracting yearly cash outflows such as operating costs, capital cost, royalties, and taxes. The resulting net annual cashflows are discounted back to the date of valuation and totaled to determine the Project NPV at selected discount rates. The internal rate of return (IRR) expresses the discount rate at which the NPV equals a zero value. The payback period is the time calculated from the start of production until all initial capital expenditures are recovered. All monetary amounts are expressed in US$. All cashflows have been discounted to the start of project construction, which has a duration of two years. Cashflows are assumed to occur at the end of the year. All pricing is stated in constant Q1 2020 US$.

The economic analysis assumes that the Project has a life of 20 years, with the following assumptions:

- Vanadium pentoxide: production of V_2O_5 flakes at 98% purity
- Sulphuric acid: the sulphuric acid plant will be used for V_2O_5 production from Year 1 to Year 16. After V_2O_5 production ends, the acid plant will operate for another four years, Year 17 to Year 20, and the sulphuric acid will be marketed to third parties
- Energy: 7 MW of electric power will be produced from the combustion of sulphur to produce sulphuric acid in the sulphuric acid plant. From Year 17 to Year 20, the power generated from the acid plant will be marketed to third parties
- The LOM recovery forecast averages 78%, with an anticipated acid consumption of 318 lb/st
- Cashflow is developed in US dollars only

- Sales terms for vanadium flake, sulphuric acid and power
- Royalties will be purchased at the start of operations
- Taxes are as envisaged in the Mining Tax Plan LLC (Mining Tax Plan) inputs to the economic model
- Reclamation bonding of US$30 M, consisting of an upfront 10% deposit on the bond at Project start, and annual coupon payments of 1.5%
- The financial model is presented on a 100% equity basis

The economic analysis returned the following results:

- Pre-tax
  - Undiscounted cashflow of US$356 M
  - NPV at 6% discount rate of US$56 M
  - IRR of 7.9%
  - Payback period of 7.5 years
- After-tax
  - Undiscounted cashflow of US$301 M
  - NPV at 6% discount rate of US$29 M
  - IRR of 7%
  - Payback period of 7.7 years.

The LOM cash operating costs average US$5.17/lb V_2O_5 payable.

Under the assumption detailed in this Report, the Project shows positive after tax NPV at a discount rate of 6%, but not at 8% or above.

1.21 Sensitivity Analysis

A sensitivity analysis was completed over a ±45% range for capital costs, operating costs, vanadium grade, and vanadium price. Vanadium grade sensitivity mirrored that of the vanadium price sensitivity. The Project cashflow is most sensitive to fluctuations in vanadium price and vanadium grade. It is less sensitive to operating costs, and least sensitive to variations in capital costs.

The price of V_2O_5 used in the study is based on market analyses by Roskill in 2019, and a limited number of recent vanadium project studies. The assumed price is in the middle range of these projections. It is significantly higher than the current market price. A sensitivity analysis has been carried out with the objective of assessing the vanadium price impact on the project economics.

The 2020 PEA includes an extension of the Project for a four-year period after the processing is completed, during which time the Project will sell sulphuric acid and energy. This assumption results in an increase of 13% and 36% to the after-tax cashflow and NPV @6% results, respectively. Wood has used conservative commodity prices for the sulphuric acid and energy and costs during this period to support a conceptual estimate. Future studies will require a deeper analysis of the sulphuric acid and energy market to confirm the assumptions. Actual results from those studies may vary from the assumptions in the 2020 PEA.

1.22 Risks and Opportunities

1.22.1 Geology and Exploration

Geophysical and structural interpretations indicate the potential for gold mineralization with affinities to Carlin Trend deposits, which warrants further investigation, and represents a Project opportunity

1.22.2 Metallurgical Testwork

There is some testwork evidence to suggest that lower comminution parameters may be applicable. The information was not included in the PEA design criteria for the milling circuit and represents an opportunity to modify the comminution design and reduce cost estimates.

The use of decanter centrifuges may be a viable solution for physical beneficiation of the Carlin vanadium material. Progressing to small-scale decanter centrifuge tests is considered to be a future opportunity.

There may be an opportunity to reduce overall mass through the process as the centrate shows an improvement over hydrocyclones. The caveat is that it is mass only, and would need to be carefully considered with corresponding analytical data to determine the vanadium recovery and carbonate rejection.

Based on the relative efficiency of centrifuges versus hydrocyclones there may be an opportunity to increase vanadium recovery and rejection rate of carbonates while reducing the overall mass pull.

There may be an opportunity for optimization of the concentrate thickener, starting with a nominally higher feed density, as the centrate has a higher solids content than hydrocyclone concentration product.

1.22.3 Mine Plan

A small portion of the pit design assumes that an agreement will be reached with the adjacent tenement holder, Nevada Gold Mines to allow a portion of the pit to extend for a distance of about 25–30 m onto ground held by Nevada Gold Mines. There is approximately 0.72 Mt, grading 0.62% V_2O_5 in the pit design that crosses the Project boundary, and is the only portion of the mine plan that would be at risk if an access agreement could not be concluded. The subset of the Mineral Resource estimate in the 2020 PEA mine plan does not include these mineralized blocks from the Nevada Gold Mines ground; the blocks are treated as though they were waste in the mine plan and are sent to the WRSF.

A better understanding of the PAG characteristics may impact the cost estimates if mitigation strategies need to be incorporated in updated mine designs.

Changes to the NSR values or NSR input values used to determine the low-grade and medium-grade stockpile tonnages and grade will have an effect on the mine and throughput plan assumptions, cost estimates, and economic analysis.

Drill factor assumptions are based on the rock to be mined having a soft to medium hardness. Test data may not confirm these assumptions, and if the material is harder than anticipated, this may result in changes to the cost estimates.

1.22.4 Recovery Plan

Mineralization upgrade or gangue rejection using cyclones has been applied on projects in the past, albeit at a coarser grind. The ultra-fine grind and the use of centrifuges instead of cyclones in the talc industry is common. However, the use of cyclones in a vanadium project as proposed in the 2020 PEA has not been done under commercial production.

Solid–liquid separation of ultra-fine slurries carries risk in the ability to achieve meaningful thickener and centrifuge slurry densities, and the impact on the selection and sizing of equipment for solid liquid separation processes.

The significant gangue acid consumption points to a high dissolved solids concentration and gypsum saturation, which would likely present challenges in the downstream processes.

Fluoride is present in the mineralization in low concentrations but could influence the selected materials of construction considering the high temperature and high acid concentrations in sections of the process.

1.22.5 Co-Disposal of Waste Rock and Coarse Fraction Upgrade Tailings

It is anticipated that additional testing and modeling will be required to satisfy the regulatory agencies that commingling waste (coarse fraction upgrade tailings and waste rock) and placing plant tailings and the fine fraction upgrade tailings in the open pit as backfill can be done without degrading waters of the State.

This method of co-disposal has not been used in Nevada, and so there is a risk to the Project cost and mine design assumptions if the regulatory authorities will not accept the commingling concept.

The 2020 PEA WRSF design was based on the estimate of waste rock tonnage to be stored. An assumption was made that the coarse upgrade tailings fraction would infill voids and spaces between the waste rocks. The WRSF design would need to be expanded to accommodate the additional 6.1 Mst of coarse upgrade tailings if this assumption is incorrect. There would be an increase in costs in conjunction with any WRSF expansion.

The 2020 PEA WRSF design assumed that the waste rock and tailings stored in the facility are not acid-generating and will not leach contaminants. Additional geochemical characterization will need to be done to confirm this. An underliner and drainage collection system may need to be incorporated into the design if the waste rock or tailings stored in the WRSF have the potential to release contaminants into the environment, and it is also likely that contact water management ponds would need to be constructed. This would increase costs related to the facility.

1.22.6 Tailings Storage Facility

The location of the TSF is conceptual. The site was selected so as to minimize both the Project footprint and the catchment reporting to the TSF, thereby facilitating water management. The tailings dam lies in the Project area, but the upstream tailings disposal area is outside First Vanadium's mineral tenure.

First Vanadium does not hold any surface rights in the upstream portion of the conceptual TSF area. There is a risk that surface rights may not be able to be obtained, or that the costs for obtaining the surface rights are outside those envisaged in the 2020 PEA.

The upstream portion of the conceptual TSF location is within mineral tenure held by third parties. There is a risk that the owner of the mineral rights that cover the conceptual TSF location could object to the TSF location as selected. Depending on the particulars of any objection, there is potential that the mine plan and cost estimates could be affected.

The 2020 PEA TSF design assumed that the tailings stored in the facility are not acid generating and will not leach contaminants. Additional geochemical characterization will need to be done to confirm this. Mitigation measures and geomembranes may need to be incorporated into the design if the tailings stored in the TSF have the potential to release contaminants into the environment. This would increase costs related to the facility.

1.22.7 Power Price Forecasting

There may be some minor upside potential for the operating cost estimate if the electricity that will be generated by First Vanadium's activities can qualify for a green energy bonus.

There is a risk to the cost estimates if the resale price estimated in the 2020 PEA for power sold into the grid is too high.

1.22.8 Acid Plant

There may be an opportunity to reduce acid plant costs if the acid plant can be modularized. Definitive quotes may result in decreases or increases to the plant costs as envisaged in the 2020 PEA.

1.22.9 Acid Consumption

The acid consumption estimate is based on the results of tests on two metallurgical composites that were assumed to be representative of the deposit. Additional testwork is required to confirm that these results are representative of the variability within the deposit as a whole. If the results are not representative, this could affect operating cost estimates, and the capital cost estimate for the acid plant.

The acid consumption formula is based on a combination of stoichiometry and extent of reaction, which has been matched to the testwork results. If these results are not representative of the variability within the deposit as a whole, there is a risk that the acid consumption will be higher than predicted, leading to increases in acid-related costs. Conversely the results may indicate that acid consumption will be lower than predicted, resulting in a project upside opportunity of acid-related cost reductions.

1.22.10 Acid Price Forecasting

Market conditions related to local or global acid pricing can be volatile. While the general assumption in the 2020 PEA is that acid is likely to be sold into the local market, this assumption primarily depends on activity within the local mining industry in Nevada. If the industry is in a downturn, the projected acid pricing may be too optimistic. If the industry is in an upturn, the projected acid pricing may be too low. If the acid is sold onto the global market, a similar risk and opportunity exist.

1.22.11 Acid Product

The assumption as to the ability to on-sell acid from the acid plant, particularly in the last years of the mine life as forecast in the 2020 PEA will be affected by the market conditions prevailing at the time. There is a risk that the market will be in oversupply, and the market assumptions may not be realized. There is an opportunity if the market is undersupplied, and there are more options for acid sales than are currently contemplated.

1.22.12 Blending of Oxide and Non-Oxide Mineralized Material

The oxide mill feed requires super-heated steam to achieve the operating temperature and pressure, whereas the non-oxide mill feed allows for autothermal operation. There may be potential to blend oxide and non-oxide material to reduce operating costs.

1.22.13 Vanadium Price Forecasting

Vanadium pricing is volatile, and there is a risk that the vanadium price will be lower than that envisaged in the 2020 PEA. Conversely, there have been historical periods where the vanadium price has been higher than that used in the 2020 PEA, and this is a potential Project upside if similar pricing highs occur during operations. The Project cashflow is most sensitive to fluctuations in the vanadium price and vanadium grade.

1.22.14 Vanadium Product

There may be potential to supply vanadium battery manufacturers, but no testwork has as yet been done to determine if this is an opportunity for the Project.

1.23 Interpretation and Conclusions

Under the assumptions set out in this 2020 PEA, the Project as envisaged shows a positive economic return.

1.24 Recommendations

Recommendations have been made for two phases of work. The second work phase is dependent on the results of the first phase.

The first recommended work phase comprises drilling, which is designed to investigate the gold target, and provide drill core for future metallurgical and geotechnical investigations. The phase also includes a metallurgical testwork program that will be undertaken to investigate possible reductions in the 2020 PEA capital and operating cost estimates.

Phase 2 recommendations would only be conducted if positive results in terms of cost reductions are obtained from the Phase 1 metallurgical testwork program. If undertaken, this phase would include step-out/infill drilling, advanced metallurgical tests, hydrological and geotechnical work, market studies, review of acid plant assumptions, consideration of the proposed waste–tailings co-disposal option, and geochemical characterization of the tailings and waste rock.

Recommendations Phase 1 is budgeted at approximately US$0.93–1.08 M. Recommendations Phase 2 is estimated at a total cost of about US$1.425–1.85 M.

2.0 INTRODUCTION

2.1 Introduction

First Vanadium Corp. (First Vanadium) requested that Wood Canada Limited, a Wood company (Wood), and SRK Consulting (U.S.) Inc (SRK) compile a technical report (the Report) on a preliminary economic assessment (PEA) study (2020 PEA) for the Carlin vanadium project (the Project), located in Nevada, USA.

2.2 Terms of Reference

The Report was prepared to support the outcomes of the 2020 PEA in the First Vanadium news release dated 11 May, 2020, entitled "First Vanadium Announces Positive Preliminary Economic Assessment for the Carlin Vanadium Project in Nevada".

Units used in the report are US customary units unless otherwise noted. The abbreviation "st" is used for US customary tons (short tons).

Monetary units are in United States dollars (US$) unless otherwise stated. The Report uses Canadian English.

Mineral Resources are reported in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014; the 2014 CIM Definition Standards).

2.3 Qualified Persons

The following serve as the qualified persons for this Technical Report as defined in National Instrument 43-101, Standards of Disclosure for Mineral Projects, and in compliance with Form 43-101F1:

- Dr. Antonio Peralta Romero, P.Eng., Open Pit Mining Manager Canada, Wood
- Ms. Susana Gonzales, P.Eng., Mining Engineer, Wood
- Mr. Alan Drake, Eng.L., Manager, Process Engineering, Wood
- Mr. Paul Baluch, P.Eng., Technical Director, Civil/Structural/Architectural, Wood
- Mr. Steven Truby, P.E., Senior Associate – Geotechnical, Wood
- Dr. Gregory Gosson, P.Geo., Technical Director, Geology & Compliance, Wood
- Dr. Bart Stryhas, CPG, Principal Associate Consultant, SRK.

Figure 2-1: Project Location Map

Note: Figure from Stryhas et al., 2019.

2.4 Site Visits and Scope of Personal Inspection

Mr. Paul Baluch visited the Project site from 6–7 November 2019. During the site visit, he inspected potential locations for key site infrastructure, including the process plant.

Dr. Bart Stryhas visited the site on 10 February 2010. During this visit, he viewed site conditions, and inspected locations of historical drill sites.

2.5 Effective Dates

The Report has a number of effective dates as follows:

- Date of the supply of the latest information on mineral tenure: 30 April, 2020
- Date of the Mineral Resource estimate: 31 January 2019
- Date of the economic analysis that supports the 2020 PEA: 11 May, 2020

The overall report effective date is the date of the economic analysis that supports the 2020 PEA and is 11 May, 2020.

2.6 Information Sources and References

2.6.1 General

Reports and documents listed in Section 3 and Section 27 of this Report were used to support preparation of the Report. Additional information was provided by First Vanadium personnel as requested. Supplemental information was also provided to the QPs by third-party consultants retained by First Vanadium in their areas of expertise.

2.6.2 SRK

Ms. Brooke Clarkson, CPG, an SRK employee, visited the Project site on 11 September, 2018. During that visit, Ms. Clarkson inspected the geological setting, and reviewed drill data with First Vanadium personnel. Ms. Clarkson provided feedback on these aspects to Dr. Stryhas.

2.7 Previous Technical Reports

First Vanadium has previously filed a technical report on the Project:

- Stryhas, B., Miller Clarkson, B., and Wright, F., 2019: NI 43-101 Technical Report, Carlin Vanadium Project Carlin, Nevada: report prepared by SRK Consulting (U.S.), Inc. for First Vanadium, effective date 31 January, 2019.

Prior to a name change to First Vanadium, Cornerstone Metals Inc. filed the following report on the Project:

- Stryhas, B., and Cooper J., 2017: NI 43-101 Technical Report on the Carlin Vanadium Project Carlin, Nevada: report prepared by report prepared by SRK Consulting (U.S.), Inc. for Cornerstone Metals Inc., effective date 25 October, 2017.

Prior to First Vanadium's Project interest, the following report was filed by EMC Metals Corp.:

- Stryhas, B., 2010: NI 43-101 Technical Report on Resources, EMC Metals Corp., Carlin Vanadium Project. Carlin, Nevada: report prepared by SRK Consulting (U.S.), Inc. for EMC Metals Corp., effective date 9 April, 2010.

3.0 RELIANCE ON OTHER EXPERTS

3.1 Introduction

The QPs have relied upon the following other expert report, which provided information regarding mineral rights, surface rights, property agreements, taxation, and marketing sections of this Report as noted below.

3.2 Project Ownership, Mineral Tenure, Surface Rights, Royalties and Encumbrances

The QPs have not reviewed the mineral tenure, nor independently verified the legal status, ownership of the Project area, underlying property agreements or permits. The QPs have fully relied upon, and disclaim responsibility for, information derived from experts retained by First Vanadium through the following document:

- Cowley P., 2020: Carlin Vanadium Project: letter prepared by First Vanadium and addressed to Mr. Ron Hamm, Project Manager, Wood Canada Limited, 30 April, 2020, 31 p.

This information is used in Section 4 of the Report. It is also used in support of the Mineral Resource statement in Section 14 and the economic analysis in Section 22.

3.3 Markets and Commodity Pricing

The QPs have relied upon, and disclaim responsibility for, information on the vanadium market and vanadium pricing derived from Roskill Consulting Group Ltd (Roskill) through the following documents:

- Roskill, 2019a: Vanadium Outlook to 2028: report prepared by Roskill Consulting Group Ltd, 5 March 2019, 20 p.
- Roskill, 2019b: Vanadium 17th Edition Update 2 - September 2019: report prepared by Roskill Consulting Group Ltd, September, 2019, 5 p.

This information is used in Section 19 of the Report. It is also used in support of the economic analysis in Section 22.

Wood considers it reasonable to rely on Roskill for this information as Roskill offers market reports that cover world supply and demand, the operations of the major producers, end-use market applications, price trends, international trade patterns and forecasts and cost curves and databases. Roskill is an independent, privately owned company and has nearly 50 years' experience of research and consulting in metals, minerals and chemical industries, and their end-use industries. The company provides published research and consultancy services for a wide variety of purposes—formulating company strategy, following industry trends, planning exploration and marketing activities, competitor analysis, training new staff and gaining a complete overview of a single industry. End-users of the information include mining, chemical, engineering and exploration companies, investment houses and financial institutions, government organisations, trading organisations, universities, and manufacturers using metals and minerals in their products.

The QPs verified the reasonableness of the vanadium pricing information in the Roskill reports by cross-checking against publicly-available documentation from other vanadium projects globally. The checks indicated that the Roskill pricing bracketed the pricing used by the reviewed projects. The QPs also reviewed the three-year and five-year trailing average pricing in the European and Chinese markets, and concluded that the Roskill pricing was also bracketed by these averaged data.

3.4 Taxation

The QPs have relied upon, and disclaim responsibility for, information on the vanadium market and vanadium pricing derived from First Vanadium and their taxation consultants Mining Tax Plan LLC through the following document:

Mining Tax Plan LLC, 2020: untitled: letter from Mining Tax Plan LLC to Mr. Paul Cowley, Chief Operating Officer, First Vanadium regarding taxation considerations to be used in the 2020 PEA, 7 May 2020, 3 p.

This information is used in support of the economic analysis in Section 22 of the Report.

4.0 PROPERTY DESCRIPTION AND LOCATION

4.1 Introduction

The Project is situated about six miles due south of the town of Carlin and 22 miles due southwest of Elko, in Nevada.

The vanadium deposit is centered about UTM Zone 11N geographical coordinates 574,328E, 4,495,637N (Lat 40°36′29″N, Long 116°07′17″W).

4.2 Property and Title in Nevada

Information in this sub-section has been compiled from Papke et al., (2019). The QPs have not independently verified this information, and have relied upon the Papke et al. report, which is in the public domain, for the data presented.

4.2.1 Mineral Title

Federal (30 USC and 43 CFR) and Nevada (NRS 517) laws concerning mining claims on Federal land are based on an 1872 Federal law titled "An Act to Promote the Development of Mineral Resources of the United States." Mining claim procedures still are based on this law, but the original scope of the law has been reduced by several legislative changes.

The Mineral Leasing Act of 1920 (30 USC Chapter 3A) provided for leasing of some non-metallic materials; and the Multiple Mineral Development Act of 1954 (30 USC Chapter 12) allowed simultaneous use of public land for mining under the mining laws and for lease operation under the mineral leasing laws. Additionally, the Multiple Surface Use Act of 1955 (30 USC 611-615) made "common variety" materials non- locatable; the Geothermal Steam Act of 1970 (30 USC Chapter 23) provided for leasing of geothermal resources; and the Federal Land Policy and Management Act of 1976 (the "BLM Organic Act," 43 USC Chapter 35) granted the Secretary of the Interior broad authority to manage public lands. Most details regarding procedures for locating claims on Federal lands have been left to individual states, providing that state laws do not conflict with Federal laws (30 USC 28; 43 CFR 3831.1).

Mineral deposits are located either by lode or placer claims (43 CFR 3840). The locator must decide whether a lode or placer claim should be used for a given material; the decision is not always easy but is critical. A lode claim is void if used to acquire a placer deposit, and a placer claim is void if used for a lode deposit. The 1872 Federal law requires a lode claim for "veins or lodes of quartz or other rock in place" (30 USC 26; 43 CFR 3841.1), and a placer claim for all "forms of deposit, excepting veins of quartz or other rock in place" (30 USC 35). The maximum size of a lode claim is 1,500 ft in length and 600 ft in width, whereas an individual or company can locate a placer claim as much as 20 acres in area.

Claims may be patented or unpatented. A patented claim is a lode or placer claim or mill site for which a patent has been issued by the Federal Government, whereas an unpatented claim means a lode or placer claim, tunnel right or mill site located under the Federal (30 USC) act, for which a patent has not been issued.

4.2.2 Surface Rights

About 85% of the land in Nevada is controlled by the Federal Government; most of this land is administered by the US Bureau of Land Management (BLM), the US Forest Service (USFS), the US Department of Energy, or the US Department of Defense. Much of the land controlled by the BLM and the USFS is open to prospecting and claim location. The distribution of public lands in Nevada is shown on the BLM "Land Status Map of Nevada" (1990) at scales of 1:500,000 and 1:1,000,000.

Bureau of Land Management regulations regarding surface disturbance and reclamation require that a notice be submitted to the appropriate BLM Field Office for exploration activities in which five acres or fewer are proposed for disturbance (43 CFR 3809.1-1 through 3809.1-4). A Plan of Operations is needed for all mining and processing activities, plus all activities exceeding five acres of proposed disturbance. A Plan of Operations is also needed for any bulk sampling in which 1,000 or more tons of presumed mineralized material are proposed for removal (43 CFR 3802.1 through 3802.6, 3809.1-4, 3809.1-5). The BLM also requires the posting of bonds for reclamation for any surface disturbance caused by more than casual use (43 CFR 3809.500 through 3809.560). The USFS has regulations regarding land disturbance in forest lands (36 CFR Subpart A). Both agencies also have regulations pertaining to land disturbance in proposed wilderness areas.

4.2.3 Environmental Regulations

All surface management activities, including reclamation, must comply with all pertinent Federal laws and regulations, and all applicable State environmental laws and regulations.

Exploration activities conducted under a Plan of Operations are required to comply with the National Environmental Policy Act (NEPA). Generally, NEPA compliance for exploration activity is through the development of an Environmental Assessment (EA), although depending on the significance of impacts determined to occur, an Environmental Impact Statement (EIS) may be required.

The fundamental requirement, implemented in 43 CFR 3809, is that all hard-rock mining under a Plan of Operations (PoO) or Notice on the public lands must prevent unnecessary or undue degradation. The PoO and any modifications to the approved PoO must meet the requirement to prevent unnecessary or undue degradation.

Authorization to allow the release of effluents into the environment must be in compliance with the Clean Water Act, Safe Drinking Water Act, Endangered Species Act, other applicable Federal and State environmental laws, consistent with BLM's multiple-use responsibilities under the Federal Land Policy and Management Act and fully reviewed in the appropriate National Environmental Policy Act (NEPA) document.

The primary State agency regulating exploration and mining activities is the Nevada Division of Environmental Protection (NDEP) Bureau of Mining Regulation and Reclamation (BMRR). The BMRR has regulatory authority for issuing reclamation permits and water pollution control permits for mining projects located on private and federally managed lands.

4.2.4 Fraser Institute Policy Perception Index

Wood has used the Policy Perception Index from the 2019 Fraser Institute Annual Survey of Mining Companies report (the 2019 Fraser Institute survey) as a credible source for the assessment of the overall political risk facing an exploration or mining project in Nevada. Each year, the Fraser Institute sends a questionnaire to selected mining and exploration companies globally. The Fraser Institute survey is an attempt to assess how mineral endowments and public policy factors such as taxation and regulatory uncertainty affect exploration investment.

Wood has relied on the 2019 Fraser Institute survey because it is globally regarded as an independent report-card style assessment to governments on how attractive their policies are from the point of view of an exploration manager or mining company and forms a proxy for the assessment by industry of political risk in specific political jurisdictions from the mining industry's perspective.

Of the 76 jurisdictions surveyed in the 2019 Fraser Institute survey, Nevada ranks third for investment attractiveness, third for policy perception and eighth for best practices mineral potential.

4.3 Project Ownership

First Vanadium has a 100% option interest in 72 claims owned by Golden Predator U.S. Holding Corp. (Golden Predator; refer to discussion in Section 4.4.3).

A further 80 acres of mineral rights are held from a third party through a Mineral Lease Agreement.

First Vanadium has added 78 unpatented lode claims adjacent and proximal to the original property in the name of its wholly-owned subsidiary Copper One USA, Inc.

4.4 Mineral Tenure

4.4.1 Tenure Overview

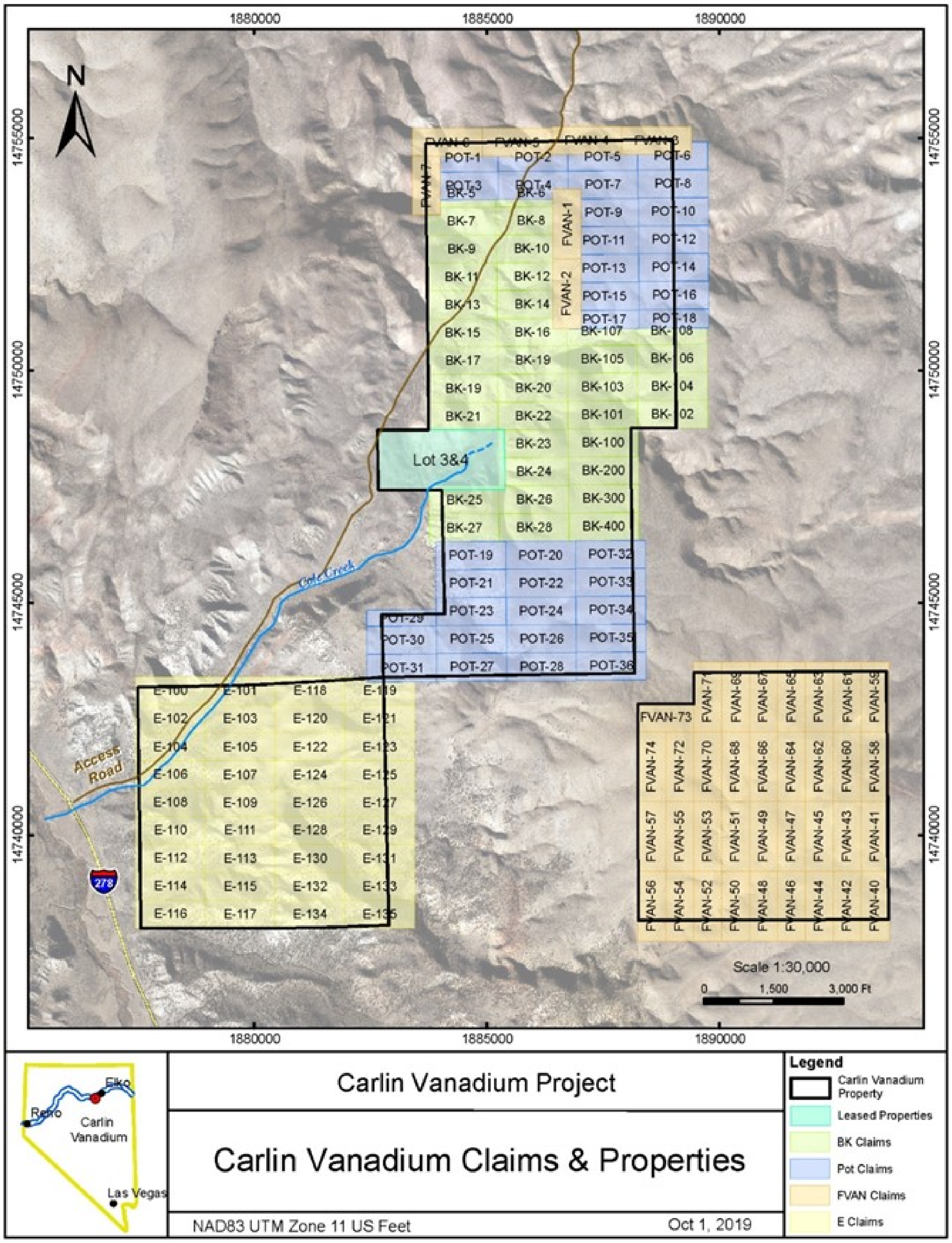
The Project consists of 150 unpatented mining claims totaling 2,528 acres (excluding overlaps and portions of claims outside section limits) and approximately 80 acres of fee simple land through a Mineral Lease Agreement covering a total of 2,608 acres. A summary figure showing the overall claim locations is provided as Figure 4-1. These claims are listed in Table 4-1.

The vanadium deposit lies on claims BK 001 through 017, 019 and 021 and Lots 3 and 4 of APN 005-04A-001 (Figure 4-2).

4.4.2 Validity of Title

First Vanadium provided the QP with a receipt for US$11,880 from the United States Department of the Interior Bureau of Land Management dated August 14, 2019 for full payment of maintenance on the original 72 claims (BK and Pot claims). The receipt confirms that all unpatented mining claims have had the 2019 to 2020 federal mining claim maintenance fees paid on August 14, 2019 and the Notice of Intent to Hold recorded in Elko County, NV on August 20, 2019 as document 0758251. By making the maintenance fee and the federal fee requirements for each claim, the claims are in good standing for the assessment year ending noon 1 September, 2020. The receipt identifies Golden Predator U.S. Holdings Corp. as the owner of the original 72 (BK and Pot) claims.

Figure 4-1: Mineral Tenure Summary Plan



Note: Figure courtesy First Vanadium, 2019.

Table 4-1: Claims Table

Claim Name	BLM Serial Number	Lead Serial Number	Claimant Name	Location Date	Type	Expiration Date
FVAN 1	NMC1185385	NMC1185385	Copper One USA, Inc.	Nov 19, 2018	Lode	Aug 31, 2020
FVAN 2	NMC1185386	NMC1185385	Copper One USA, Inc.	Nov 19, 2018	Lode	Aug 31, 2020
FVAN 3	NMC1185387	NMC1185385	Copper One USA, Inc.	Nov 19, 2018	Lode	Aug 31, 2020
FVAN 4	NMC1185388	NMC1185385	Copper One USA, Inc.	Nov 19, 2018	Lode	Aug 31, 2020
FVAN 5	NMC1185389	NMC1185385	Copper One USA, Inc.	Nov 19, 2018	Lode	Aug 31, 2020
FVAN 6	NMC1185390	NMC1185385	Copper One USA, Inc.	Nov 19, 2018	Lode	Aug 31, 2020
FVAN 7	NMC1185391	NMC1185385	Copper One USA, Inc.	Nov 19, 2018	Lode	Aug 31, 2020
E100	NMC1185570	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E101	NMC1185571	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E102	NMC1185572	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E103	NMC1185573	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E104	NMC1185574	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E105	NMC1185575	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E106	NMC1185576	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E107	NMC1185577	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E108	NMC1185578	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E109	NMC1185579	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E110	NMC1185580	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E111	NMC1185581	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E112	NMC1185582	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E113	NMC1185583	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E114	NMC1185584	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020

Claim Name	BLM Serial Number	Lead Serial Number	Claimant Name	Location Date	Type	Expiration Date
E115	NMC1185585	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E116	NMC1185586	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E117	NMC1185587	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E118	NMC1185588	NMC1185570	Copper One USA, Inc.	Nov 06, 2018	Lode	Aug 31, 2020
E119	NMC1185589	NMC1185570	Copper One USA, Inc.	Nov 06, 2018	Lode	Aug 31, 2020
E120	NMC1185590	NMC1185570	Copper One USA, Inc.	Nov 06, 2018	Lode	Aug 31, 2020
E121	NMC1185591	NMC1185570	Copper One USA, Inc.	Nov 06, 2018	Lode	Aug 31, 2020
E122	NMC1185592	NMC1185570	Copper One USA, Inc.	Nov 06, 2018	Lode	Aug 31, 2020
E123	NMC1185593	NMC1185570	Copper One USA, Inc.	Nov 06, 2018	Lode	Aug 31, 2020
E124	NMC1185594	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E125	NMC1185595	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E126	NMC1185596	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E127	NMC1185597	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E128	NMC1185598	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E129	NMC1185599	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E130	NMC1185600	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E131	NMC1185601	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E132	NMC1185602	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E133	NMC1185603	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E134	NMC1185604	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
E135	NMC1185605	NMC1185570	Copper One USA, Inc.	Nov 05, 2018	Lode	Aug 31, 2020
FVAN 40	NMC1187381	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 41	NMC1187382	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020

Claim Name	BLM Serial Number	Lead Serial Number	Claimant Name	Location Date	Type	Expiration Date
FVAN 42	NMC1187383	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 43	NMC1187384	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 44	NMC1187385	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 45	NMC1187386	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 46	NMC1187387	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 47	NMC1187388	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 48	NMC1187389	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 49	NMC1187390	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 50	NMC1187391	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 51	NMC1187392	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 52	NMC1187393	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 53	NMC1187394	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 54	NMC1187395	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 55	NMC1187396	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 56	NMC1187397	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 57	NMC1187398	NMC1187381	Copper One USA, Inc.	Dec 10, 2018	Lode	Aug 31, 2020
FVAN 58	NMC1187399	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 59	NMC1187400	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 60	NMC1187401	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 61	NMC1187402	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 62	NMC1187403	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 63	NMC1187404	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 64	NMC1187405	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020

Claim Name	BLM Serial Number	Lead Serial Number	Claimant Name	Location Date	Type	Expiration Date
FVAN 65	NMC1187406	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 66	NMC1187407	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 67	NMC1187408	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 68	NMC1187409	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 69	NMC1187410	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 70	NMC1187411	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 71	NMC1187412	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 72	NMC1187413	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 73	NMC1187414	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
FVAN 74	NMC1187415	NMC1187381	Copper One USA, Inc.	Dec 09, 2018	Lode	Aug 31, 2020
BK-22	NMC821342	NMC821342	Golden Predator US Holding Corp	Sep 08, 2000	Lode	Aug 31, 2020
BK-23	NMC821343	NMC821342	Golden Predator US Holding Corp	Sep 08, 2000	Lode	Aug 31, 2020
BK-24	NMC821344	NMC821342	Golden Predator US Holding Corp	Sep 08, 2000	Lode	Aug 31, 2020
POT 1	NMC841816	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 10	NMC841825	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 11	NMC841826	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 12	NMC841827	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 13	NMC841828	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 14	NMC841829	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 15	NMC841830	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 16	NMC841831	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 17	NMC841832	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 18	NMC841833	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020

Claim Name	BLM Serial Number	Lead Serial Number	Claimant Name	Location Date	Type	Expiration Date
POT 19	NMC841834	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 2	NMC841817	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 20	NMC841835	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 21	NMC841836	NMC841816	Golden Predator US Holding Corp	Oct 21, 2002	Lode	Aug 31, 2020
POT 22	NMC841837	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 23	NMC841838	NMC841816	Golden Predator US Holding Corp	Oct 21, 2002	Lode	Aug 31, 2020
POT 24	NMC841839	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 25	NMC841840	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 26	NMC841841	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 27	NMC841842	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 28	NMC841843	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 29	NMC841844	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 3	NMC841818	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 30	NMC841845	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 31	NMC841846	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 32	NMC841847	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 33	NMC841848	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 34	NMC841849	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 35	NMC841850	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 36	NMC841851	NMC841816	Golden Predator US Holding Corp	Oct 20, 2002	Lode	Aug 31, 2020
POT 4	NMC841819	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 5	NMC841820	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 6	NMC841821	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020

Claim Name	BLM Serial Number	Lead Serial Number	Claimant Name	Location Date	Type	Expiration Date
POT 7	NMC841822	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 8	NMC841823	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
POT 9	NMC841824	NMC841816	Golden Predator US Holding Corp	Oct 18, 2002	Lode	Aug 31, 2020
BK-10	NMC844510	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-100	NMC844526	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-101	NMC844527	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-102	NMC844528	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-103	NMC844529	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-104	NMC844530	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-105	NMC844531	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-106	NMC844532	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-107	NMC844533	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-108	NMC844534	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-11	NMC844511	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-12	NMC844512	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-13	NMC844513	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-14	NMC844514	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-15	NMC844515	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-16	NMC844516	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-17	NMC844517	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-18	NMC844518	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-19	NMC844519	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-20	NMC844520	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020

Claim Name	BLM Serial Number	Lead Serial Number	Claimant Name	Location Date	Type	Expiration Date
BK-200	NMC844535	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-21	NMC844521	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-25	NMC844522	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-26	NMC844523	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-27	NMC844524	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-28	NMC844525	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-300	NMC844536	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-400	NMC844537	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-5	NMC844505	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-6	NMC844506	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-7	NMC844507	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-8	NMC844508	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020
BK-9	NMC844509	NMC844505	Golden Predator US Holding Corp	Dec 12, 2002	Lode	Aug 31, 2020

Figure 4-2: Mineralization in Relation to Claim Boundaries

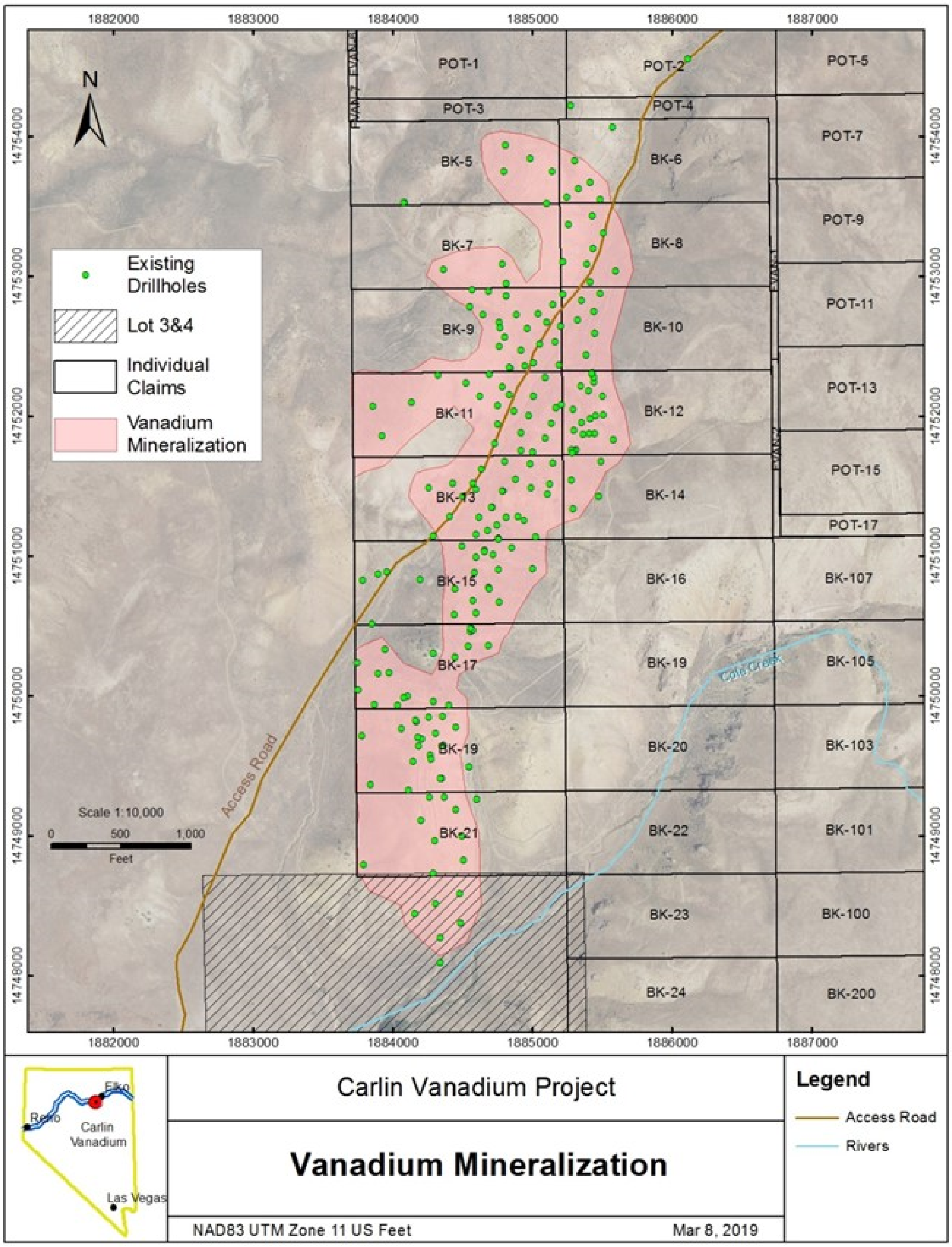


Figure courtesy First Vanadium, 2020.

First Vanadium has provided the QP with a receipt of US$12,870 from the United States Department of the Interior Bureau of Land Management dated August 14, 2019 for full payment of maintenance on the FVAN 1-7, FVAN 40-74 and E100-135 claims staked in the name of Copper One USA, Inc. By making the maintenance fee and the federal fee requirements for each claim, the claims are in good standing for the assessment year ending noon 1 September, 2020. The receipt identifies Copper One USA, Inc. as the owner of the FVAN 1-7, FVAN 40-74 and E 100-135 claims.

First Vanadium has also provided the QP with receipts for US$1,594 for Elko county fees paid August 20, 2019 for these claims and a receipt for US$344 for Eureka county fees paid August 20, 2019 for these claims.

4.4.3 BK and Pot Claims, Golden Predator US Holding Corp

The original BK and Pot claims are owned by Golden Predator. Americas Gold Exploration Inc. (AGEI), a private Nevada corporation held an option to acquire 100% of the Carlin Vanadium Project from Golden Predator which was then assigned to First Vanadium (then operating as Cornerstone Metals Inc. or Cornerstone) through a signed definitive Assignment Agreement with AGEI dated 22 September, 2017. The definitive Assignment Agreement outlined the terms under which AGEI would assign its interest to First Vanadium. The closing of the deal was subject to TSX Venture exchange approval, which was granted on 9 November, 2017.

First Vanadium assumes all of the optionee's obligations to Golden Predator set out in the five-year underlying option agreement, which include cash payments totaling US$75,000 (US$25,000 made as of date of this Report) and US$400,000 in work commitments over 2.5 years (completed as of date of this Report). In addition to these commitments, a US$1.91 million payment would complete the option exercise requirements, at which time First Vanadium would acquire a 100% interest in the claims, subject to a 2% net smelter return (NSR) royalty in favor of Golden Predator., The NSR royalty could be bought out at the time of option exercise for US$4 million.

As set out in the definitive Assignment Agreement, First Vanadium paid AGEI total cash payments of US$50,000 and issued to AGEI two million shares of First Vanadium, in two tranches. First Vanadium must produce a PEA on the claims within four years. Once the underlying option agreement is fully exercised by First Vanadium, AGEI was to be granted a 1.5% NSR which could be entirely bought out at any time by First Vanadium for a total of US$3 million. On November 30, 2018, First Vanadium extinguished this 1.5% NSR early by making an issuance of 1.3 million shares of First Vanadium to AGEI.

4.4.4 Access and Mineral Lease Agreement, Cole Creek Property

On January 31, 2019, First Vanadium announced entering into an Access and Mineral Lease Agreement to approximately 80 acres of private (fee simple) land immediately adjacent to the Carlin Vanadium property (referred to as the Cole Creek property), specifically a portion of APN 005-04A- 001 Lot 3 and Lot 4, in Section 4, Township 31N., Range 52 E. Pursuant to the terms of the Access and Mineral Lease Agreement, First Vanadium paid the Julian Tomera Ranches, Inc., Stonehouse Division (the lessor) US$50,000 on signing, and is required to pay an additional US$20,000 annually for the lease of all minerals beneath the surface of, within or that may be produced from the Cole Creek property. In the event that First Vanadium commences mining operations on the Cole Creek property, the annual payments will be replaced with a 5% NSR royalty in favor of the lessor. Pursuant to the terms of the lease, First Vanadium is also required to incur at least US$100,000 expenditures on the property within 36 months, or to remedy any shortfall by making a cash payment to the lessor in the amount of such shortfall. The term of the lease is for an initial five-year period which may be extended, at the First Vanadium's option, for additional five-year periods provided that First Vanadium remains in good standing under the agreement. First Vanadium has the right to terminate the lease portion of the agreement without terminating the road access portion of the agreement.

The lessor also owns or has rights to certain lands containing roads which First Vanadium wishes to use for access to the Cole Creek property and to the Carlin Vanadium property. The Access and Mineral Lease Agreement grants to First Vanadium the right to access such lands and roads by making annual payments during the exploration period, First Vanadium is also required to build and maintain a gate and cattle guard in order to keep its access rights in good standing. In addition, amongst other matters including compensation for lost cattle and lost grazing, the agreement also contemplates that upon commencement of development and mining operations, First Vanadium will construct additional roads to be agreed upon between First Vanadium and the lessor and at such time First Vanadium will pay the lessor additional fees for the new road access until mining ceases and reclamation is completed. The access rights have been granted for an initial five-year term which may be extended, at First Vanadium's option, for additional five-year periods provided First Vanadium remains in good standing under the agreement.

4.5 Surface Rights

The Project consists chiefly of unpatented mining claims, the surface estate of which is owned by the United States, and administered by the Department of Interior, Bureau of Land Management (BLM). A mining claimant has the right to use the surface estate of the lands to develop the mineral interest of the claim. These lands have guaranteed public access which is governed by United States law. No easements or rights of way are required for access over public lands.

A small part of the property (80 acres), Lot 3 and 4, are fee simple land. First Vanadium has an access agreement with the owner of the fee simple land.

4.6 Water Rights

There is currently no developed water supply, or grant of water rights attached to the project. Water rights can be granted following application to the State.

4.7 Royalties and Encumbrances

A 2% NSR in favor of the property owner of the Carlin Vanadium property, Golden Predator, will be incurred when First Vanadium acquires a 100% property ownership. This royalty can be bought out at the time of option exercise for US$4 million.

AGEI was to be granted a 1.5% NSR which could be entirely bought out at any time by First Vanadium for a total of US$3 million. On November 30, 2018, First Vanadium extinguished this 1.5% NSR early by making an issuance of 1.3 million shares of First Vanadium to AGEI.

A 5% NSR in favour of the property owner of the Cole Creek property will be incurred in the event that First Vanadium commences mining operations on the Cole Creek property.

4.8 Permitting Considerations

Permits that will be required in support of Project development are discussed in Section 20.

4.9 Environmental Considerations

Environmental studies and environmental permitting that will be required in support of Project development are discussed in Section 20.

4.9.1 Notices of Intent

In November 2017, First Vanadium submitted a Notice of Intent (NOI) application to the BLM for proposed surface disturbance related to exploration drilling. Proposed activities included new road construction, and new drill pad construction from new and existing roads. Total estimated new disturbance to date under the NOI is estimated at 4.9 acres. The reclamation bond paid by First Vanadium was equal to the estimated cost of reclaiming the proposed disturbance.

Exploration drilling conducted in December 2017 through present was permitted with the 2017 NOI filed with the BLM in early November 2017, and with the approved reclamation bond accepted in early December 2018.

First Vanadium submitted a PoO application with the BLM in May 2020 to ramp up surface disturbance to a maximum of 100 acres. Cultural, botany, soil, terrain and wildlife studies were undertaken in 2018 and were submitted with the PoO application.

4.9.2 Environmental Liabilities

Current environmental liabilities at the Project are limited to road and drill pad construction from the 2017–2018 drilling programs. Reclamation of disturbance related to these activities is bonded with the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM).

Historical environmental liabilities are restricted to drill access roads and drill sites, which were left as constructed, as was the standard industry practice at the time.

4.10 Social License Considerations

Social licence considerations that will need to be addressed in support of Project development are discussed in Section 20.

4.11 Comments on Section 4

The QP notes:

- The Carlin Vanadium property is held under option. All required statutory expenditure and reporting have been made as of 30 April, 2020
- The Cole Creek property is held under lease and agreement. All required statutory expenditure and reporting have been made as of 30 April, 2020
- There are two project royalties. One, on the Carlin Vanadium property, payable to Golden Predator, consists of a 2.0% NSR that is payable once the First Vanadium option is exercised. The second, on the Cole Creek property, is payable to Julian Tomera Ranches, Inc., Stonehouse Division, and will be incurred once mining starts on that property
- A mining claimant has the right to use the surface estate of the lands to develop the mineral interest of the claim. These lands have guaranteed public access which is governed by United States law. No easements or rights of way are required for access over public lands. First Vanadium has an access agreement with the owner of the fee simple land
- There is currently no developed water supply, or grant of water rights attached to the project. Water rights can be granted following application to the State
- There is an expectation of environmental liabilities associated with historical mining and exploration activity.

First Vanadium advised that to the extent known, there are no other significant factors and risks that may affect access, title or right or ability to perform work on the Project.

5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

5.1 Accessibility

The Project can be accessed from the town of Carlin, via two road routes; one approaching from the south and one approaching from the north. The southern approach follows the paved Nevada State Highway 278, a major north–south highway, for a distance of 11.5 miles, then via a one-lane dirt road which leads, after 1.5 miles, to the Project area. Travel time is approximately 20 minutes by vehicle. The northern approach is south from Carlin for a distance of 1.5 miles along Highway 278, followed by seven miles of one-lane dirt road to the Project area. Travel time is approximately 30 minutes due to the poorer road conditions.

The Union Pacific Railroad and US Interstate Highway 80 both run through the town of Carlin, where there are rail sidings, and rail links to both US coasts.

The Project location showing adjacent transportation infrastructure is shown in Figure 5-1.

Regularly scheduled air passenger service is available in Elko, Nevada, which is located 21 miles east of the town of Carlin.

5.2 Climate

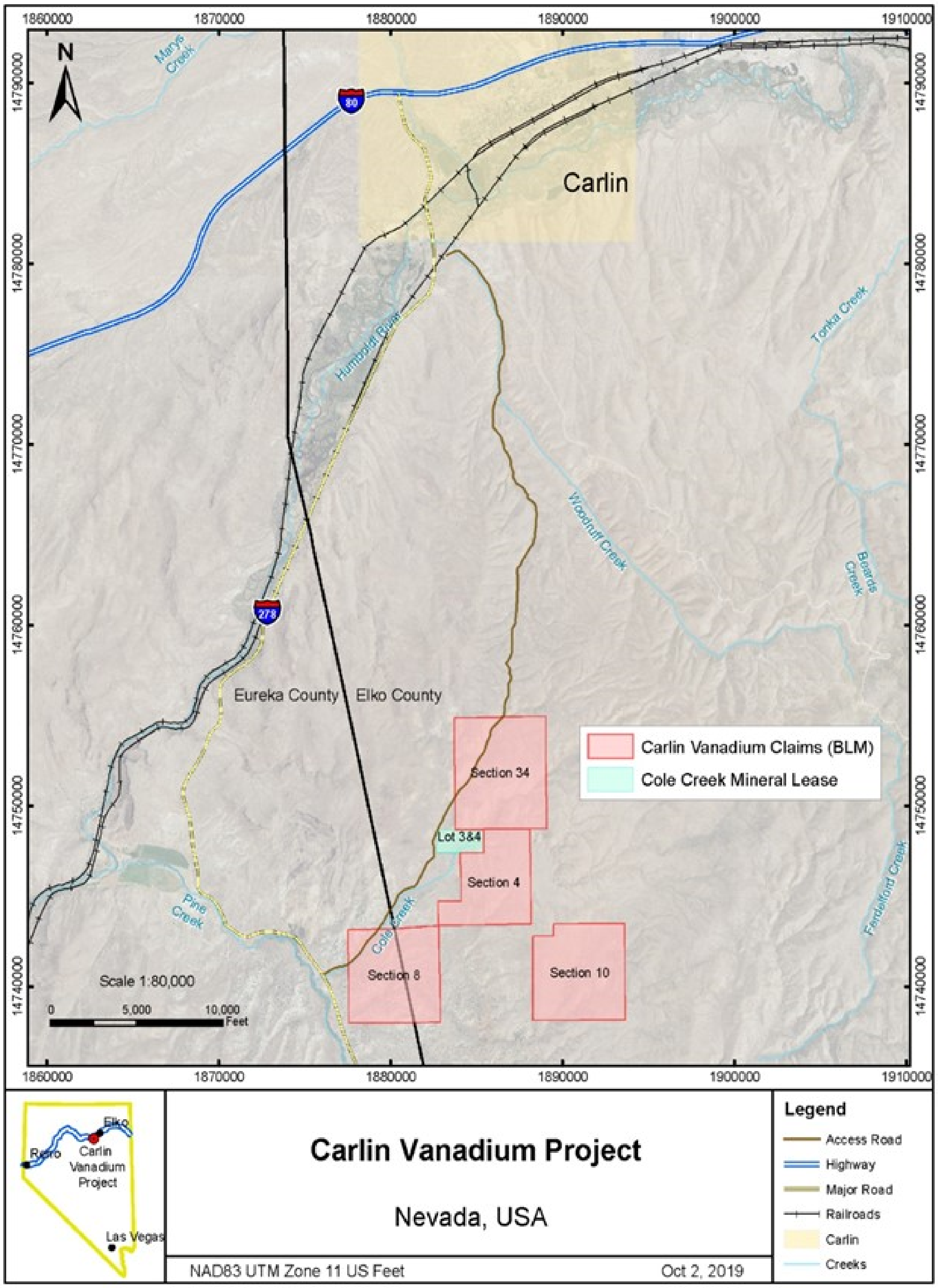
The climate is typical for the high-desert regions of central Nevada, with hot, dry summers and cold, snowy winters.

Summer temperatures are typically about 80°F, but highs can peak at 95°F. Winter temperatures range between lows of 0°F to 20°F to highs of 30°F to 40°F.

Most of the regional precipitation falls as snow in the winter months. Rainfall occurs as mild showers in the spring and as severe thunderstorms during the late summer.

Mining operations in the region are conducted year-round, and it is expected that the proposed Carlin Vanadium operation will also be year-round. Exploration activities can be conducted year-round but may be curtailed for short periods due to high snowfall or rainfall.

Figure 5-1: Project Access



Note: Figure courtesy First Vanadium, 2019.

5.3 Local Resources and Infrastructure

Carlin and Elko are the closest towns with a significant population to provide manpower for a mining operation. Elko currently support numerous large-scale mining operations and is a major hub for the supply of mining consumables.

The closest electrical transmission line is located along Highway 278. There is also a transmission line that is approximately five miles northeast of the property which services Newmont's Emigrant Mine.

Additional information on the infrastructure contemplated as part of the PEA is provided in Section 18.

5.4 Physiography

The Project lies within the Basin and Range physiographic province of east-central Nevada. This province consists of northerly trending mountain ranges with 2,000 to 5,000 ft of topographic relief above relatively broad and flat intervening valleys. The vanadium-mineralized area is situated along the western flank of the Piñon Range within the headwaters of Cole Creek. Topography is characterized by moderate to steeply sloped hillsides at elevations ranging from 6,000 to 6,500 ft above sea level.

The hills and ridges are covered by thin soil and colluvial sediments. Outcrop is generally moderate, perhaps 15% to 30% or less over the entire property.

Vegetation is typical of the Basin and Range Province, varying locally between none and sparse desert vegetation. North-facing slopes are slightly more vegetated than south-facing slopes. Typical vegetation found at the site includes pinion pine, juniper, creosote bush, sagebrush and a variety of desert grasses and flowers.

5.5 Comments on Section 5

The QP notes:

The Project is at an early evaluation stage. The existing local infrastructure, availability of staff, and methods whereby goods could be transported to the Project area to support exploration activities are well understood by First Vanadium, and can support the declaration of Mineral Resources.

The Project covers an area that is sufficient for a portion of the infrastructure requirements to support a mining operation. The proposed tailings storage facility (TSF) is conceptually sited for 2020 PEA purposes in an area where First Vanadium holds neither surface nor mineral rights (refer to discussion in Section 25.15.6). The open pit design assumes that agreement will be reached to allow a small portion of the pit layback onto the adjacent claim holdings (see discussion in Section 16.4 and Section 25.15.3).

Surface rights are discussed in Section 4.5.

Adjacent mining operations are conducted year-round, and it is expected that any operation conducted by First Vanadium would also be year-round.

6.0 HISTORY

6.1 Exploration History

6.1.1 Vanadium

Union Carbide Corporation (UCC) undertook the first exploration programs in the period 1966–1968. No additional on-ground work was conducted until First Vanadium acquired its Project interest in 2017.

Exploration work conducted for vanadium is summarized in Table 6-1.

6.1.2 Gold

The Project area is within the Carlin Gold Trend. The Black Kettle prospect, on the other side of Cole Creek from the Carlin Vanadium deposit, has been explored in the period 1985–1993, with most of the work being completed in 1991–1993 (Table 6-2).

The results of the 1991–1993 exploration programs identified a structural/stratigraphic target with anomalous gold and mercury mineralization. The occurrence has an area of 1,000 ft by 500 ft and trends northeast. There are also two small east–west zones up to 10 ft wide of silicification (multi-episodic chalcedonic banding) cutting the limestone unit on the southern part of Section 34.

Of the 11 shallow reverse circulation (RC) drill holes completed over the Black Kettle prospect, eight encountered elevated gold values, or encountered elevated mercury tenors. There is no record of any additional exploration work conducted after the 1993 exploration season.

6.2 Production

There has been no formal vanadium or gold production from the Project area.

Table 6-1: Vanadium Exploration History

Dates	Company	Comment
1966–1968	UCC	Staked IZA claims. Completed a total of 17.8 line miles of road building. Surface mapping, trenching and sampling, auger and rotary drilling were conducted. Completed 70 caterpillar-dig trenches; aggregate total length of approximately 3.3 miles (17,400 ft). About 1,000 assays were taken from these trenches, with individual samples as horizontal chips across 3–10 ft intervals A total of 127 rotary drill holes (31,095 ft or 9,478 m) completed. Undertakes resource estimate.
1967–1972	UCC and U.S. Dept. of Interior, Bureau of Mines	Metallurgical testwork on trench samples and drill cuttings, focusing on a salt roast process to extract vanadium
2002	Teck/Cominco and Great American Minerals Corporation (GAM)	Claims Pot-1 through Pot-36 staked by Teck/Cominco and transferred to GAM, a private US company.
2003	GAM	March: Claims BK-5 through BK-28, BK-100 through BK-108, BK-22, BK-300 and BK-400 deeded to GAM by Donald McDowell May: BK-22 through BK-24 deeded to GAM from Donald McDowell August: Pot-1 through Pot-36 were deeded to GAM again via a corrected quitclaim deed by Teck/Cominco
2008	Golden Predator U.S. Holding Corp.	Claims transferred into the name of Golden Predator U.S. Holding Corp., a subsidiary of Golden Predator Mines Inc., through the acquisition of GAM
2009	EMC Metals Corp. (EMC)	Golden Predator Mines Inc. changes its name to EMC.
2010	EMC	Resource estimate using historical UCC data
2017	AGEI	A private Nevada company, AGEI options claims from Golden Predator U.S. Holding Corp.
2017	Cornerstone Metals Inc. (Cornerstone)	Entered into a non-binding Letter of Intent (LOI) to acquire a 100% interest in the underlying AGEI option agreement for the Carlin Vanadium Project. Completes due diligence.
2017	AGEI/Cornerstone	Assigned the option to Cornerstone through a signed definitive Assignment Agreement with Cornerstone.
2017–2018	Cornerstone	Aerial surveys that generated orthophotos, geological mapping, and core and reverse circulation drilling, totalling 89 holes (20,521 ft or 6,255 m). Staked 110 unpatented lode claims.

Dates	Company	Comment
2018	Cornerstone/First Vanadium	Changes name from Cornerstone Metals Inc. to First Vanadium Corp., effective 25 September, 2018.
2018	First Vanadium	Acquires 80 acres of fee-simple land via Access and Mineral Lease Agreement
2019	First Vanadium	Completes Mineral Resource estimate.
2020	First Vanadium	PEA, including supporting mining, process, and environmental studies, and metallurgical testwork.

Table 6-2: Gold Exploration History

Dates	Company	Comment
1985	Santa Fe Pacific Mining (Santa Fe)	Drilled six holes totaling 1,865 ft. There are currently no detailed records of the results of this work in the data files. A single cross section shows one of the holes encountered silicification associated with iron oxides
1991	Cambior USA Inc (Cambior)	Optioned the prospect from Santa Fe. Completed soil sampling, followed by rock chip sampling. Identified an anomalous gold zone within the Woodruff Formation. The gold zone extended 550 ft along strike and intensified at the contact with overlying Permian-Pennsylvanian rocks. The mineralization was believed to follow a north striking, steeply dipping fault structure and was best developed at the upper Woodruff contact
1992	Cambior	Gold-anomalous zone extended following exposure in road cuts. Five-hole, reverse circulation (RC) drilling program. Encountered anomalous gold intervals, and gold pathfinder elements. Forty-nine additional rock chip samples collected.
1993	Cambior	Completed six additional RC drill holes. All of the holes appear to target at upper Woodruff contact zone. Only five of the six reached this target and one hole was lost. Of the five successful drill holes, two encountered anomalous gold values in the target zone, two other encountered high mercury values and one was barren. Conducted scalar controlled-source audio-magnetotelluric resistivity geophysical surveys (CSAMT). No results or interpretations from this survey are available.

7.0 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

The Project is located on the western flank of the Piñon Range, a block faulted horst of the Basin and Range tectonic province. The area is underlain by Paleozoic meta-sedimentary rocks overlain by a variety of Tertiary volcanic rocks (Morgan, 1969). The generalized regional geology is shown in Figure 7-1.

During the Cambrian through Devonian Periods, the Project area was part of a large passive continental shelf forming the western margin of the North American Craton (NAC). At this time, two general sequences were formed:

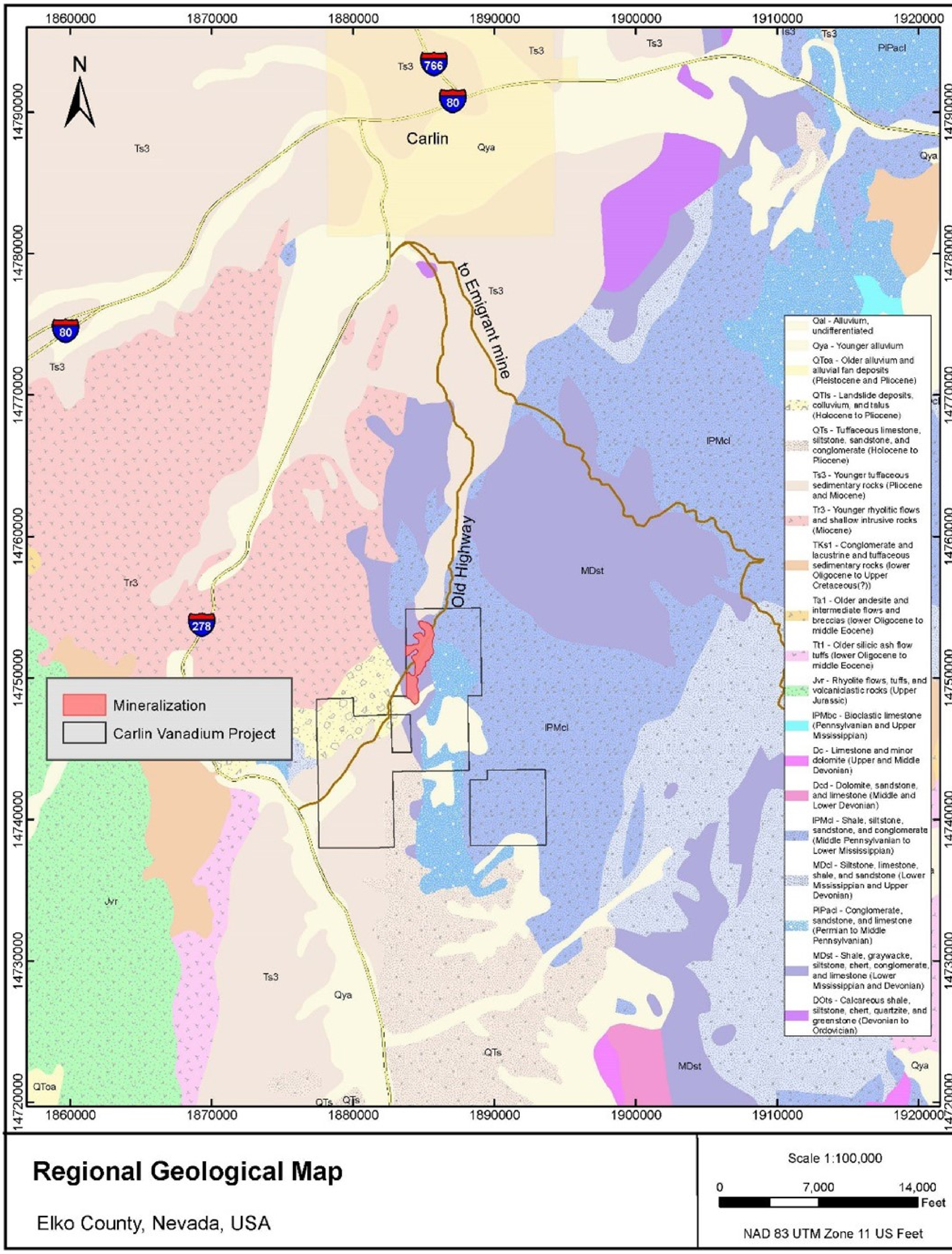
- Shallow water mud, limey mud and sandy-mud were deposited in the eastern assemblage
- A coeval continental rise sequence consisting of siliceous eugeosynclinal sediments formed the western assemblage.

During the Carboniferous Period, the Antler Arc collided with the NAC creating the Antler Mountain Range, which is mostly to the west of the Project area.

In the Triassic, the area was subject to over thrusting related to collision of the Quesnel Fragment with the NAC. Shallow thrust faulting displaced the entire western assemblage over the eastern assemblage along the Roberts Mountain Thrust Fault. As the Wrangellia oceanic plateau was subducted beneath the NAC, large batholiths and plutons began to form further inland, probably at the end of the Jurassic.

The Tertiary brought about a change from compressional to extensional tectonics marked by the development of widespread volcanism and caldera development followed by the eventual development of the basin and range faulting which dominates the current landscape. Basin and range faulting has been active from Miocene to present day. The combination of compressional folding and thrust faulting overprinted by normal faulting has produced the complex regional structural setting (Blakely et al., 1997; Fergusson and Muller, 1949; Ross, 1961).

Figure 7-1: Regional Geology Plan



Note: Figure from Stryhas et al., 2019.

7.2 Project Geology

The Woodruff Formation within central Nevada hosts several other vanadium deposits with similar characteristics. The vanadium is believed to have originally formed in a deep, restricted basin associated with the depositional environment of the western assemblage lithologies. Subsequently these lithologies were transported tectonically to their current location. Regionally, the Vinini and Woodruff Formations were subjected to at least two periods of thrust faulting prior to basin and range faulting. Uplift and erosion have exposed the mineralization, and oxidation by meteoric waters has resulted in an over-printing redox boundary.

7.3 Deposit Descriptions

7.3.1 Overview

The Project is underlain primarily by a generally north trending sequence of Permian to Mississippian sedimentary rocks composed of siltstones, mudstones, sandstones, conglomerates and limestones, subdivided into several units or formations.

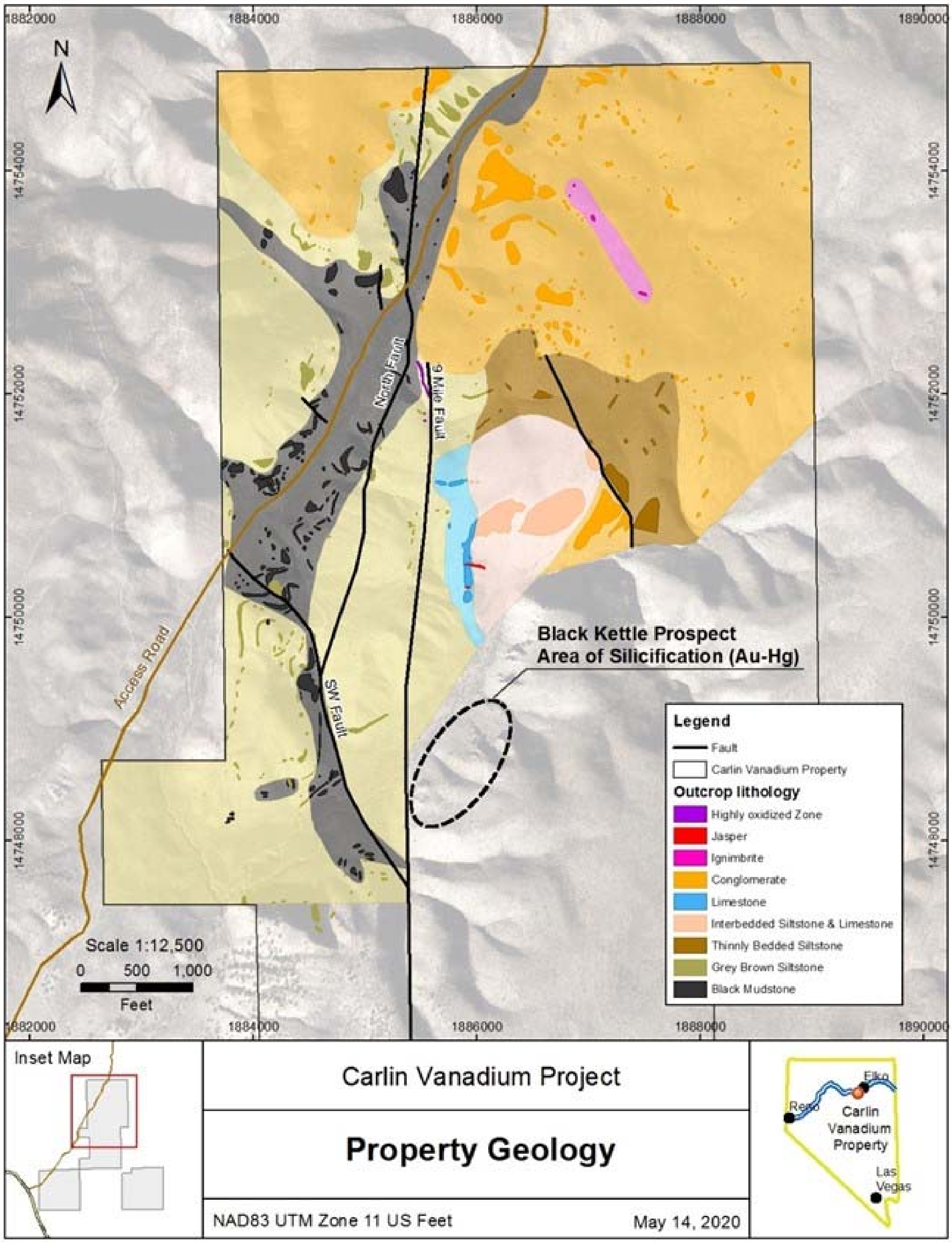
Detailed surface geology of the Project area is shown in Figure 7-2.

This map is based on outcrop mapping completed in 2018 by First Vanadium.

The oldest unit appears to be an undifferentiated Permian unit composed of limestone, limey siltstone and siltstone that lies in the eastern half of Sections 4 and 34 as a north-striking folded sequence. To the west of this unit lies the Devonian-age Woodruff Formation, composed of siltstones and mudstones, also generally forming a north-trending band and lying on the west side of Sections 4 and 34.

The contact between the underlying Permian unit and the Woodruff Formation appears unconformable or possibly fault-bounded. The Woodruff Formation in the Project area is flat-lying to gently-dipping within an apparent broad north-oriented anticline, with local easterly and westerly gently-dipping flanks. The Woodruff Formation is differentiated into an upper grey–brown siltstone and a lower brown to black mudstone sequence. The Woodruff Formation hosts the vanadium-bearing zones or beds.

Figure 7-2: Geology Map, Section 34



Note: Figure from Stryhas et al., 2019. Figure shows the northern portion of the Carlin Vanadium Project.

Unconformably overlying the Woodruff Formation is the Diamond Peak Formation composed of hematite oxidized conglomerate ± sandstone. This unit lies at the northern end of the Project area and underlies most of Section 10. A small amount of Holocene-Pliocene-aged tuff unit is located in the southwestern part of Section 4. Miocene-aged rhyolite flows occur in the northernmost part of Section 5 and as an isolated remnant overlying Diamond Peak in the northern part of Section 34. The rhyolite flows form prominent ridges to the west of the Project area.

7.3.2 Lithologies

Undifferentiated Permian-aged Unit

This unit was subdivided by First Vanadium geologists during the 2018 mapping. The lowest subunit appears to be a sequence of light brown thin- to medium-bedded siltstone. This unit grades up into a sequence of thinly-bedded, light brown siltstone, limey siltstone and occasional thin beds of light grey crinoid-bearing limestone. This unit is capped by a unit of bedded light grey–brown limestone, which is approximately 100 ft thick.

Woodruff Formation

The Woodruff Formation consists principally of siliceous mudstone and chert with lesser amounts of mudstone, siltstone, dolomitic siltstone and dolomite with some limestone and calcareous sandstone. The Woodruff Formation can be subdivided stratigraphically into upper and lower rock units in the Project area. The lower unit is a monotonous sequence of mudstone (silty to muddy) that is medium to dark brown or grey to black in colour. The colour change to dark grey to black signifies the presence of more carbon as kerogen which is strongly associated with vanadium mineralization. Black sooty mudstone signifies high vanadium grades. Within the black mudstone sequence, the mudstones can be somewhat cherty, particularly below the vanadium-rich sections, which tend to occur closer to the upper contact of the black mudstone sequence.

The lower mudstone unit tends to be very crumbly on surface due to surface effects, and in most of the property remains relatively fresh at surface with just a film of oxidation to give a medium-dark brown colour. In the northern part of the Project area, this unit weathers deeper, up to 60 ft deep where it becomes a brown clay-rich unit. Where this unit is weathered and vanadium-rich, the colours become shades of deep brown–red to purple. The contact between the upper grey–brown siltstone and lower black mudstone can be sharp or gradational with interlayering over as much as 60 ft.

The upper unit is characterized by light grey-brown siltstone, and is moderate to weakly calcareous. Occasionally this unit has 2–5-inch thick, medium-grey cherty beds interbedded with the siltstone. Vanadium-rich units occur in this upper unit, but are generally lower grade and less continuous. Upon weathering, the upper grey brown mudstone is oxidized to various hues of yellow–brown and pink. The vanadium-rich zones in this unit also weather to shades of purple and red.

Local broad to rolling bedding attitudes and the absence of marker beds precludes reliable thickness measurements in the Woodruff Formation. It may be as much as several thousand feet thick.

Diamond Peak Formation

The Diamond Peak Formation in the Project area is predominately a red, hematite-oxidized conglomerate. The grain size is generally clast-dominated pebble to cobble, but locally can be granular, or grade to a medium-grained sandstone. The unit is typically bedded to massive, and forms prominent ridges.

Tertiary Formation

The oldest Tertiary lithology in the Project area is the Miocene age Palisade Canyon Rhyolite. This unit is not differentiated in the Project area and is present only in the extreme western area.

Quaternary

The Cole Creek valley and its secondary valleys are filled with valley alluvium, eroded from the surrounding rock units and locally covers parts of the Woodruff Formation. Alluvium thickness is variable, up to about 65 ft in some areas, and absent in others.

7.3.3 Structure

Due to the recessive nature of the sedimentary sequence, particularly in the main valley hosting the deposit, outcrop exposures are limited. However, good outcrop can be found in areas of higher relief. The extensive road building and trenching by UCC has provided outcrop exposure.

In the Diamond Peak Formation and the undifferentiated Permian units, and to a lesser degree the upper brown–grey siltstone, bedding attitudes are generally discernable and able to be measured. Due to the lack of bedding and markers in exposures of the lower black mudstone unit in road cuts, however, bedding measurements are less obvious. What aids the structural picture of the black mudstone unit is its clear contact with the upper grey–brown siltstone unit which is much easier to pick up in outcrop, trenches, and in drill holes.

The lithological units form a broad anticlinal structure which is cut by several faults. The axial trace of the antiform trends roughly due north with the western flank dipping 15–30^0 west and the eastern flank dipping 10–20º east. On a local scale in some exposures, there are broad rolls and small-scale open folds.

The antiform is cut by at least two mapped faults that affect the resource estimate area and which merge to the south. The SW Fault (as named by First Vanadium) strikes northwest–southeast with a near vertical dip. This structure is interpreted to be the larger of the two faults. The North Fault (as named by First Vanadium) strikes north–south, with a near-vertical dip. This structure merges into the SW Fault where it shows a flexure in strike. No direct displacement is observed across the SW Fault; however, its location marks a significant change in lithological dip. The North Fault is interpreted to show an east-side up displacement ranging from a few feet at its north end up to 200 ft toward the south where it merges into the SW Fault.

To the immediate east of the vanadium deposit is a mapped north-trending subvertical structure interpreted to be part of a larger nine-mile-long structure associated with late-stage hydrothermal alteration with associated gold and gold pathfinder elements such as arsenic, mercury and antimony. This is the structure that is interpreted contributed to the Black Kettle prospect on the property (refer to discussion in Section 9.6).

7.3.4 Alteration

A dolomite hydrothermal alteration overprint has been interpreted within the Project area, based on geochemical drill hole data from drill holes that variably penetrate into the grey–brown siltstone and black mudstone sequences, and vanadium-rich zones.

7.3.5 Vanadium Mineralization

Vanadium mineralization is stratigraphically controlled, and appears to follow the strike and dip of the host lithology, near the contact between an overlying grey–brown siltstone and the underlying brown to black mudstone unit of the Devonian-age Woodruff Formation. The mineralized zones form as stratigraphic subunits or beds within the Woodruff Formation mudstone, hosting elevated concentrations of vanadium in the form of vanadium pentoxide (V_2O_5).

Drilling to date has defined multiple zones of vanadium-enriched mineralization (>0.2% V_2O_5) both in the grey–brown siltstone and the brown–black mudstone unit. The most persistent, thickest, and highest-grade vanadium unit lies in the brown–black mudstone unit and averages approximately 115 ft (35 m) thick, striking north–south over 6,000 ft (1,800 m) of length and 2,000 ft (600 m) wide in the east–west direction.

The mineralization is locally exposed at surface at both the Central and South Zones, but mostly at a shallow depth less than 200 feet (60 m) from surface. Above and below the high-grade zone are other vanadium zones within the brown–black mudstone unit that are generally less persistent laterally, which are of moderate grade (0.2–0.5% V_2O_5) but are thinner (30–75 ft thick).

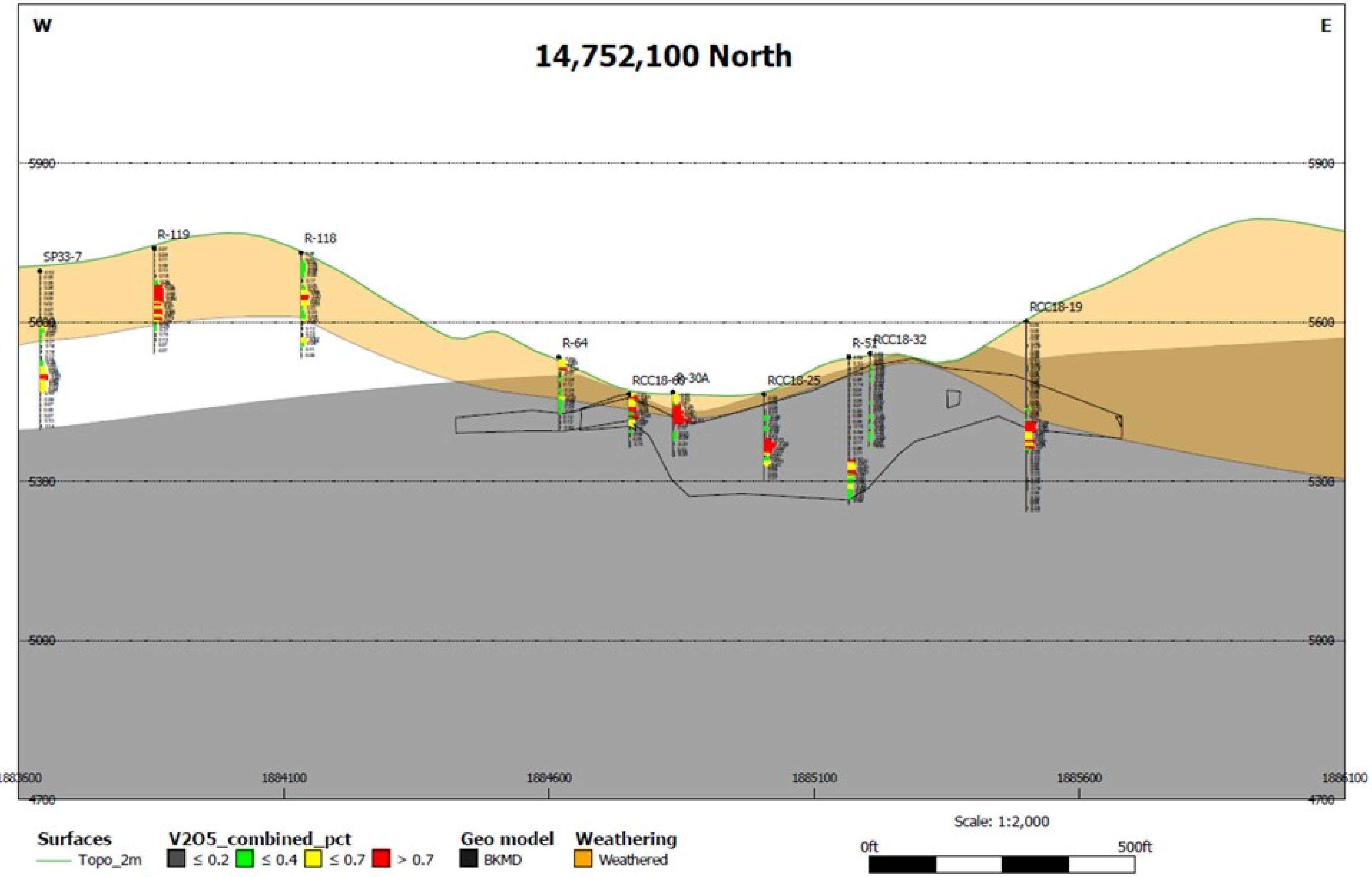
There is a relatively persistent, flat-lying, high-grade vanadium-enriched bed averaging 115 ft thick within the upper grey–brown mudstone unit to the west of the Central Zone. Other vanadium zones within the grey–brown mudstone are generally less persistent laterally, of moderate grade (0.2–0.4% V_2O_5), and are thinner (30–60 ft thick). Figure 7-3 and Figure 7-4 are cross-sections showing an example of the mineralization in the Central Zone and Southern Zone, respectively.

Mineralogical studies by First Vanadium and UCC show the vanadium is present in the form of metahewettite ($CaV_6O_{16}•3(H_2O)$) and corvusite ($(Na,Ca,K)V_8O_{20}•4(H_2O)$), which are finely and evenly disseminated throughout the host lithologies with grain size from a few micrometers to almost 100 µm, averaging about 10–20 µm.

Other vanadium minerals identified in the deposit in rare, very rare or trace amounts were montroseite ($(V3^+,Fe3^+)O(OH)$)–goethite, pascoite ($Ca_3(V_{10}O_{28})•17H_2O$), steigerite ($Al(VO_4)•3H_2O$), tangeite ($CaCu(VO_4)(OH)$), tyuyamunite ($Ca(UO_2)2(VO_4)_2•5–8H_2O$) and vesignieite ($BaCu_3(VO_4)_2(OH)_2$).

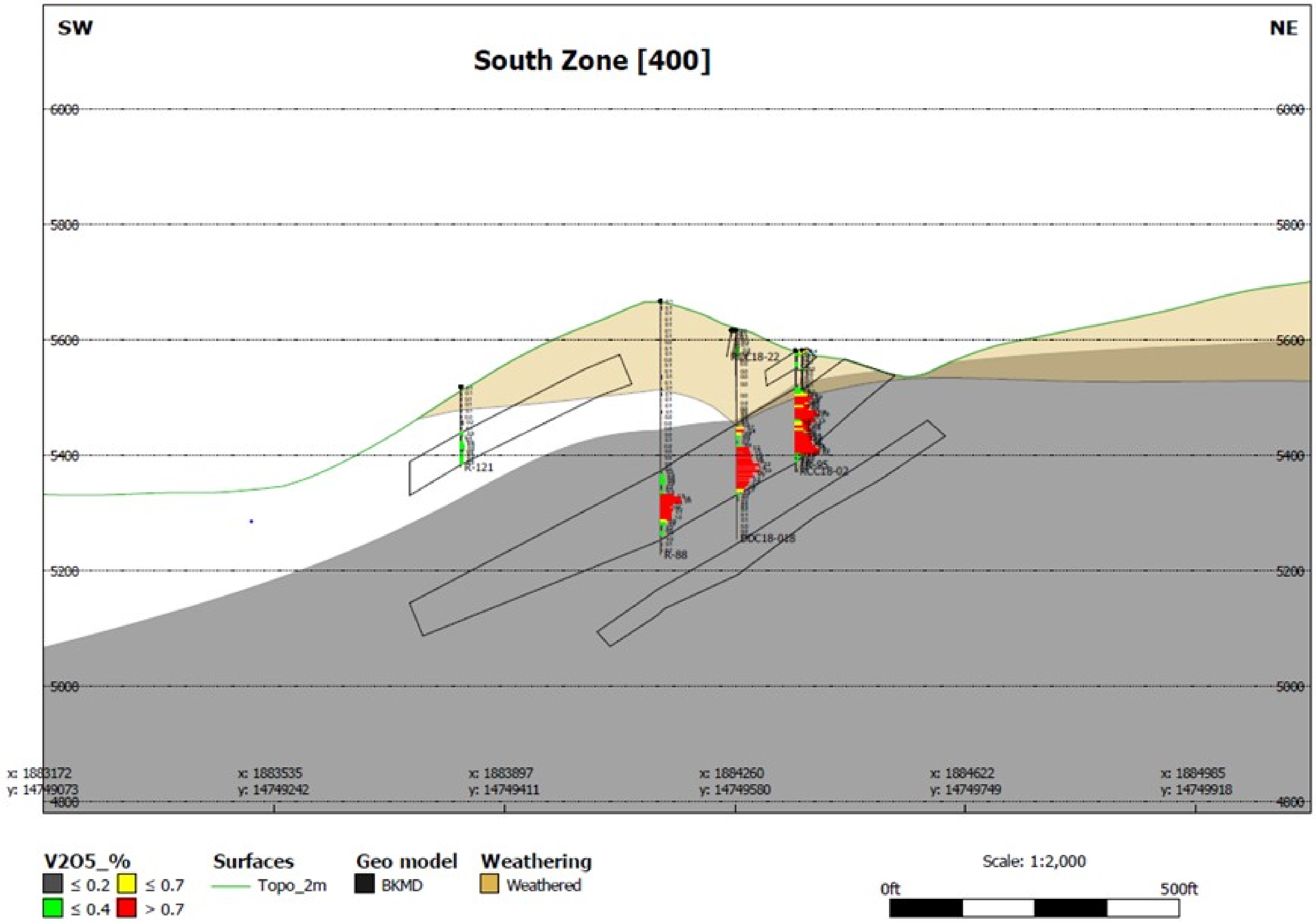
There are no visual sulphides indicating vanadium mineralization. The only visual distinctions in the lithology which indicate areas of elevated vanadium grades or mineralization from the unmineralized host mudstone is a colour change from medium-brown to black, reflecting an increase of carbon in the form of kerogen in the mudstone. All the mineralized zones have been defined by chemical analysis.

Figure 7-3: Cross-Section, Central Zone



Note: Figure courtesy First Vanadium, 2019. The non-oxide black mudstone unit is grey and the oxide black mudstone unit is medium brown. The overlying grey–brown siltstone unit is shown in light brown.

Figure 7-4: Cross-Section, South Zone



Note: Figure courtesy First Vanadium, 2019. The non-oxide black mudstone unit is grey and the oxide black mudstone unit is medium brown. The overlying grey–brown siltstone unit is shown in light brown.

7.4 Prospects/Exploration Targets

Prospects are discussed in Section 9.

7.5 Comments on Section 7

In the opinion of the QP:

- Knowledge of the Carlin vanadium deposit settings, lithologies, and structural and alteration controls on mineralization is sufficient to support Mineral Resource estimation and conceptual mine planning
- The mineralization style and setting of the Carlin vanadium deposit is sufficiently well understood to support Mineral Resource estimation, and conceptual mine planning
- The Project has gold potential, which is discussed in Section 9.6.

8.0 DEPOSIT TYPES

8.1 Vanadium Deposit Model

Vanadium deposits in the Western United States fall under two general types; reduction-precipitation and syngenetic. The reduction-precipitation type is commonly associated with uranium. The syngenetic type are typically much larger but lower grade (0.2–1.0% V_2O_5) associated with black shales (mudstones) and are believed to have formed by direct precipitation of vanadium from seawater. This method of mineralization is similar to the processes which form syngenetic copper or iron deposits. Typically, a restricted basin develops containing seawater, which was already enriched with vanadium. Over time, evaporation or deep-water stagnation enriches the vanadium content within a primarily reducing environment, and the vanadium precipitates out as the siliceous sediments are deposited in a low-energy environment. Vanadium is commonly bound with iron or manganese oxides or with kerogen. Subsequent oxidation and remobilization of the vanadium can occur (Premović et al., 1988; Hanson et al., 2010).

The Carlin Vanadium deposit is interpreted to be a syngenetic-type vanadium deposit. The Woodruff Formation within central Nevada hosts several other vanadium deposits to the south, all with similar characteristics. The vanadium is believed to have originally formed in a deep, restricted marine basin associated with the depositional environment of the western assemblage lithologies. As the marine basin filled, sub-basins formed. Organisms likely in the form of algae, bloomed on the shallow flanks of the sub-basins. As these organisms died, they contributed to carbon input into the basin. It is interpreted that the vanadium was concentrated into laterally relatively continuous mudstone/siltstone units by precipitation, absorption aided by carbon accumulation and evaporation processes as the restricted basin filled, evaporated, and concentrated the seawater into salts.

8.2 Gold Deposit Model

This section is summarized from Teal and Jackson (2002).

The mineral deposits along the Carlin Trend form a suite of deposits known as Carlin-type, or sediment-hosted, low-grade disseminated gold deposits. The Carlin Trend hosts the largest concentration of gold deposits in North America. Over 40 deposits have been discovered along the 38-mile long, north–northwest-oriented Carlin Trend. Gold deposits are generally hosted in a variable stratigraphic package of Ordovician through

Lower Mississippian rocks. The preferential host rocks are autochthonous carbonate assemblage rocks that are now preserved in uplifted tectonic windows. All Carlin Trend gold deposits that have been discovered to date are either within the Bootstrap, Lynn, Carlin, and Rain tectonic windows, or proximal to them. Within specific deposits, Cretaceous and Tertiary dike swarms and a Jurassic-aged granodiorite stock (Goldstrike stock) may constitute as much as 15% of the mineralized material.

Host rocks are most commonly thinly-bedded silty or argillaceous carbonaceous limestone or dolomite, commonly with carbonaceous shale/mudstone. Although less mineralized, non-carbonate siliciclastic and rare metavolcanic rocks can locally host gold that reaches economic grades. Felsic plutons and dikes may also be mineralized at some deposits. Deposits typically have a tabular shape, are stratigraphically and structurally controlled, are localized at contacts between contrasting lithologies or structural intersections, but can also be discordant or breccia-related.

Mineralization consists primarily of micrometer-sized gold and sulphide grains disseminated in zones of siliciclastic and decarbonated calcareous rocks and are commonly associated jasperoids. Major ore minerals include native gold, pyrite, arsenopyrite, stibnite, realgar, orpiment, cinnabar, fluorite, barite, and rare thallium minerals. Gangue minerals typically comprise fine-grained quartz, barite, clay minerals, carbonaceous matter, and late-stage calcite veins.

Current models attribute the genesis of the deposits to:

- Epizonal plutons that contributed heat and possibly fluids and metals
- Meteoric fluid circulation resulting from crustal extension
- Metamorphic fluids, possibly with a magmatic contribution, from deep or mid-crustal levels
- Upper crustal orogenic-gold processes within an extensional tectonic regime.

8.3 Comments on Section 8

Exploration programs that use a syngenetic-type model for vanadium mineralization are considered to be applicable to the Project area.

Exploration programs that use a Carlin-type model for gold mineralization are applicable to the Project area.

9.0 EXPLORATION

9.1 Grids and Surveys

Farr West Engineering (Farr West) of Elko, Nevada provided drill hole collar surveying with control from state benchmarks and corner section markers. Data were provided in UTM, Datum NAD83 GRS1980, projection UTM Zone 11, unit: US survey feet (0.3048006096012192, or 1200/3937). No local grids were created.

Topography was established in conjunction with Farr West and an aerial survey conducted by GSP Consulting/Synergy Mapping to generate orthophotos and contours. Orthophoto survey control used field markers which were surveyed by Farr West to benchmark control. Horizontal data was acquired at a scale of 1:2,400. Elevation data were acquired in 5 ft intervals. Twelve photogrammetric panels were produced. High resolution orthophotos (in US ft) had a resolution of 1 ft pixel size.

9.2 Geological Mapping

Mapping was done on orthophotos at a scale of 1:500 scale in Section 34 of the property which generated an outcrop pattern map (see Figure 7-2).

First Vanadium plans to map Section 4 of the property at a similar scale to identify potential for additional vanadium mineralization and for Carlin-style gold mineralization.

9.3 Geochemical Sampling

In 1982, Cambior completed soil sampling, followed by rock chip sampling the Black Kettle gold prospect. This work outlined a gold anomalous zone.

9.4 Geophysics

In 1983 Cambior hired Quantech Consulting to conduct a scalar controlled-source audio-magnetotelluric resistivity (CSAMT) geophysical survey over the Black Kettle prospect. Seven cross-section lines are available; however, the location of the geophysical grid and sections are in question. No interpretations from this survey are available.

9.5 Pits and Trenches

UCC excavated 70 trenches during 1966–1967, primarily along roads to expose outcrop for mapping and sampling of the vanadium mineralized zones and vanadium-hosted stratigraphy. These trenches have an aggregate total length of approximately 3.3 miles (17,400 ft). About 1,000 assays were taken from these trenches, with individual samples taken as horizontal chips across 3–10 ft intervals. Trench locations and a large portion of the individual assay results were identified on 1968 paper maps and were digitized into First Vanadium's mapping database. Locations and grades where known are provided in Figure 9-1 and Figure 9-2.

9.6 Exploration Potential

First Vanadium engaged Mr. David Mathewson to evaluate the potential for gold mineralization within the Project area, given the strategic location of the Project within the Carlin Trend. Mr. Mathewson is an expert on gold exploration within the Carlin Trend.

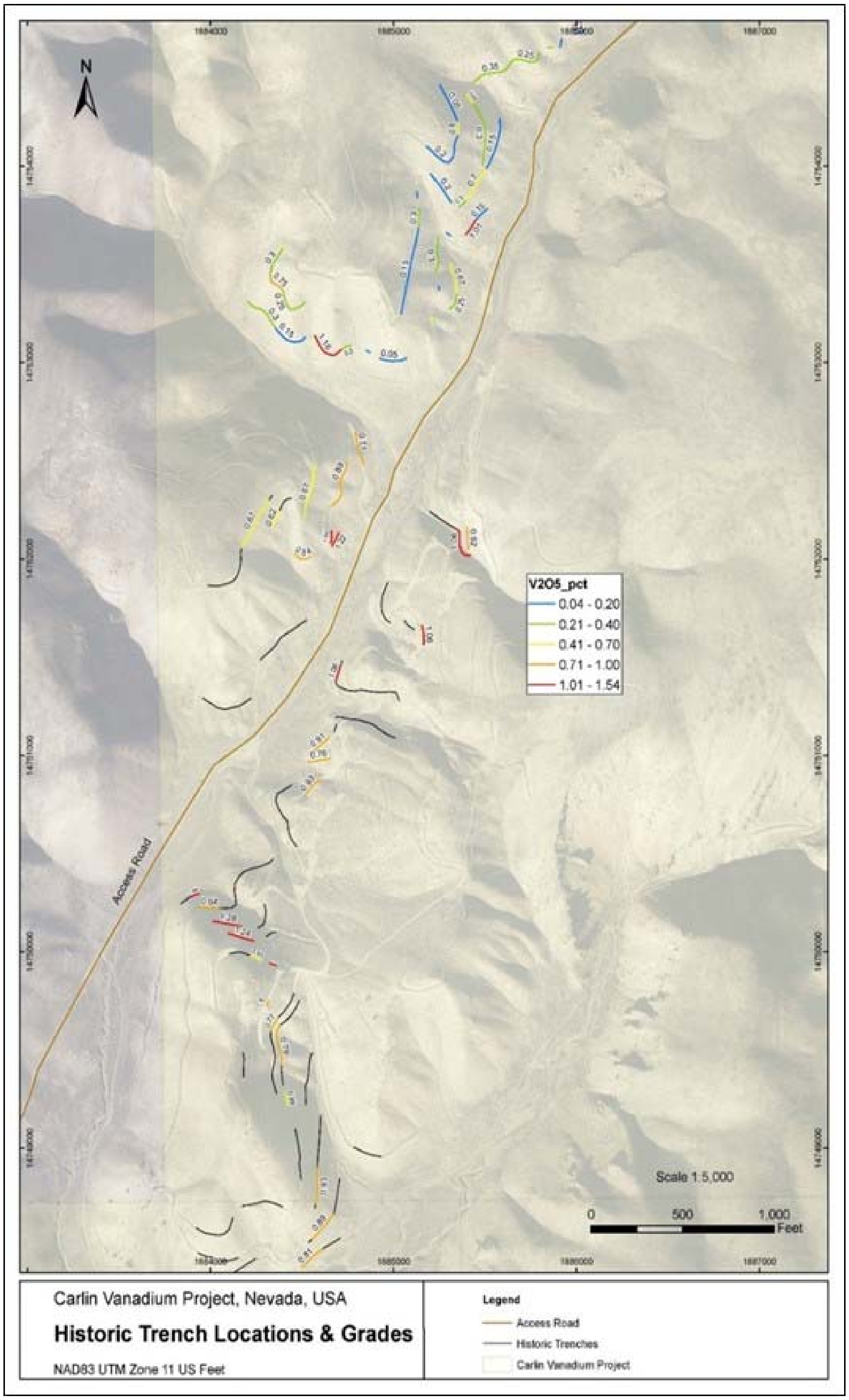
Mr. Mathewson reviewed the Project structural setting to identify areas where structures are co-incident with geophysical gravity highs, in particular focusing on faults that have north–south, northwest–southeast, and northeast–southwest orientations. Figure 9-3 is a structural interpretation of the major interpreted faults, and the locations of known deposits along those structural trends in the southern portion of the Carlin Gold Trend. A key feature of the interpretation is a nine-mile-long north–south structure that sub-parallels the Bullion Fault that is associated with gold deposits on the Gold Standard Ventures-owned property to the east of the Carlin Vanadium Project area. The Project area covers two miles of strike extent of the nine-mile-long structure. The figure shows the locations of exploration potential within the Project area at the intersection of this fault with northwest–southeast and northeast–southwest oriented structures.

Figure 9-4 is the same interpretation as shown in Figure 9-3 superimposed on a regional gravity map. This shows that the north–south linear structure that trends through the Project area is co-incident with a regional linear gravity high. Two miles of this gravity high strike extent fall within the Project area. In the Rain area of the Carlin Trend, gravity highs are coincident with large hydrothermal alteration systems at depth and coincident with gold deposits such as Emigrant, Rain, Tess and Saddle.

Figure 9-1: UCC Trench Location Plans

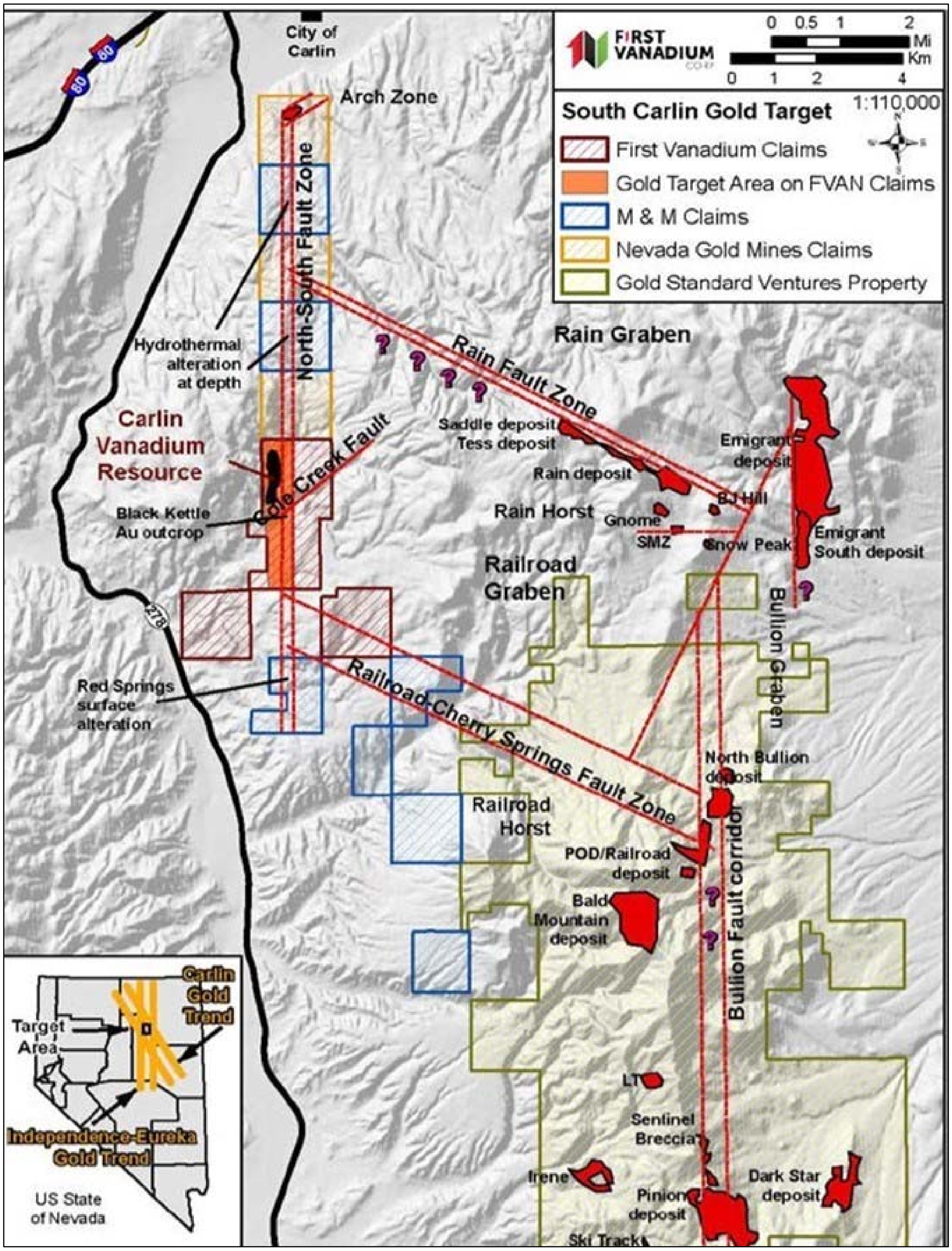
Note: Figure from Stryhas et al., 2019.

Figure 9-2: UCC Trench Grade Compilation



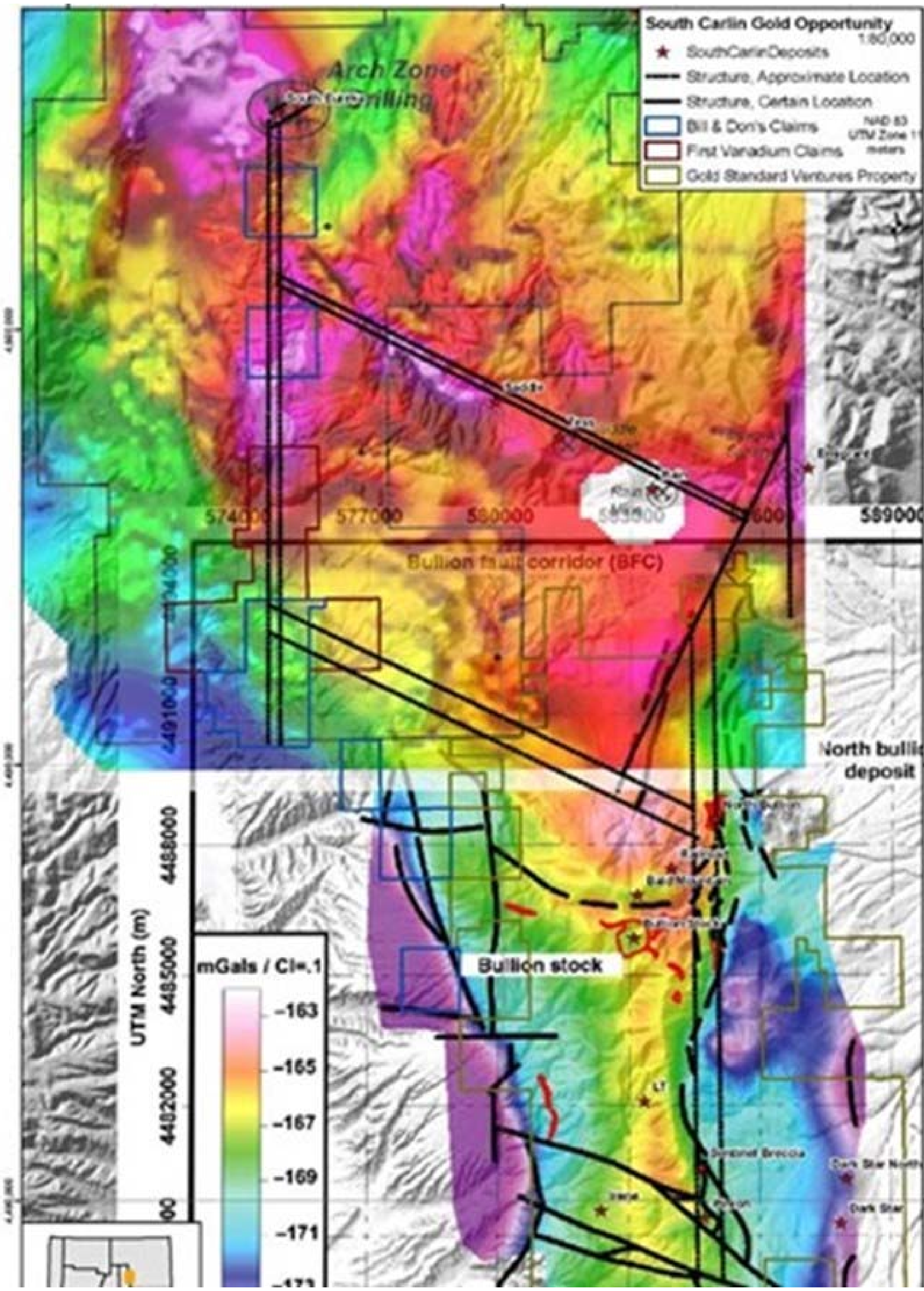
Note: Figure from Stryhas et al., 2019.

Figure 9-3: Regional Structural Interpretation



Note: Figure courtesy First Vanadium, 2019.

Figure 9-4: Regional Gravity Map



Note: Figure courtesy First Vanadium, 2019.

Mr. Mathewson has postulated that surface outcrops of silicification and elevated gold and trace element values at the Black Kettle prospect within the Project (refer to location in Figure 9-3) as expressions of hydrothermal fluid leakage from a high-grade gold target at depth where these key north–south, northwest–southeast, and northeast–southwest oriented structures are projected to intercept favourable lithologies known to host gold deposits elsewhere on the Carlin Trend. The Black Kettle prospect was drill tested to shallow depths by Santa Fe Gold and Cambior in the 1980s and 1990s, and encountered some elevated gold and mercury grades (refer to Section 6.1.2), but the depth potential of the prospect area was not tested.

The gold target is coincident with a gravity high that suggests a large hydrothermal alteration system at depth, coupled with the strong possibility of favourable gold-hosting lithologies being at a reasonable range of drill depths in the Project area. The dolomite alteration that occurs within the stratigraphy drilled for vanadium mineralization has been interpreted by Mr. Mathewson to be additional evidence of an overprinting hydrothermal alteration system related to the gold target.

9.7 Comments on Section 9

In the QP's opinion:

- The exploration programs completed to date are appropriate to the style of the vanadium deposit;
- Geophysical and structural interpretations indicate the potential for gold mineralization with affinities to Carlin Trend deposits, which warrants further investigation.

10.0 DRILLING

10.1 Introduction

Exploration drill campaigns have targeted vanadium and gold mineralization. Drilling related to gold exploration was summarized in Section 6.2.

UCC completed a total of 127 rotary drill holes (31,095 ft or 9,478 m) as part of their vanadium exploration efforts; data from this program are referred to as legacy data. Collar locations are provided in Figure 10-1. Note this figure also shows the gold drill collar locations for completeness.

First Vanadium completed 20 core holes (5,346 ft or 1,629 m) during 2017–2018. Collar locations are provided in Figure 10-2. An additional 69 RC drill holes were completed in 2018, for 15,175 ft (4,625 m). Collar locations are provided in Figure 10-3.

10.2 Drill Methods

10.2.1 Legacy

Various progress reports and internal notes describe the drill as a rotary type with samples recovered by an air, air-water or air-mud system. There are numerous notations in the drill logs describing relatively high water flows which impeded sample recovery and resulted in hole termination. Several drill holes encountered cavities which resulted in poor sample recovery.

10.2.2 First Vanadium

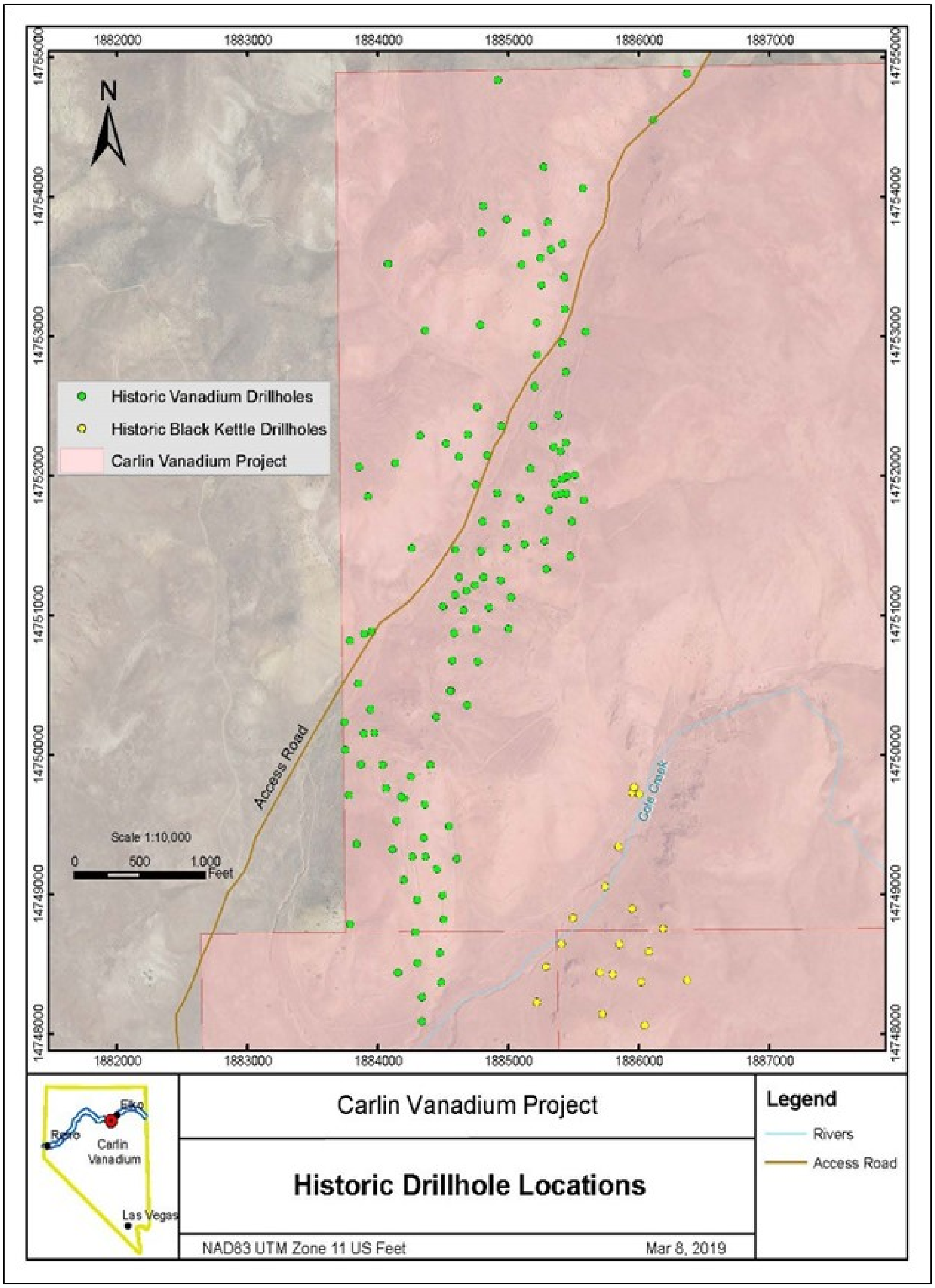
The core drilling was performed by Redcore Drilling, based in Carlin, Nevada, and generated conventional HQ diameter core (2.5 inch).

RC drilling was performed by AK Drilling of Butte, Montana and New Frontier Drilling of Fallon, Nevada.

AK Drilling used a Foremost Explorer 1500 drill rig. The drill pipe outside diameter was 4 ½ inch, driven dry with a hammer bit. Most of the drill holes were vertical.

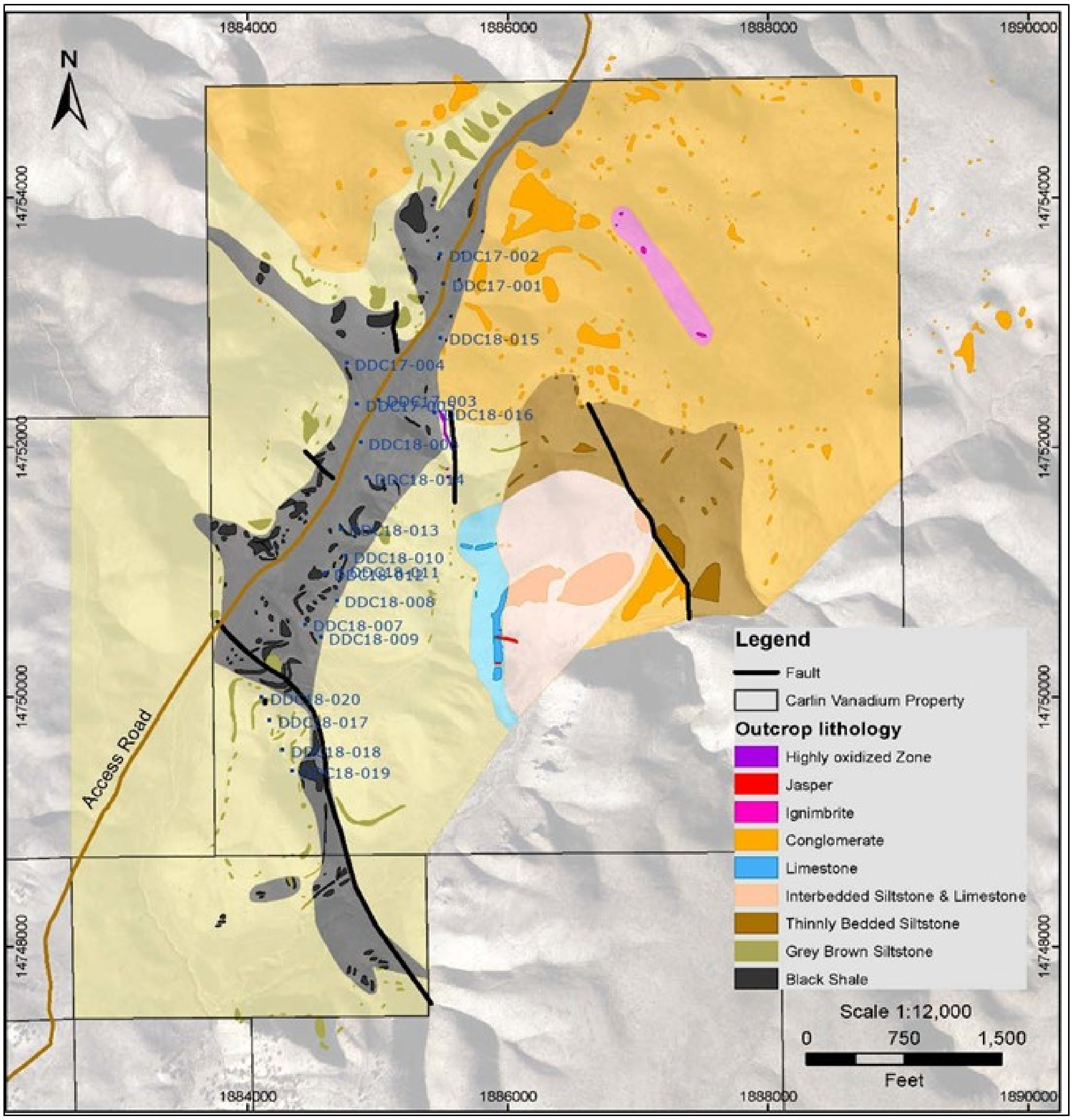
New Frontier used a track-mounted, Foremost MPD RC drill rig, and completed angled drill holes. Angle holes by New Frontier were to have a small amount of water added for ground control.

Figure 10-1: Legacy Drill Collar Location Map



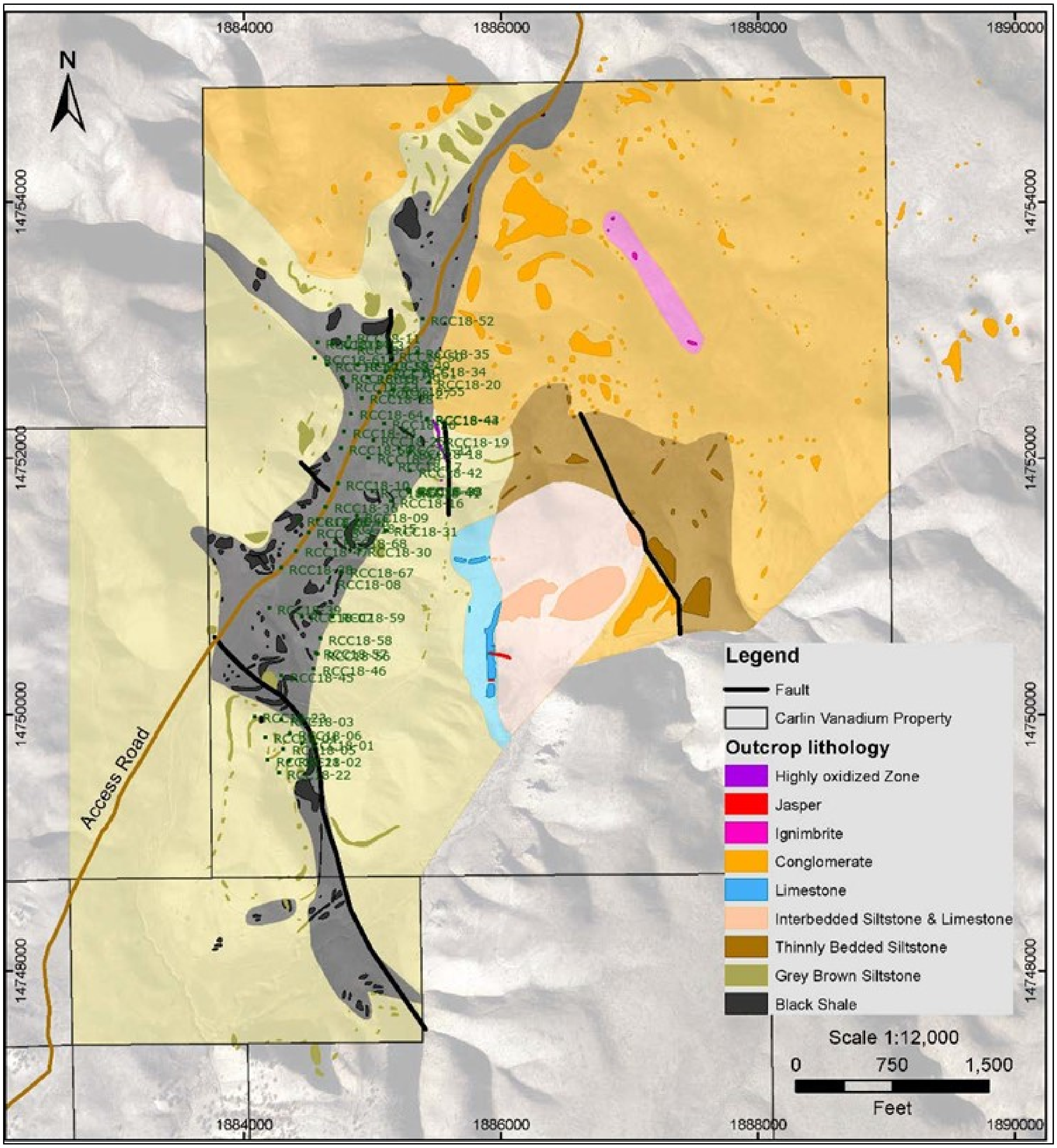
Note: Figure from Stryhas et al., 2019.

Figure 10-2: First Vanadium Core Drill Collar Location Map



Note: Figure from Stryhas et al., 2019.

Figure 10-3: First Vanadium RC Drill Collar Location Map



Note: Figure from Stryhas et al., 2019.

10.3 Logging Procedures

10.3.1 Legacy

Original drill logs are available. The UCC drilling results were all recorded on standard handwritten drill logs which were later transcribed to typed final manuscripts.

The drill logs contain specifics information pertaining to; hole no., local x, y coordinates, elevation, claim location, orientation, date started, date completed, total depth, logged by and summary of results. Each 5 ft interval is described by; from-to, interval length, % V_2O_5, anomalous % Zn values and comments. Typical comments relate to rock types, colour and drilling conditions.

10.3.2 First Vanadium

Core

Drill runs were removed from the core tube and placed in wax-coated cardboard core boxes by the drill crew. The boxes were labeled by the drill crew with the hole ID, depth interval in feet, and box number. Depths in meters were added to the boxes by First Vanadium. Core samples were transported by Rangefront Geological Services contract geologists via pickup truck to Rangefront's facility in Elko for logging, saw-splitting and sampling. Rangefront is and was independent of First Vanadium.

Geological logs recorded lithology, colour, grain size, hardness, and oxidation state. A graphic record was made of bedding, contacts and structures/fracture density.

Core was photographed both wet and dry with a camera placed perpendicular to the core box.

Geotechnical logging was undertaken digitally on an Excel spreadsheet by a trained technician. Geotechnical logs recorded recovery, rock quality designation (RQD), fracture density and dip, rock strength, fracture conditions including persistence, aperture, roughness and infill.

RC

Field geologists described the rock chips and then placed a representative sample into pre-labelled plastic RC chip trays. Logging was performed on hard copy sheets and data recorded included drill hole ID, sample number and depth, oxidation state, colour, lithologies, carbonaceous enrichment, carbonate reaction with acid and siliceous enrichment.

Logging data were subsequently input into Microsoft Excel files. All geological descriptions were encoded, and standard codes were used during the program.

Chip trays were laid horizontally on a desk and a digital camera was fixed at the same height perpendicular to the chip tray for images. Incandescent light was used for photographing all chips in chip trays. The images were then white-balanced in Lightroom software to reflect the true colour of the rock.

10.4 Recovery

10.4.1 Legacy

There is no available information on recovery statistics during the UCC campaigns.

10.4.2 First Vanadium

The friable rock quality caused breakage in the core. Core recovery averaged 85.6%. RQD measurements of the black mudstone unit averaged 20%. RQD measurements of the overlying siltstone unit averaged 55%.

The RC holes completed by AK Drilling were drilled dry to maximize sample recovery. During the RC drilling conducted by New Frontier, sample recovery risks were mitigated with minimal added water and monitoring of sample mass during drilling.

10.5 Collar Surveys

10.5.1 Legacy

Rare drill collars are evident in the field with open holes or chip piles.

Original drill logs contained surveyed UTM collar coordinates. Several drill collars are still evident in the field with open holes or chip piles. Numerous drill pads on unreclaimed roads are also evidence of the legacy drill holes. The legacy dataset that had drill collars locations were verified by more recent collar surveying.

10.5.2 First Vanadium

Surface drill collar locations for the core and RC programs were surveyed by Farr West Engineering of Elko, Nevada in November 2018, using Trimble global positioning system (GPS) equipment. Existing on-site control points were used in the survey.

10.6 Downhole Surveys

10.6.1 Legacy

No downhole surveys were done on these holes due to their short length and vertical orientation of the drill holes.

10.6.2 First Vanadium

No downhole surveys were completed on the core holes, as First Vanadium was of the opinion that vertical HQ-size drill holes would display nominal deviation.

An Axis Champ Gyro gyroscopic downhole survey tool was supplied to First Vanadium by International Directional Services (IDS) and operated by the RC drilling contractors. Measurements were taken typically at the bottom and top of each drill hole and at 50 ft increments. Deviation on the vertical 2018 RC drill holes was less than 0.5º, over about 200 ft drilled.

10.7 Twin Drilling

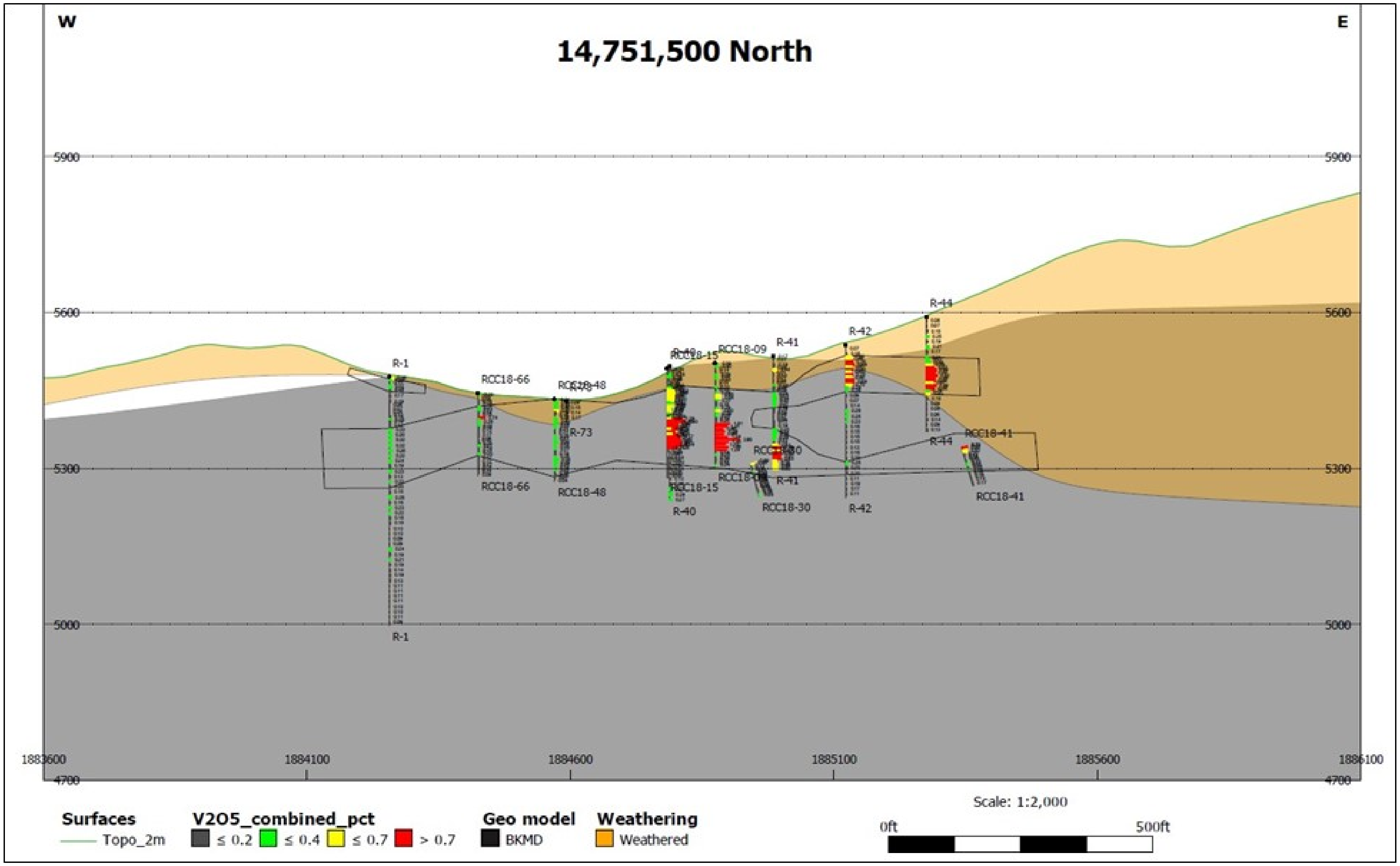
First Vanadium sited the 2017–2018 program drilling to offset the legacy drill holes in areas of known vanadium mineralization, and to provide twin checks on the legacy drilling. The legacy drill holes were twinned using both diamond core and RC drilling. The core and RC programs provided material for assay, density, and metallurgical testing, and confirmed the location and tenor of vanadium grades defined by the legacy drilling and testwork (Table 10-1).

Figure 10-4 and Figure 10-5 are example sections showing the results of the twin drilling in relation to the legacy drilling. Note that in these sections, legacy drill holes have an "R" prefix; First Vanadium drill holes have either an "RCC" or DDC" prefix and a year identifier (17 or 18) in the drill collar ID.

Table 10-1: Results, Twin Drilling

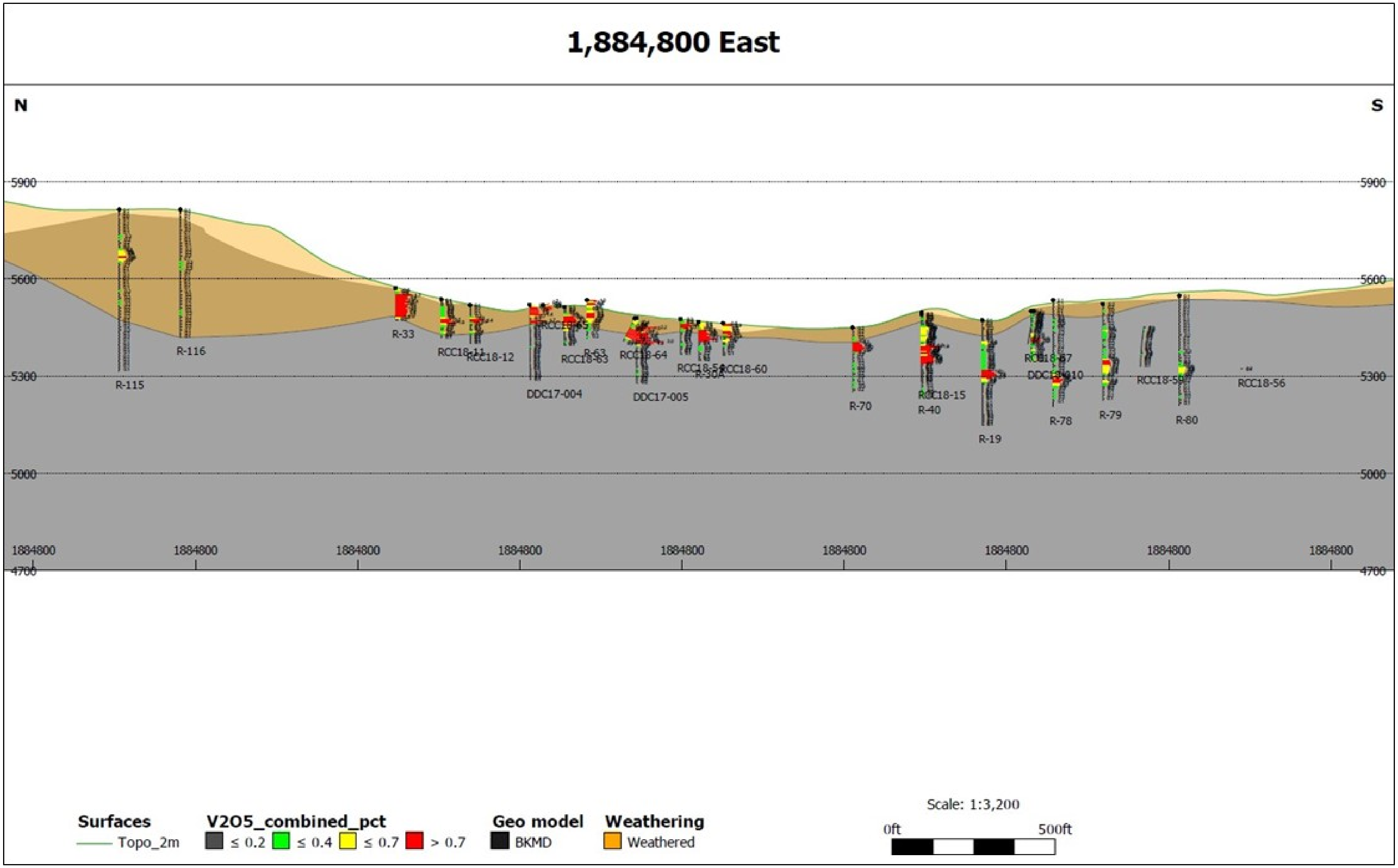
First Vanadium				**Union Carbide**				**Difference (FV to UCC %)**
Hole ID	**From (ft)**	**To (ft)**	**V_2O_5 (%)**	**Hole ID**	**From (ft)**	**To (ft)**	**V_2O_5 (%)**	
DDC18-09	32.8	185.4	1.47	R-111A	25	185	0.89	39
DDC18-16	37.7	200.1	0.84	R-67	40	200	0.92	-10
DDC18-19	59	249.3	0.91	R-94	60	250	0.96	-5
RCC18-02	70	190	1.02	R-95	70	190	0.81	21
RCC18-08	0	160	1.03	R-75	0	160	1.32	-28
RCC18-15	35	155	0.67	R-40	35	155	0.68	-1
All								***3***

Figure 10-4: Drill Section 14,751,500 N



Note: Figure from Stryhas et al., 2019.

Figure 10-5: Long Section 1,884,800 East



Note: Figure from Stryhas et al., 2019.

10.8 Sample Length/True Thickness

10.8.1 Legacy

All of the holes were drilled vertically, and the mineralization is interpreted have a general strike northward and a gentle dip to the west. Therefore, the drill hole length of interception is near true thickness of the mineralization, about 80% to 100% of the drill hole interception length.

10.8.2 First Vanadium

The majority of the First Vanadium drill holes, both RC and core, were vertical, cutting mineralization with a general strike northward and a gentle dip to the west. Therefore, the drill hole length of interception in the vertical holes is near true thickness of the mineralization, about 80% to 100% of the drill hole interception length. Angle hole holes and their intersections varied between 70% to 85% of the drill hole interception length.

10.9 Comments on Section 10

In the opinion of the QP, the quantity and quality of the lithological, geotechnical, collar and downhole survey data collected in the exploration and infill drill programs completed by First Vanadium, and the verification performed by First Vanadium on legacy drill data are sufficient to support Mineral Resource estimation as follows:

- RC chip and core logging meets industry standards for vanadium exploration
- Drill hole collar locations were verified using industry-standard instrumentation
- No down hole surveys were performed on the legacy drill holes. The lack of down-hole surveys is not considered to be a significant concern. No downhole surveys were completed on the core holes, as First Vanadium was of the opinion that vertical HQ-size drill holes would display nominal deviation. Downhole surveys for the First Vanadium RC drilling used industry-accepted practices and instrumentation
- Recovery data from First Vanadium RC and core drill programs are acceptable
- Twin hole drilling by First Vanadium supports that legacy core recoveries can be considered acceptable
- Geotechnical logging of drill core meets industry standards for planned open pit operations

- Drill hole orientations are generally appropriate for the mineralization style, and have been drilled at orientations that are optimal for the orientation of mineralization for the bulk of the deposit area
- Drill hole orientations are shown in the example cross-sections included in Section 7 (Figure 7-3 and Figure 7-4) and in Figure 10-4 and Figure 10-5 in this Report section, and can be seen to appropriately test the mineralization
- Drill hole intercepts, as summarized in Figure 7-3, Figure 7-4, Figure 10-4 and Figure 10-5, appropriately reflect the nature of the vanadium mineralization encountered in both the legacy and the First Vanadium drill programs. The figures demonstrate that sampling is representative of the vanadium grades in the deposit, reflecting areas of higher and lower grades.

No material factors were identified with the data collection from the drill programs that could affect Mineral Resource estimation or conceptual mine planning.

11.0 SAMPLE PREPARATION, ANALYSES, AND SECURITY

11.1 Sampling Methods

11.1.1 Legacy

Trench

Individual samples were taken as horizontal chips across 3–10 ft intervals.

Rotary

The drilling samples were all collected using a rotary air, air-water or air-mud system. In this case air is forced down the center of the drill steel and it blows cuttings up the drill hole. Once water is encountered or drilling gets tight, the samples are circulated up the hole suspended in water. If the hole begins to cave, then mud is introduced to hold the hole open and the samples are circulated up suspended in mud.

The rotary air-water-mud system was a commonly used procedure in soft rock exploration in the 1960s. As drilling methods evolved and improved, rotary-mud systems were abandoned from use where analytical samples are collected. This was due to potential sample contamination problems. The rotary system circulates the samples from the face of the bit up along the outside of the drill steel in contact with the country rock. The abrasive nature of the air-water-mud had a tendency to cavitate and incorporate zones of soft country rock located above, therefore producing samples at the collar which were not truly representative of the material encountered at the bottom of the hole.

The drill cuttings were collected at the collar in 5 ft increments. Each 5 ft sample was referred to as the regular sample. An additional grab sample was also collected from every alternate 5 ft interval.

In the opinion of the QP, the sample length is appropriate for the nature of the mineralization as it would have isolated relatively higher-grade samples from lower grade. The entire drill hole was sampled and therefore any potential mineralization encountered in the holes should have been identified.

In soft or broken rocks, rotary drilling samples are known to be subject of contamination from material located higher up in the drill hole. There is no direct evidence that this was a problem at the Project and subsequent drilling by First Vanadium confirmed similar results. In the opinion of the QP, the samples collected by UCC are adequate to be included in the current resource estimate.

11.1.2 First Vanadium

Core

Core was cut in half, bisecting the mineralization. Core sampling was carried out by use of a diamond blade core saw. The core sampler was highly experienced and sampling work was closely monitored by on-site core logging geologists.

Core samples were generally 1.5 m long. A minor number of samples taken were less than 1.5 m in length due to poor recovery. Sampling was carried out immediately below the overburden and all the way down to the base of the drill hole.

Technicians were instructed to place the same side of core back into the box and the other into a labelled clean plastic sample bag that was then sealed using a plastic zip tie. Sample bags were placed in address-labelled rice bags, sealed with plastic zap-straps.

All samples were assigned a blind sample identification number, and quality control samples were included in the sequence. Sample serial numbers with depth intervals or QA/QC sample type were recorded in booklets provided by the laboratory. Samples were shipped via commercial freight carrier to MS Analytical of Langley, British Columbia, for sample preparation and analysis.

RC

A contract geologist provided by Rangefront was present for all RC drilling. The geologist set up a table for sample splitting at a safe distance from the rig. The drill crew collected the fine, powdery sample material in 5-gallon plastic buckets lined with polyethylene sample bags. The crew brought the buckets to the table for the geologist to split and re-package.

Average total sample weight was about 12 pounds per five-foot interval. Dry samples were split at the rig, to separate about 25% for multi-element assay, and the remainder was retained metallurgical testing.

A single-tier riffle splitter with 16 riffles was used at the rig. The dry sample material flowed freely through the riffle splitter. A small, representative amount of material was collected in chip trays for geologic logging and archival.

Samples with added water were collected from the rig in one bag and split after drying at the analytical laboratory. This eliminated the potential risk of sample bias from splitting cohesive material that does not flow freely.

An additional small sample (200 g) was separated out for X-ray fusion (XRF) analyses. A Niton hand-held analyzer was used on every 5 ft run as samples were produced from the drill. The analyzer determined V_2O_5 grades from the 200 g subsample and the geologist recorded these numbers on drill logs. As the Niton analyzer had been tested by First Vanadium on core pulps with laboratory assays, there was reasonable confidence in the XRF results. This procedure assisted in determining when the hole had passed through the high-grade zone for hole termination.

Five-foot sample intervals were assigned a blind sample identification number, and quality control samples were included in the sequence. Sample serial numbers with depth intervals or quality-assurance and quality control (QA/QC) sample type were recorded in booklets provided by the laboratory. The RC samples were collected in polyethylene bags at the rig. These were transported via pickup truck to the storage facility in Elko for inventory prior to shipment to the analytical laboratory. The polyethylene bags were placed in larger rice sacks for protection during shipping. Samples were shipped via commercial freight carrier to MS Analytical of Langley, British Columbia, for sample preparation and analysis.

11.2 Metallurgical Sampling

Sampling for metallurgical testwork is discussed in Section 13.

11.3 Density Determinations

Density testwork was taken by the logging geologists during the 2018 core drilling campaign. A total of 206 measurements were taken. A piece of representative core approximately 8 cm long was weighed dry, using an analytical balance and weighed suspended but submerged in a beaker of water which had been weighed and tared. The dried weight divided by the wet weight equalled the specific gravity (SG) of the sample.

11.4 Analytical and Test Laboratories

11.4.1 Legacy

The two laboratories used in the legacy programs were located in Carlin, NV, and in Grand Junction, CO. The Carlin laboratory and Grand Junction laboratories were both in-house, UCC facilities. During the era of this work, it was common for large companies such as UCC to operate their own analytical laboratories. In many cases, these laboratories were the best in the business at the time.

11.4.2 First Vanadium

MS Analytical is an accredited laboratory independent of First Vanadium and has both ISO 17025 and ISO 9001 accreditation for laboratory testing and calibration, and Quality Management Systems, respectively. These accreditations apply to both analytical procedures and sample preparation procedures.

Check assays were performed by ALS Global in Vancouver, BC., which is an independent, third-party laboratory that holds ISO17025 for selected analytical techniques.

11.5 Sample Preparation and Analysis

11.5.1 Legacy

There is no information currently available which describes the sample preparation methods by UCC.

The samples were analyzed using a two-stage approach. First, the alternate grab samples were analyzed by XRF for V_2O_5 at Carlin NV. If a particular grab sample or run of grab samples produced anomalous results, then the original sample for that interval and the two adjacent intervals were sent to Grand Junction, CO. for V_2O_5 and zinc analysis. It is unknown what analytical procedures were used at the Grand Junction laboratory.

11.5.2 First Vanadium

Sample Preparation

All sample preparation was completed at the MS Analytical laboratory in Langley, BC. The RC sample material is a fine powder and has low risk for sample bias during laboratory sample reduction. Core samples were larger particles, but the soft material would also crush and homogenize easily.

The sample preparation procedure PRP-910 was used for all samples:

- Dry and weigh;
- Crush to 70% passing 2 mm;
- Split 250g with a riffle splitter;
- Pulverize split to 85% passing 75 µm.

The remaining coarse reject material was retained and returned to First Vanadium.

Analysis

The analytical methods at MS Analytical consisted of

- Code IMS-230:
  - Ultra-trace level multi-element determination for all samples;
  - Four-acid digestion and inductively-coupled plasma (ICP) atomic emission spectroscopy (AES) or mass spectrometry (MS) analysis;
  - Sample mass 0.2 g;
  - Suite of 48 major and trace elements;
  - Method detection limit range is 1–10,000 ppm V_2O_5 (up to 1%).
- Code ICF-6V:
  - Ore-grade vanadium determination for samples with at least 0.3% V_2O_5 (3,000 ppm);
  - Four-acid digestion and ICP-AES analysis;
  - Sample mass 0.2 g;
  - Lower method detection limit is 0.001% V_2O_5 (10 ppm).

On the assay certificates, V_2O_5 results are reported and were determined by converting elemental vanadium results. The conversion formula is:

- $V_2O_5 = V * 1.7852$.

11.6 Quality Assurance and Quality Control

11.6.1 Legacy

At the time that the exploration drilling by UCC was completed, it was not a common procedure for the exploration department to conduct rigorous QA/QC programs on its in-house laboratories. Each of the in-house laboratories was held accountable for their own QA/QC programs.

The existing assay certificates do not contain any data for internal duplicates or standards.

The nature of the sampling at the Project does, however, provide for an incidental check on results. Since many of the samples originally analyzed at the Carlin laboratory were then rerun at the Grand Junction laboratory, a direct comparison can be made. Figure 11-1 is an x-y scatter plot of the V_2O_5 results for duplicate analyses on 891 samples. The plot shows very good correlation between the two laboratories with no bias from either.

11.6.2 First Vanadium

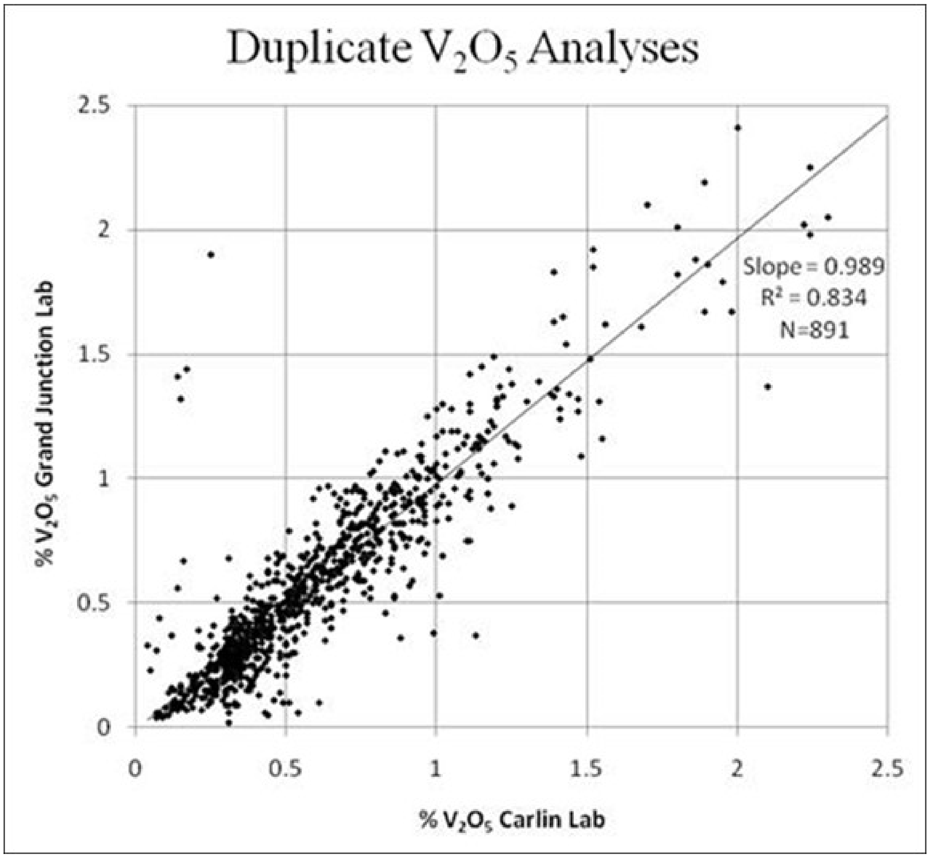
Control samples, as standard reference material (SRM) and blank samples, were included in the core and RC drilling programs conducted by First Vanadium. Several types of duplicate samples were analyzed, to test for bias in sample reduction. Results for V_2O_5 from the QA/QC samples are reported in the following sub-sections. Laboratory results and certified values were reported in parts per million.

Standard Reference Materials

Three types of SRMs were included in the core sample assay program. OREAS 45e is a weathered soil and is similar material to the drill samples. This SRM was also used in the RC sample assay program.

The other two SRMs are from carbonatite-hosted rare earth element (REE) deposits, and while they have certified mean values for vanadium, the material is considerably different than the drill samples. SRM samples were inserted after every 20th drill sample in the serial number sample list for both drilling programs. The mean values for four-acid digestion and ICP analysis are summarized in Table 11-1.

Figure 11-1: Duplicate Check Samples



Note: Figure from Stryhas, 2010.

Table 11-1: SRM Summary

CRM	Material Type	Certified Mean (V_2O_5 ppm)	Standard Deviation (V_2O_5 ppm)	Samples (Core Program)	Samples (RC Program)
OREAS 45e	Lateritic soil	575	27.5	11	160
OREAS 461	Carbonatite supergene REE	628	51.3	22	--
OREAS 465	Carbonatite supergene REE	762	123.1	28	--
Total				***61***	***160***

Note: lower method detection limit 1 ppm; resource cut-off grade 3,000 ppm.

Results for OREAS 45e were within two standard deviations of the mean value for all but one sample (Figure 11-2 and Figure 11-3). Values are symmetrically distributed about the mean and there is no apparent sample bias.

Results for OREAS 461 are shown in Figure 11-4, and are systematically lower than the mean value, and all results but one are within two standard deviations of the mean. Results for OREAS 465, in Figure 11-5, have more values less than the mean than greater, but all samples are within one standard deviation of the certified mean value.

The cause of apparently low values for two of the reference materials is not clear. All have similar V_2O_5 values, about five times less than economic grades. Difference in the matrix composition, interference from other elements, and possible refractory material in 461 and 465 are possible causes for low reported values. OREAS 45e results from both drilling programs indicate reliable and consistent values.

Blanks

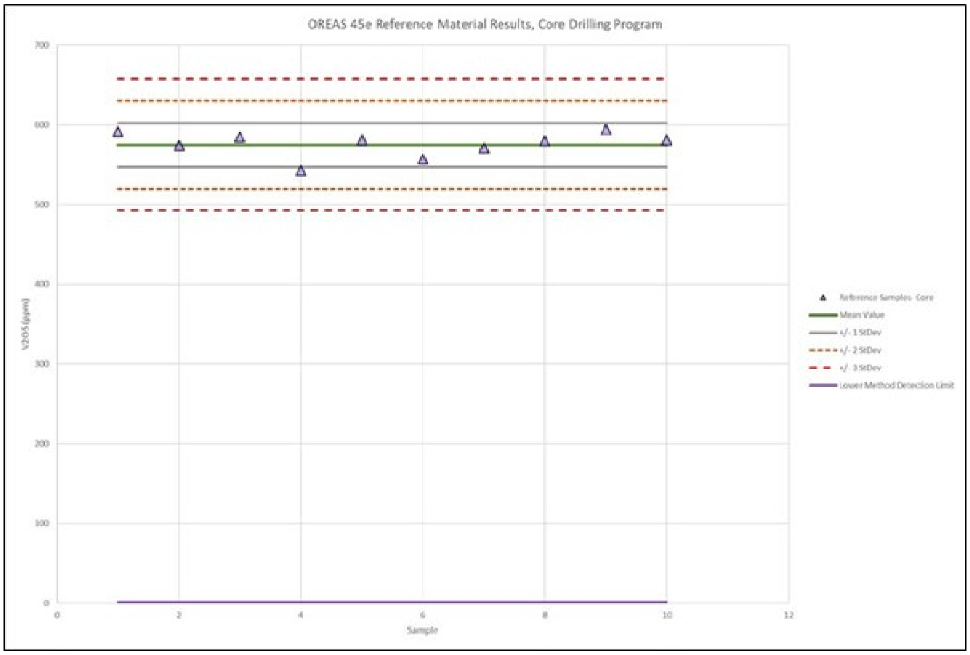
Blank samples of fine silica sand or coarse rock were inserted in the sample sequence after every 20th drill sample, at the same insertion rate as the SRM samples. Blank sample results from the core program are plotted in Figure 11-6.

While most values were <10 times the method detection limit (10 ppm), this benchmark may be overly stringent for vanadium results. The average crustal abundance of V_2O_5 is on the order of 300 ppm.

All values were an order of magnitude less than the average crustal abundance, and two orders less than economic grades. Blank results from the core program indicate sample preparation free of cross contamination and reliable analytical results.

Fine and coarse blank sample materials were also used for the RC assay program. Results are plotted in Figure 11-7. Coarse material was used early in the program, and fine material was used later, to better match the fine-grained RC drill samples. Distribution of blank sample values from the RC program is similar to the core program. The results do not indicate any material cross contamination or analytical issues.

Figure 11-2: OREAS 45e Results, Core Program

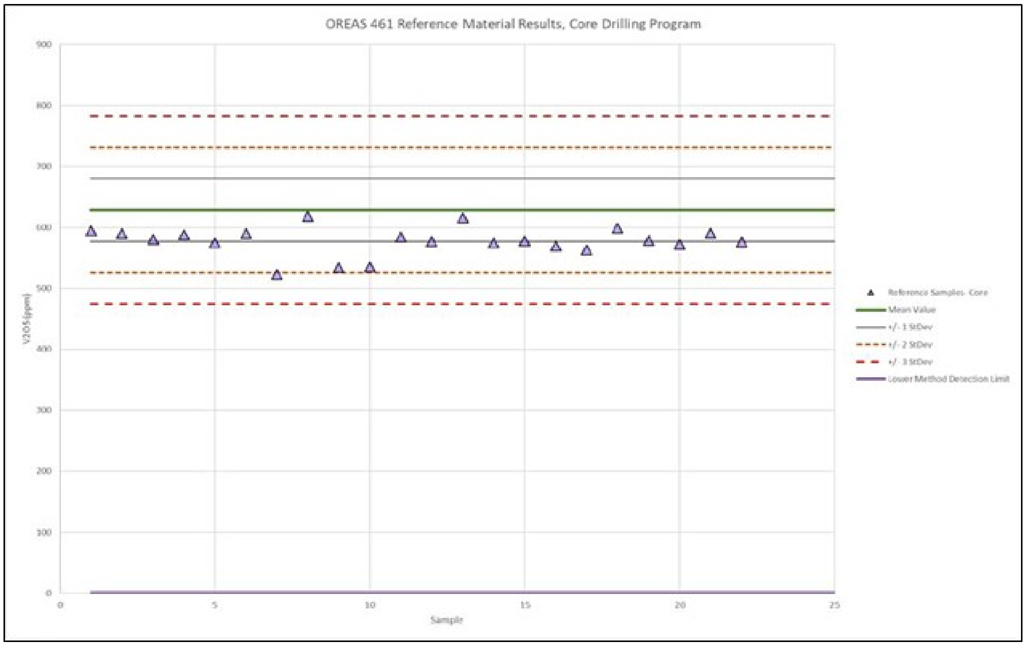


Note: Figure from Stryhas et al., 2019.

Figure 11-3: OREAS 45e Results, RC Program

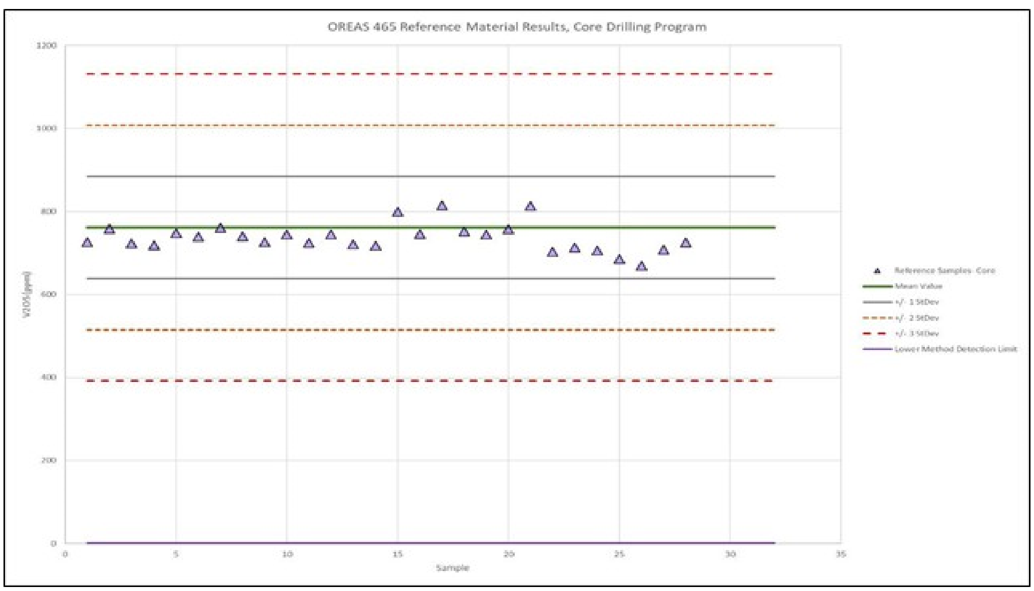
Note: Figure from Stryhas et al., 2019.

Figure 11-4: OREAS 461 Results, Core Program



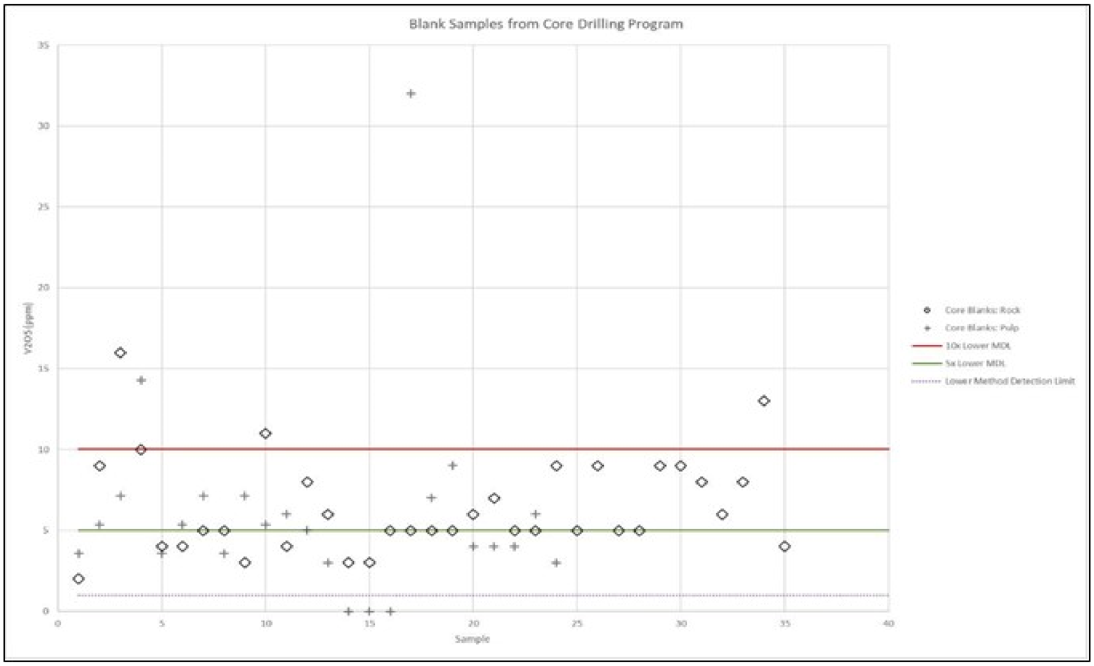
Note: Figure from Stryhas et al., 2019.

Figure 11-5: OREAS 465 Results, Core Program



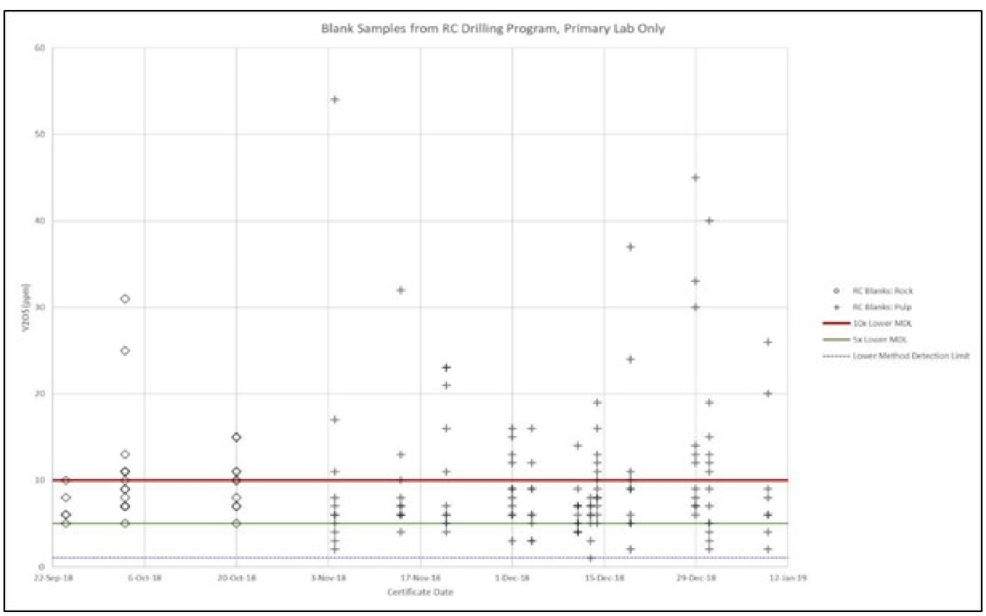
Note: Figure from Stryhas et al., 2019.

Figure 11-6: Blanks from Core Program



Note: Figure from Stryhas et al., 2019.

Figure 11-7: Blanks from RC Program



Note: Figure from Stryhas et al., 2019.

Duplicates

Duplicate core samples were collected for approximately one out of 18 samples. Variation in the in- situ material with coarse particle size is expected to be up to 30%, depending on the nature of mineralization. Percent difference of original and duplicate core sample pairs is plotted in Figure 11-8.

All duplicate pairs have values well above the method detection limit. For higher values, the difference between original and duplicate samples is relatively smaller. There is slightly more variation for samples <1,000 ppm than there is for original samples with higher values. Duplicate pairs have differences within the expected range, and all duplicate sample values except one are within 30% of the corresponding original value. This reflects a sound approach for core splitting and sampling and shows that the half-core assay sampling method is free of bias.

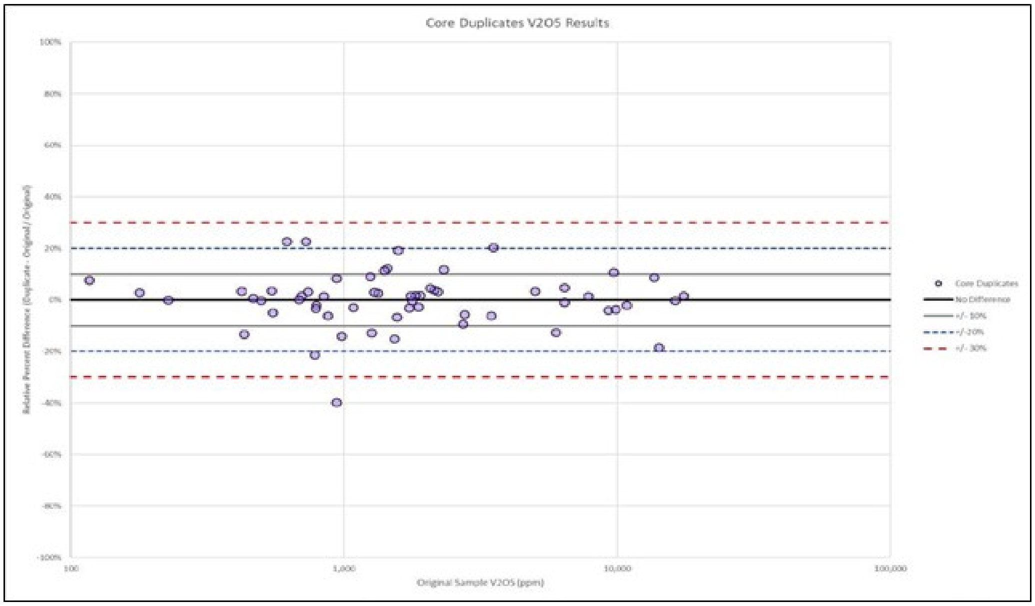
Duplicate RC samples were collected in the field from dry material to assess the quality of sample splitting done in the field. Duplicates were collected on every 20th drill sample, at 100ft depth intervals. Like the core duplicate samples, the RC duplicates tested the first stage of sample mass reduction. Unlike the coarse core samples, the RC samples were milled to consistently fine particle size by the hammer bit. Percent difference of RC duplicate samples compared to original sample values are plotted in Figure 11-9. Differences between original and duplicate RC samples have a similar distribution to the core duplicate pairs. Differences are symmetrical about 0% (no difference) and the majority of pairs have less than 20% difference. A small proportion have greater variability.

Check Assays

Check assays were completed at ALS Global on all duplicate pulps from the core and RC programs. The analytical procedures were comparable to those at MS Analytical:

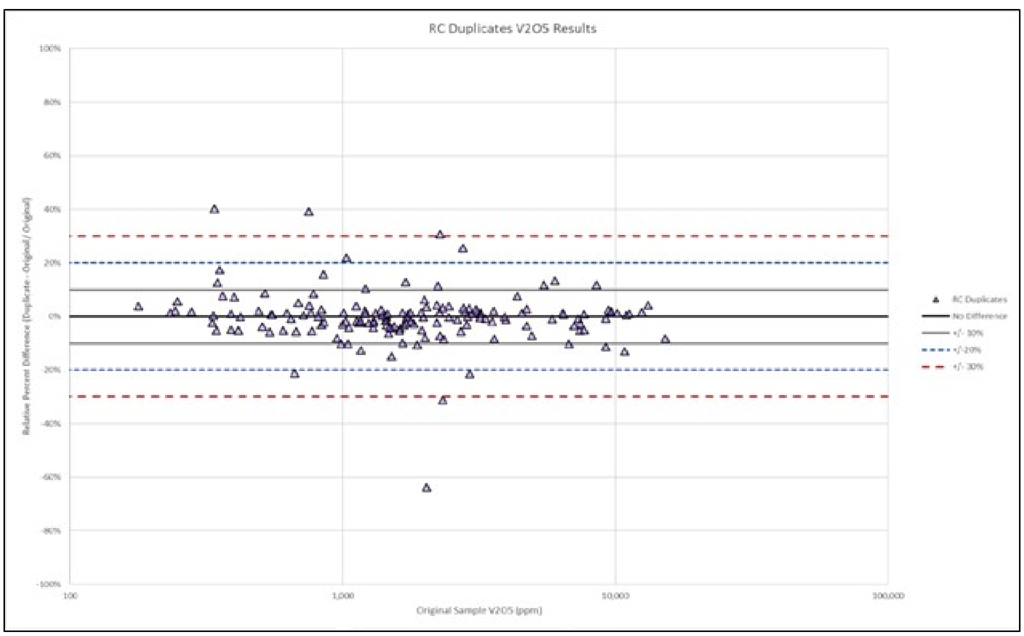
- ALS code ME-ICP61, 4-acid digestion with ICP-AES finish for 33-element suite, detection range for V is 1–10,000 ppm;
- ALS code ME-MS61a, 4-acid digestion, ICP analysis for V only, on samples >3,000 ppm V_2O_5, detection range 10–100,000 ppm.

Figure 11-8: Core Duplicate Pair Relative Percent Difference



Note: Figure from Stryhas et al., 2019.

Figure 11-9: RC Duplicate Pair Relative Percent Difference



Note: Figure from Stryhas et al., 2019.

Relative percent difference of check assays versus original assays are plotted in Figure 11-10. Check assay results are between 30% higher and 12% lower than the original assay values. The 142 pairs of check assay drill samples average 6.9% higher than the original values. The eight pairs of OREAS 45e check assays average 5.6% higher than the original values. Two pairs of each OREAS 461 and OREAS 465 have less than 10% difference, and average to less than 1% difference.

The check assay results appear to be systematically greater than the original assay results by about 6%. The cause of this is unknown. SRM check assay results are within 10% of the original and the limited number of sample pairs do not show a high bias.

11.6.3 Conclusions

All SRM and blank sample results from initial analysis were within acceptable ranges. No samples were re-analyzed, nor does the QP recommend re-analysis.

Assay results of control samples and sets of duplicate samples indicate reliable and accurate analytical results from the primary laboratory. The slight high bias apparent in check assay samples is not well understood but is not a cause for concern about the quality and repeatability of the analysis by MS Analytical.

11.7 Databases

The electronic drill hole data for the Project is stored in a secure database program managed by a consulting geologist, Mr. Tao Song, who is independent of First Vanadium.

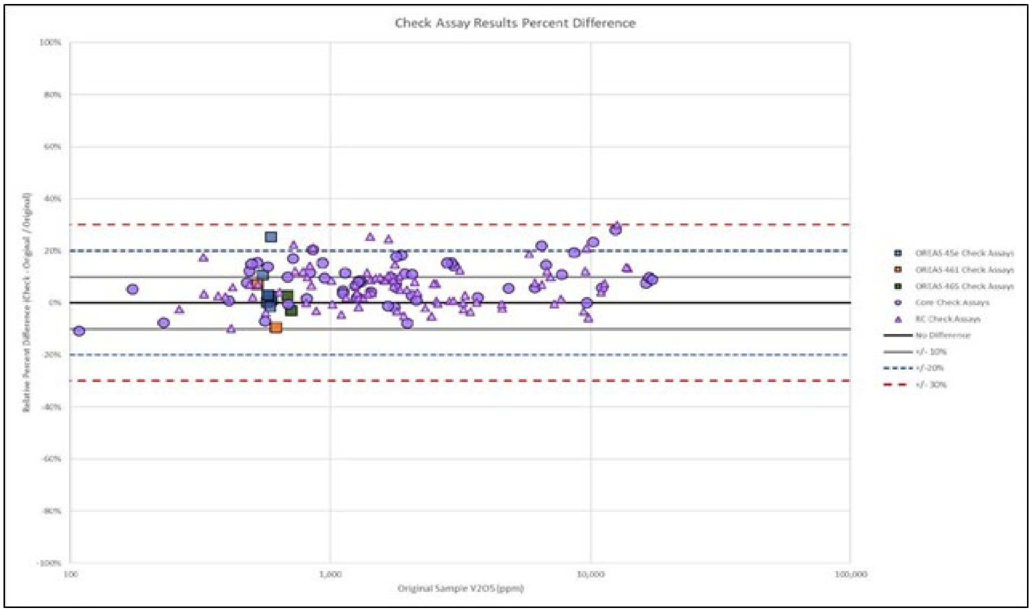
Assay data from the First Vanadium 2017–2018 drilling programs were received from MS Analytical as comma-separated value (CSV) files, which were imported directly to the Project database. Assay certificates were received as portable document format (PDF) files, for archival.

Core and RC drill hole logs were completed on paper forms and tabulated in an Excel file with built-in validation of logging codes and depths. The completed tabular logs were then imported to the database program for secure storage.

Downhole survey and collar survey data were provided digitally from their source and imported by Mr. Song into the database program.

Density measurements and lithologies were typed into Excel spreadsheets and uploaded by Mr. Song into the database program.

Figure 11-10:Check Assay Sample Pair Relative Percent Difference



Note: Figure from Stryhas et al., 2019.

The database is backed up on the First Vanadium server and is also backed up by Mr. Song's home office.

11.8 Sample Security

Sample security practices for the legacy programs are not known.

During the First Vanadium programs, samples were collected in the field for RC or in the core shed for core. All material was handled by contracted staff independent of First Vanadium. Sample bags were placed in woven rice sacks, which were palletized and wrapped for secure shipment. The required shipment waybill for each batch served as evidence for secure sample chain of custody between First Vanadium's possession and receipt of samples at the laboratory. Each batch of samples included a sample submittal form that detailed the material shipped and served to document the laboratory's receipt of the samples.

11.9 Sample Storage

There are no known remaining legacy samples.

Core from the First Vanadium drill programs is stored in a storage unit in Elko, Nevada, with controlled access.

Sample pulps from the First Vanadium drilling programs are stored at MS Analytical.

11.10 Comments on Section 11

The analytical results produced by UCC demonstrate adequate quality to support a resource estimate. The UCC data have been subsequently been verified by the 2017–2018 First Vanadium drilling programs.

The QA/QC program established and implemented by First Vanadium for the 2017–2018 drilling programs allowed assessment of sample reduction and analytical procedures at several stages of the process. The QA/QC sample results indicate adequate sub-sample size for the degree of homogeneity in the material, and repeatable and reliable analytical results. Sample handling and chain of custody procedures ensured the samples were safe from tampering or accidental contamination.

The QP’s opinion is that the analytical data from the 2017–2018 drilling programs meet and exceed current requirements for quality of sampling and analysis procedures, and the data are suitable to support Mineral Resource estimation.

12.0 DATA VERIFICATION

12.1 Witness Sampling

In 2010, EMC, the owners of the property at that time, took two surface samples while the QP was on site. The two surface samples were collected by removing unconsolidated surface material and then collecting a composite of rock fragments from broken bedrock. Approximately 25 lb of samples were collected from each outcrop. The two outcrops were located about 30 ft apart. The samples both returned relatively high grades on mineralization as shown in Table 12-1.

12.2 Legacy Data

In 2009, the historical UCC drill logs were tabulated to create an electronic drill hole database. First Vanadium identified and corrected some collar locations and elevations from the EMC database from orthophotos prepared from airborne and field target surveying conducted in October 2017.

First Vanadium possesses copies of the historical UCC drill logs, most assay certificates, and cross-sections and plan maps used to compile the historical UCC estimation. The electronic database was generated by hand entry of information taken from the UCC drill logs.

Drill hole collar locations were compiled into an Excel spreadsheet by x, y, z in the local coordinates as listed on the drill logs. EMC later transformed these locations by conducting a licensed field survey of the local control points and then transforming the historical coordinates to Nevada State Plane using ESRI software.

There are no downhole surveys recorded on the drill logs. The descriptive data for each drill hole logged interval was entered into Excel spreadsheets. This included hole ID, from, to, % V_2O_5 Carlin laboratory assay, % Zn Carlin laboratory for some intervals, % V_2O_5 Grand Junction laboratory assay, % Zn Grand Junction laboratory for some intervals, primary rock type, secondary rock type, primary colour, secondary colour and original remarks.

UCC drill logs contained V_2O_5 from two different laboratories. The database from the UCC drill program was constructed primarily from the Grand Junction analyses if available. The intervals not sent to Grand Junction were supported by the Carlin analyses. In the latter case, analyses were only available for every other sample interval.

Table 12-1: 2010 Outcrop Sample Results

Sample Number	V_2O_5 %
CV001	0.845
Cv002	0.445

12.3 First Vanadium

The drill hole data tables with the information used for the 2019 Mineral Resource estimate were exported on 31 January, 2019 and provided to SRK as Microsoft Excel files.

SRK reviewed assay data for seven of the 89 RC holes completed in 2018. The drill holes were selected to represent the north–south extent of the deposit and comprise 9.2% of the drill hole interval assays. The silver and zinc values in the database matched the reported values on the assay certificates. V_2O_5 values were reported in parts per million and converted to weight percent in the database; this resulted in a loss of precision that is not material to the grades of economic interest. One sample interval of 281 inspected was noted to have an incorrect V_2O_5 value.

Similar procedures were used for core and RC samples to incorporate logging and assay data to the Project database. The most recent drilling program, limited to RC samples, was selected for verification of assay data. The issue noted is minor and is easily corrected by re-importing the laboratory data.

Geological logs were not compared to the data table used for modeling; rather, the interpreted geologic solids provided by First Vanadium were compared with drill hole data, and no discrepancies were noted during resource estimation.

12.4 Comments on Section 12

The process of data collection, database validation, and data storage used for the Project database ensures that the drill hole data are securely stored and readily available for resource estimation.

The QP visited the site on February 10, 2010, and observed independent witness sampling, and inspected the Project setting and outcrops on site.

The QP believes that the dataset is of adequate quality to support Mineral Resource estimation.

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Introduction

Metallurgical research has been conducted on samples from the Carlin Vanadium property beginning in the late 1960s. A substantial campaign was completed by Union Carbide Corporation (UCC), followed by the U.S. Bureau of Mines. This initial testwork focused on salt roasting as the preferred process route. First Vanadium staff and experts retained by First Vanadium reviewed the findings, and performed some additional tests in 2018–2019. As a result, First Vanadium considered that salt roast would not be the preferred route for 2020 PEA purposes. However, a summary of the salt roast testwork is included in this Report section for completeness.

First Vanadium selected an acid pressure oxidation process as the preferred option for 2020 PEA purposes. A testwork program in support of the pressure oxidation and acid leach option was conducted under the direction of First Vanadium, commencing in 2018 and is the primary focus of this Report section.

13.2 Metallurgical Testwork

Metallurgical testwork on samples from the Project was first carried out by UCC through their Mining and Metals Division – Research and Development Department located in Niagara Falls, New York, between February 1967 and December 1968. The comprehensive program investigated numerous beneficiation and extractive processes (Fox, 1968).

This work was continued by the U.S. Bureau of Mines in the early 1970s at their Reno, Nevada facility. Follow up work included beneficiation and roasting tests (Brooks and Potter, 1974).

First Vanadium commenced metallurgical testing in 2018. The research targeted process flowsheet development and advancing key unit processes. Testwork has been completed in the following areas; mineralogy, comminution, physical beneficiation, acidulation, pressure oxidation, ion exchange, solvent extraction, ammonium metavanadate precipitation, and calcination. The studies were carried out at eight independent laboratories. Two major programs at SGS Minerals in Lakefield, Ontario (SGS Minerals) and Sherritt Technologies, Fort Saskatchewan, Alberta (Sherritt) were conducted. A summary of laboratories and their specific focus is provided in Table 13-1.

Table 13-1: Metallurgical Testwork Summary

Year	Laboratory/Location	Testwork Performed
1967–1968	Union Carbide Corporation, Niagara, New York	Attrition scrubbing, decantation, hydrocycloning, flotation, alkali leaching, acid leaching, NaCl roasting-water leaching, roasting with Na_2CO_3 and Na_2SO_4
1970 and 1974	U.S Bureau of Mines, Reno, Nevada	Physical beneficiation, acid leaching, standard roasting, and NaCl roasting
2018	Process Mineralogical Consulting Ltd, Maple Ridge, British Columbia (PMC)	Mineralogy, petrography, and geochemistry
2018	Kemetco Research, Inc., Richmond, British Columbia (Kemetco)	Flotation
2018	ALS Metallurgy Kamloops, Kamloops, British Columbia (ALS Metallurgy)	Comminution
2018-2019	Sherritt Technologies, Fort Saskatchewan, Alberta	Acid pressure oxidation, alkaline pressure oxidation, roast–pressure oxidation, and solvent extraction
2019	Bureau Veritas Commodities Canada, Richmond, British Columbia (Bureau Veritas)	Physical beneficiation-decantation, comminution
2019	Hazen Research, Inc., Golden, Colorado (Hazen)	NaCl roasting
2019	SGS Minerals, Lakefield, Ontario	Attrition scrubbing, hydrocycloning, flotation, acid pressure oxidation, ion exchange, solvent extraction, NH_4VO_3 precipitation, calcination
2019	Thomas Broadbent & Sons Ltd., Huddersfield, West Yorkshire (Broadbent)	Physical beneficiation-decantation/centrifuge

Metallurgical testwork laboratories are not typically accredited for metallurgical testwork. All laboratories are independent of First Vanadium.

13.2.1 Historical Testwork

Union Carbide Corporation

Several classic extraction methods were tested to determine the mineralized materials response. The UCC research investigated physical beneficiation, acid leaching, alkali leaching, NaCl roasting–water leaching, and roasting with Na_2SO_4 or Na_2CO_3.

Physical beneficiation of the carbonaceous (fresh or non-oxide) and non-carbonaceous (oxide) material was determined to be critical to reduce acid consumption. Vanadium in the non-carbonaceous material is concentrated in the fine fractions. It was successfully separated via attrition scrubbing and decantation with the best result upgrading to 87.9% w/w V_2O_5, 6% w/w CO_3 in 33% of the mass (where w/w is defined as weight percent). Decantation was not a scalable option and testing with hydrocyclones had just commenced when the UCC test program was concluded. The carbonaceous sample beneficiation required de-sliming and flotation as the vanadium was evenly distributed through the size fractions. The best test upgraded 63.2% w/w V_2O_5 in 33.5% of the mass.

Carbonaceous material calcined at temperatures from 675°C to 950°C, followed by NaOH leach extracted 64% vanadium. Carbonaceous material calcined with FeS_2, followed by a pressure leach with Na_2CO_3–$NaHCO_3$ solution extracted a maximum of 62% V_2O_5.

Material pre-calcined from 625–1,050°C, followed by an H_2SO_4 leach at boiling point dissolved 81% of the vanadium with an acid consumption of 47 lb. of H_2SO_4 per pound of V_2O_5 extracted. Acid baking of upgraded material at 280°C, followed by hot water leach extracted 93% of the vanadium with an acid consumption of 64 lb of H_2SO_4 per pound of V_2O_5 extracted.

Samples of material both carbonaceous and non-carbonaceous, were NaCl roasted and water leached and achieved vanadium extractions from 1–66%. Roasting of carbonate samples using various salt additives failed to extract >58% of the vanadium.

Sample locations are not known. The descriptions of the sample materials are typical for the deposit. UCC referenced the material types as carbonaceous and non-carbonaceous and this designation could lead to misinterpretation. From the physical descriptions the carbonaceous material is referencing what the current work identifies as the non-oxide black mudstone, and the non-carbonaceous material is referencing the oxide mudstone.

U.S. Bureau of Mines

The U.S. Bureau of Mines followed up on the UCC work. The vanadium extraction of the non-carbonaceous weathered mudstone was influenced by several factors. Larger hard particles were found to be more refractory than soft, friable particles or clay. Maximum extraction was achieved by grinding to 100% minus 35 mesh which coincidentally produced a grind with 65% minus 100 mesh. Optimum salt usage was determined to be about 200 lb/st. Acid consumption was determined to be about 10 lbs for each pound of V_2O_5 extracted. These combined produced an average vanadium extraction of 69%.

The vanadium extraction of the carbonaceous mudstone was tested using similar procedures as those described above. The same grinding and standard roasting or salt roasting was followed by a standard acid leaching recovered 45% of the vanadium. Increasing the acid concentration such that 40 lbs of acid are required for each recovered V_2O_5 lb increased the total V_2O_5 recovery to 60%. Recovery was improved by pre-roasting the material to 700°C to drive off the carbonaceous material. In this case, 70% of the V_2O_5 was recovered with 11.0 lb of acid consumed for each V_2O_5 lb recovered.

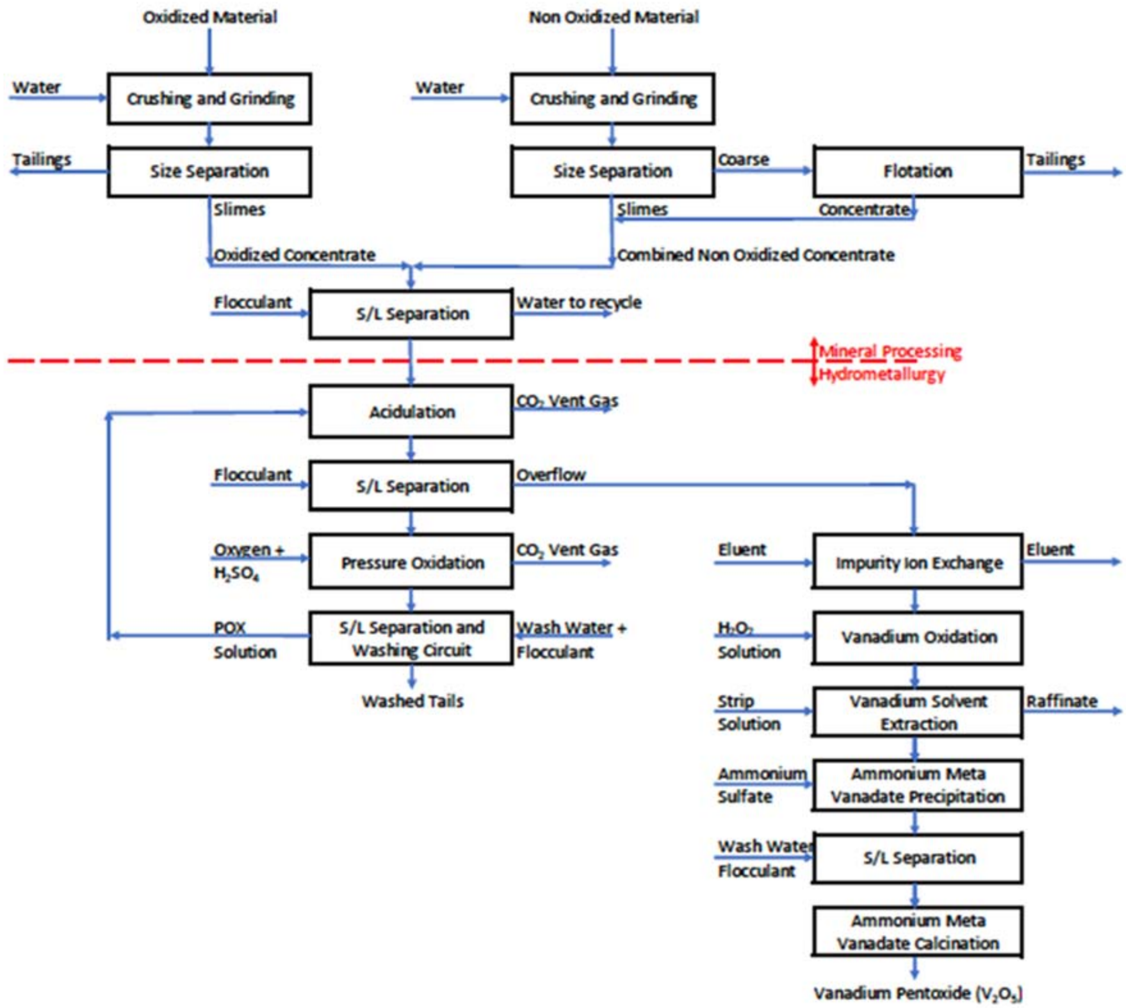
Physical beneficiation did not show significant benefits due to the very fine-grained nature of the host rock. Simple salt roasting was not beneficial because the material contains in excess of 15% calcium and magnesium oxides, which form water-insoluble calcium vanadate. High vanadium extraction was achieved by prolonged digestion in hot sulphuric acid, but time and acid requirements were excessive.

13.2.2 First Vanadium Testwork

Introduction

This sub-section discusses First Vanadium's 2018–2019 metallurgical test results directly impacting the process flowsheet and design criteria. For clarity, presentation is by unit process as opposed to specific research facility. The bulk of this testwork was conducted at SGS Minerals and Sherritt, but also includes pertinent results from ALS Metallurgy, Bureau Veritas, and Broadbent as identified. The process flowsheet is presented in Figure 13-1.

Figure 13-1: Schematic Flowsheet



Note: Figure prepared by First Vanadium, 2020.

Ten composite samples representative of oxide and non-oxide material types of low, medium, and high vanadium grades were used in the testwork and are presented in **Error! Not a valid bookmark self-reference.**. A description including location and core drill hole derivation of the composites is provided in Section 13.4.

Table 13-2: Metallurgical Test Composite Assays

Metallurgical Composite ID	wt %									Sample Description
	Al	Fe	Mg	Ca	S_2-	V_2O_5	C	C (NAL)	C (CO_3)	
DDC-18-06 Hi	2.09	2.26	3.46	6.86	1.69	0.95	16.60	12.40	4.20	Non-oxide mudstone
MT1/1A	2.22	1.28	4.07	7.89	2.11	0.68	19.60	12.40	7.20	Non-oxide mudstone
MT2	2.72	8.11	2.10	4.00	1.91	0.69	18.90	12.70	6.20	Non-oxide mudstone
MT3	1.84	0.99	4.38	10.50	1.47	0.64	17.10	9.78	7.32	Non-oxide mudstone
MT4	2.81	2.03	3.16	5.60	2.40	1.02	16.70	11.70	5.00	Non-oxide mudstone
MT5	2.66	1.96	6.08	10.40	1.41	0.39	10.70	3.96	6.74	Non-oxide mudstone
MT6/6A	3.55	2.16	5.84	11.20	0.06	0.62	7.30	0.90	6.40	Oxide mudstone
MT7	3.48	2.36	3.55	5.70	0.04	0.54	4.09	0.53	3.56	Oxide mudstone
MT8	2.33	1.81	1.71	3.50	0.02	0.93	1.90	0.06	1.84	Oxide mudstone
MT9	3.23	2.18	6.52	10.60	0.00	0.42	6.44	0.12	6.32	Oxide mudstone

Comminution

A composite sample of non-oxide material from the deposit was sent to ALS Metallurgy Kamloops for basic comminution testing. A standard Bond low impact crusher test and a Bond mill work index test were completed on the half core composite. The Bond low impact crusher index measured 4.8 kW-hr/t and would be considered very soft in terms of breakage in a crusher. The Bond mill work index test was conducted at a closing screen size setting of 106 µm, which yielded a Bond ball mill work index of 13.7 kW-hr/t. This is considered to be moderately soft in terms of ball milling.

Upon review, it was determined that the sample tested at ALS Metallurgy was not a good representation of the non-oxide mineralization. A second composite sample was assembled and sent to Bureau Veritas for a standard Bond mill work index test. This yielded a ball mill work index of 9.5 kW-hr/t, and is reflective of the mineralized zones of the non-oxide material. The information was not included in the PEA design criteria for the milling circuit, and represents an opportunity.

Beneficiation of Oxide Material

Beneficiation tests were conducted on several oxide composites created from drill holes across the resource for variability testing in 2018. Composites MT6A and MT7 were selected to demonstrate the beneficiation of vanadium and rejection of carbonate in the oxide material. Historical work indicated that vanadium in the oxide material was concentrated in the ultra-fine ≤5-µm fraction and could be physically separated from the carbonate and other acid-consuming gangue. Through a series of tests, a flowsheet for oxide beneficiation was developed that included attrition scrubbing followed by a multi-stage hydrocyclone process.

Tests on the MT7 composite resulted in 87.3% of the total vanadium in the original sample reporting to the concentrate that had 55.6% of the total mass of the sample, it also contained 29.3% of the total weight of carbonate in the original sample.

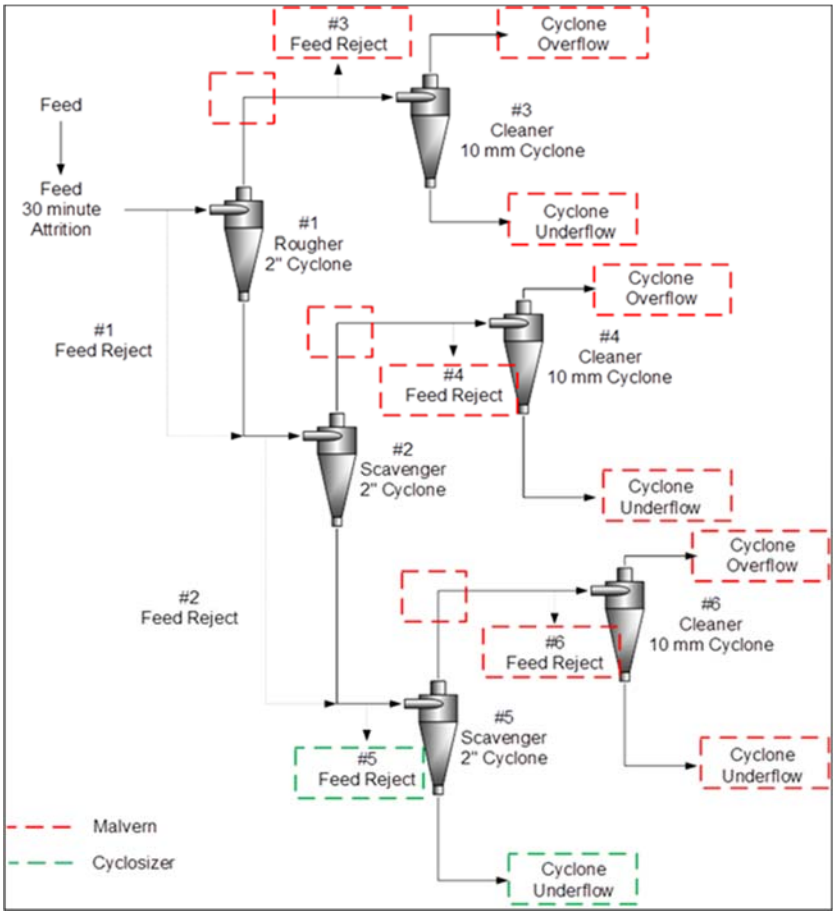
The particle size analysis of the final concentrate had a K80 of 6.92 µm. This composite is representative of the average grade and carbonate content for the oxide material across the resource. Concentrate from this composite was used as the starting material for select downstream metallurgical work.

Attrition Scrubbing and Hydrocyclone Testwork

Attrition scrubbing was conducted in a 4 L Denver D12 flotation machine equipped with an attrition impeller. Four 2 kg charges of oxide samples were pulped with water to 50% solids and scrubbed for 30 minutes. The scrubbed slurry from each feed charge was combined and diluted to 5% solids prior to the hydrocyclone circuit. The cyclone circuit was tested in three different configurations of four, six, and eight stages.

The six-stage circuit was ultimately selected and was operated as follows (Figure 13-2). The slurry was pumped through a 50.8 mm cyclone (11 mm vortex finder and 6.4 mm apex) at a feed pressure of 28 psi (Cyc#1). The Cyc#1 underflow was pumped through the 50.8 mm cyclone again for the second cycloning stage (Cyc #2). Similarly, the Cyc#2 underflow fed the fifth cycloning stage (Cyc#5). The Cyc#5 underflow was dried, filtered, weighed and a subsample was submitted for assays.

Figure 13-2: Hydrocyclone Six-Stage Configuration



Note: Figure prepared by SGS Minerals, 2019.

The overflow from Cyc#1, Cyc#2, and Cyc#5 fed the third (Cyc#3), fourth (Cyc#4), and sixth (Cyc#6) cycloning stages, respectively. For each of the stages 3–6, the slurry was pumped through a 10 mm hydrocyclone at a feed pressure of 50 psi.

The MT7 metallurgical balance for the individual streams is presented in Table 13-3. As expected, the cyclone overflow products showed the best upgrade of vanadium and rejection of carbonate and confirmed the conclusion that the vanadium is contained in the sub 5-µm particle size fraction.

Table 13-3: MT7 Metallurgical Balance Six-Stage Hydrocycloning

Product	Weight		Assays %		% Distribution		
	kg	%	V_2O_5	CO_3	V_2O_5	CO_3	K_{80} µm
Cyc# 3 O/F	1.5	20.8	1.12	6.08	41.6	6.8	4.70
Cyc# 3 U/F	0.5	7.3	0.76	11.3	9.9	4.4	7.00
Cyc# 4 O/F	0.6	7.9	1.10	6.47	15.5	2.8	5.40
Cyc# 4 U/F	0.3	4.4	0.59	15.1	4.7	3.6	9.70
Cyc# 6 O/F	0.2	2.4	1.04	7.80	4.4	1.0	6.00
Cyc# 6 U/F	0.2	3.2	0.34	21.1	1.9	3.6	12.00
Cyc# 5 U/F	3.1	44.4	0.16	29.5	12.7	70.5	77.30
Cyc# 3 feed reject	0.3	4.7	0.74	13.4	6.2	3.4	11.20
Cyc# 4 feed reject	0.1	1.1	0.64	13.7	1.2	0.8	9.00
Cyc# 5 feed reject	0.2	3.0	0.21	13.4	1.1	2.2	77.30
Cyc# 6 feed reject	0.1	0.9	0.42	21.1	0.7	1.0	13.20
Feed (calc.)	7.0	100	0.56	18.6	100	100	40.20
Feed (dir.)			0.55	16.1			

Note: O/F = overflow, U/F = underflow.

Individual product streams from the MT7 beneficiation tests were combined into a final concentrate that prioritized vanadium recovery while rejecting carbonate and mass. The only stream that was rejected was the Cyclone #5 underflow. All other streams were combined. The final concentrate contained 87.3% of the vanadium and 29.5% carbonate in 55.6% of the mass (Table 13-4). The K_{80} of the combined streams was 6.92 µm.

Consistent successful laboratory results were achieved using the attrition scrubbing hydrocyclone procedure. However, Wood considered that there were other methods that had greater potential for commercial scale-up.

Beneficiation Decanter Centrifuge Testwork

Decanter centrifuges are commonly employed in an industrial setting to separate particles in the sub-5-µm range. A test to determine if this equipment was a viable solution for physical beneficiation of the Carlin vanadium material was conducted on an oxide composite sample (MT7) by Broadbent. This initial test was more qualitative in nature and served as an indicator for an additional test program.

Table 13-4: MT7 Combined Products/Final Concentrate

Product	Weight		Assays, %		% Distribution		K_{80}
	kg	%	V_2O_5	CO_3	V_2O_5	CO_3	μ
Combined products	3.9	55.6	0.88	9.9	87.3	29.5	6.92

The MT7 composite was attrition scrubbed at SGS Minerals prior to shipping. Once at Broadbent, the sample was screened at 212 µm, and three splits of the <212 µm slurry was spun at different 'G' forces for incrementally increasing time periods. After spinning at each stage, the top liquor (decanter centrate) was poured off leaving the consolidated solid (decanter cake) in the tube. Having dried off the various proportions it was possible to determine the approximate fraction w/w and particle size of the dry solid that may be discharged with the centrate from a decanter centrifuge (Table 13-5 and Figure 13-3).

The result of the exercise is that spinning for 30 seconds at 1,000 x 'G' allows the proportion of material which is <6–8 µm in size to be spilled off (or cut) with the centrate. With this in mind it may be possible to translate this outcome to a decanter centrifuge.

It was concluded from this preliminary evaluation that it would be worthwhile progressing to small-scale decanter centrifuge tests as a future opportunity.

It should be noted that there are several opportunities that may be realized in the next phase of testing:

- At an approximate "cut" of 5 µm, only 23.44% w/w of the mass is pulled to the centrate (refer to Figure 13-2). This indicates a significant improvement over the hydrocyclones where the mass pull is 55.6% w/w (refer to Table 13-4). This may lead to an opportunity to reduce overall mass through the process. The caveat is that it is mass only, and would need to be carefully considered with corresponding analytical data to determine the vanadium recovery and carbonate rejection
- The percent solids in the centrate is also higher, at 10.6%, as opposed to 2% for the hydrocyclone concentration product. This may be an opportunity for optimization of the concentrate thickener, starting with a nominally higher feed density.

Table 13-5: Centrifuge Classification Tests

Spin Time (sec)	Separating Effect (G')	Solid Centrate (%)	Recovery to Centrate (%)
10	1,000	13.68	32.45
20		11.6	26.15
30		10.63	23.44

Figure 13-3: Approximate Particle Size Distribution and Mass Discharged with Centrate

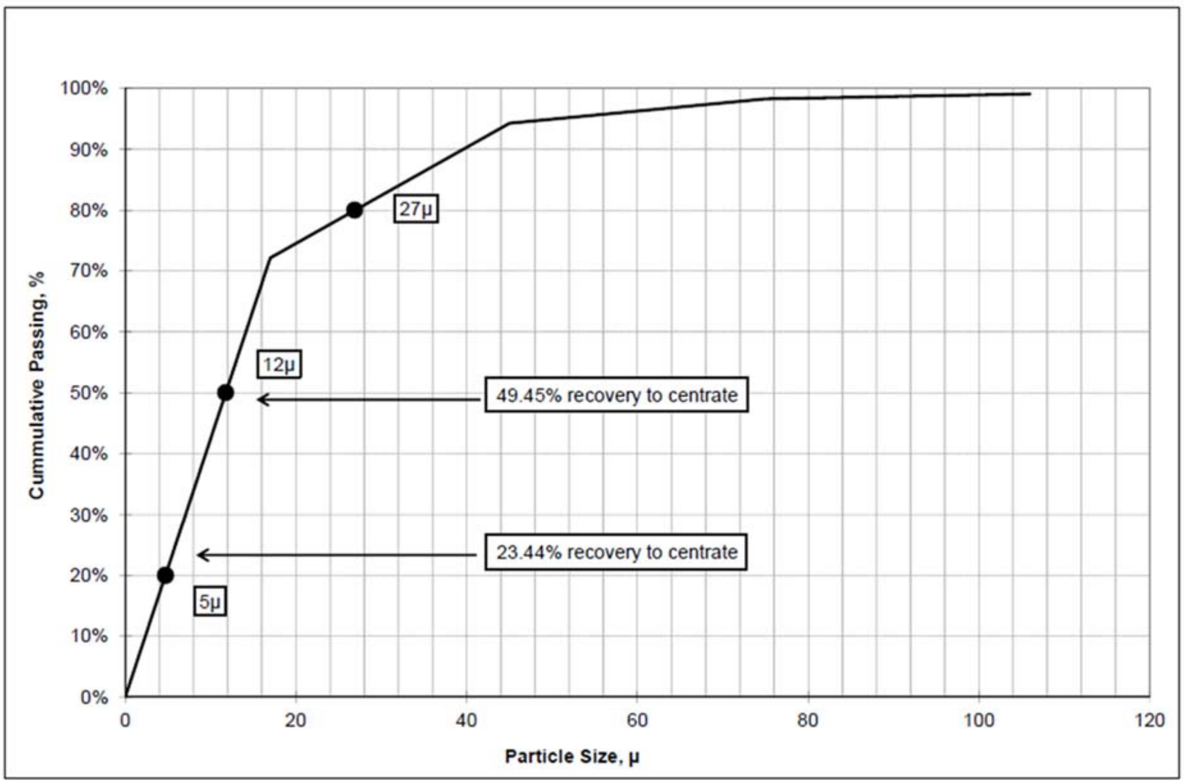


Figure prepared by Thomas Broadbent and Sons, Ltd., 2019.

Beneficiation of Non-Oxide Material

Non-oxide mudstone composites MT1 and MT4 were evaluated to demonstrate effective beneficiation of vanadium and rejection of carbonate in non-oxide material. Historic work indicated that the vanadium in the non-oxide material was more evenly distributed across size fractions than the oxide material. The test program developed consisted of grinding, attrition scrubbing, de-sliming, and froth flotation steps to concentrate vanadium and reject the carbonate gangue.

The selected flowsheet yielded 92.5% w/w vanadium in 72.0% w/w of the mass and carried 37.1% of the carbonate in the MT4 composite. The MT4 composite was representative of the average grade and carbonate content across the resource. Concentrate from this composite was used as the starting material for select downstream metallurgical work.

De-Sliming and Froth Flotation Testwork

A 2 kg charge of non-oxide material was pulped with water to 65% solids and ground in a rod mill for approximately 45 minutes. The ground slurry was placed in the attrition scrubbing tank for 30 minutes. The scrubbed material was diluted to 5% solids and pumped through a 10 mm hydrocyclone at a feed pressure of 50 psi. The cyclone overflow pulp was dried, filtered, weighed and a subsample was submitted for assays. The cyclone underflow was conditioned at high density and high intensity (1,800 rpm) with emulsified diesel (collector) and MIBC (frother) for five minutes in a 4 L flotation cell. Following the conditioning stage, air was introduced to the flotation cell for a finite time, completing the first of six rougher flotation stages. Flotation time for each stage varied from 2–10 minutes increasing in time in the later stages. Additional doses of collector and frother were added during each stage. At the end of each stage, the flotation concentrate was filtered, dried, weighed and a subsample was submitted for assays. The tailings from each stage were used as feed for the next rougher flotation stage.

The foregoing procedure yielded the results shown in Table 13-6, demonstrating successful beneficiation of vanadium and rejection of carbonate from the non-oxide composite.

Table 13-6: MT4 Metallurgical Balance De-Slime and Flotation

Product	Weight		Assays, %		% Distribution		Time
	g	%	V_2O_5	CO_3	V_2O_5	CO_3	min
Cyclone O/F	447	23.1	1.46	10.6	39.3	15.8	-
Carbon conc 1	313	16.2	1.13	5.28	21.3	5.5	4
Carbon conc 2	282	14.6	0.96	6.60	16.3	6.2	4
Carbon conc 3	350	18.1	0.74	8.10	15.6	9.5	10
Carbon conc 4	66.7	3.4	0.41	16.4	1.6	3.7	10
Carbon conc 5	33.2	1.7	0.42	20.5	0.8	2.3	10
Carbon conc 6	23.0	1.2	0.36	25.0	0.5	1.9	10
Carbon tails	419	21.7	0.18	39.3	4.5	55.1	-
Head (calc.)	1934	100	0.86	15.5	100	100	48
(Direct)			0.89	15.7			

Note: O/F = overflow.

The selected flowsheet products were combined into a final concentrate and included the cyclone overflow (slimes), and three stages of carbon flotation concentrates with a total flotation time of 18 minutes. The final concentrate contained 92.5% w/w of the vanadium and 37.1% w/w carbonate in 72.0% of the mass (Table 13-7).

Solid–Liquid Separation

Standard Separation Test

Basic solid liquid separation tests were conducted to provide information for thickener/clarifier design. Oxide concentrate MT7 produced from the physical beneficiation via attrition scrubbing and hydrocyclone was subjected to static solid liquid separation tests and established a baseline underflow density and flocculent dosage rate. The settling tests indicated that a dosage rate of 350 g/t BASF Magnafloc 919 yielded an underflow solids density of 19% w/w from a 2% w/w thickener feed, reaching an ultimate underflow density of 35.3% w/w.

Table 13-7: MT4 Combined Products/Final Concentrate

Product	Weight		Assays, %		% Distribution		Time
	g	%	V_2O_5	CO_3	V_2O_5	CO_3	min
Cyc O/F + carbon conc 1-3	—	72.0	1.10	7.96	92.5	37.1	18

Note: O/F = overflow.

Static Settling

Flocculant scoping was performed using a range (17 total) of anionic, nonionic and cationic flocculants. Coagulant-flocculant combinations were also tested. The scoping test results indicated that the sample responded well to BASF Magnafloc 919 flocculant, which is an ultra-high molecular weight, anionic polyacrylamide flocculant.

Two series of static settling tests were conducted. The first series of settling tests examined the effect of feed solids density. The second series examined the effect of flocculant dosage.

Static settling test results indicated that the MT7 concentrate settled well in the presence of 350 g/t BASF Magnafloc 919, producing a 29% w/w solids underflow from a 2.0% w/w solids thickener feed. Relevant thickener data included: 0.59 m^2/(t/day) thickener underflow unit area and 2,249 m^3/m^2/d initial thickening rate (ISR). Results are summarized in Table 13-8 and Table 13-9.

After completion of the static settling tests, an ultimate underflow density measurement was determined by combining all the underflows from the individual static settling tests into a single 1 L graduated cylinder and allowing the underflow to compact to a final settled density overnight. The ultimate underflow density was 35.3%w/w solids.

Decanter Centrifuge Separation Test

A preliminary solid liquid separation test on post-autoclave oxide material (MT7) to assess the feasibility of dewatering in a solid bowl decanter centrifuge was performed by Broadbent.

The basic test procedure called for 10 ml aliquots of the slurry sample to be spun in the laboratory centrifuge at 1000 x ‘G’ and 2000 x ‘G’ for up to 10 minutes in order to determine the settling characteristics of the slurry. The volume of settled solid, cake compaction and centrate clarity were assessed at 30 second intervals.

Table 13-8: MT7 Concentrate Feed Solid Density Optimization

Settling Test Number	Unit	1	2	3
Diluted feed solid content	% w/w	1.0	1.5	2.0
BASF Magnafloc 919	g/t dry	298	298	297
U/F solids density	% w/w	31	27	31
Thickener unit area	$m^2/(t/day)$	1.21	0.91	0.94
Initial settling rate	$m^3/m^2/day$	987	689	630
TSS 10 minutes	mg/L	182	351	479

Table 13-9: MT7 Concentrate Flocculant Dosage Optimization

Settling Test Number		4	5	6	7
Diluted feed solid content	% w/w	1.0	1.0	2.0	2.0
BASF Magnafloc 919	g/t dry	275	250	350	400
U/F solids density	% w/w	25	27	29	31
Thickener unit area	$m^2/(t/day)$	1.35	1.48	0.59	0.52
Initial settling rate	$m^3/m^2/day$	735	578	2249	2696
TSS 10 minutes	mg/L	244	256	176	138

The results showed that a decanter operating at 1000 x 'G' would be expected to settle the majority of the suspended solids and discharge a cake at ≤50 wt% moisture. However, a significant amount of fine suspended material would be lost to the centrate stream. It is unlikely that the quality of the centrate would allow it to be of returned to the thickener without causing a progressive deterioration in the overflow.

If high recoveries are to be achieved using a decanter, it may be necessary to consider the use of flocculants. To come to a conclusive result, it was recommended that further testing using a flocculant in conjunction with the decanter be pursued.

Filtration

Standard pressure and vacuum filtration tests were conducted on the physical beneficiation circuit rejects. Cyclone underflow from the MT7 beneficiation test was used to establish filter outputs based on cake thickness and moisture content. Pressure filtration test results at 6.9 bar and feed solids of 15% yielded a maximum throughput of 844 dry kg/m^{2}h and a final moisture content of 15.4%. Vacuum filtration tests at 21 in Hg and feed solids of 15% yielded a maximum filter throughput of 306 dry kg/m^{2}h and a final moisture content of 19.4%. Pressure filtration was superior to vacuum filtration in both throughput and final cake moisture. Test results are summarized in Table 13-10.

Acidulation and Pressure Oxidation Autoclave Processing

The extraction of vanadium from deposit mineralization using pressure oxidation autoclave leaching has proceeded in three distinct phases. The first phase involved scoping work by Sherritt in order to demonstrate high extraction of vanadium from oxide and non-oxide materials within the deposit. The second phase involved variability study work by Sherritt to examine a range of nine samples taken from recent drill core from the deposit. The third phase of work was conducted by SGS Minerals, and focused on autoclave processing of both drill core samples and concentrates derived from mineral processing of various samples.

Sherritt Report (Batch Testing Program Mineralization Characterization and Pressure Leach, October 2018)

The testwork was conducted in April 2018 on a composite sample that was derived from core hole DDH18-06, composited from a continuous sample series of non-oxide black mudstone from 15.60 m to 34.50 m depth. The head assay of this composite sample was 0.95% V_2O_5 (calculated).

Due to the carbonate content of the sample, 10 acidulation tests were conducted on the sample to evaluate carbonate destruction prior to pressure leach testing and to provide feed material for the pressure leach testwork. Carbonate decomposition was efficient, resulting in extractions of vanadium ranging from 22–30% in the acidulation step. This step was done prior to pressure leach testing to provide feed material for the pressure leach testwork.

Table 13-10: MT7 Beneficiation Reject Pressure and Vacuum Filtration

Sample	Filter Cloth	Operating Conditions						Filter Outputs			
		Feed Solids (% w/w)	Vacuum (inch Hg)	Pressure (bar)	Form Time (sec)	Dry Time (sec)	Form/Dry Ratio	Cake Thickness (mm)	Throughput (dry kg/m²h)	Cake Moisture (% w/w)	Filtrate (TSS)
MT7 Cyclone #5 Underflow	Testori P 6527 T	15.0	21	—	519	104	5.00	20	198	20.5	127
					123	123	1.00	15	305	19.4	403
					30	150	0.20	5	190	20.5	653
	Testori P 6620 TC		—	6.9	98	69	1.42	24	787	14.9	122
					63	45	1.41	15	844	15.4	117
					25	29	0.87	8	814	15.3	354

Note: TSS = total suspended solids.

Fifteen batch POX tests were then conducted to evaluate the extraction of vanadium from roasted and non-roasted material. The initial conditions for the POX tests were under low temperature, low oxygen pressure, and low acid addition, resulting in vanadium extraction of 66%. For the next series of POX tests, changes in acid dosage, oxygen overpressure and ferric sulphate addition were investigated and resulted in vanadium extraction from 66–80%. In order to reduce the carbon content in the autoclave feed further, tests were then conducted by either a pre-roast of the material or by increasing the temperature in the pressure oxidation step. Resulting overall extractions of vanadium increased to 94.5% and 95.5% when processing pre-roasted material, and 95.6% and 96.0% under total POX conditions of 220°C temperature and 700 kPa oxygen pressure (Sherritt, 2018).

Sherritt Report (Batch Testing Program Variability Testing and Product Preparation, May 2019)

Nine composite samples were derived from drill holes across the Carlin deposit to test the variability of two different material types (oxide and non-oxide mudstone) of varying vanadium grades (low, average, and high) as shown in Table 13-11.

The preliminary extractions of vanadium from the nine variability samples, which were completed in March 2019, ranged from 92.1% to 97.8%. This variability work provided a good indication of the expected average and range of vanadium extractions across the deposit.

SGS Minerals Testwork on Pressure Oxidation (June 2019 to present)

SGS Minerals tested sample MT4 (non-oxide mudstone sample) and various concentrates prepared by cycloning and/or flotation of samples MT3, MT4 and MT7. MT3 and MT4 represent non-oxide mudstone material and MT7 represents oxide mudstone material.

The concentrate compositions are shown in Table 13-12.

The drill core samples and the concentrate were treated by acidulation prior to autoclave oxidation. Acidulation is performed to decompose carbonates prior to pressure oxidation to minimize carbon dioxide venting requirements during pressure oxidation.

Table 13-11:Vanadium Extractions from Variability Sampling

Metallurgical Sample ID	HoleID	Depth (m)		Calculated Grade % V_2O_5	Sample Description	Vanadium Extraction (%)
		From	To			
MT1A	DDC18-011	36	58.5	0.68	Non-oxide mudstone	94.1
MT2	DDC18-016	37	79.86	0.69	Non-oxide mudstone	93.1
MT3	DDC18-014	44.5	56.5	0.64	Non-oxide mudstone	97.8
MT4	DDC18-018	51	90	1.02	Non-oxide mudstone	95.3
MT5	DDC18-010	16.5	46.5	0.39	Non-oxide mudstone	92.1
MT6A	DDC18-016	8.5	31	0.62	Oxide mudstone	92.4
MT7	DDC18-017	43.5	62.64	0.54	Oxide mudstone	93.9
MT8	DDC18-004	0	11.5	0.93	Oxide mudstone	95.3
MT9	DDC18-020	19.5	30	0.42	Oxide mudstone	96.0

Table 13-12:Concentrate Samples Tested at SGS Minerals

Species	Assay Units	Sample			
		MT3 Conc	MT7 Conc	MT4 Conc	MT4 Conc #2
Al	%	2.36	6.18	3.82	3.58
Ca	%	8.93	3.66	3.53	3.79
Cr	%	0.03	0.03	0.04	0.02
Fe	%	1.37	3.53	1.97	2.10
K	%	1.10	2.36	1.68	1.68
Mg	%	3.69	2.61	2.00	2.02
Mn	%	0.02	0.01	0.02	0.03
Na	%	0.13	0.14	0.18	0.14
P	%	0.11	0.10	0.35	0.42
Si	%	15.24	25.80	20.50	20.90
Ti	%	0.14	0.34	0.23	0.22
V	%	0.49	0.52	0.68	0.63
F	%	0.12	0.26	0.24	0.22
C tot	%			19.80	
CO_3	%	21.40	9.48	8.02	8.19

The results of acidulation testing are shown in Table 13-13 and summarized as follows:

- Carbonate destruction was 98–100% efficient across the full range of conditions
- Tests A4, A5, A6 and A10 all used POX solution (synthetic) as the source of acid for acidulation. This is important as it illustrates the counter current nature of acidulation and POX unit operations working together to minimize overall acid use (i.e. POX acid is used in acidulation and acidulation serves to neutralize POX liquor prior to downstream recovery of vanadium)
- Some vanadium is extracted in acidulation. In this way acidulation works as a pre-leach.

The acidulated solids were subjected to a series of POX tests at SGS Minerals. The intent of the SGS Minerals tests was to produce POX solution for acidulation and downstream testing for vanadium recovery. A total of 11 tests were performed. POX 1-3 tests are not reported due to experimental difficulties at SGS Minerals with these tests. POX Test 8 was done in two parts. POX 8-2 was a re-leach of the POX 8 residue at higher terminal free acid to confirm high vanadium recovery.

The key results of the POX testing are summarized in Table 13-14. The SGS Minerals results largely confirmed the earlier Sherritt work and extended the knowledge of critical factors for successful POX treatment:

- POX 4 on A7 residue demonstrated very high overall vanadium recovery (95%) with (i) a high final free acidity (80 g/L) and (ii) a substantial oxidation of the carbon. The original sample was MT4, a non-oxide mudstone sample. Vanadium is associated with the carbonaceous material in this rock type and hence a high extraction rate depends on a high level of carbon oxidation. The somewhat lower recoveries for POX 5, 6, 7 and 11 are attributed to too low a level of final acidity or an incomplete oxidation of carbon (due to procedure employed). With higher free acid (+60 g/L H_2SO_4) and adequate carbon oxidation (+70%) the overall vanadium extraction from non-oxide material (either drill core or concentrate) exceeded 90% (as shown in POX 9 and 10)

Table 13-13:SGS Minerals Acidulation Results on Drill Core and Concentrate Samples

Test ID	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**
Feed	**MT4**	**MT4**	**MT4**	**MT4**	**MT4**	**MT4**	**MT4**	**MT3 Conc.**	**MT7 Conc.**	**MT4**	**MT4 Conc. #1**	**MT4 Conc. #2**
Size (P95, µm)	**105**	**105**	**105**	**105**	**105**	**105**	**105**	**N/A**	**NA**	**105**	**N/A**	**N/A**
Acid Supply	**Conc H_2SO_4**	**Conc H_2SO_4**	**Conc H_2SO_4**	**Synth POX Soln**	**Synth POX Soln**	**Synth POX Soln**	**Conc H_2SO_4**	**Conc H_2SO_4**	**Conc H_2SO_4**	**Synth POX Soln**	**Conc H_2SO_4**	**Conc H_2SO_4**
Temp. (°C)	75	75	75	80	80	80	75	75	75	80	75	75
Time (minutes)	180	180	180	480	480	480	180	180	180	480	180	480
Init. % Solids	15%	15%	15%	14%	18%	23%	15%	15%	15%	17%	15%	20%
Target (g/L H_2SO_4)	30	30	30	pH 1.5	pH 2	pH 2.5	30	30	30	pH 2.25	30	pH 2.25
Addition (kg H_2SO_4/t)	448	455	445	354	257	180	471	547	374	261	357	169
Final (g/L H_2SO_4)	29	30	28	18	5	2	32	31	30	3	32	1
Final % solids	13%	13%	12%	15%	22%	27%	13%	14%	13%	21%	14%	
H_2SO_4 cons. (kg/t)	285	273	284	275	242	175	288	376	207	250	181	165
V extn (%)	37	36	39	30	19	0	36	13	19	17	32	22
Mg extn (%)	92	93	92	92	91	91	92	93	71	91	78	79
Fe extn	12	26	11	-	-	-	12	29	29	-	21	21
CO_3 dest'n (%)	100	100	100	99	99	99	100	100	100	99	98	100

Table 13-14:SGS Minerals Test Results for POX 4-11

Test ID	POX4	POX5	POX6	POX7	POX8	POX8-2	POX9	POX10	POX11
Feed	A7 Residue	A8 Residue	A9 Residue	A11 Residue	A9 Residue	POX8 Residue	A11 Residue	A5 & A10 Residue	A12 Residue
Temperature (°C)	220	220	220	220	220	220	220	230	230
Oxygen overpressure (kPa)	699	699	699	699	699	699	699	1397	1397
Acid addition (kg/t)	220	230	230	220	295	294	220	240	240
Retention time (minutes)	180	180	120	180	120	180	180	180	180
Surfactant addition (g/t)	5	5	5	5	5	5	5	5	5
Ferric addition (g/L)	4	4	4	4	4	4	4	4	4
Final acidity (g/L)	80	77	42	57	47	78	64	74	45
Final ORP (mV vs. Ag/AgCl)	558	424	779	446	867	643	495	733	654
Vanadium extraction (%)	93	79	71	63	82	68	87	88	76
Acidulation V extraction (%)	36	13	19	32	19	85	32	18	19
Overall Vanadium extraction (%)	95	82	76	75	85	95	91	90	81
Solids carbon oxidation (%)	78	35	66	46	-	-	71	82	73

Note: ORP = Oxidation–Reduction Potential

- POX 8 on A9 residue from acidulation produced an overall vanadium extraction of 85%. A9 residue was obtained from acidulation of the MT7 concentrate. MT7 represents an oxide mudstone material. The 85% overall vanadium recovery for this test was attributed to too low a free acid in the final solution (47 g/L). POX 8-2 was carried to out to confirm that at a suitably high free acid level (78 g/L) the overall vanadium extraction could be improved to over 90%. The final overall vanadium extraction for POX8-2 was 95%.

The SGS Minerals acidulation and POX testwork confirmed the efficiency of these two unit operations in producing a vanadium-containing solution to advance to downstream recovery. The acidulation process was highly efficient with +98% carbonate destruction under all conditions with significant vanadium extraction. High overall extractions (90–95% vanadium extraction) were obtained from both drill core samples and concentrates produced at SGS Minerals by the combination of acidulation and pressure oxidation.

Ion Exchange

Ion exchange of the acidulation product solution is low in acid (pH around 2.25) and has some residual iron, vanadium species and some minor uranium and molybdenum. Uranium and molybdenum are removed by strong base ion exchange to avoid any transfer of uranium or molybdenum to the vanadium product.

A solution containing 1.6 g/L V, 14 ppm U and 32.6 ppm Mo was used to test ion exchange. The acid concentration was 8.7 g/L.

The solution was contacted with two strong base resins. The Purolite A660 resin was more effective than the Dowex 21K resin in removing uranium in the original scoping testing.

The Purolite A660 resin was tested in a single column system using 100 mL of wet settled resin in the sulphate form. The resin was rinsed twice with 150 g/L H_2SO_4 solution at 10x the resin volume and then washed twice with distilled water also at 10x the resin volume. The solution was passed through the column at 5 bed volume (BV)/h at 20ºC for a total of 100 BV over ~20 hr. Three portions of solution were collected and analyzed for vanadium, uranium and molybdenum. The vanadium concentration was not changed (within experimental error) while the minor amounts of uranium and molybdenum impurities were effectively removed from solution using ion exchange. This is illustrated in Figure 13-4.

Figure 13-4: Uranium and Molybdenum Removal by Ion Exchange on Purolite A660 Resin

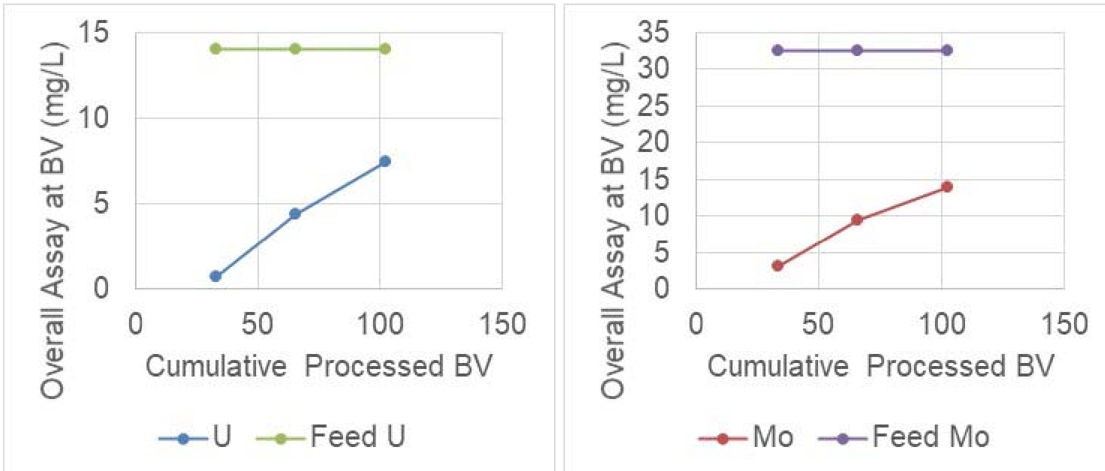


Figure prepared by SGS Minerals, 2019

It is recommended that the elution of the resin and the use of multiple loading and elution cycles be tested in the next Project phase. It is also recommended that the loading test be repeated with the resin starting in the sulphate form to avoid the use of acid conditioning.

Vanadium Oxidation and Solvent Extraction

The solution after removal of uranium and optional removal of molybdenum passes to pre-oxidation with peroxide. This step is important to ensure that the vanadium species formed is in the V^{5+} oxidation state. Hydrogen peroxide and temperature are used to oxidize all vanadium species.

SGS Minerals carried out a series of oxidation and solvent extraction tests in 2019–2020. The early work on vanadium oxidation (tests Ox 1-7) were performed at room temperature (~20 °) and were not successful due to incomplete vanadium oxidation.

The solution used for the oxidation and solvent extraction tests was a portion of the solution tested in the ion exchange process for uranium and molybdenum removal (Table 13-15).

Table 13-15:Solution Composition of the Feed to Oxidation and Solvent Extraction

Element	Units	Assay
Al	mg/L, g/t	5,520
Ca	mg/L, g/t	635
Cu	mg/L, g/t	50.2
Fe	mg/L, g/t	6,420
K	mg/L, g/t	1,290
Mg	mg/L, g/t	9,830
Mn	mg/L, g/t	29.7
Mo	mg/L, g/t	32.6
Na	mg/L, g/t	70
Ni	mg/L, g/t	175
P	mg/L, g/t	848
Sr	mg/L, g/t	6.02
U	mg/L, g/t	14
V	mg/L, g/t	1,600
Zn	mg/L, g/t	1,600
Si	mg/L, g/t	230
Fe(II)	mg/L, g/t	5,184

Tests Ox 8–11 are summarized in **Error! Not a valid bookmark self-reference.**. Single-stage extraction contacts were carried out on the oxidized solution to assess the degree of extractability. The first extraction test (VE12) was performed immediately after oxidation, and the second 24 hr later.

The oxidation potential for Ox8 was low, indicating incomplete oxidation of vanadium to the V^{5+} oxidation state. This is reflected in the poor extraction for both VE12 and VE13. The Ox9–11 tests demonstrated excellent oxidation (high oxygen reduction potential) and excellent single contact vanadium extraction of approximately 80%.

Table 13-16:Oxidation and Solvent Extraction of Vanadium at Various Doses of H_2O_2

Test	Ox8	Ox9	Ox10	Ox11
Dose (g H_2O_2/L)	2.5	5.0	7.5	9.3
Final ORP (at 60°C)	524	793	750	759
Ambient ORP VE12 Feed	477	781	652	657
Ambient ORP VE13 Feed	487	798	790	796
VE12 Raff. ORP	492	691	576	597
VE13 Raff. ORP	500	692	677	676
VE12 V Loading (%)	0	81	81	79
VE13 V Loading (%)	7	83	80	82

Note: Oxidation temperature of 60 C for 2 h. H_2O_2 dosage varied from 2.5 to 10 g/L. Solvent extraction with 1% Alamine 336 in Aromatic 150ND diluent. Organic was washed (2X) with 20 g/L H_2SO_4 prior to extraction. Extraction at A/O=1/5, T = 45 C and pH ~ 1.5. ORP = oxidation–reduction potential.

A McCabe–Thiele isotherm was developed for the vanadium extraction process. This is shown in **Error! Not a valid bookmark self-reference.**. The diagram indicates that two stages of extraction would be required to achieve approximately 1.5 g/L V in the organic solution and recover ~ 90% of the vanadium. Vanadium extraction releases H_2SO_4 into solution and therefore higher initial pH would be expected to improve the vanadium recovery. It is recommended that higher initial pH values for extraction be studied in further work. The pH of the solution from acidulation is approximately 2.25, so this appears feasible within the current process design.

Scrubbing of the loaded organic was not studied in the SGS Minerals program. However, it is envisaged that the loaded organic will be scrubbed with weak sulphuric acid solution to displace co-loaded iron and other impurities.

The stripping of the loaded organic was studied with 100 g/L Na_2CO_3. Na_2CO_3 is able to strip vanadium, iron, magnesium, molybdenum and uranium from the loaded organic and to produce high concentrations of vanadium in solution. A series of strip tests were conducted using a loaded 1% Alamine 336 – 99% Aromatic 150 ND organic containing 960 mg/L V and 47 mg/L Fe and minor magnesium, molybdenum and uranium. The organic was stripped at an aqueous:organic (A:O) ratio of 1 and 45ºC, and stripping was 100% in a single contact. After reuse of the strip solution multiple times (with fresh organic), the strip solution contained 34.6 g/L V, 1.74 g/L Fe, 82.8 mg/L Mg and 102 mg/L Mo.

Figure 13-5: McCabe–Thiele Diagram for Vanadium Extraction

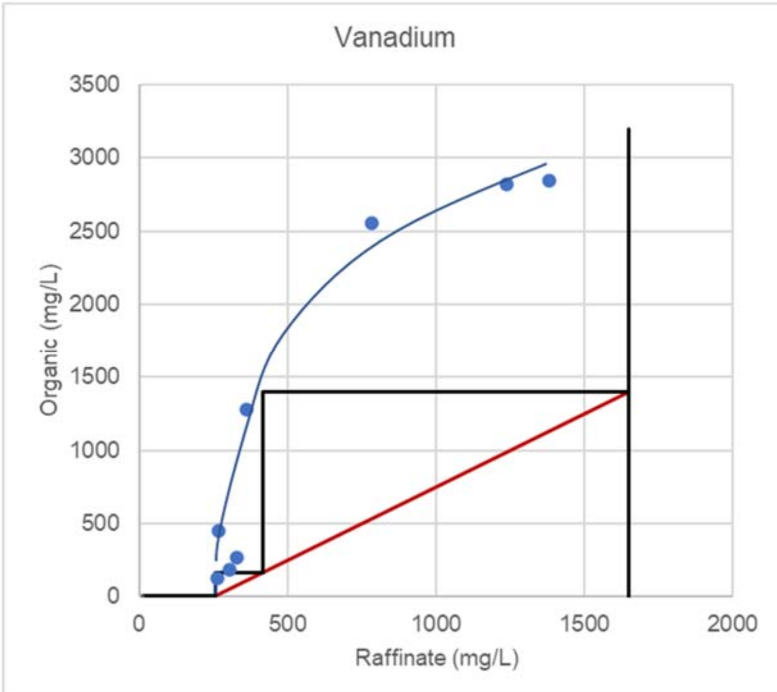


Figure prepared by SGS Minerals, 2019. 1% Alamine 336 in Aromatic 150ND, washed 2x with 20 g/L H_2SO_4 prior to use. T = 45º C and pH 1.5. Aqueous to organic volumetric ratio (A:O ratio) of 10:1, 7:1, 3:1, 1:1, 1:3, 1:7 and 1:10.

It is recommended that further work be performed on loading, scrubbing and stripping of vanadium.

The strip solution from solvent extraction is treated for recovery of vanadium as ammonium meta vanadate by addition of ammonium sulphate. In the event that there is too much iron in the strip solution, the strip solution may be heated and "aged" for a period of time for the iron to precipitate from solution.

SGS Minerals demonstrated the removal of iron by heating a synthetic strip solution from solvent extraction. These results are shown in Table 13-17. The synthetic strip solution contained 30.6 g/L V, 1.54 g/L Fe and 93.2 g/L Na. The solution was prepared by mixing sodium vanadate, ferric sulphate, sodium carbonate and sodium sulphate. The initial pH was 10.26. After heating for seven hours, the iron in solution decreased to <100 mg/L and precipitated as a synthetic iron-oxy-hydroxide species. The vanadium loss with the iron precipitate was <1%.

Table 13-17:Iron Removal Experiment using Synthetic Strip Solution

Sample & Quant.	Assay Units	Feed Solution	1 h Sample	2 h Sample	4 h Sample	7 h Sample	Residue
		500	**30**	**29**	**20**	**464**	**1.6**
V	mg/L, g/t	30,600	30,100	32,500	32,300	33,000	76,400
Fe	mg/L, g/t	1,540	170	141	108	81	479,000
Na	mg/L, g/t	93,200	109,000	110,000	112,000	114,000	43,600

Ammonium Metavanadate Precipitation and Calcination to Form V_2O_5

The precipitation of ammonium metavanadate was tested on a sample of strip solution obtained through sequential stripping of loaded organic using 100 g/L Na_2CO_3 solution. The strip solution was heated to 95ºC for six hours and filtered to remove an iron precipitate. The resulting solution contained 42.3 g/L V, 0.126 g/L Fe and 142 g/L Na. The precipitation of AMV was performed by stepwise addition of 450 g/L $(NH4)_2SO_4$ solution.

Vanadium precipitation was 97% and iron co-precipitation was 69%, while molybdenum did not precipitate. The final solid was filtered but not washed before calcining at 500°C for two hours to convert ammonium metavanadate to vanadium pentoxide. The analysis of the final V_2O_5 product is shown in Table 13-18.

The purity of the final product was low due to co-precipitation of sodium carbonate and sodium sulphate by "salting out" upon addition of ammonium sulphate solution; the amount of precipitate was small, exacerbating the issue. Washing of sodium carbonate and sodium sulphate away from the vanadium pentoxide product was tested at a small scale and increased the grade of vanadium pentoxide. The impurity content was dramatically reduced by washing.

The basic elements of the acidulation, pressure oxidation, uranium removal by ion exchange, oxidation, solvent extraction, scrubbing and stripping, iron removal, AMV precipitation and calcination have been demonstrated. There is a requirement to optimize the conditions to refine the process design. Nevertheless, it is possible to process oxide or non-oxide material for production of a vanadium pentoxide final product.

Table 13-18: Analysis of the Calcined Ammonium Metavanadate Precipitate Before and After Washing

Element	Assay Units	Calcine	Washed Calcine
Al	g/t	159	226
Ca	g/t	<71	114
Fe	g/t	629	853
K	g/t	<83	89
Mg	g/t	482	16
Mn	g/t	<77	1.4
Mo	g/t	32	50
Na	%	11.72	1.82
U	g/t	<20	<20
V	%	28.2	49.7
Zn	g/t	<10	<10
S	%	10.5	0.02

13.2.3 Additional Testwork

Bureau Veritas

Bureau Veritas completed a physical beneficiation test including attrition and decantation of an oxide composite sample. The primary objective was to verify that vanadium is concentrated in the minus 5-µm fraction of the sample's particle size distribution. The results confirmed that 81.3% w/w of the V_2O_5 was contained in the minus 5-µm fraction of the oxide composite sample MT6A.

Hazen

Hazen studied NaCl roasting of the Carlin material (which has shown success in other deposits) but this work did not result in high recoveries of vanadium, and has not been pursued any further at this time.

Kemetco

Kemetco conducted a small scoping study to determine the feasibility of vanadium concentration and carbonate rejection through a froth flotation process. This preliminary assessment concluded that froth flotation was viable for the non-oxide material.

PMC

Seven vanadium samples, two oxide, five non-oxide, including one composite, were analyzed by process mineralogical methods to determine key mineralogical attributes for vanadium deportment and overall mineralogy/petrography/geochemistry reconciliation, as well as to provide a record of textural and mineralogical features for benchmarking purposes.

The oxide material has the following mineralogy:

- Vanadiferous goethite
- Highly oxidized and patchy kerogen of indeterminate composition with poorly defined and difficult-to-detect vanadates.

It is considered that the bulk of the vanadium likely reports as vanadates such as metahewettite, and that goethites contain both minor structurally-bound vanadium (given a wide range of detectable vanadium grades from 0.6–9.1 % by EDS analysis) and surface coatings of vanadates.

In non-oxide material, vanadium was found exclusively in association with sulphur-bearing kerogen. While scanning electron microscope (SEM)–energy dispersive X-ray spectroscopy (EDS) does not give an accurate determination of vanadium due to the combined effects of secondary fluorescence and decrepitation of kerogen under the electron beam, EDS analyses and supporting size-dependent geochemical data, reveal a strong correlation of vanadium with SO_3 but not as clearly with total organic carbon, indicating a strong relationship between vanadium grade of kerogen and sample grade (i.e. not all kerogen has a constant vanadium grade) and that kerogen is the host for vanadium in non-oxide material.

These findings were consistent with the mineralogical descriptions of the carbonaceous and non-carbonaceous material found in the UCC research reports.

13.3 Recovery Estimates

Metallurgical testing has focused on the extraction of V_2O_5 as a saleable product from two distinct material types that make up the resource. The oxide and non-oxide mudstones have been represented in each step of the work through varied use of 10 composite samples. The composites were created from drill core at low, medium, and high V_2O_5 grades across the deposit (four oxide and six non-oxide).

Two composites in particular, MT7 for the oxide, and MT4 for the non-oxide were selected as representative samples once test parameters had been 'optimized.' This is in recognition that the carbonate content of the material is a key constituent influencing economics. These two composites represent the average carbonate composition of the resource for their respective material types.

There are four unit processes that will contribute to the overall vanadium extraction in the oxide material:

- Hydrocycloning
- Acid pressure oxidation
- Solvent extraction
- Calcination.

Based on the SGS Minerals' physical beneficiation testwork of MT7, 87.3% of the V_2O_5 is contained in the concentrate (refer to Table 13-4). Acidulation and pressure leach tests at Sherritt yielded 92.1% V_2O_5 extraction at 60 minutes of retention time for MT7. Solvent extraction is based on similar circuits operating efficiently and is assumed to be 98.0%. The final steps, precipitation and calcining tests conducted at SGS Minerals produced a saleable product of V_2O_5, and using a continuous recycle will result in a recovery of 99.8%. The overall recovery of V_2O_5 through the process flowsheet for oxide material is calculated at 78.6% and is summarized in Table 13-19.

The non-oxide material will be processed through five units that contribute to the overall vanadium extraction:

- Hydrocycloning
- Flotation
- Acid pressure oxidation
- Solvent extraction
- Calcination.

Based on the SGS Minerals' physical beneficiation testwork of MT4, 39.3% of the V_2O_5 is collected in the de-sliming step and an additional 53.2% is retained in flotation (refer to

Table 13-7). Acidulation and pressure leach tests at Sherritt yielded 85.5% V_2O_5 extraction at 60 minutes of retention time for MT4. Solvent extraction, precipitation and calcining extractions are the same basis as the oxide material. The overall recovery of V_2O_5 for non-oxide material is calculated at 77.4% (Table 13-19).

13.4 Metallurgical Variability

Figure 13-6 depicts the locations of the 10 composite samples used in the major metallurgical test campaigns. The composite samples were derived from diamond drill holes across the deposit area, and represent the two material types (oxide and non-oxide mudstone) of varying vanadium grades (low, average, and high) as presented in Table 13-20.

13.5 Deleterious Elements

Iron and low concentrations of uranium and molybdenum are the three elements that must be controlled in the process in order to ensure a quality vanadium pentoxide product for the market. All these elements are co-extracted with vanadium in the acidulation and pressure oxidation processes.

Uranium and molybdenum can be removed from the acidulation liquor by ion exchange prior to oxidation and solvent extraction. In addition, molybdenum is not precipitated with the ammonium metavanadate product after solvent extraction stripping.

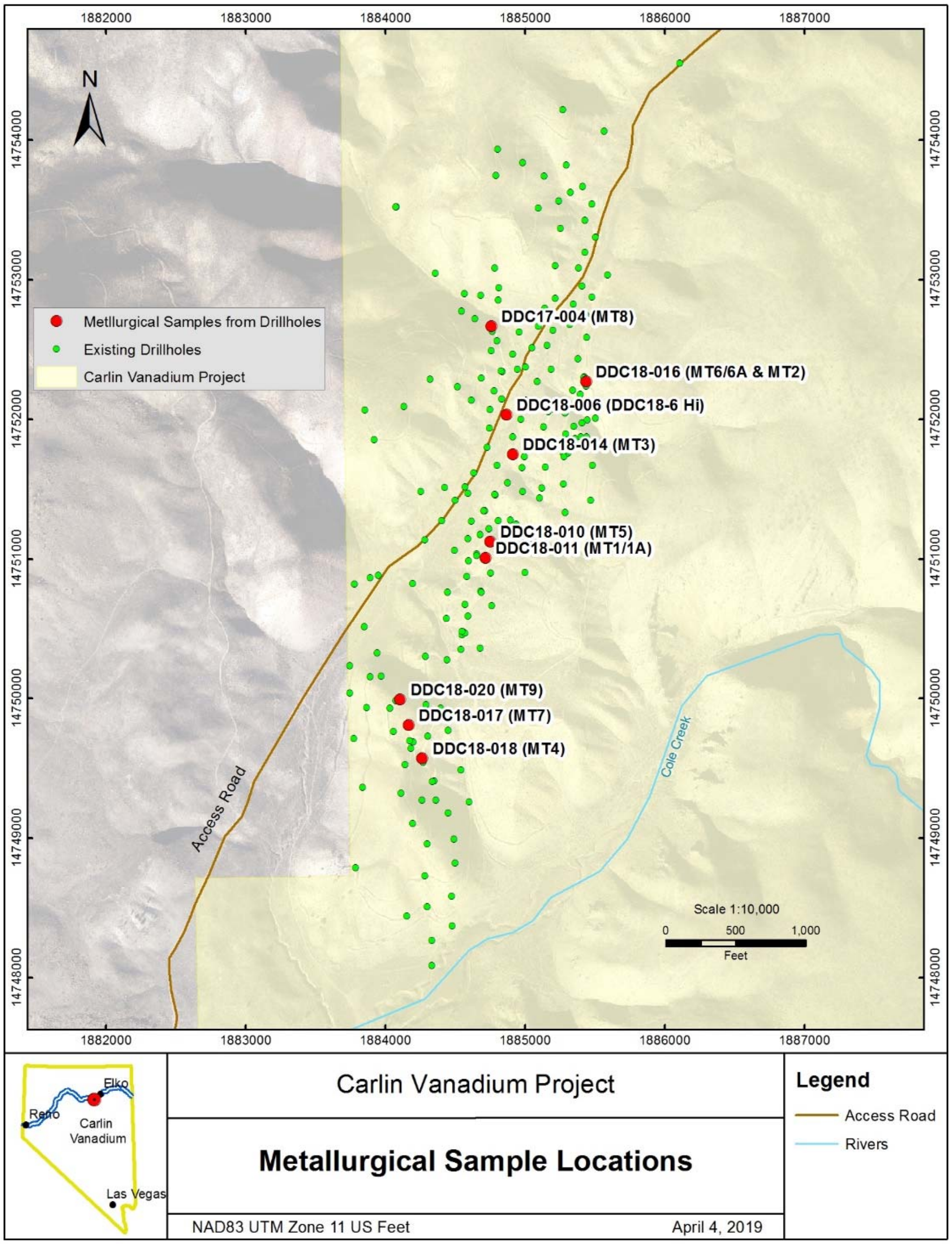
Iron is extracted into solution during pressure oxidation. Some iron can also be leached during acidulation of the incoming concentrate. The primary rejection of iron is by oxidation (to ferric ion) and precipitation (to ferric oxy-hydroxide) during acidulation.

The secondary control of iron is via the solvent extraction scrubbing process. It is expected that the small amounts of iron that are co-extracted with vanadium on the Alamine 336 organic may be washed from the organic by scrubbing with weak sulphuric acid solution. This will be confirmed in the next stage of development.

Table 13-19:Overall Recovery for Oxide and Non-Oxide Material

V_2O_5 Recovery	Oxide	Non-oxide
Hydrocycloning	87.3%	39.3%
Flotation	—	53.2%
Total beneficiation	87.3%	92.5%
Acidulation/pressure leach	92.1%	85.5%
Solvent extraction	98.0%	98.0%
Calcining	99.8%	99.8%
Final recovery	78.6%	77.4%

Figure 13-6: Location of Metallurgical Test Composites



Note: Figure prepared by First Vanadium, 2020.

Table 13-20:Representative Metallurgical Composites

Metallurgical Sample ID	HoleID	Depth (m)		Calculated Grade % V_2O_5	Sample Description
		From	To		
DDC18-06 Hi	DDC18-06	15.6	34.5	0.95	Non-oxide mudstone
MT1A	DDC18-011	36	58.5	0.68	Non-oxide mudstone
MT2	DDC18-016	37	79.86	0.69	Non-oxide mudstone
MT3	DDC18-014	44.5	56.5	0.64	Non-oxide mudstone
MT4	DDC18-018	51	90	1.02	Non-oxide mudstone
MT5	DDC18-010	16.5	46.5	0.39	Non-oxide mudstone
MT6A	DDC18-016	8.5	31	0.62	Oxide mudstone
MT7	DDC18-017	43.5	62.64	0.54	Oxide mudstone
MT8	DDC18-004	0.0	11.5	0.93	Oxide mudstone
MT9	DDC18-020	19.5	30	0.42	Oxide mudstone

13.6 Comments on Section 13

The QP notes:

- Recognized testing facilities conducted the First Vanadium metallurgical work and associated analytical procedures. The tests were appropriate for the mineralization type
- Variability of sample composites used in metallurgical tests were representative of both oxide and non-oxide material across the deposit area
- Metallurgical recovery assumptions for the 2020 PEA include:
  - Overall oxide material recovery: 78.6%
  - Overall non-oxide material recovery: 77.4%
- It is recognized that a processing facility of this configuration has not been used for recovery of vanadium. However, the individual unit processes selected are common to, and conventional in, the mining industry, each having multiple installations.
- Comminution testing is currently limited to two composite tests. Testing should be expanded to include multiple composite tests to establish preliminary variability across the deposit

- Beneficiation and de-sliming of the oxide and non-oxide material warrants further investigation to establish vanadium concentrate recovery, mass, and carbonate rejection rates. Based on the relative efficiency of centrifuges versus hydrocyclones this may be an opportunity to increase vanadium recovery and rejection rate of carbonates while reducing the overall mass pull
- Solid–liquid separation testing was conducted on samples representing pre-acidulation thickening and filtration, and testing was not carried out on acidulated slurry and autoclave discharge slurry. Testing of all relevant slurries should be included in future test programs
- The low slurry densities obtained during solid–liquid separation testing has an impact on the sizing of downstream equipment. Additional testing, including dynamic settling tests, should be carried out to improve on the results obtained
- Post autoclave solid-liquid separation by decantation was not resolved with the current test campaigns. It will require a test program to establish firm design criteria. The testwork should include flocculant and coagulant investigation with consideration of centrifuge/decantation technology
- The results indicate that uranium and molybdenum may be removed from the vanadium leach solution using ion exchange. It is recommended that the loading and elution of the resin and the use of multiple loading and elution cycles be tested in the next phase of the project.
- The current process design of the solvent extraction circuit makes use of ammonium hydroxide for stripping and precipitation rather than sodium carbonate as tested. Ammonium hydroxide is also used for the precipitation of ammonium metavanadate and the formation of ammonium sulphate, a portion of which is recycled to stripping. It is recommended that further solvent extraction work be performed on loading, scrubbing and stripping of vanadium using ammonium hydroxide
- Precipitation testing was carried out on a sodium vanadate strip solution. The current process design is based on generating an ammonium decavanadate strip solution that is converted to ammonium metavanadate by adding ammonia or ammonium hydroxide. Testwork should be conducted to establish precipitation parameters
- The calcination testing should be carried out on washed precipitates under differing temperature conditions to determine preliminary calcination parameters

- The basic elements of the acidulation, pressure oxidation, uranium removal by ion exchange, oxidation, solvent extraction, scrubbing and stripping, iron removal, AMV precipitation and calcination have been demonstrated. There is a requirement to optimize the conditions to refine the process design. Nevertheless, it is possible to process Carlin oxide or non-oxide material for production of a vanadium pentoxide final product.

14.0 MINERAL RESOURCE ESTIMATES

14.1 Introduction

The 2019 drill hole database consisted of 216 drill holes in the Project area, of which 127 are legacy drill holes, and the remainder were completed by First Vanadium, of which 20 holes were HQ core from 2017–2018 and 69 were RC holes from 2018.

There were 208 drill holes within the resource area, including all 89 holes drilled by First Vanadium.

14.2 Block Model

The block model was constructed within the NAD83 UTM Zone 11US Survey feet coordinates. A 20 ft cubic block size was chosen as an appropriate dimension based on the current drill hole spacing and the smallest mining unit of a conceptual open pit mining scenario. The block model limits are provided in Table 14-1.

A topographic surface generated from 2 m LiDAR data provided by First Vanadium was used to flag the top of bedrock in the block model. Soil thickness varies slightly over the vanadium deposit, although the soil thickness is generally very thin or non-existent.

14.3 Geological Models

The mineralization is interpreted to be hosted within favorable sedimentary horizons which have been weakly deformed by low intensity folding and subsequent block faulting. Figure 14-1 shows the key features of the generalized geologic model supporting the Mineral Resource estimation.

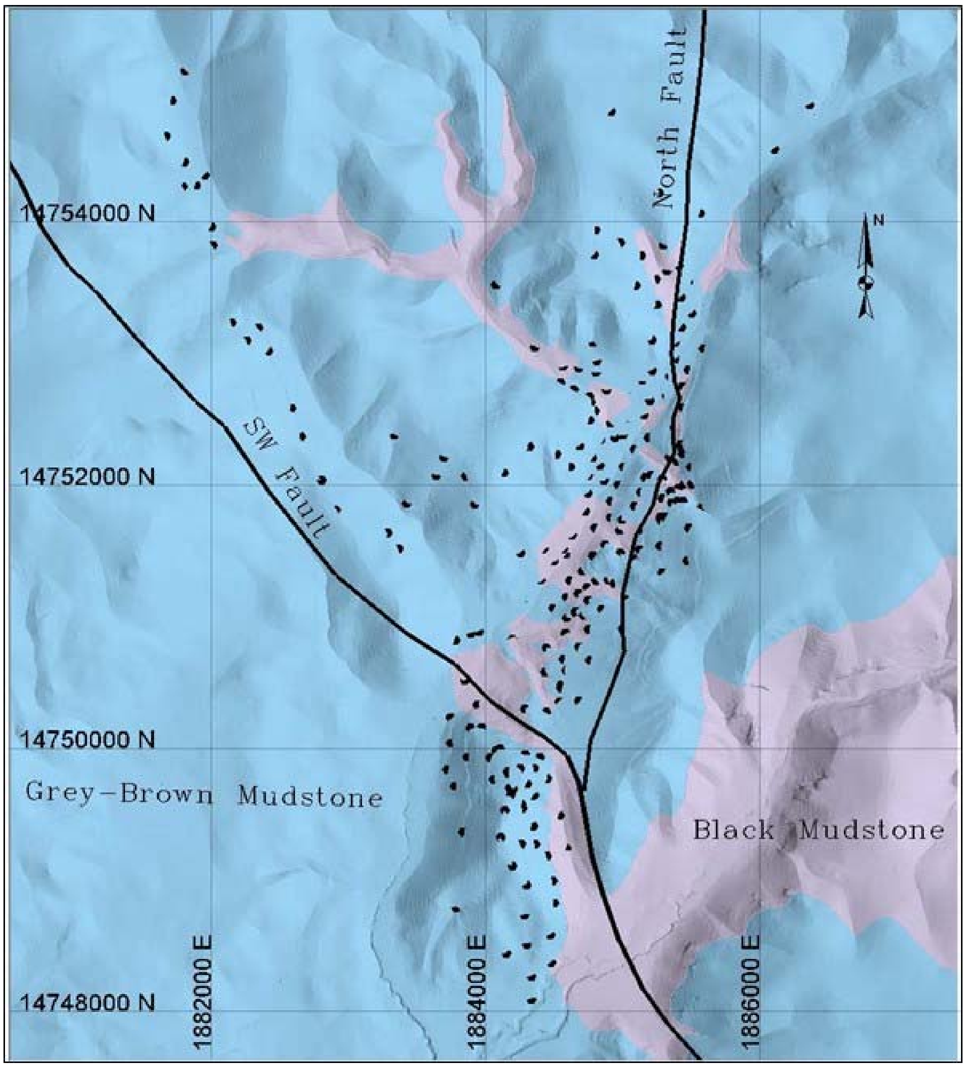
The vanadium mineralization is primarily controlled by lithology, likely related to redox conditions at the time of deposition. The mineralization within the mudstones is generally localized in planar zones interpreted to be parallel to the bedding horizons. The orientation of these preferred planes of mineralization is important to understand its continuity. SRK constructed trend planes for the highest-grade zones of mineralization by digitizing lines of continuity in sections spaced 100 ft apart and then combining these into a three-dimensional surface.

These surfaces were then used to guide the construction of grade shells for each domain of mineralization. The domains are essentially the fault blocks.

Table 14-1: Block Model Limits

Orientation	Minimum (ft)	Maximum (ft)	Block Dimension (ft)
Easting	1,880,500.0	1,887,000.0	20
Northing	14,747,000.0	1,4756,000.0	20
Elevation	4,800	6,400	20

Figure 14-1: Key Elements in Geological Model



Note: Figure from Stryhas et al., 2019. Drill hole collars shown as black dots, interpreted fault traces as thick black lines. Blue = grey–brown mudstone, pink = black mudstone. Figure has topography shown as shaded.

Grade shells were constructed using commercially-available Leapfrog software, based on a grade threshold of 0.1% V_2O_5. These grade shells were used to constrain the resource grade estimation.

The grade shells were evaluated for validity and functionality using three methods:

- Firstly, they were visually inspected to evaluate how well they followed the SRK trend planes, and how well they demonstrated continuity of mineralization and capture of appropriate data;
- Secondly, they were queried to determine what percentage of the available samples above the respective threshold are captured internal to the grade shell. This evaluates the capture ratio of the shells;
- Thirdly, they were queried to determine what percentage of the samples in the grade shell are above and below the respective threshold. This evaluates the internal dilution of the shells.

The results of the query validations are presented in Table 14-2. The grade shells have a very good capture ratio and have relatively low internal dilution.

14.4 Grade Capping/Outlier Restrictions

The raw assay V_2O_5 data were first plotted on histogram and cumulative distribution graphs to understand its basic statistical distribution. The histogram shows a strongly negative skewed distribution. The cumulative distribution curve in Figure 14.2 illustrates a continuous population set up to 2.5% V_2O_5.

The raw assay data was capped at 2.5%, resulting in six assays ranging from 2.61% to 3.34% being reduced to 2.5% prior to compositing.

14.5 Composites

The original assay sample lengths are predominately 5 ft in length.

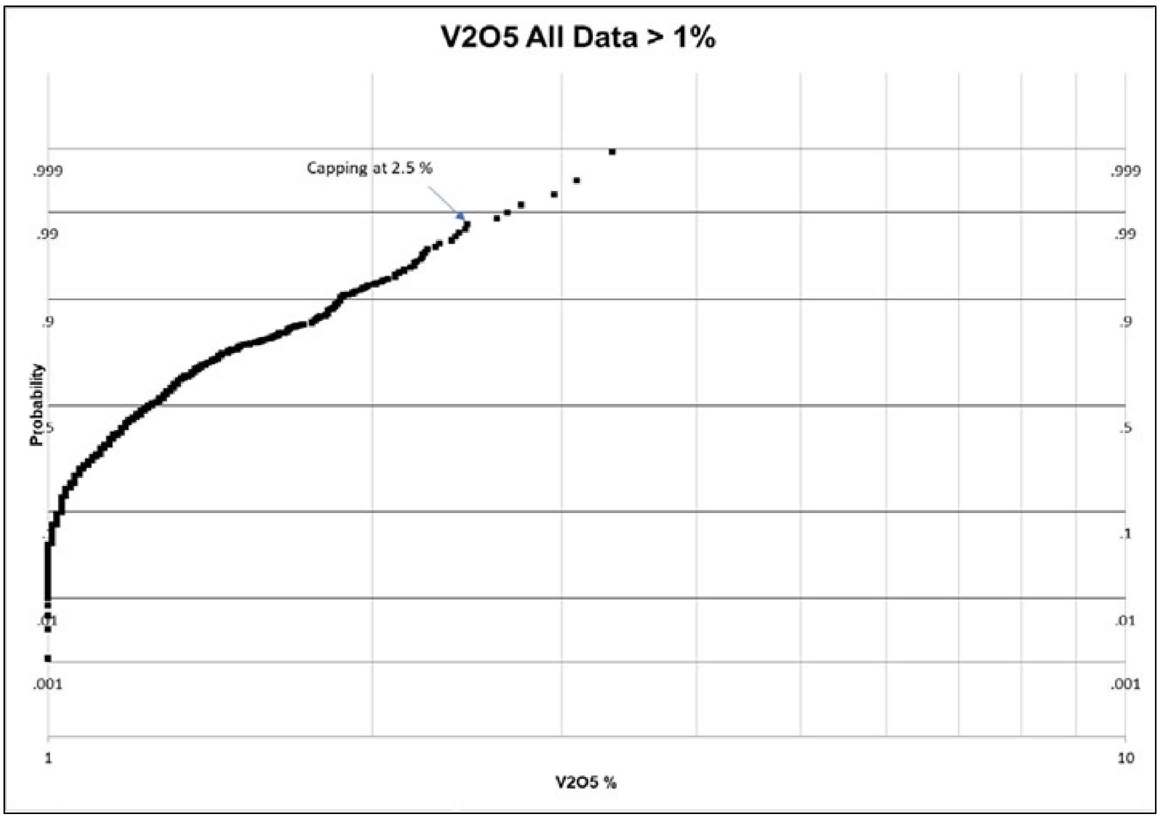
For modeling purposes, these were composited into 10 ft run length composites with no breaks at geological contacts. This length was chosen to provide initial smoothing and for approximately two composites to intersect the 20 ft vertical length blocks.

Where analyses were only available for every other sample interval, the missing intervals were ignored, and the composites were generated from the data available.

Table 14-2: Grade Shell Validation Results

Samples Above Grade Threshold Captured by Shell	Samples in Shell Above Grade Threshold	Samples in Shell Below Grade Threshold (Dilution)
93%	94%	6%

Figure 14-2: Cumulative Distribution Plot of V_2O_5%



Note: Figure from Stryhas et al., 2019.

14.6 Density Assignment

Average densities were used for each of the two predominant lithologies based mainly on oxidation state.

Table 14-3 lists the densities used for the block model. Note that in the table, all reporting is listed as short tons (2,000 lbs).

Table 14-3: Block Model Density

Lithology	Average Density (tons/ft^3)	Number of Measurements
Oxide	0.0716	72
Non-oxide	0.0655	134

14.7 Variography

Variography studies of the capped and composited data did not return very good results. In general, weak variogram structures were obtained, which reflected the average drill hole spacings. The results are interpreted to be related to the varied orientations of the mineralized horizons as well as the variability of the original mineralized horizons.

14.8 Estimation/Interpolation Methods

The Carlin Vanadium deposit was modeled for V_2O_5 and Zn. Only the V_2O_5 is reported as Mineral Resource. All block grade estimates were made using the 10 ft run length composites. The resource is constrained within a grade shell based on a 0.2% V_2O_5 threshold constructed with Leapfrog software.

The grade estimation was run using an inverse distance squared (ID^2) algorithm considering only the composites and blocks within the grade shell. The grade estimation considered all blocks with centroids within the grade shell. A dynamic search orientation was used based on the same trend plane used to construct the grade shells. A three-pass search estimation was used. The estimation parameters are listed in Table 14-4.

A plan view of the estimated blocks is shown in Figure 14-3 and a representative cross section of the interpolated block model grades is shown in Figure 14-4.

14.9 Block Model Validation

Four techniques were used to evaluate the validity of the block model.

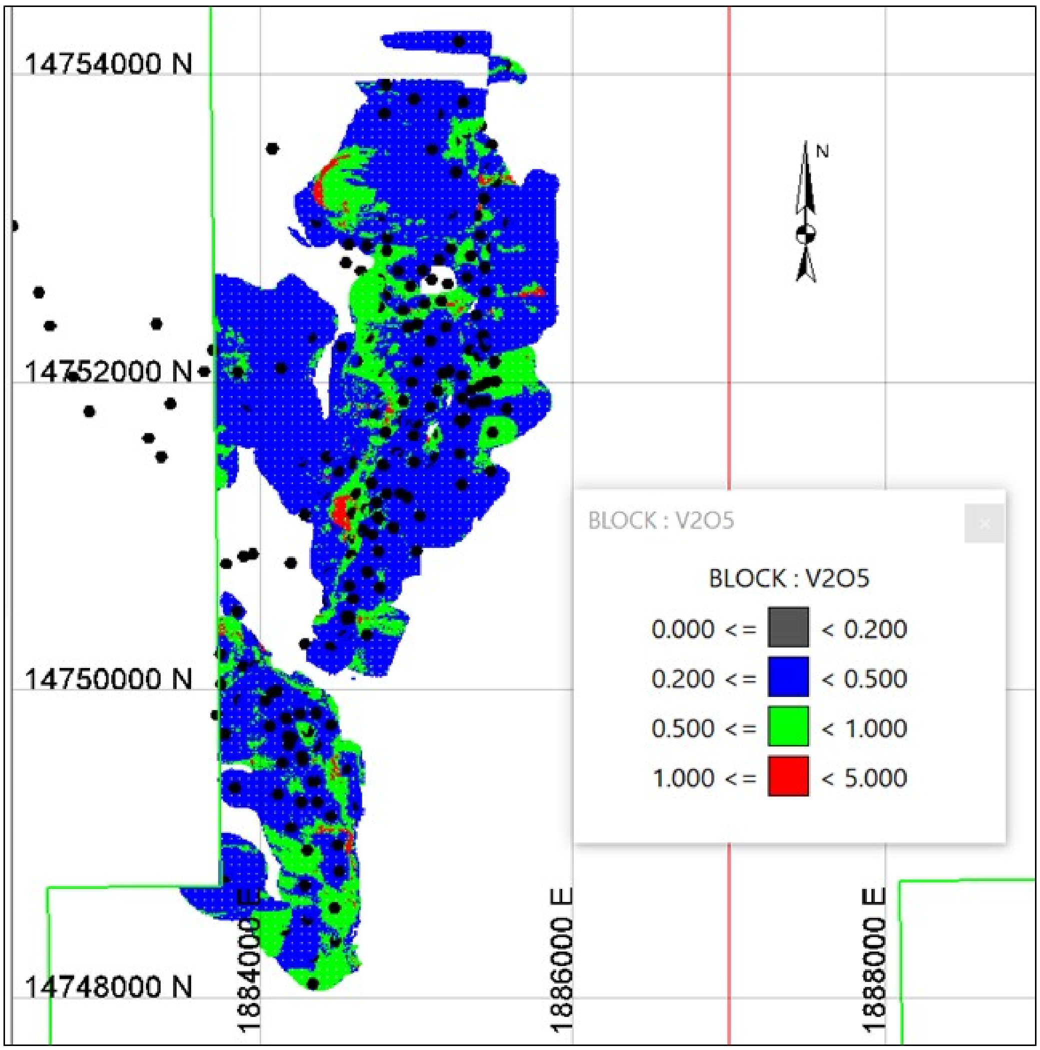
The interpolated block grades were visually checked on sections and bench plans for comparison to the composite assay grades.

The estimation parameter results were reviewed to evaluate the performance of the grade estimation. These are presented in Table 14-5.

Table 14-4: Estimation Parameters

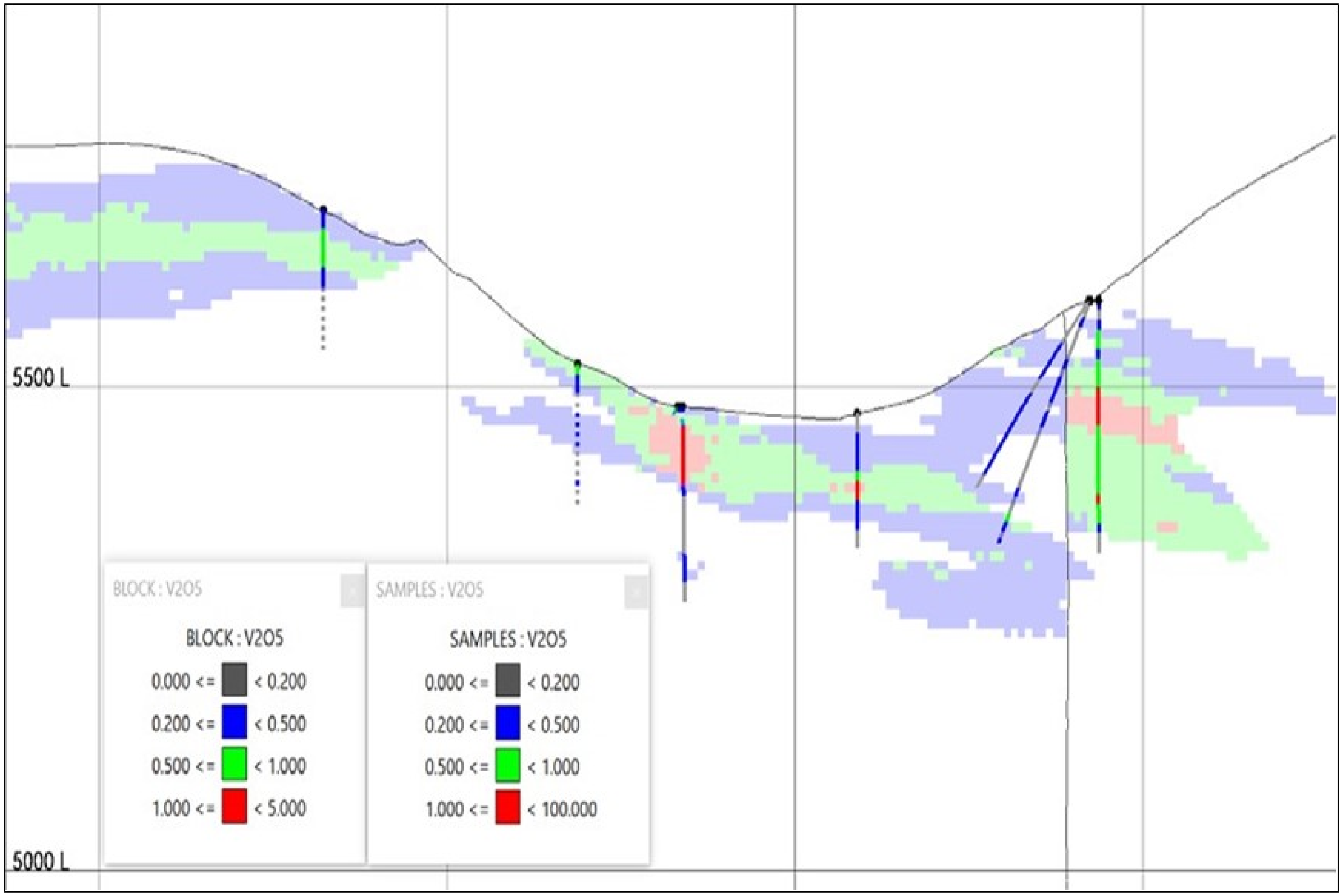
Search Pass	Search Ellipsoid in ft (x, y, z)	Min/Max Samples	Min # Drill Holes	Max Samples/Octant
1	225,225,15	3/16	2	2
2	400,400,25	3/16	2	2
3	500,500,35	3/16	2	2

Figure 14-3: Plan View of the Estimated Model Blocks



Note: Figure from Stryhas et al., 2019.

Figure 14-4: Cross-Section 14,752,300N Showing North Fault, Estimated V_2O_5 Block Grades and Drill Hole Composites (Viewing North)



Note: Figure from Stryhas et al., 2019.

Table 14-5: Validation by Estimation Parameter Results

Estimation Pass	Average Number of Composites per Block	Average Number of Drill Holes per Block	Average Distance to all Samples (ft)	Percentage of Blocks Estimated
1	5.2	3.3	120	27
2	4.4	2.7	220	22
3	3.3	1.9	200	51

Statistical analyses were undertaken comparing the estimated block grades from the ID^2 estimation to the composite drill hole data in each of the three fault domains, shown in Figure 14-5 and results are summarized in Table 14-6. The final model results show block grades which are slightly less than the composite grades as desired.

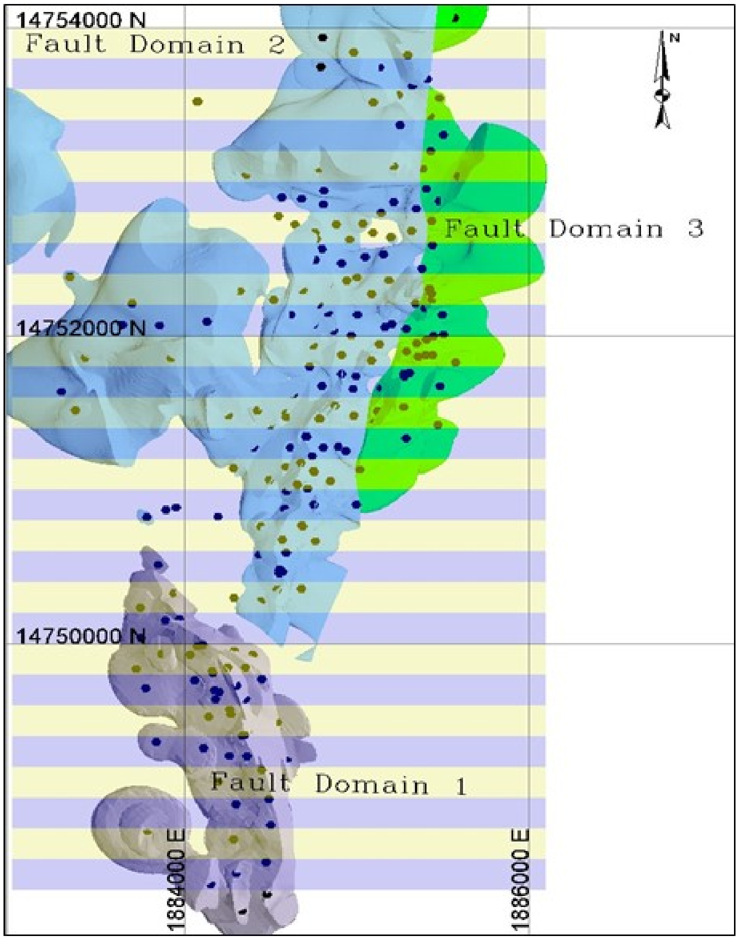
East–west-oriented swath plots were constructed, comparing the estimated average block grades to the composites. The swath plot locations are shown in Figure 14-5 and the results are presented in Table 14-6.

The results of all of the model validation tests provided good confidence in the resource estimation.

14.10 Classification of Mineral Resources

Classification of the resources reflects the relative confidence of the grade estimates and the continuity of the mineralization. This classification is based on several factors including; sample spacing relative to geological and geo-statistical observations regarding the continuity of mineralization, data verification to original sources, specific gravity determinations, accuracy of drill collar locations, accuracy of topographic surface, quality of the assay data and many other factors, which influence the confidence of the mineral estimation. No single factor controls the resource classification; rather. each factor influences the result. Generally, most of the factors influencing the resource classification at for the Carlin vanadium deposit are positive.

Figure 14-5: Swath Plot Locations, Drill Collars, Grade Shells and Fault Domains

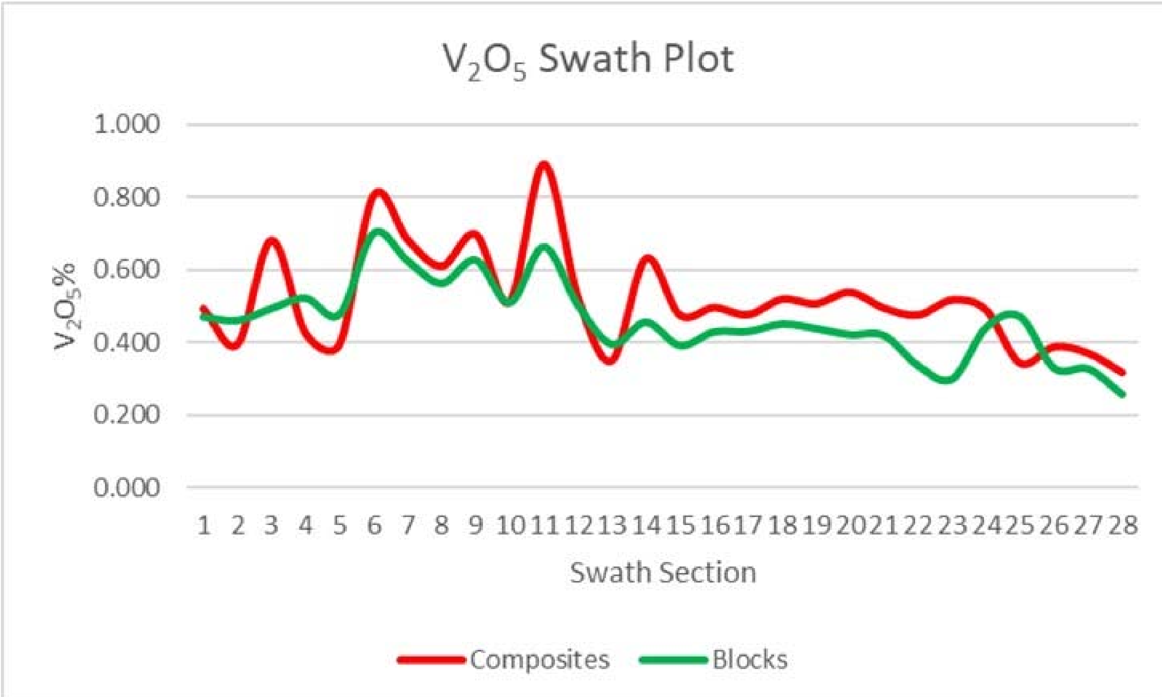


Note: Figure from Stryhas et al., 2019. Alternating cream and lilac rows are the swath plot sections. Drill hole collars are shown as black circles; however, the colour can be altered by the overprinting swath plot row colours.

Table 14-6: Model Validation by Statistical Analysis

Fault Block Domain	Average Composite V_2O_5	Average Block V_2O_5	% Difference Composite to Blocks
1	0.617	0.555	10
2	0.509	0.455	11
3	0.518	0.457	12

Figure 14-6: Swath Plot of the Estimated V_2O_5 Block Grades and Drill Hole Composites

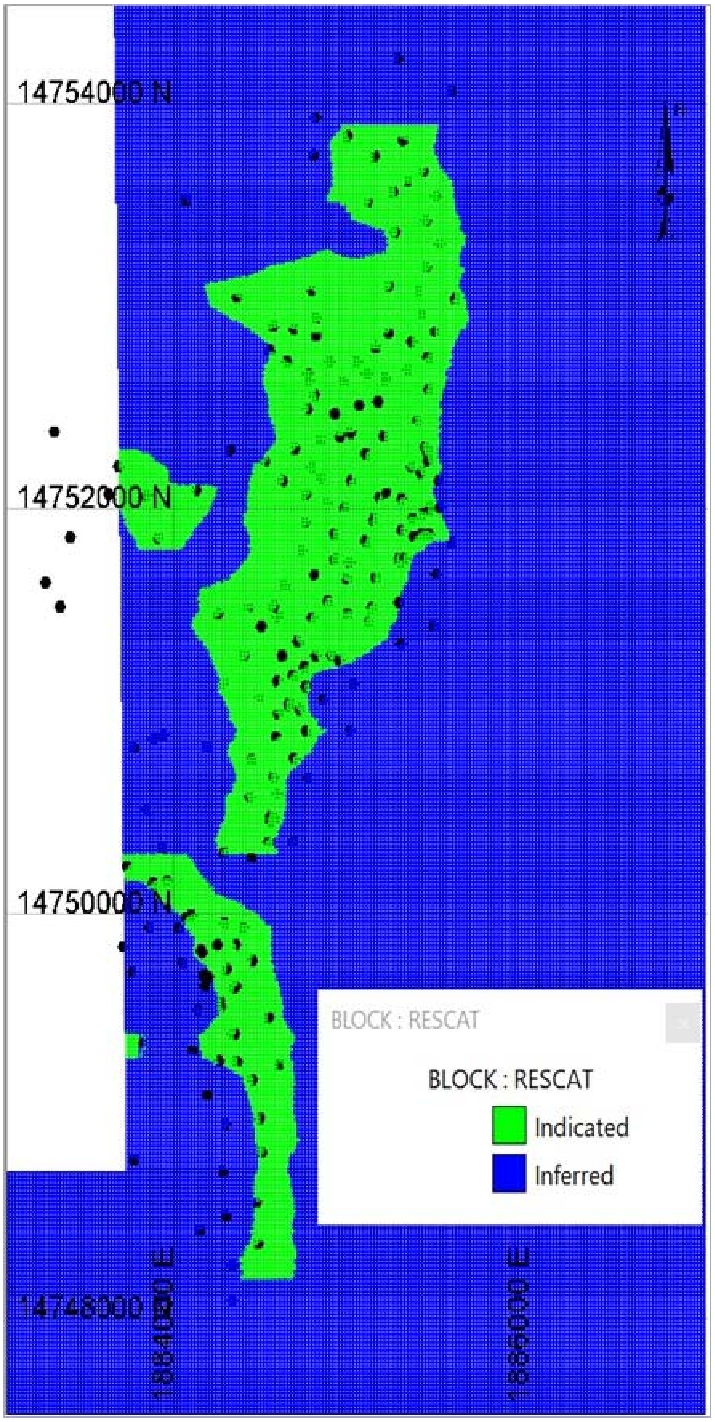


Note: Figure from Stryhas et al., 2019.

Mineral Resources are classified as Indicated and Inferred based primarily on the average drill hole spacing. All Mineral Resources that are supported by the areas of infill drilling with an average spacing of 200 ft or less were classified as Indicated Mineral Resources. No areas of the deposit are drilled to a sufficient density to support a Measured Mineral Resource. This was completed by digitizing cross-section polygons of the higher-confidence areas of the mineralization.

The assigned classifications are shown in Figure 14-7.

Figure 14-7: Plan View of Mineral Resource Classification



Note: Figure from Stryhas et al., 2019. Drill collars shown as black circles.

14.11 Reasonable Prospects of Eventual Economic Extraction

Mineral Resources are confined within a conceptual open pit shell that uses the following input parameters:

- Pit slope angle: 45°
- Metal price: US$12.50/lb V_2O_5 flake
- Mining cost of US$2.50/st
- Processing cost of US$52.50/st
- General and administrative (G&A) costs of US$1.50/st
- Product transport costs of US$2.00/st
- Metallurgical recovery of 85%.

Mineral Resources are reported using a 0.3% V_2O_5 cut-off grade.

14.12 Mineral Resource Statement

Mineral Resources are reported using the 2014 CIM Definition Standards in Table 14-7, and have an effective date of 31 January, 2019. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

The QP for the estimate is Dr. Bart Stryhas, CPG, an SRK employee.

14.13 Factors That May Affect the Mineral Resource Estimate

Factors that may affect the Mineral Resource estimate include:

- Changes to commodity price assumptions
- Changes to metallurgical recovery assumptions and assumptions that the proposed metallurgical recovery process will operate as envisaged
- Changes to interpretations of geological continuity due to changes in lithological, weathering or structural interpretations
- Changes to assigned density values in the estimation domains
- Changes to the input assumptions in the conceptual open pit shape that constrains the estimate
- Changes to environmental, permitting and social licence assumptions.

Table 14-7: Mineral Resource Statement

Classification	Cut-off (% V_2O_5)	Tons (Mst)	Grade (%V_2O_5)	Contained Metal (V_2O_5 Mlb)
Indicated	0.3	24.64	0.615	303
Inferred	0.3	7.19	0.520	75

Notes to Accompany Mineral Resource Table:

1. Mineral Resources are reported with an effective date of 31 January, 2019. The Qualified Person for the estimate is Dr. Bart Stryhas, CPG, an employee of SRK Consulting (U.S.) Inc.
2. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability. Mineral Resources are reported using the 2014 CIM Definition Standards
3. Mineral Resources are reported using a 0.3% V_2O_5 grade, based on the following assumptions: Open pit mining methods; constrained within a pit shell with a 45º pit slope, metal price of US$12.50/lb V_2O_5 flake, mining cost of US$2.50/st, processing cost of US$52.50/st, general and administrative (G&A) costs of US$1.50/st, product transport costs of US$2.00/st, and a metallurgical recovery of 85%.
4. Figures have been rounded.

14.14 Acid Consumption Factor

SRK updated the block model in October 2019 by estimating calcium, magnesium, and sulphur contents, to derive an acid consumption estimate for the purposes of the 2020 PEA.

14.14.1 Exploratory Data Analysis

Exploratory data analysis was undertaken, using histogram and cumulative distribution plots, on calcium, magnesium, and sulphur data collected from a multi-element analytical suite completed on the First Vanadium drill holes to review the data distributions and determine any relations with rock types and vanadium mineralization. The histogram plots of all three elements show a skewed distribution.

14.14.2 Grade Capping/Outlier Restrictions

The cumulative distribution plots combined with the histograms were used to determine appropriate capping levels which were applied prior to compositing.

14.14.3 Composites

Drill holes were composited to 10 ft run length composites.

14.14.4 Domains

Box plots of each element were domained by lithology (brown–black mudstone mudstone and grey–brown mudstone) and vanadium mineralization to identify the domains that each element would be estimated within. The vanadium mineralization was domained by a previously-constructed grade shell at a 0.2% vanadium threshold. The calcium and magnesium estimations were conducted in four domains: one for each lithology and one for each vanadium zone within each lithology. Sulphur was only estimated in two domains: one for each lithology.

14.14.5 Variography

A variography study was attempted; however, the variograms showed poor results. In general, the variogram results are similar for all three elements regardless of domains or orientations.

14.14.6 Estimation

The three elements were estimated into the existing block model using ID^2. In addition to the domains, the estimation was further divided by search orientation. There are two predominant lithology/vanadium trends present in the deposit that are directly related to fault blocks. A three-pass estimation was used for each element with each sequential pass searching longer distances (Table 14-8).

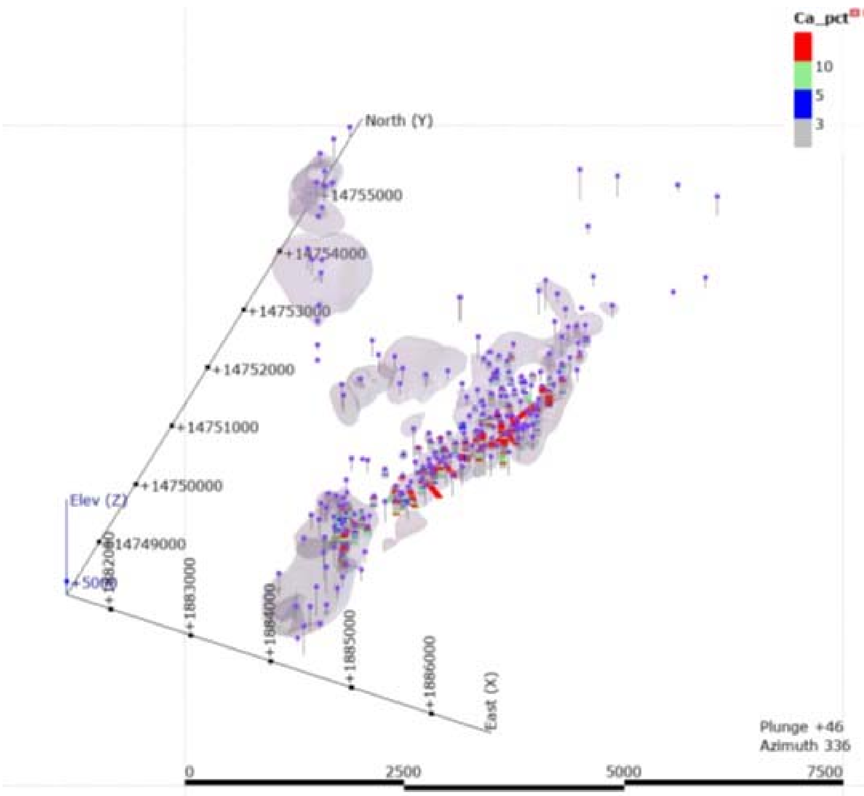
The multi-element data supplied by First Vanadium is only representative of the First Vanadium drilling. None of the legacy drilling has any calcium, magnesium, or sulphur data. First Vanadium completed infill and confirmation drilling throughout much of the main deposit area; however, there are areas, particularly toward the west and northwest, which do not have any multi-element data, see example in Figure 14-8 for calcium.

Based on the various domains, orientations, and search passes, the grade estimation of the three elements encompasses 60 estimation runs. Because the multi-element data does not cover the entire block model, there are areas of the deposit that are not estimated. To overcome this, SRK applied default values for each of the three elements to any of the blocks which were not estimated. The default values used were the averages for each of the lithology/vanadium domains.

Table 14-8: Estimation Parameters (Ca, Mg, S)

Fault Block/ Orientation	Lithology/ Vanadium Domain	Search Passes (ft)	Min/Max Samples	Octant/ Drill Hole Restriction
FB1: Azimuth 247, Dip -36	All	P1: 300 x 300 x 50 P2: 500 x 500 x100 P3: 1,000 x 1,000 x 150	Min 3 Max 16 All passes	P1: 2 samples/octant, min 2 drill holes P2 and P3: No octant, min 2 drill holes
FB 4 and FB 6: Azimuth 100, Dip -12	All	P1: 300 x 300 x 50 P2: 500 x 500 x100 P3: 1,000 x 1,000 x150	Min 3 Max 16 All passes	P1: 2 samples/octant, Min 2 drill holes P2 and P3: No octant, min 2 drill holes

Figure 14-8: Calcium Drill Data Distribution Map with 0.2% Vanadium Oxide Shell Shaded (oblique view to the northwest)



Note: Figure prepared by SRK, 2019.

Table 14-9: Default Values (Ca, Mg, S)

Element	Brown–Black Mudstone in Vanadium Shell (%)	Brown–Black Mudstone out of Vanadium Shell (%)	Grey–Brown Mudstone in Vanadium Shell (%)	Grey–Brown Mudstone out of Vanadium Shell (%)
Ca	6.965	5.583	9.203	6.276
Mg	3.665	2.986	5.050	3.706
S	1.256	1.322	0.068	0.131

14.14.7 Block Model Validation

Visual validation using cross-sections, and statistical validation comparing composites to blocks, were completed.

The statistical validation results of the BKMD show the average blocks are 10–15% lower than the supporting composites in most cases. This difference is due to the amount of extrapolation versus interpolation which occurs during the estimation. Because the multi-element data are limited to the main parts of the deposit, many of the peripheral blocks are estimated by extrapolation, and therefore show a decrease in grade away from the supporting data due to the ID2 estimation methodology. This effect creates the relatively large difference between the composites and the blocks. The low number of supporting samples in the GBMB also has a negative impact on the statistical validation.

SRK also tried running an inverse distance to the third power (ID^3) interpolation to test for improvement of the statistical validation; however, the results did not improve.

14.14.8 Acid Consumption Calculation

An acid consumption formula was provided by First Vanadium:

- Acid consumption (pounds/ton) = Calcium% × 49 + Magnesium% × 80.8 + (V_2O_5 ÷1.785) × 38.6 – Sulfur% × 61.2 + 50.

The results of this formula were applied to the block model to estimate the acid consumption for each block.

14.15 Comments on Section 14

Mineral Resources estimated for vanadium are reported in accordance with the 2014 CIM Definition Standards, and have been classified as Indicated and Inferred Mineral Resources.

An estimate was made of the likely acid consumption for each block within the block model based on interpolation of magnesium, calcium and sulphur grades into the block model.

15.0 MINERAL RESERVE ESTIMATES

This section is not relevant to this Report.

16.0 MINING METHODS

16.1 Overview

The 2020 PEA is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the 2020 PEA based on these Mineral Resources will be realized.

The 2020 PEA assumes conventional open pit mining using a conventional Owner-operated equipment fleet. The mining operations will have an 11-year life, with one year of pre-production. A stockpiling strategy is planned, which will provide process plant feed after the cessation of mining operations.

16.2 Pit Optimization

The pit shells that define the ultimate pit limit, as well as the internal phases, were derived using a Lerchs–Grossmann (LG) pit optimization algorithm. This process considers the information stored in the geological block model, pit slope angles, commodity prices, mining and processing costs, process recovery, and the sales costs for the metals produced. The geotechnical assumptions used in the pit design may vary in future assessments and could materially affect the strip ratio, or mine access design.

Table 16-1 provides a summary of the primary optimization inputs.

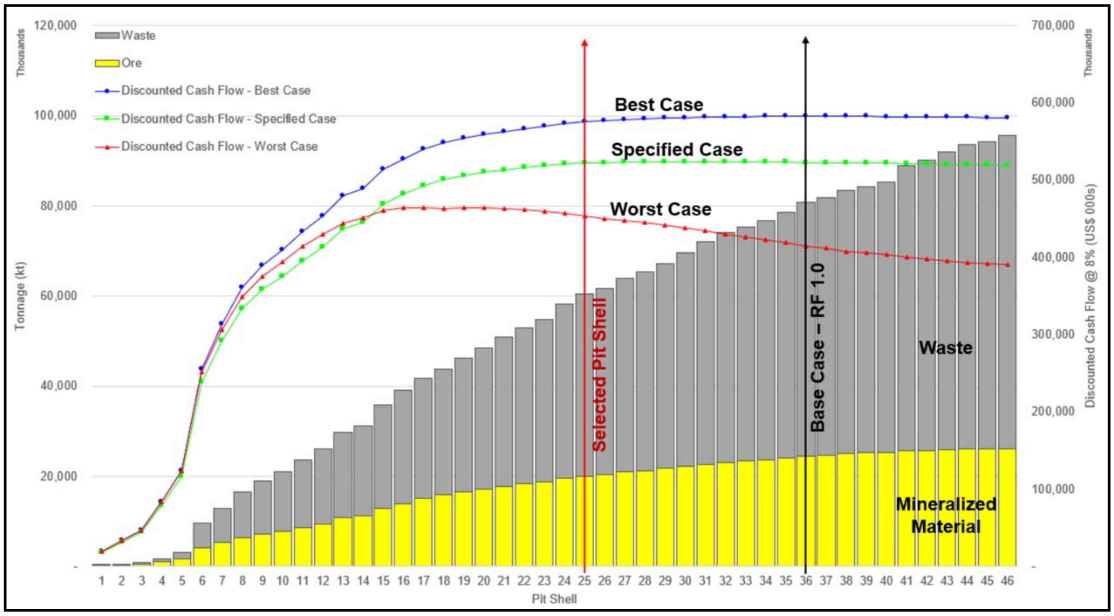
Wood imported the resource model, containing grades, material density, material types, and net smelter return (NSR) values, into the optimization software. The optimization run was completed using Indicated and Inferred Mineral Resources to define the optimal mining limits.

The optimization run included 46 pit shells defined according to different revenue factors, where a revenue factor of 1 is the base case. To select the optimal pit shell that defines the ultimate pit limit, Wood conducted a pit-by-pit analysis to evaluate the contribution of each incremental shell to NPV at discount rate of 8% (Figure 16-1). Following this analysis, the selected pit shell is usually smaller than the base case pit shell. The selected pit shell is pit shell 25, which corresponds to revenue factor 0.78 (Figure 16-2).

Table 16-1: Pit Optimization Parameters

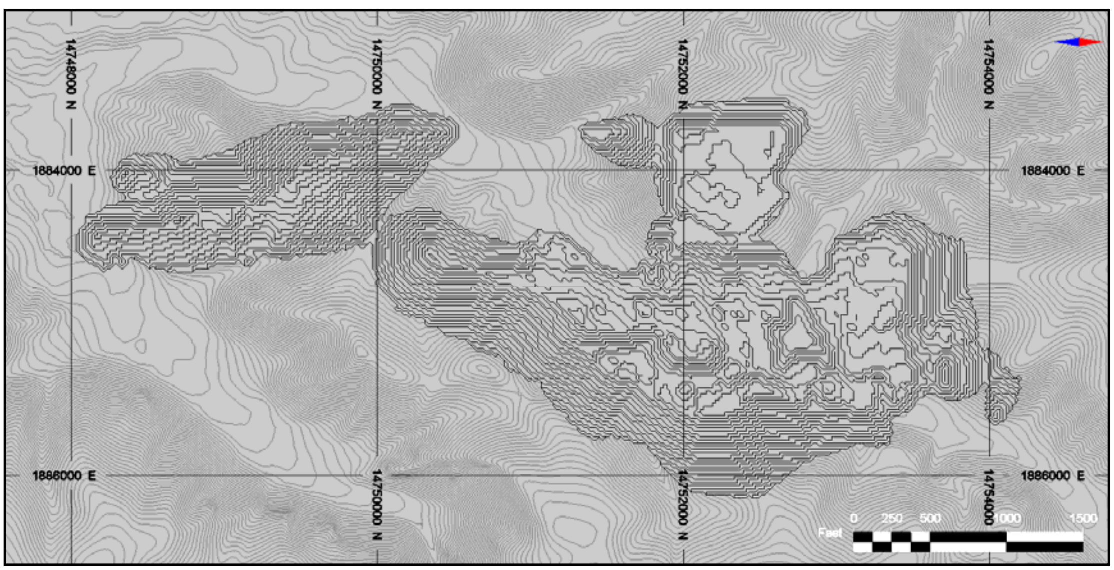
Area	Parameter	Unit	Value
Metal prices	V_2O_5	US$/lb	12.00
Discount rate	Discount rate	%	8
Processing rate	Oxide material	st/d	3,200
	Non-oxide material	st/d	2,500
Dilution	Dilution		Variable
Mining losses	Mining losses	%	—
Process recovery	Oxide material	%	70.8
	Non-oxide material	%	75.4
Operating cost	Base mining cost	US$/st	2.50
	Stockpile reclaim cost	US$/st	1.50
Process cost (acid cost not included)	Oxide material	US$/st milled	31.45
	Non-oxide material	US$/st milled	43.58
Sustaining capital	Sustaining capital	US$/st milled	2.00
G&A cost	G&A cost	US$/st milled	1.50
Closure cost	Closure cost	US$/st milled	1.00
Royalty	Royalty	%	0.01
Payable V_2O_5	Payable V_2O_5	%	99.0
Sales cost	Sales cost	US$/lb	0.37
Geotechnical	Overall slope angle (OSA)	degrees	40

Figure 16-1: Pit-by-Pit Analysis



Note: Figure prepared by Wood, 2020.

Figure 16-2: Selected Pit Shell



Note: Figure prepared by Wood, 2020.

Although the NPV is slightly lower in comparison to the base case pit shell, the selected pit shell saves 15.9 Mst of waste while only losing 4.4 Mst of mineralized material. In summary, the selected pit shell has 20.3 Mst less than the base case pit shell, while only decreasing by 0.13% in NPV.

16.3 Subset of Mineral Resource Estimate within the 2020 PEA Mine Plan

The pit shell 25 subset of the Mineral Resource estimate in Section 14 that was used as the basis for the PEA mine plan is provided in Table 16-2.

16.4 Mine Design

The Project is designed as a conventional truck-shovel operation with 45 st trucks and 6.5 yd^3 front-end loaders (FEL). The pit design includes four nested phases to balance stripping requirements while satisfying the process plant requirements.

The design parameters include a ramp width of 82 ft, road grades of 10%, bench height of 20 ft, targeted mining width of 200 ft, berm interval of 40 ft, fixed slope angle of 40° and a minimum mining width of 82 ft. Table 16-3 shows the mine design parameters.

The smoothed final pit design contains approximately 16.4 Mst of mineralized material and 52.7 Mst of waste for a resulting stripping ratio of 3.2:1. Within the 16.4 Mst of mineralized material the average grades are 0.71% V_2O_5. Figure 16-3 shows the ultimate pit design. Figure 16-4 and Figure 16-5 are cross-sections through the pit comparing the mine design to the selected pit shell.

A small portion of the pit design assumes that an agreement will be reached with the adjacent tenement holder, Nevada Gold Mines to allow a portion of the pit to extend for a distance of about 25–30 m onto ground held by Nevada Gold Mines. The portion of the pit design that is based on this assumption is shown in Figure 16-6 in relation to the Project boundary.

First Vanadium and Nevada Gold Mines are reviewing a term sheet that envisages simple access to the land to allow for the pit cutback. Considerations in the term sheet potentially involve a combination of up-front cash payments and NSR payments for any vanadium-bearing mineralization that is mined within the Nevada Gold Mines tenure.

Table 16-2: Subset of Mineral Resource Estimate in 2020 PEA Mine Plan

Classification	Material Type	Cut-off (Block value US$/st)	Tons (Mst)	Grade (%V_2O_5)	Contained Metal (V_2O_5 Mlb)
Indicated	Oxide	10	6.76	0.664	90
	Non-oxide	10	6.94	0.792	110
	Total		***13.69***	***0.729***	***200***
Inferred	Oxide	10	2.57	0.619	32
	Non-oxide	10	0.10	0.684	1
	Total		***2.67***	***0.622***	***33***
Waste	***Total***		***52.68***		

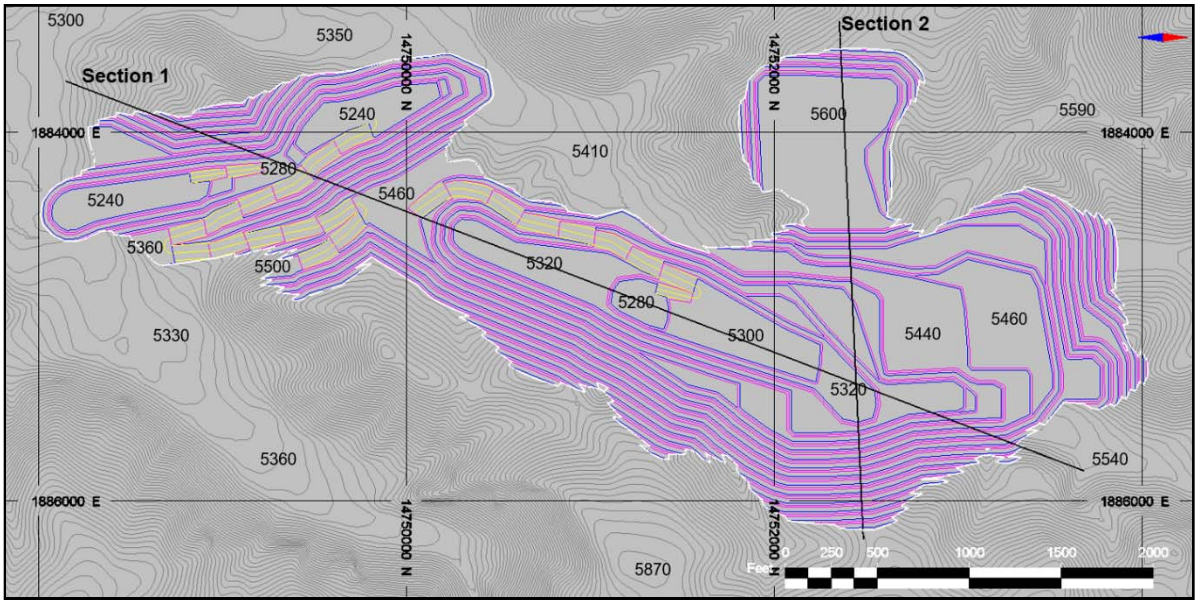
Notes to Accompany Subset of Mineral Resource Estimate within the 2020 PEA Mine Plan Table:

1. Mineral Resources within the 2020 PEA Mine Plan were estimated assuming open pit mining methods and include the dilution resulting from reblocking from a 10 x 10 x 10 ft to a 20 x 20 x 20 ft block size.
2. Input assumptions to the pit shell that constrains the estimate include metal price of $12/lb V_2O_5, fixed process recoveries of 70.8% for oxide material and 75.4% for non-oxide material. Mining cost is assumed to be $2.50/st and reclaim cost is $1.50/st. Processing operating costs were estimated as $31.45/st for oxide material and $43.58/st for non-oxide material. The process cost assumption for the pit shell does not include allocation for acid prices, which are variable. In addition, G&A costs were estimated at US$1.50/st, sustaining capital costs at US$2.00/st and closure costs at US$1.00/st. A fixed royalty percentage of 0.01% was included. Overall slope angles of 40° were used.
3. Tonnes, grade and contained metal content may not sum due to rounding.

Table 16-3: Mine Design Parameters

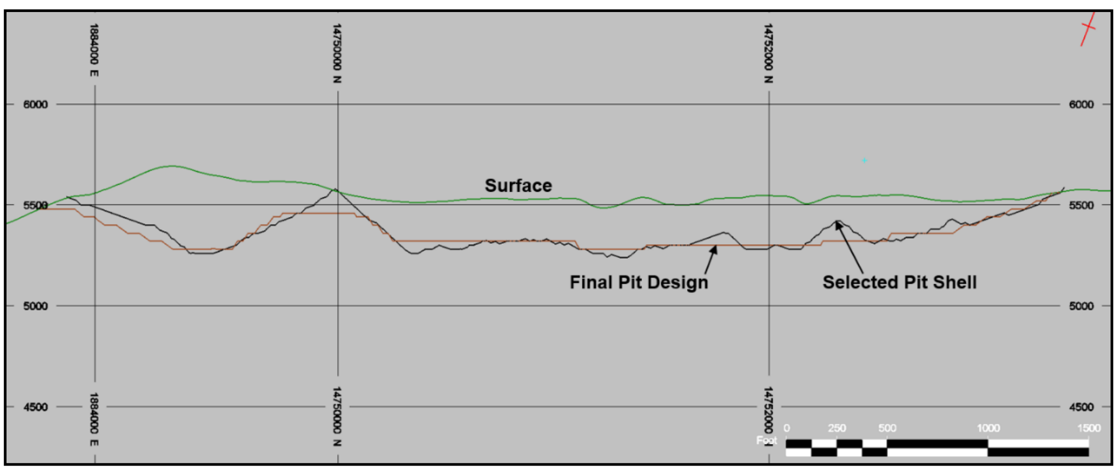
Parameter	Units	Value
Inter-ramp angle	degrees	40
Bench face angle	degrees	60
Bench height	ft	20
Catch bench spacing	bench	2
Road gradient	%	10
Road width, two lanes	ft	82
Road width, one lane	ft	52

Figure 16-3: Ultimate Pit Design



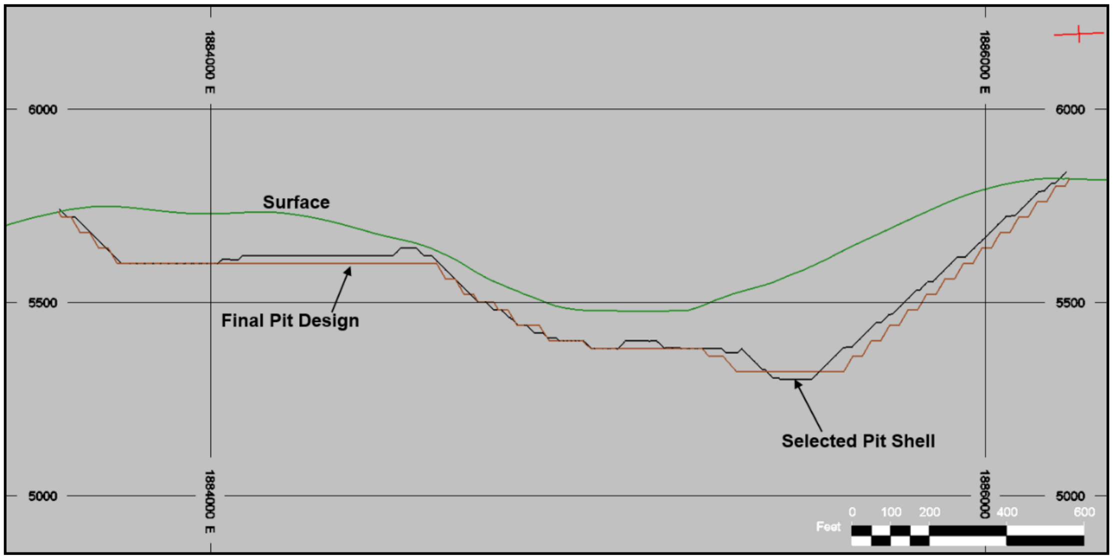
Note: Figure prepared by Wood, 2020.

Figure 16-4: Section 1 Showing Mine Design and Selected Pit Shell



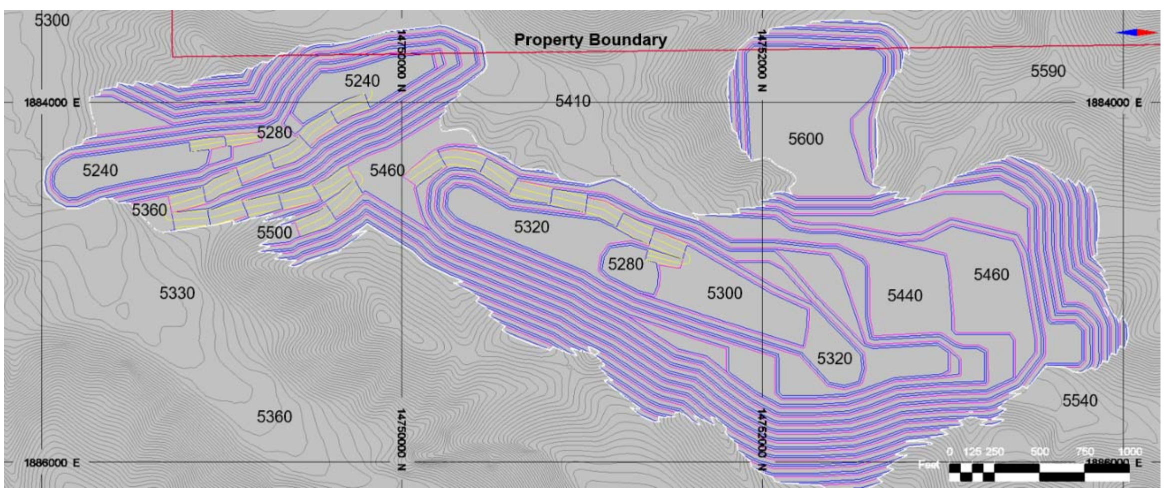
Note: Figure prepared by Wood, 2020. Section looks northwest

Figure 16-5: Section 2 Showing Mine Design and Selected Pit Shell



Note: Figure prepared by Wood, 2020. Section looks north.

Figure 16-6: Pit Layback Assumption



Note: Figure prepared by Wood, 2020.

There is approximately 0.72 Mt, grading 0.62% V_2O_5 in the pit design that crosses the Project boundary, and is the only portion of the mine plan that would be at risk if an access agreement could not be concluded. The subset of the Mineral Resource estimate in the 2020 PEA mine plan does not include these mineralized blocks from the Nevada Gold Mines ground; the blocks are treated as though they were waste in the mine plan and are sent to the waste rock storage facility (WRSF). If the mineralized blocks from the Nevada Gold Mines ground were to be included in the mine plan, it would represent about 4% of the total tonnage to be mined over the LOM.

A sensitivity case was run on inclusion of this mineralized material in the economic analysis, together with the provisional term sheet payment assumptions, has no material impact on the 2020 PEA economics as presented.

The 2020 PEA economic analysis, however, assumes the mineralized material is sent to the WRSF, is included as a contributor to Project costs, and does not contribute vanadium revenue to Project economics.

16.5 Waste Rock Facilities

The WRSF is designed for a capacity of approximately 45 Mst of waste rock. An additional 2.5 Mst of waste rock will be sent to the tailings storage facility (TSF) buttress, and 5.3 Mt of waste rock will be used to construct the stockpile platform. A portion of the coarse upgrade tailings fraction is intended to be stored with the waste rock in the WRSF. No specific allocation was made for the estimated 6.1 Mt of this material in the WRSF design, as it was assumed that the tailings would infill voids and spaces between the waste rocks. There is additional space to the north of the conceptual site that may allow WRSF expansion in this direction if required.

The design and construction of the WRSF should ensure physical and chemical stability during and after mining activities. To achieve this, the WRSF is designed to account for benching, drainage, geotechnical stability, and concurrent reclamation.

Figure 16-7 shows the WRSF outline.

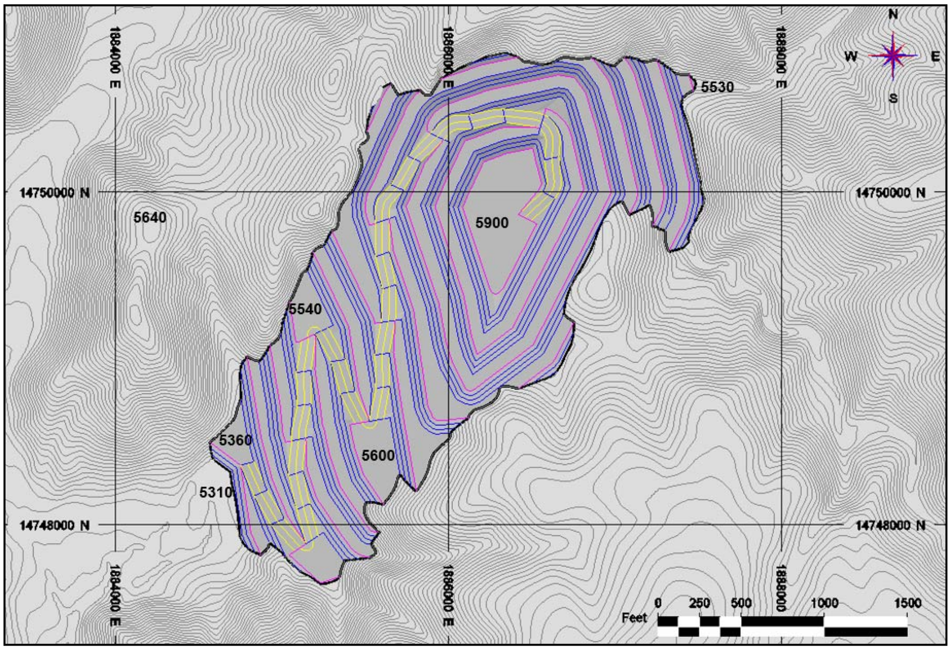
Although sulphides are present, there is no information in the block model to determine PAG characteristics for the waste material.

Additional information on waste handling is provided in Section 16.8, and information on proposed tailings management is included in Section 20.5.

16.6 Stockpiles

As part of the elevated cut-off strategy used in the production schedule, medium- and low-grade stockpiles are required to allow higher grades to be fed to the process plant during the first years of production. Most of the stockpiled material will be reclaimed once mining has ceased, and stockpiled materials will represent 100% of the feed during the last five years of the process plant operation.

Figure 16-7: Waste Rock Facility

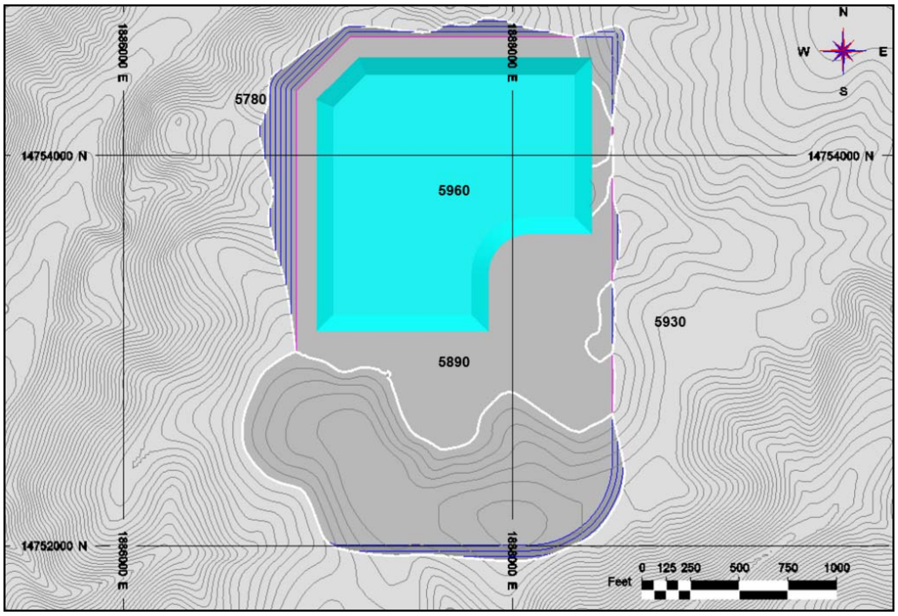


Note: Figure prepared by Wood, 2020.

The stockpile area has a total storage capacity of 3.6 Mft^3. This volume is sufficient to satisfy the maximum stockpiling capacity of approximately 5.4 Mst. Stockpile design criteria included a material repose angle of 37° and a maximum height of 70 ft. The stockpile area is designed to account for benching, drainage, geotechnical stability, and concurrent reclamation.

Figure 16-8 shows the proposed stockpile layout. The low- and medium-grade oxide material, and non-oxide mineralization will be stockpiled separately on the same pad.

Figure 16-8: Mineralized Material Stockpile



Note: Figure prepared by Wood, 2020.

16.7 Production Schedule

The deposit is proposed to be mined in four nested phases, including the ultimate pit limit. The schedule was developed in yearly periods. The operating phases were sequenced starting in the south portion of the deposit, then proceeding to mine the north and central portions, to finally mine to the final pit limit. The scheduling constraints set the maximum mining capacity at 7 Mst/a, and the maximum number of benches mined per year at 10 in each phase.

To maximize Project value, an elevated cut-off strategy was followed to feed the highest possible grades at the beginning of the operation. A total stockpiling capacity of 6.1 Mst is required to store medium- and low-grade material.

The material was classified according to the following NSR values:

- Medium-grade: NSR ≤US$40/st but >US$20/st
- Low-grade: NSR ≤US$20/st.

The production schedule based on the Indicated and Inferred Mineral Resources captured by the final pit design supports a 17 year mine life, including one year of pre-production. The amount of re-handled mill feed material from stockpiles is 6.1 Mst.

The average grades to the process plant over the life-of-mine (LOM) are forecast to be 0.71% V_2O_5. The yearly LOM schedule is shown in Table 16-4 and Figure 16-9.

Figure 16-10 shows the scheduled V_2O_5 feed grade and Figure 16-11 shows the stockpile balance.

16.8 Waste Material Handling

Waste will be hauled to the WRSF using 45 st trucks. A 30% swell factor was used for estimating volumes.

The construction sequence will start at the bottom of the WRSF by placing the waste in 20-ft lifts, leaving a 76.9 ft berm every three lifts. The resulting overall slope angle of the WRSF face will be 2.6H:1V.

An initial phase will be built on the west wall to allow the open pit to be connected with the WRSF through the existing road to the proposed plant site.

16.9 Operating Schedule

Operations are scheduled to operate 24 hours a day, seven days a week, using four rotating crews working 12-hour shifts. During the day, there will be two 12-hour shifts scheduled, consisting of a day shift and a night shift. A number of duties only require work during the daylight hours. For these duties, two crews will rotate to provide seven day-a-week day-shift coverage. Personnel not engaged in shift work will work a seven-day-on, seven-day-off schedule.

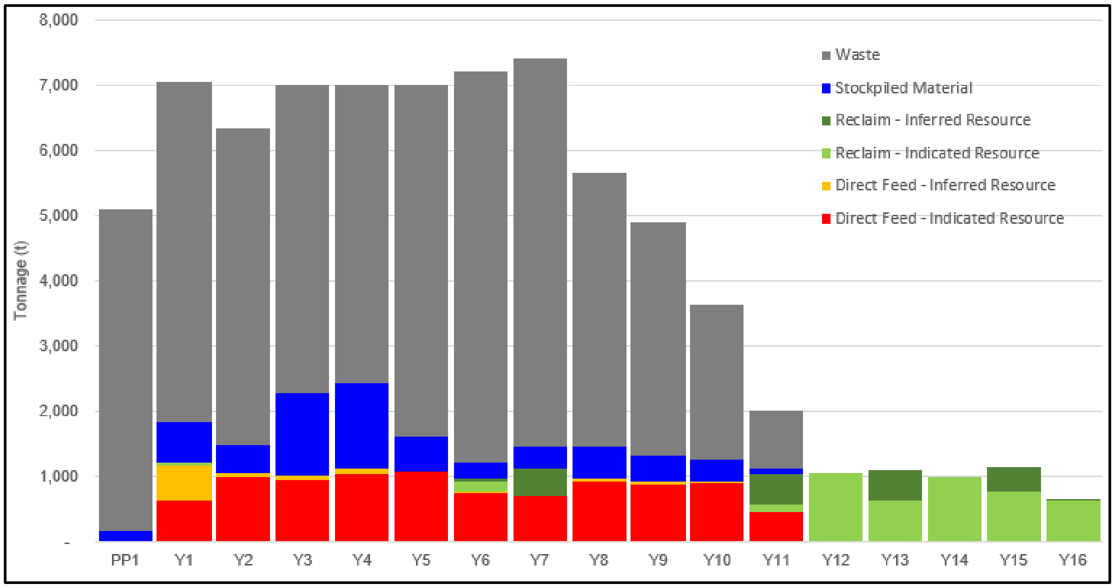
For the rotating mine operations crews, approximately 3.5 hours are anticipated to be lost per day to standby time, inclusive of two hours for breaks, 30 minutes for fueling, 20 minutes for shift change, 20 minutes for blast delay, and 20 minutes for meetings. Accounting for standby time and weather delays, equipment will accumulate approximately 6,283 gross operating hours (GOH) per year using the above assumptions.

Table 16-4: Production Schedule

Period	Feed (Mst)									Waste (Mst)	To Stockpile (Mst)	V_2O_5 (%)
	Direct Feed			Reclaim			Total Feed					
	Indicated	Inferred	Total	Indicated	Inferred	Total	Indicated	Inferred	Total			
PP1	—	—	—	—	—	—	—	—	—	4.93	0.17	—
Y1	0.63	0.54	1.17	0.05	—	—	0.68	0.54	1.22	5.23	0.61	0.82
Y2	0.99	0.07	1.06	—	—	—	0.99	0.07	1.06	4.86	0.42	0.88
Y3	0.94	0.07	1.01	—	—	—	0.94	0.07	1.01	4.73	1.26	0.88
Y4	1.04	0.07	1.12	—	—	—	1.04	0.07	1.12	4.57	1.32	0.75
Y5	1.07	#	1.08	—	—	—	1.07	#	1.08	5.39	0.54	0.82
Y6	0.76	#	0.76	0.16	0.05	0.21	0.92	0.05	0.97	6.01	0.23	0.87
Y7	0.71	#	0.71	—	0.41	0.41	0.71	0.42	1.12	5.96	0.33	0.71
Y8	0.93	0.04	0.97	—	—	—	0.93	0.04	0.97	4.19	0.50	0.80
Y9	0.88	0.04	0.92	—	—	—	0.88	0.04	0.92	3.57	0.40	0.87
Y10	0.91	0.01	0.92	—	—	—	0.91	0.01	0.92	2.36	0.35	0.84
Y11	0.45	0.01	0.46	0.10	0.48	0.58	0.55	0.49	1.04	0.89	0.08	0.65
Y12	—	—	—	1.05	—	1.05	1.05	—	1.05	—	—	0.55
Y13	—	—	—	0.63	0.48	1.11	0.63	0.48	1.11	—	—	0.50
Y14	—	—	—	1.00	—	1.00	1.00	—	1.00	—	—	0.50
Y15	—	—	—	0.76	0.39	1.15	0.76	0.39	1.15	—	—	0.43
Y16	—	—	—	0.63	#	0.64	0.63	#	0.64	—	—	0.46
Total	***9.31***	***0.86***	***10.18***	***4.38***	***1.81***	***6.14***	***13.69***	***2.67***	***16.37***	***52.68***	***6.19***	***0.71***

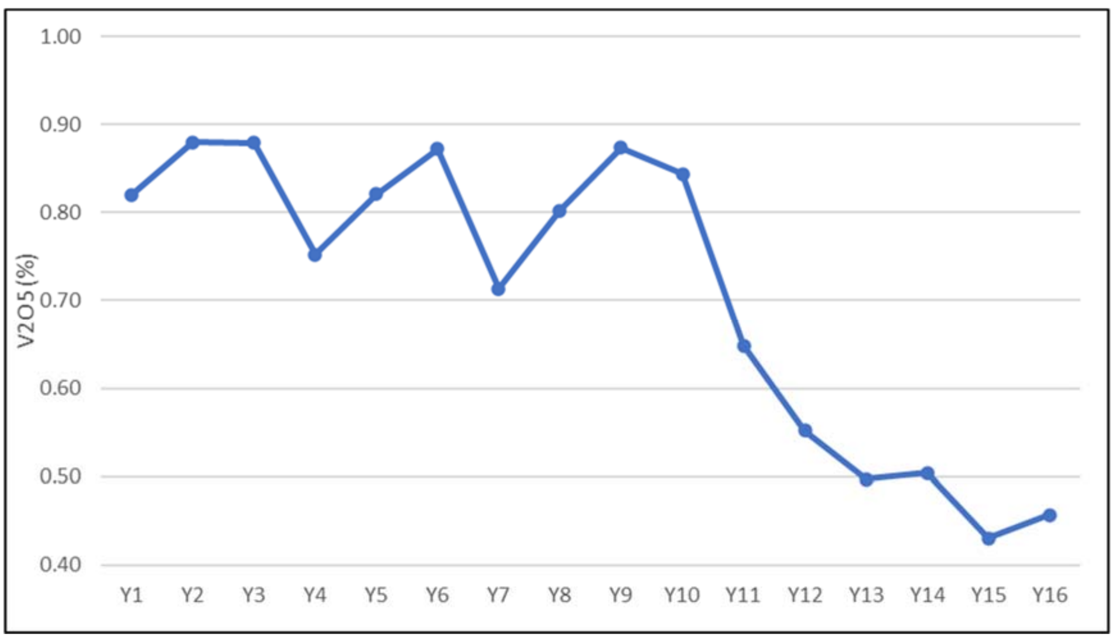
Note: all figures have been rounded. # indicates tonnage exists, but rounding does not result in a reported number. — indicates not applicable.

Figure 16-9: Production Schedule



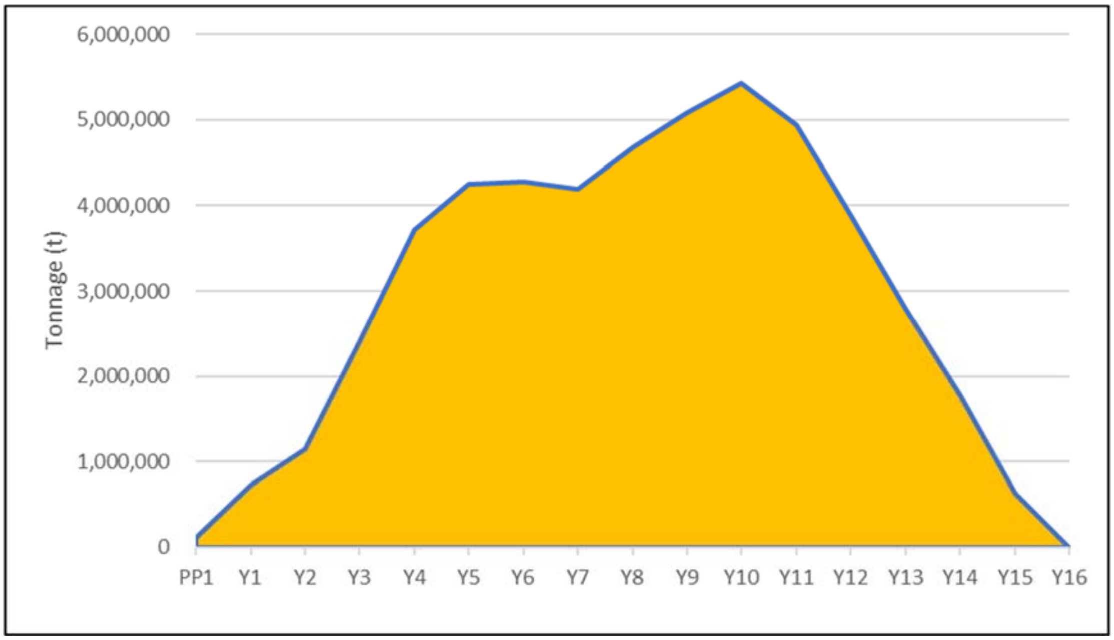
Note: Figure prepared by Wood, 2020. Tonnage figures shown in X-axis are short tonnes x 1,000.

Figure 16-10: Scheduled V_2O_5 Feed Grade



Note: Figure prepared by Wood, 2020.

Figure 16-11:Stockpile Balance



Note: Figure prepared by Wood, 2020.

Owner-mining was selected to support the 2020 PEA.

As with mine operations, mine maintenance is scheduled to work a 24/7 schedule to allow for continuous maintenance coverage. However, the majority of planned maintenance work will be done during the day shift with a skeleton crew scheduled for the night shift.

Blasting is only scheduled during the daylight hours. Two blasting crews will rotate on a 10-hour day shift, for four day-a-week coverage.

16.10 Mining Equipment

The operation is assumed to use a conventional Owner-operated truck fleet loaded by a combination of FELs. The truck fleet will consist of articulated trucks for waste stripping and for mining the mineralized zones. The trucks will be diesel powered with a combined capacity to mine a maximum of 7 Mst/a, operating on a combination of 20 ft benches. The loading fleet will also be diesel powered. A small hydraulic shovel/backhoe will support the FELs.

Equipment requirements were estimated on an annual basis. Equipment sizing and numbers were based on the mine plan, the operational factors considered by Wood, and a 24-hour per day, seven-day-a-week work schedule.

The LOM major equipment fleet requirements are summarized in Table 16-5.

16.10.1 Blasting

Two types of explosive will be used:

- Heavy ANFO blend (HA) will be used for wet material, with a specific gravity of 77 lb/ft^3
- ANFO will be used for dry material, with a specific gravity 55 lb/ft^3.

It is assumed that the relation of wet:dry material is 30:70%.

Table 16-6 shows the design parameters for production blasting. It is assumed that a medium to soft rock will be mined.

Based on benchmarking, a powder factor of 0.41 lb/st was used for mineralized material, and a powder factor of 0.30 lb/st was used for waste.

16.10.2 Drilling

Throughout the operations life, drilling will be required for both grade control and blasting. Rock fragmentation achieved through blasting was the overriding design criteria for the drill hole pattern design. The blast hole drilling design discussed in Section 16.10.1, together with Wood-calculated drill penetration rates, were used to estimate drilling requirements. Drill penetration is a function of bit size, bit load, drilling method, and rock strength properties. There were no unconfined compressive strength test results available at the Report effective date; however, from what can be observed in site images, it has been assumed that a medium to soft rock is mined.

Two top head hammer (THH) drills with a 4¾ inch bit are required at the peak of production.

16.10.3 Loading

The primary loading units selected are two 6.5 yd^3 FELs. After Year 9, only one FEL is required. To assist the FEL, one 5 yd^3 hydraulic shovel/backhoe is scheduled for the LOM. Loading assumptions are shown in Figure 16-12.

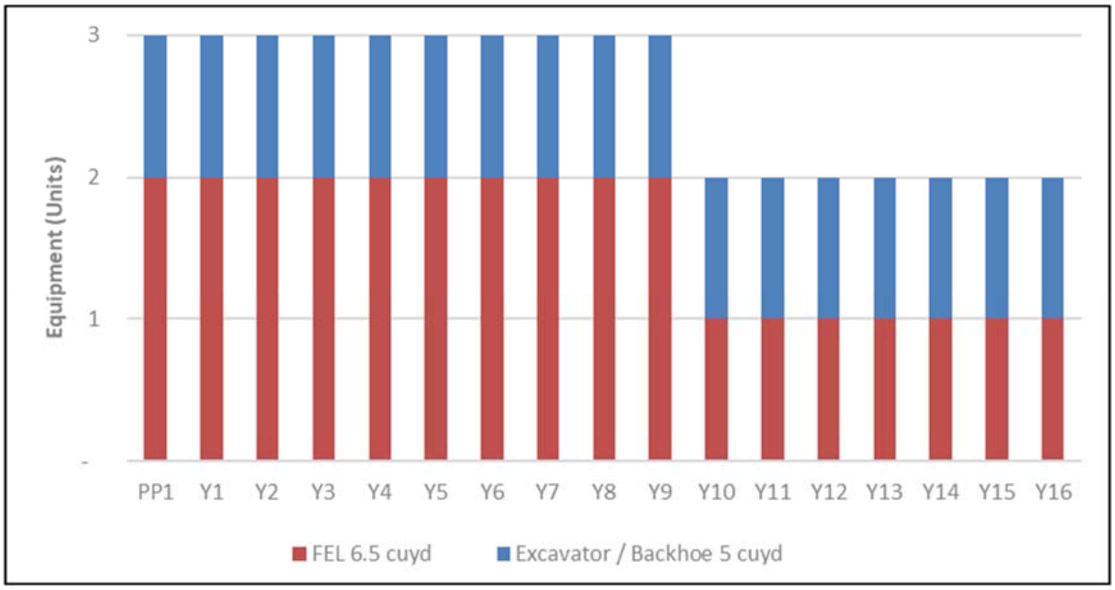
Table 16-5: Major Equipment Requirements

Major Equipment	PP1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16
Top hammer drill	1	2	2	2	2	2	2	2	2	1	1	1	0	0	0	0	0
FEL	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
Hydraulic shovel	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Articulated truck	6	7	7	8	8	8	8	8	7	7	5	3	1	1	1	1	1

Table 16-6: Blasting Design Input

Description	Units	Waste Dry	Mineralized Material Dry	Waste Wet	Mineralized Material Wet
Rock density	st/ft^3	0.07	0.07	0.07	0.07
Explosive		ANFO	ANFO	HA37	HA37
Explosive density	lb/ft^3	50	50	77	77
Bench height	ft	20	20	20	20
Hole diameter	ft	0.40	0.40	0.40	0.40
Burden	ft	13.59	12.05	16.24	14.45
Spacing	ft	15.63	13.85	18.67	16.62
Sub drill	ft	4.08	3.61	4.87	4.34
Stemming	ft	9.52	8.43	11.37	10.12
Drill length per hole	ft	24.08	23.61	24.87	24.34
Rock volume per hole	ft^3	4,250	3,338	6,064	4,806
Rock tonnage per hole	st/ft^3	295.64	230.24	421.83	331.51
Rock tonnage	st/ft	12	10	17	14
Explosive column	ft	14.56	15.18	13.50	14.22
Weight of explosive	lb	90	94	128	135
Powder factor (by rock volume)	lb/ft^3	0.02	0.03	0.02	0.03
Powder factor	lb/st	0.30	0.41	0.30	0.41

Figure 16-12: Loading Requirements and Performance



Note: Figure prepared by Wood, 2020.

16.10.4 Hauling

The primary hauling unit selected for ore and waste mining is a mechanical drive truck with a payload capacity of 45 st wet, assuming a standard body with a full set of liners. The dry capacity is estimated at 44 st, assuming 3% moisture and carry back.

Wood estimated truck requirements on a period by period basis using travel distances from a road network developed within MineSight software. Haul segment distances were reported for each material type from their location on a mining bench to their final destination. Assuming 2% rolling resistance for haul roads, travel speeds were estimated from the manufacture's performance curves, and applied to each haul segment to estimate travel time.

Truck requirements by period are shown in Table 16-7 for 45 st trucks, together with the average one-way haul distance, average fuel consumption, and average truck productivity. Twelve trucks are projected to be commissioned during pre-production. Over the next year, the fleet will be ramped up to 15. The truck fleet will reach its peak in Year 3, keeping steady until Year 7, and dropping progressively until it reaches a single unit in Year 12, and thereafter remaining steady at the single unit for the next four years.

Table 16-7: Truck Requirements and Performance

Period	Trucks Required (number)	Average One-Way Haul Distance (ft)	Average Fuel Burn (US gal/GOH)	Average Truck Production (st/GOH)
PP-1	6	6,401	7	134
Y1	7	5,433	8	160
Y2	7	4,556	8	168
Y3	8	6,144	9	139
Y4	8	5,798	9	139
Y5	8	4,627	8	159
Y6	8	4,603	8	164
Y7	8	5,514	9	148
Y8	7	6,746	10	129
Y9	7	7,380	10	111
Y10	5	7,957	11	115
Y11	3	7,293	10	107
Y12	1	3,300	5	167
Y13	1	3,300	5	177
Y14	1	3,300	5	158
Y15	1	3,300	5	182
Y16	1	3,300	5	101
Average	***7***	***5,634***	***8***	***145***

Note: GOH = gross operating hours.

16.10.5 Support

Support equipment will include track dozers, rubber-tired dozers (RTDs), motor graders, and water trucks.

Requirements for support equipment over the LOM are provided in Table 16-8.

Table 16-8: LOM Support Equipment Requirements

Support Equipment	PP1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16
Dozer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RTD	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Motor grader	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Water truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

16.10.6 Auxiliary

To support mine maintenance and mine operation activities, a fleet of auxiliary equipment will be required. The fleet will consist of fuel/lube trucks, small water trucks, skid steers, flatbed trucks, lighting plants, pickups, mining and geology software, a heavy ANFO truck, survey equipment, and pumps.

Requirements for auxiliary equipment over the LOM are provided in Table 16-9.

16.11 Comments on Section 16

The mine plan assumes conventional open pit mining using conventional Owner-operated equipment. Mining operations will run for 11 years, plus one year of pre-production. Once mining operations cease, the plant will treat stockpiles for an additional five years.

Table 16-9: LOM Auxiliary Equipment Requirements

Auxiliary Equipment	PP1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16
Small Fuel/Lube truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Small water truck	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Skid steer	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1
Flatbed truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Light plant	5	5	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1
Pickup, ¾ st	3	3	3	3	3	3	3	3	3	3	3	3	0	0	0	0	0
Pickup, 1 st	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
Crew bus	2	2	2	2	2	2	2	2	2	2	2	1	0	0	0	0	0
Mine & geology software	3	3	3	3	3	3	3	3	3	3	3	3	0	0	0	0	0
Heavy ANFO (blend) truck	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Leica system - total station	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
63 hp pump	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0

17.0 RECOVERY METHODS

17.1 Introduction

The process flowsheet for vanadium recovery can follow a number of potential processing routes. The most common method used globally includes a salt roast to oxidize the vanadium from its insoluble trivalent and tetravalent states to a soluble pentavalent state. In the case of the Project mill feed materials, the recovery response to salt roasting is inconsistent across the samples tested, with recent testing supporting historical data. An alternative approach with consistent and higher recovery was proposed for the purposes of the 2020 PEA, and is supported by testwork.

For the purposes of the process plant design, the mudstone-hosted mineralization types are classified as being an oxide and a non-oxide type. The mineralization types have significantly different mineralogical and physical characteristics which results in differences to the front end of the flowsheet for the two mineralization types:

- The oxide mineralization is friable, with the gangue being dominated by acid-consuming dolomite and K-feldspar, and is not significantly upgradable by conventional flotation or gravimetric methods
- The non-oxide mineralization is competent, is also dominated by acid-consuming dolomite and K-feldspar, but generally contains a greater proportion of sulphide minerals. In addition, the non-oxide mineralization contains a high proportion of sulphur-bearing kerogen with which the vanadium is associated.

In general, the vanadium minerals are very fine-grained.

Testing showed that it is possible to upgrade the mineralization by cycloning:

- The cyclone underflow from the oxide mineralization type is rejected to tailings, thus removing a substantial quantity of acid consuming gangue from downstream processes
- The cyclone underflow from the non-oxide mineralization contains a large proportion of the vanadium-bearing kerogen, so the underflow advances to carbon flotation for kerogen recovery.

The oxide and non-oxide concentrates generated from cycloning and flotation advance to common processes:

- Acidulation
- Acid pressure oxidation
- Ion exchange
- Solvent extraction
- Precipitation
- Calcining processes.

The process, including gangue and mineral chemistry, was modelled using METSIM to generate a mass, water, chemical and heat balance. The model provided the ability to test the effects of process configuration changes on mass and volumetric flowrates, recoveries and reagent requirements.

The process design assumes mineralization supply from an active mining operation for the first 11 years (plus one year of pre-production), followed by five years of stockpile treatment, then a final four years of acid-plant only operation.

17.2 Process Flowsheet

A block process flowsheet is included as Figure 17-1. The associated major mechanical equipment list for the process flowsheet is provided in Table 17-1.

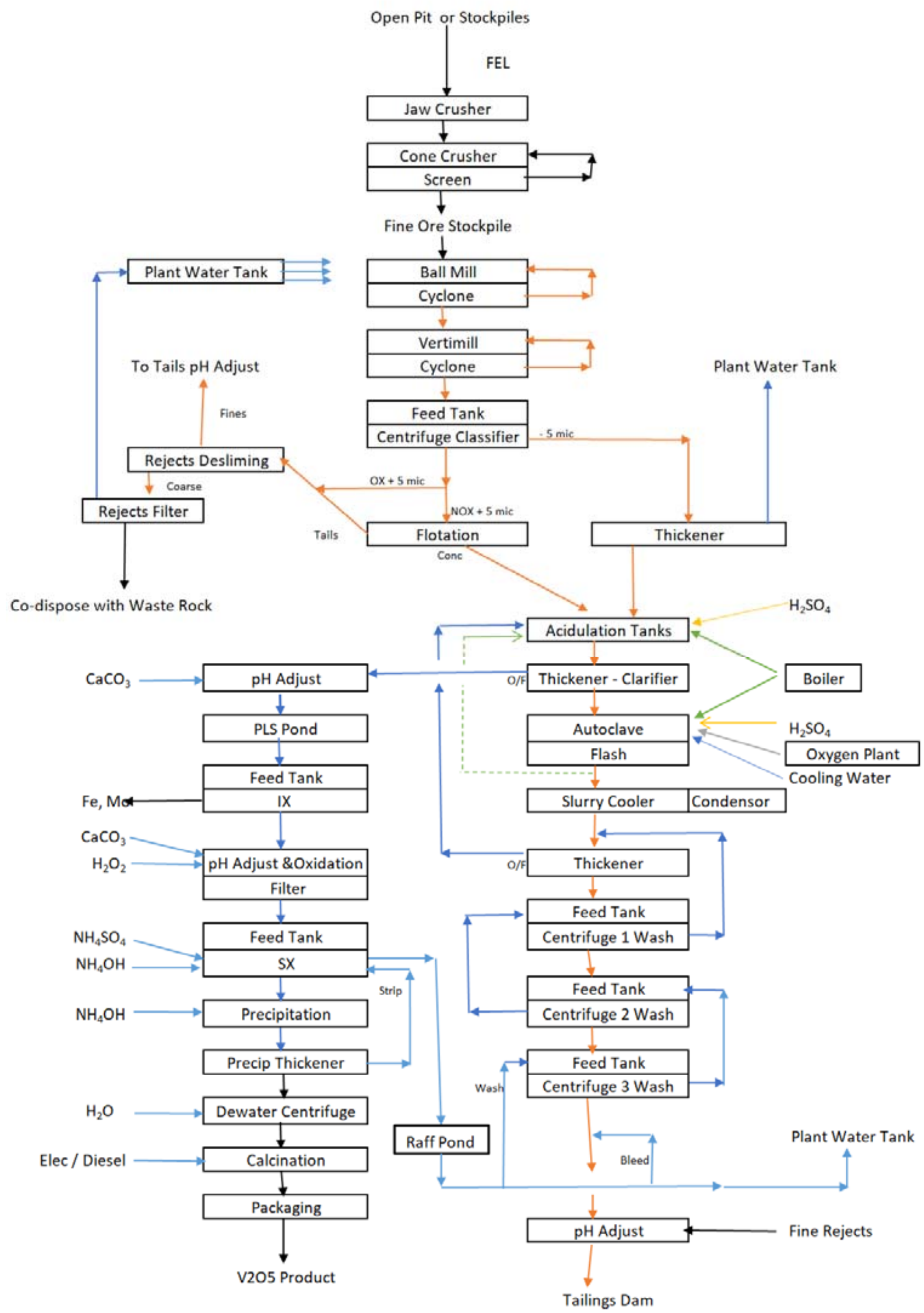
17.3 Plant Design

The process plant is designed to treat the mill feed materials separately on a campaign basis using common equipment. It is possible to treat a blend of mill feed materials through the plant, although this was not modelled for this study.

The design capacity of the plant is as follows (all tonnages are quoted as short tons):

- Oxide mill feed material only: 3,200 st/d
- Non-oxide mill feed material only: 2,500 st/d.

Figure 17-1: Process Flowsheet



Note: Figure prepared by Wood, 2020.

Table 17-1: Process Equipment List

Description	Quantity	Size
Feed hopper including double-deck grizzly	1	3,500 t/d
Jaw crusher modular	1	30" x 24"
Cone crusher, modular	1	Tels 44
Ball mill + trommel	1	2,500 HP; 15 ft x 19 ft
Cyclone pack	1	3 x 14"
Vertimill	1	800 HP
Cyclone pack	1	6 x 10"
Centrifuges	2	Single stage
Fines thickener	1	115 ft
Flotation cells	3	250 ft^3
Rejects thickener	1	115'
Rejects filter	2	8 ft x 8 ft
Acidulation tanks	3	7,000 ft^3
Leach thickener/clarifier	2	115 ft
Autoclave	1	14 ft x 65 ft; 425°F; 600 psi
Boiler	2	200 BHP
Oxygen plant	1	300 st/d
Counter-current decant thickeners	1	115 ft
Dewatering centrifuges	3	Two stage
Pregnant leach solution pond	1	36 hours
Ion Exchange Columns	3	Adsorption 11.3 ft; elution 5.5 ft
Multi-media filters	1	Disc
Solvent extraction plant extraction mixer/settler	9	1,500 ft^2
Raffinate pond	1	20 hours
Precipitation tanks	1	4 hours
Product centrifuge	1	Single stage
Calcination	1	600 kW
Product bagging	1	Package
Reagent preparation	3	Modular skids

Description	Quantity	Size
Water treatment plant	1	800 gpm
Plant air compressor	1	100 ft^3/min (cfm)
Acid plant including stockpile, cooling, turbine generator set, acid storage	1	550 st/d

17.3.1 Stockpile and Crushing

The higher-grade mill feed material will be processed during the initial years of the Project, while the lower-grade mineralization will be stockpiled close to the processing plant. The oxide and non-oxide mill feed material will be stockpiled separately. The final five years of operation will be fed exclusively from these lower-grade stockpiles.

Mill feed material will be either dumped directly into the plant feed hopper or withdrawn from the stockpile via a front-end loader to feed a primary jaw crusher. The jaw crusher discharge will be screened and the oversize will be fed to a secondary cone crusher in closed circuit with the sizing screen. The screen undersize will advance to the milling section.

17.3.2 Milling and Classification

The oxide mineralization is friable, and testing has shown that the material breaks down to a slurry in an attrition scrubber. The fine vanadium minerals are liberated from the coarser gangue mineral which provides the opportunity to upgrade the vanadium minerals using particle size classification. Processing the mill feed material through a ball mill is potentially detrimental to recovery by particle size, due to overgrinding of the gangue minerals, so the oxide mineralization will bypass the primary ball mill and report directly to the secondary tower mill, which will be configured to do duty as an attrition scrubber.

The non-oxide mineralization is substantially more competent than the oxide mineralization. The crushed mineralization will feed into a ball mill in closed circuit with a hydrocyclone cluster, classifying the overflow to a P_{80} of 105 µm. The overflow will advance to a tower mill which will be configured as a secondary milling stage.

The tower mill will operate in closed circuit with a hydrocyclone cluster, classifying the overflow to a P_{80} -50 µm. The overflow will advance to a fines classification circuit.

Limited comminution testwork is available at this time. A Bond mill work index of 13.7 kWh/t was used to size the comminution equipment.

17.3.3 Fines Classification

The vanadium minerals are predominantly in the -5 µm fraction and can be concentrated by classifying at a cut point of approximately 8 µm. The gangue minerals, particularly the acid-consuming calcium and magnesium carbonates, are in the coarser fractions. Testing with hydrocyclones showed a vanadium grade improvement in the overflow and a significant reduction in the concentration of calcium and magnesium carbonate minerals. This factor is key to reducing sulphuric acid consumption in downstream acidulation and pressure leach processes. However, a large proportion of the aluminum-bearing minerals reported to the overflow. The leachable species significantly contributed to the overall acid consumption.

The cyclones tested were commercially-available units of 1″ diameter. Each cyclone is capable of processing between 0.68–1.14 m^3/h. The cyclones are typically configured in clusters of 250 cyclones manifolded within a vessel, and are utilized in liquor desanding applications. There is no commercial reference using these cyclones for slurry classification in the minerals industry. The size, number and complexity of the cyclone arrangement present operability and maintainability concerns.

Centrifuges are commonly employed in dewatering and classifying applications and routinely do duty at 5–8 µm cut points in large industrial applications. In addition, centrifuges can be configured to classify on the basis of particle density or particle size. Preliminary testing has demonstrated that centrifuges can be applied in the process as fines classifiers and have thus been used as the preferred classification equipment.

The centrifuges will be configured in open circuit, receiving a conditioned cyclone overflow from the tower mill. The coarse rejects will either be sent to the upgrade tailings circuit in the case of the oxide mill feed type, or carbon flotation in the case of the non-oxide mill feed type. The centrate containing the fines fraction will advance to acidulation.

17.3.4 Carbon Flotation

Flotation testing has demonstrated that the kerogen can be recovered by a single bank of conventional mechanical flotation cells, using emulsified diesel as a collector and

MIBC as a frother. The aluminium-bearing minerals, including the leachable species, tend to follow the concentrate and advance to acidulation and pressure leach.

The carbon flotation circuit will only be operated when the kerogen-containing non-oxide mill feed material is treated. When oxide mineralization is treated, the fines from the classification centrifuges will by-pass flotation and advance directly to the pre-acidulation thickener.

Flotation tailings will report to the tailings circuit.

17.3.5 Acidulation

The centrifuge centrate and flotation concentrate will combine in the feed to the pre-acidulation thickener. The thickener overflow will be used as process dilution water in the comminution circuit, supplemented by water from the plant process water tank. The thickener underflow will be pumped to the acidulation circuit.

The pre-acidulation thickener underflow will combine with the autoclave discharge thickener overflow solution. Energy recovery using flash and splash from the autoclave discharge will be used to heat the slurry fed to acidulation.

As the full acid requirement in acidulation will be met by the residual acid in the autoclave discharge thickener overflow solution, additional acid dosing into acidulation will not be necessary.

The acidulation tanks will overflow to the pressure leach feed thickener where flocculant will be added to the feed. The thickener overflow will advance to the pregnant leach solution (PLS) pond.

Thickener underflow will be pumped to the pressure leach circuit.

17.3.6 Pressure Oxidation

The pressure oxidation feed thickener underflow will pass through a slurry–slurry heat exchanger to recover energy from the second-stage flash slurry discharge.

The autoclave will be a six-compartment vessel, sized at 14 ft internal diameter by 65 ft length, and will operate at 245ºF to a maximum pressure of 600 psi. Concentrated sulphuric acid will be added to the autoclave to maintain a residual acid concentration of 65 g/L in the discharge. Oxygen will be added to maintain a 102 psi oxygen over-pressure.

The oxygen will be an "over-the-fence" supply from a vendor-owned plant.

The operating conditions differ between the oxide and non-oxide mineralization types. The oxide mill feed requires super-heated steam to achieve the operating temperature and pressure, whereas the non-oxide mill feed allows for autothermal operation.

Testing has indicated that approximately 5% of the kerogen oxidizes in the autoclave, which alleviates initial concerns around the high organic carbon content in the autoclave and related safety aspects.

The autoclave discharge will be cooled using a conventional two-stage flash, with flash steam utilized to heat the acidulation feed slurry and maintain elevated temperature in the acidulation tanks. The slurry will pass through a slurry–slurry heat exchanger to recover residual energy to the autoclave feed slurry.

17.3.7 Thickening and Counter-Current Washing

The leached slurry will advance to the pressure oxidation discharge thickener.

The thickener underflow will be pumped through a three-stage decanting centrifuge circuit where the slurry will be washed counter-current with solvent extraction raffinate solution. The centrate from the first centrifuge will combine with the leached slurry feed to the pressure oxidation discharge thickener. The thickener overflow will return to acidulation to recover residual acid.

The final stage centrifuge discharge slurry will be pumped to the tailings circuit.

17.3.8 Ion Exchange

The PLS will be pumped from the PLS pond through a NIMCIX ion exchange extraction circuit to target the extraction of uranium and molybdenum impurities. The vanadium will be in the V^{4+} state and will not be adsorbed onto the strong-base ion exchange resin. The loaded resin will be eluted in an up-flow elution column using a sulphuric acid eluant and returned to the extraction circuit. Batches of eluted resin will be regenerated with dilute sodium hydroxide, sulphated and returned to the extraction circuit. The eluate and spent regenerant will report to the tailings circuit.

The ion exchange raffinate solution will be treated with hydrogen peroxide to oxidize the V^{4+} to V^{5+} ahead of solvent extraction. The oxidation reaction will take place above pH 2.5 so calcium carbonate will be added to the solution for pH control. The solution will be filtered to remove suspended solids and will pass through a heat exchanger for temperature adjustment before reporting to the solvent extraction feed tank.

17.3.9 Solvent Extraction

The extraction circuit will consist of four reverse-flow mixer–settler stages in series. The stages will be operated organic continuous. The extraction raffinate will be recycled back to the counter-current washing circuit as wash liquor. A raffinate bleed stream will be diverted to the tailings circuit.

The loaded organic will advance to a single scrub mixer–settler where the organic will be scrubbed with acidified demineralized water to reduce iron contamination.

The scrubbed organic will advance to three-stage strip mixer–settlers. The third stage mixer–settler will receive recycled ammonium sulphate solution from the precipitation circuit for initial pH change. The second and first stages will have stepped pH adjustment using ammonium hydroxide solution to pH 6.5 in the first stage, stripping the vanadium as ammonium decavanadate. The loaded strip liquor from the first strip stage will advance to the loaded strip liquor tank.

The stripped organic will report to the sulphation tank where it will be contacted with sulphuric acid solution to sulphate the organic. The organic will then be returned to the stripped organic tank from where it will again be pumped to the extraction circuit.

Approximately 10% of the stripped organic will report to a regeneration mixer–settler where the organic will be contacted with sodium carbonate or sodium hydroxide solution to strip and regenerate the organic. The regenerated organic will be transferred to the sulphation tank.

The solvent extraction process flowsheet as designed deviates from the process flowsheet that was used as the basis for the testwork. The testwork flowsheet used sodium carbonate as a strip solution, forming a sodium vanadate strip liquor containing sodium sulphate. The sodium vanadate strip liquor is treated with ammonium sulphate to precipitate ammonium metavanadate.

The ammonium sulphate strip and precipitation process was adopted during the process flowsheet development as it allows for process simplification and potential cost benefits.

17.3.10 Precipitation

The loaded strip liquor will be filtered through a carbon filter to remove entrained organic before being pumped to the ammonium metavanadate precipitation tanks that will be arranged in series.

The first precipitation tank will receive recycled thickener underflow from the ammonium metavanadate (AMV) thickener, which will act as a seed for AMV crystal formation. The pH will be controlled above pH 7 with the addition of ammonium hydroxide, which will convert the soluble decavanadate to the insoluble metavanadate species. The temperature in the precipitation tanks will be elevated and controlled to promote the precipitation reaction.

The precipitate slurry will overflow the final tank to the AMV thickener where the precipitate will settle out. A portion of the underflow slurry will be recycled back to the precipitation stage to act as crystal seeds. The remainder will advance to a centrifuge feed tank where demineralized water will be added to the underflow slurry. The diluted slurry will be pumped through a decanting centrifuge to wash the precipitate. The centrifuge centrate will report to the precipitation barren solution tank for use in the process

The centrifuge solids will discharge to a filtration step to dewater the solids. The filtered cake will advance to the calcination and product handling section. The filtrate will report to the precipitation barren solution tank.

A portion of the precipitation barren solution will be recycled back to the third strip mixer–settler as strip solution. The excess will report to the tailings circuit.

17.3.11 Calcination and Product Handling

The filtered cake will be fed into a multi-hearth furnace that will dry and calcine the AMV under oxidizing conditions to produce vanadium pentoxide. The vanadium pentoxide will discharge from furnace as an oxide melt onto a casting wheel, which will cool and solidify the vanadium pentoxide. The vanadium pentoxide will be removed from the casting wheel, crushed, and bagged in one-ton supersacks.

The discharge gas from the multi-hearth furnace will pass through a gas scrubbing system prior to being vented.

17.3.12 Tailings Management

The tailings neutralisation tanks will receive tailings from the following sources:

- Fines classification tailings
- Flotation tailings
- Counter-current washing slurry
- Ion exchange eluate
- Ion exchange regeneration solution
- Solvent extraction raffinate bleed solution
- Solvent extraction regeneration solution
- Precipitation barren solution bleed.

Calcium hydroxide slurry will be added to the neutralisation tanks to neutralize the slurry before being pumped to the tailings storage facility (TSF). Opportunities to treat and recycle tailings return water have not been explored in the 2020 PEA.

17.4 Energy, Water and Process Materials Requirements

17.4.1 Reagents

The following reagents will be required during the processing operations:

- Sulphuric acid
- Ammonium hydroxide
- Sodium hydroxide
- Calcium hydroxide
- Sodium carbonate
- Calcium carbonate
- Flocculant
- Hydrogen peroxide
- MIBC
- Diesel

- Aliphatic diluent
- Isodecanol
- Alamine 336 extractant
- Oxygen.

17.4.2 Water

Raw water will be sourced from a well-field within the Project boundary and stored in a raw water tank within the process area. The raw water will be used for potable water and process water make-up, and will be demineralized for use in the acid plant, solvent extraction and precipitation.

The raw water requirement is expected to be approximately 660 gpm.

17.4.3 Electrical/Power

The plant will draw an average of:

- 8.7 MW while processing non-oxide feed
- 7.6 MW while processing oxide feed.

Power for the process is assumed to be supplied from a turbine-generator set which will use waste heat from the acid plant in parallel with a new distribution line to be constructed for the Project.

Electrical power requirements for the process area were incorporated in both the capital and operating cost allocations in Section 21 of this Report.

17.5 Comments on Section 17

There are several aspects of the process design that should be investigated as part of metallurgical testing ahead of subsequent study phases, which could have a significant impact on the process design.

- Mineralization upgrade or gangue rejection using cyclones has been applied on projects in the past, albeit at a coarser grind. The ultra-fine grind and the use of centrifuges instead of cyclones in the talc industry is common. Sighting tests suggest that the process should work as intended. Further testing is necessary

- Solid–liquid separation of ultra-fine slurries carries risk in the ability to achieve meaningful thickener and centrifuge slurry densities, and the impact on the selection and sizing of equipment for solid liquid separation processes. Further testing is necessary
- The significant gangue acid consumption points to a high dissolved solids concentration and gypsum saturation, which would likely present challenges in the downstream processes
- Fluoride is present in the mineralization in low concentrations but could nevertheless influence the selected materials of construction considering the high temperature and high acid concentrations in sections of the process.

18.0 PROJECT INFRASTRUCTURE

18.1 Overview

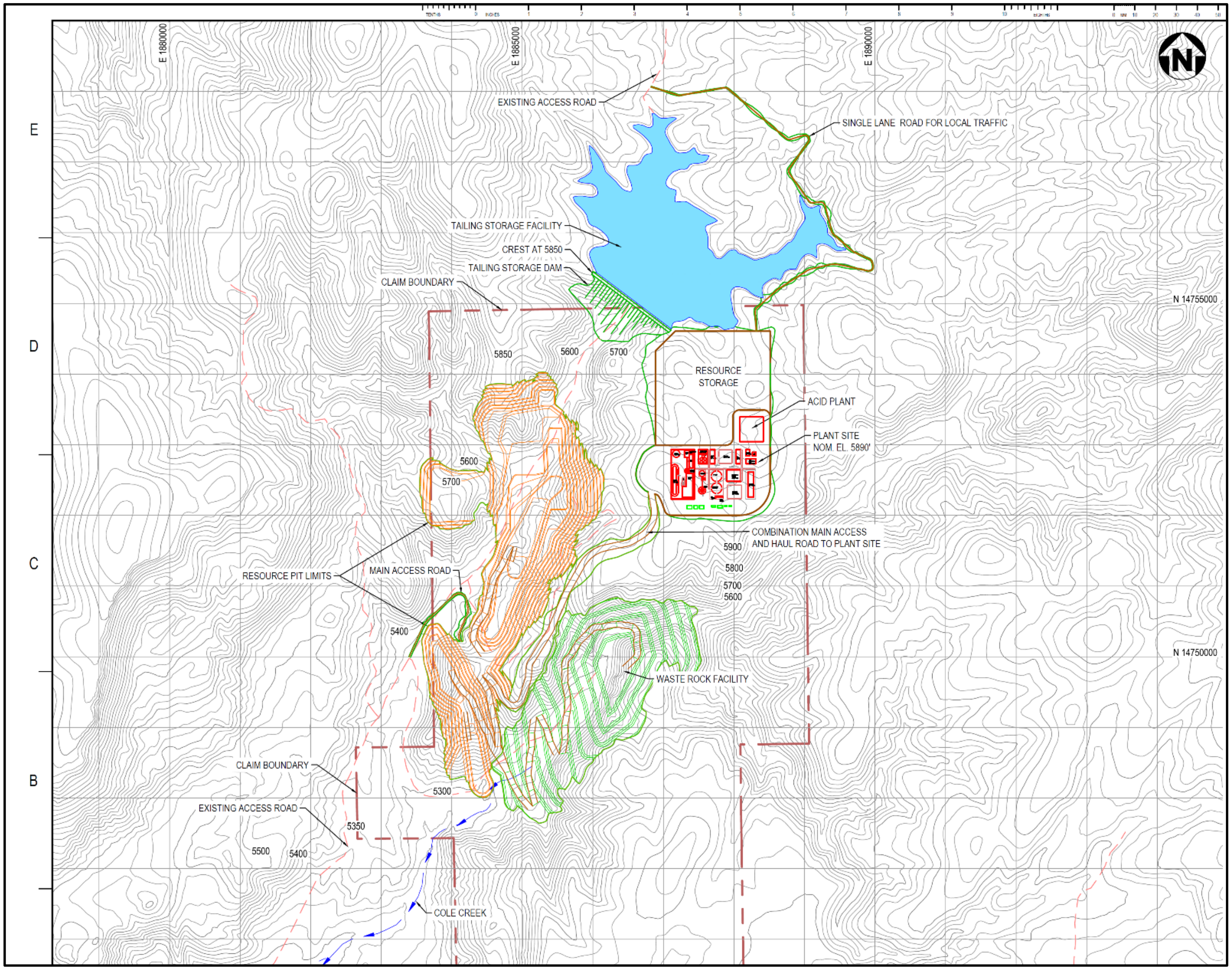
Given the planned small throughput of the open pit mine and processing facility, the infrastructure has been combined and integrated as much as possible.

The infrastructure envisaged in the 2020 PEA for the site includes:

- One open pit
- Processing facilities: grinding/classification and extraction (POX, ion exchange, solvent extraction, precipitation) process areas; stand-alone sulphuric acid plant including acid storage; contracted oxygen plant
- Mining facilities: the truck workshop, wash bay, explosives storage facility, diesel storage and distribution
- Administration facilities: combined mine and process offices will be provided for administration, management and engineering; change house; workshop; and warehouse
- Assay laboratory: will handle both mine sampling and process sample assays
- Gatehouse complex: a single gate house, first aid facility and induction and training facility will cater for the whole site.
- Haul roads and commercial vehicle access roads
- Mineralized material stockpile
- WRSF
- TSF
- Water management facilities: stormwater and water diversions, culverts
- Well field for fresh water supply
- Sewage and gray water treatment facility
- Hazardous waste handling facility
- Incoming power supply and acid plant with turbine generator set.

An infrastructure layout plan is provided in Figure 18-1.

Figure 18-1: Conceptual Infrastructure Layout Plan



Note: Figure prepared by Wood, 2020.

18.2 Introduction

Infrastructure to support the Project will consist of site civil work, site facilities/buildings, a water system, and site electrical. The site civil work includes designs for the following infrastructure:

- Light vehicle and heavy equipment roads
- Stormwater diversion channels
- Growth media stripping and stockpiling
- Process plant facility foundation
- TSF and associated seepage collection pond
- WRSF
- Mineralized material stockpile foundation.

Site facilities will combine both mine and process facilities:

- The mine facilities will include the main office building, truck shop and warehouse, truck wash, fuel storage and distribution, and miscellaneous facilities
- The process facilities will include the process office building and assay laboratory, process buildings for the pressure oxidation, centrifuging and filtration and precipitation process areas and the product storage building
- Both the mine facilities and the process facilities will be serviced with potable water, fire water, power, communication, and sanitary systems.

18.3 Site Infrastructure

The key facilities required in support of the mining and processing operation include:

- Main office building for the general and administrative (G&A), supervisory and technical staff
- Truck shop sized for 50 t haul trucks with truck wash
- Fuel storage and distribution
- Warehouse and workshop
- Changerooms

- Gatehouse, first aid and training
- Analytical laboratory
- Miscellaneous facilities: hazardous waste storage pad, and explosives storage facility.

18.4 Road and Logistics

Access to the site will be provided by a light vehicle road from highway 278 approximately 1.5 miles south of the Project area. This route will provide the main access to the site.

Internal site roads will include:

- North–south private ranch track. As the proposed pit lies directly on the existing ranch track access, a through route will be maintained using the plant access road and a track will be constructed around the eastern edge of the process plant and tailings impoundment, to link up with the existing ranch track on the northern end of the Project area
- Haul road/commercial vehicle access road from the pit to the process plant and the plant feed stockpile area. This road will have separately bermed lanes for haul and commercial traffic.
- Haul road from the pit to the WRSF.

18.5 Camps and Accommodation

All mine personnel are expected to commute from Carlin or other towns located in the region. No onsite camps or accommodations are anticipated.

18.6 Stockpiles

Stockpiles are discussed in Section 16.6 and Section 20.3 of this Report.

18.7 Waste Rock Storage Facilities

Aspects relating to the WRSF are discussed in Section 16.5, Section 16.8, and Section 20.4 of this Report.

18.8 Tailings Storage Facility

The TSF is discussed in Section 20.5 of this Report.

18.9 Water System

The water supply source for future operations has not yet been positioned on the site.

The pit is not expected to require dewatering as the water table is below the expected pit base.

An initial hydrology report indicates that 1,750 gpm of water is available from sub-surface waters. The Project as envisaged requires approximately half of this quantity for the process plant and dust control. The process plant design assumes an average water requirement of 660 gpm, of which 40 gpm would be potable, and the remainder non-potable.

A plant process water make-up and the fire system will share a single steel tank with the fire water being supplied from the lower portion of the tank. A reverse osmosis and demineralizing plant will supply the specific needs of the process and acid plants from the process water make-up tank.

18.10 Power and Electrical

The local power supply company Nevada Energy has confirmed that sufficient power (estimated at 12 MW) is available, and that the planned mine lies within their existing service territory.

The closest circuit would be the 120 kV circuit in the town of Carlin. The supply to the proposed mine will require the construction of a 120 kV switching station and a 9–10-mile-long line extension to the mine site. This line would largely follow the existing ranch access road, which connects the Project site to the southern area of Carlin.

The sulphuric acid plant will be equipped with a steam turbine generator set which is expected to generate up to 8 MW from the waste energy produced during the acid production process. This will be sufficient to power the majority of the plant. There is also an opportunity to supply excess power to the grid when the plant demand is lower than the steam production rate. Conversely, when insufficient steam is being produced by the acid plant, the overall demand will be topped up from the grid.

Given the two potential sources of power, it is not considered necessary to provide additional emergency diesel generation on site.

A new step down/up substation will be constructed on site and will distribute power to the operation at 11 kV.

Electrical rooms would be distributed around the site and located as close as possible to the major electrical loads. Process control for the plant would use a network of programmable logic controllers and human-machine-interface (HMI) equipment. The degree of instrumentation would be sufficient to ensure safe operation of the plant and efficient control of the process using a minimum number of operators.

Local uninterruptible power supplies (UPSs) would ensure continuity of supply to the process control and safety aspects of the operation.

18.11 Comment on Section 18

The 2020 PEA assumes development of conventional infrastructure.

19.0 MARKET STUDIES AND CONTRACTS

19.1 Market Studies

19.1.1 Vanadium

First Vanadium sourced a vanadium market study and update by Roskill Consulting Group Ltd (Roskill) to understand vanadium's uses, global and country-by-country supply and demand, pipeline of projects, market outlook and their price forecasts.

Vanadium is critical and strategic metal as an alloy primarily for infrastructural steel. As an infrastructural alloy it is used in rebar for buildings and bridges, pipelines, long-range aircraft bodies, jet engines, and car frames. A small amount of vanadium added to steel lightens steel and provides strength and corrosion and heat resistance, thus making end products safer for its added strength and lighter weight thus more fuel-efficient in transport applications.

Vanadium is a strategic element for utility-scale battery storage technology as an electrolyte. Currently, about 5% of vanadium is used in growing green technologies which started to commercialize in 2017. Roskill (2019b) expects a growing market for vanadium is utility-scale battery vanadium redox flow battery (VRFB) storage arrays for power companies (peak load shift), micro-grids, marine vessels, wind and solar applications, and back-up power. The VRFB has many positive attributes over lithium ion batteries in large energy storage applications. By using only vanadium, there is no cross-contamination of battery materials, resulting in a battery lifespan of 25^{+} years. VRFBs are scalable, can rapidly or slowly release large amounts of electricity, are non-flammable and extremely safe, can be quickly charged and discharged at the same time, and the vanadium electrolyte is reusable.

China is projected by Roskill (2019a) to account for most of the future vanadium demand. The predicted vanadium supply and demand to 2028 is provided as Figure 19-1.

19.1.2 Sulphuric Acid

Wood completed a trade-off study to evaluate acid purchased from a third party over the LOM versus construction of a dedicated acid plant fed with imported prilled elemental sulphur.

Figure 19-1: Vanadium Supply and Demand (2010–2028)

Note: Figure from Roskill, 2019a.

The additional operational complexity associated with the acid plant was found to be an acceptable trade-off when compared to the short payback period of the acid plant option. There were also annual costs saving relative to the acid import option and the onsite plant mitigated any potential difficulties that could arise when procuring and transporting acid.

Acid consumption is not fixed over the LOM, and is averaged on an annual basis in the economic analysis in Section 22. In actuality, there may be months where the acid plant cannot meet the acid requirements of the process plant, and the acid deficit would need to be met through third-party purchase. Conversely, there may be months where the acid plant produces excess acid, superfluous to process plant requirements. The excess acid would be on-sold to a third party.

19.1.3 Electricity

Some of the power requirements for processing will be generated from a turbine-generator set which will use waste heat from the acid plant in parallel with a new distribution line to be constructed for the Project. The turbine is in deficit throughout the life of the mine with power being imported. However, in the last four years of the projected operating life, the turbines produce excess power, superfluous to operational requirements. The excess power would be on-sold to a third party.

On-selling of power into the electrical grid is possible without any additional capital expenditure, because the process plant will already have a connection to a Nevada power supplier.

19.2 Commodity Pricing

19.2.1 Vanadium

Historical Vanadium Pricing

The vanadium market saw deficits and resulting price increasing in 2016 attributed to changes in supply, with some South African mines being closed or put on care and maintenance, as well as with increases in demand. The prices ramped up in 2018 as China implemented stricter environmental regulations putting pressure on supply, and, set deadlines for improved rebar quality standards for Chinese steel producers, which required more vanadium consumption. As the industry absorbed the recent changes to the supply and demand, prices stabilized in the first half of 2019 but have softened since due to a weaker macroeconomic environment. The implementation of the new Chinese rebar standards has been slow, and although environmental regulations are supposed to be strict, Roskill understands that some smaller producers may not comply (Roskill, 2019a, 2019b).

Roskill Vanadium Price Projections

Roskill (2019a) noted that vanadium price forecasting was particularly challenging due to a combination of the higher prices seen in 2018, the pricing being a combination of fundamentals and speculation, and uncertainty over the Chinese rebar regulations. Roskill (2019a) stated that the 2018 pricing was not likely to be sustainable over the longer-term, due to changes in market certainty, medium-term supply responses from new projects, and vanadium substitution by other elements such as niobium. However, Roskill also believed that the market was in structural deficit, which would support a period of higher prices.

With further adoption of the new quality construction steel standards in the near term in China and its environmental regulations enforced, as well as vanadium redox flow battery uptake adopted more widely, it is anticipated that vanadium prices will return to a range of US$8.30–US$12.20/lb V_2O_5 in the short term (Roskill, 2019a, 2019b).

Modelled on its supply and demand expectations, Roskill provided a range of vanadium price forecasts for the period 2019 to 2028 (Roskill, 2019a). From tight supply and considerable increased demand, a deficit in the vanadium market is anticipated until the mid-2020s. By 2025, new project development may add to supply if vanadium "incentive pricing" is experienced. Roskill's probabilistic pricing forecasts for vanadium pentoxide to 2030 are provided in Figure 19-2.

Vanadium Price Forecast in Support of 2020 PEA

Wood completed a targeting study that reviewed spot vanadium pentoxide prices, and vanadium pricing in publicly-available reports on vanadium projects.

The review of spot pricing in Europe and China covered the period February 2015 to January 2020. The chart of three-year trailing pricing, which averaged US$12.36, is shown in Figure 19-3, and is clearly strongly affected by the price peak in 2018. Figure 19-4 is a chart that shows the five-year trailing pricing, which averaged US$8.96, with the 2018 peak ameliorated by the lower pricing in 2015–2016.

Table 19-1 summarizes the vanadium pricing used in publicly-available reports on a number of global vanadium projects. These show a range of pricing from US$5.50–US$15.00 (US$/lb) for Mineral Resource estimation and cashflow forecasting.

Price Selection

Wood and First Vanadium reviewed the Roskill and publicly-available pricing data, and selected a long-term price forecast of US$10.65 per pound of V_2O_5 sold as an appropriate target metal price for the economic analysis. This price selection is bracketed by the peak and low of the five-year trailing average, by the pricing used by peers in publicly-available studies, and by the pricing forecast probabilities from Roskill.

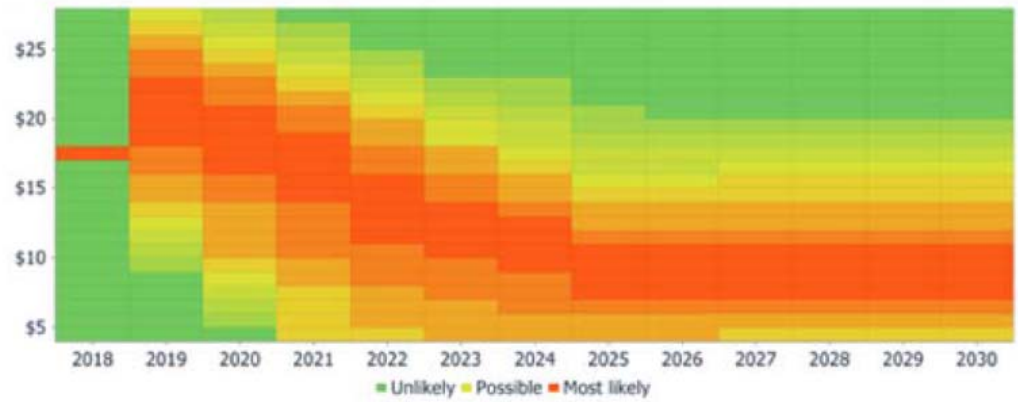
19.2.2 Sulphuric Acid

For the purposes of the economic model in Section 22, Wood assumed:

- Sulphuric acid purchase price: US$144/st
- Sulphuric acid selling price: US$104/st.

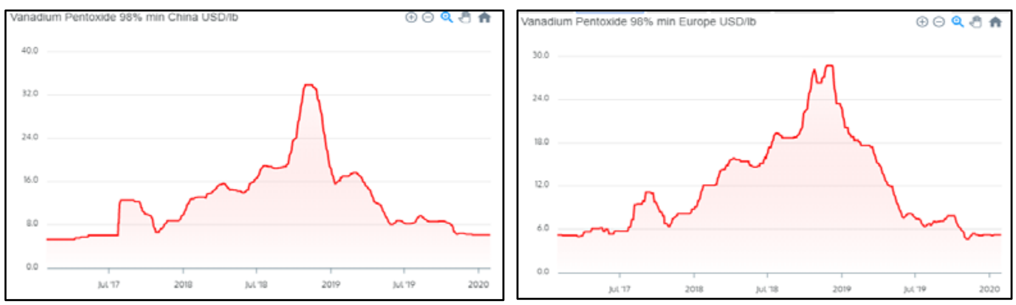
Wood has assumed sulphur prill costs of US$178/st, on a delivered to site, freight-on-board Los Angeles or San Francisco basis.

Figure 19-2: Probabilistic Vanadium Pentoxide Pricing, 2018–2030 (US$)



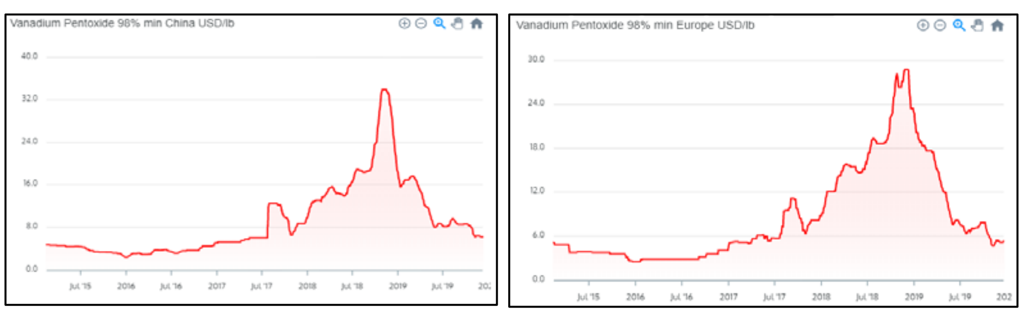
Note: Figure from Roskill (2019a).

Figure 19-3: Three-Year Trailing Average Spot Pricing (US$)



Note: Figure from www.vanadiumprice.com, 2020. Left = China; right = Europe.

Figure 19-4: Five-Year Trailing Average Spot Pricing (US$)



Note: Figure from www.vanadiumprice.com, 2020. Left = China; right = Europe.

Table 19-1: Vanadium Pricing, Global Vanadium Projects

Resource Price (US$/lb)	Cashflow Price (US$/lb)	Year	Country	Company	Project
15.00	15.00	2019	Argentina	Blue Sky Uranium	Amarillo Grande
8.67	8.67	2019	Australia	Australian Vanadium	Australian Vanadium
10.82	10.82	2019	Australia	Technology Metals	Gabanintha
11.50	11.50	2019	Australia	TNG Limited	Mount Peak
6.34	6.34	2017	Brazil	Largo Resources Ltd.	Maracas Menchen
5.50		2017	Canada	Vanadiumcorp Resources	Lac Dore
14.00	7.50	2020	Canada	VanadiumOne Iron Corp	Mont Sorcier
10.81	10.81	2017	USA	Prophecy	Gibellini
14.64	12.63	2018	USA	Prophecy	Gibellini

19.2.3 Electricity

Nevada Energy advised Wood that a realistic power supply cost from an existing power provider to a mining operation in northern Nevada would be about US$0.05/kWh/hr. Given that the residential rate in Nevada is US$0.08/kWh, Wood assumed for 2020 PEA purposes that supply into the existing grid of a Nevada power supplier from the Project turbines would attract a payment of about US$0.05/kWh/hr.

There may be some minor upside potential for the operating cost estimate if the electricity that will be generated by First Vanadium’s activities can qualify for a green energy bonus. The energy generation is carbon neutral.

19.3 Contracts and Off-take Agreements

19.3.1 Vanadium

First Vanadium’s expectation is that the company will rail bagged product to US-based consumers, primarily to the steel industry on both east and west coasts, and master alloy companies. However, due to the early stage of development, no rail or port contracts have been made. No off-take agreements are in place. There may be potential to supply vanadium battery manufacturers, but no testwork has been undertaken to determine if this provides an opportunity for the Project.

First Vanadium expects that the eventual terms, rates or charges that will be associated with contracts when they are concluded, will be within industry norms for a relatively non-freely traded commodity such as vanadium.

19.3.2 Sulphuric Acid

First Vanadium has had initial discussions with acid providers in the Carlin area, and these providers could meet projected supply shortfalls and would be able to purchase excess acid production. The discussions indicate that that Nevada acid market is volatile, and commodity-cycle dependent, but does have long-term potential.

First Vanadium has had initial contact with suppliers of prilled sulphur.

No contracts have been entered into. First Vanadium expects that the eventual terms, rates or charges that will be associated with contracts when they are concluded, will be within industry norms for relatively non-freely traded commodities such as sulphuric acid and prilled sulphur supply.

19.3.3 Electricity

No contracts have been entered into for the supply of electrical power. First Vanadium expects that the eventual terms, rates or charges that will be associated with contracts when they are concluded, will be within industry norms for supply of electrical energy in Nevada.

19.3.4 Other Contracts

No mining, concentrating, smelting, refining, transportation, handling, sales and hedging, and forward sales contracts or arrangements are in place.

19.4 Comments on Section 19

Market studies for vanadium are based on information sourced from Roskill reports in 2018 and 2019.

Wood and First Vanadium reviewed the Roskill and publicly available pricing data, and selected a long-term price forecast of US$10.65 per pound of V_2O_5 sold as an appropriate target metal price for the economic analysis. This price selection is considered to be reasonable as it is bracketed by the peak and low of the five-year trailing average, by the pricing used by peers in publicly-available studies, and by the pricing forecast probabilities from Roskill. Vanadium pricing is volatile, and there is a risk that the vanadium price will be lower than that envisaged in the 2020 PEA. Conversely, there have been historical periods where the vanadium price has been higher than that used in the 2020 PEA, and this is a potential Project upside if similar pricing highs occur during operations. The Project sensitivity to the vanadium price is evaluated in Section 22.5.

The sulphuric acid and sulphur prill pricing used by Wood for the 2020 PEA is based on discussion with US based suppliers who supply into the Nevada market and who have internal forecasts as well as access to global likely long-term sulphur and acid supply and demand. Sulphur is largely generated from the oil and gas industry and is dependent on the quality of the oil feedstock.

The electricity price forecast is based on the residential rate in Nevada. Future pricing may be driven higher or lower, depending on the impacts of consumer sentiment for power providers to move away from fossil fuels as a source, or by future regulatory requirements for providers to have a mix of generating technology.

Wood recommends that First Vanadium retain specialist marketing consultants to provide a more robust sulphur and sulphuric acid market overview and pricing forecasts, and to provide better definition for long-term electricity price forecasts to support more detailed studies.

No mining, concentrating, smelting, refining, transportation, handling, sales and hedging, and forward sales contracts or arrangements are in place.

20.0 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

20.1 Introduction

The Project is located in Elko County, Nevada on a combination of private land and public land administered by the BLM Tuscarora Field Office.

First Vanadium, under its subsidiary of Copper One, filed an NOI in November 2017, with the reclamation bond approval provided by the BLM on December 8, 2017. First Vanadium contracted EM Strategies to prepare a PoO for additional exploration activity with a proposed disturbance of up to 100 acres, which would occur in phases. The proposed exploration area identified in the PoO is limited to Section 34, Township 32 North (T32N), Range 52 East (R52E) and Section 4, T31N, R52E. This PoO was prepared in June 2019 and submitted to the BLM in May 2020. Approval of the PoO is pending completion of NEPA compliance.

20.2 Environmental Considerations

20.2.1 Completed Baseline Studies

The 2018 surveys included vegetation community and habitat assessment, noxious weeds, wildlife, special status species, and Nevada Natural Heritage Program (NNHP) habitats and sensitive species. Additional sensitive species surveys were completed for burrowing owl, bats, pygmy rabbit, Merriam and Prebles shrews, greater sage-grouse and leks, and springsnails.

The survey report also discussed the impacts the August 2018 County Line Fire had on the Project area, as this fire burned approximately 91% of the Project area.

In addition to baseline surveys, eagle and raptor surveys were conducted in 2018 for the Project area and included a four-mile buffer around the Project area.

One additional threatened and endangered species, the grey wolf, has been added to the register of species that require baseline studies since the Project baseline surveys were completed.

A cultural resources survey was conducted in support of the PoO modification in April 2019.

20.2.2 Additional Baseline Studies

Likely Study Requirements

Studies that will likely require data collection for a proposed mining operation include, but not limited to, the following:

- Paleontological resources
- Native American coordination and consultation
- Visual resources
- Recreational resources
- Social and economic values
- Environmental justice
- Air quality
- Noise
- Noxious weeds, invasive and non-native species
- Grazing management
- Forests and rangelands
- Floodplains
- Water quality
- Wetlands/riparian zones
- Wildlife
- Threatened and endangered species
- Special status species
- Migratory birds
- Wild horses and burros
- Human health and safety
- Wastes, hazardous or solid
- Mining law administration

- Geology and minerals.

Biological Resources

EM Strategies completed the baseline biological studies for the exploration PoO prepared and submitted to the BLM in June 2019. The baseline study includes results for vegetation community survey, ecological site assessment, special status plant survey, noxious weed survey, general wildlife habitat inventory, and special status wildlife species survey, and effects of the County Line Fire.

Cultural Resources

Following the submittal of a final cultural survey report and addendum, the BLM archaeologist and the State Historic Preservation Office (SHPO) will make a determination on the eligibility status of the cultural sites documented within the Project for listing on the National Register of Historic Places (NRHP). Additional surveys and/or testing may be needed to determine eligibility status of cultural sites.

Following the determination of the eligibility status and concurrence with the State Historic Preservation Office (SHPO), if the eligible cultural sites cannot be avoided by Project activities, these sites will likely require mitigation, which may include data recovery. The above steps are required to be in compliance with Section 106 of the National Historic Preservation Act of 1966 (NHPA).

Surface Water Resources

EM Strategies used US Geological Survey data and field observations to prepare a surface hydrology map for the baseline report. Cole Creek is identified as an intermittent stream, and a number of other ephemeral streams were identified in the USGS data and from field observations. Three springs were mapped, including one spring identified on the USGS data and two unmapped springs. No formal Waters of the US or wetland surveys appear to have been completed.

No water quality data were available or reported from the United States Geologic Survey on the one identified spring in the basin. No samples for water quality were collected during the baseline survey in 2018.

Ground Water Resources

A technical memorandum was generated by Donahoe Hydro-Geo of Reno Nevada, which contains a copy of the Mining Questionnaire presented to the Nevada Division of Water Resources.

The conclusions reached in the technical memorandum read as follows:

- Preliminary results from the committed resource assessment and a Glover–Balmer analysis indicate that the proposed use of groundwater is likely to temporarily meet the statutory criteria and the chances of a permit being granted are favorable.
- Where encountered, groundwater has been below the mineralization, and dewatering is not anticipated to be necessary
- The required water volume of 1,750 gpm would not cause pumping or consumption of groundwater to exceed the perennial yield from the basin
- The preliminary plant water balance shows that less than half this volume of make-up water would be required.

Groundwater depth and water quality will be required for both the Water Pollution Control Permit application and for NEPA compliance.

Geological and Geochemical Considerations

Overall, materials characterization provides an assessment of the potential geochemical behavior of the mined rock material as mill feed material, used as backfill, placed in surface waste rock storage areas or rock that will remain exposed in the pit walls. These materials will come in contact with direct precipitation, run-off, and infiltration. No information was provided regarding the geochemical composition of the mineralization or waste rock.

Industry-standard, BLM, and NDEP specific indices are used as indicators of potential acid-rock drainage (ARD) based on sulphur (sulphides) and carbon (inorganic) speciation. Typically, static test results for ARD are used to indicate potential ARD materials that warrant further confirmatory testing and longer-term kinetic testing.

Waste rock is currently defined by recoverable mineral cut-off grade. Samples collected during exploration drilling are expected to be tested for acid-generating potential (AGP) and acid-neutralizing potential (ANP). In addition, tailings material is also anticipated to be tested for AGP and ANP.

Environmental Considerations/Monitoring Programs

No environmental monitoring programs associated with the proposed exploration project or future mining project were identified as at the Report effective date. Once final designs are completed, various waste rock management, surface ground water monitoring and other monitoring/sampling programs will be implemented.

Monitoring programs will be developed based on requirements of the regulatory agencies and the associated permits/approvals issued by those agencies. Some of the major permits required would include:

- Water Pollution Control Permit (WPCP)
- Reclamation Permit
- Air Quality Operating Permit
- NEPA Record of Decision
- Various other federal, state and local permits and approvals.

Reclamation bonds associated with the reclamation permit must be reviewed and updated every three years to assess adequacy of the bond to cover current reclamation costs.

Plan of Operations Considerations

In addition to NEPA compliance, numerous federal, state and local permits and approvals will need to be obtained prior to the start of operations. A list of permits and approvals that may be needed are provided in Table 20-1. This table does not include NEPA compliance as that has been identified above.

Table 20-1: Required Environmental Permits

Permit	Regulatory Agency	Status	Notes
Road access on BLM administered land	BLM	Unknown	Likely approved through the NEPA process.
Endangered Species Act compliance	US Fish and Wildlife Service	Partial, baseline surveys conducted for exploration activity. No Federally threatened or endangered species were discovered; however, one species has been added since the 2018 surveys. Additional survey data likely needed with implementation of a mine POO.	New species added since 2018 survey.
Clean Water Act 404 Permit	United States Army Corps of Engineers	Not currently needed for exploration activity as streams, springs, seeps, and wetlands will be avoided. With development of a mine, permitting through the USACE would likely be required.	Current 2018 baseline survey area did not identify any wetland areas. Impacts to drainages with implementation of a mine would likely require a 404 dredge and fill permit.
Air quality operating permit	Nevada Division of Environmental Protection, Bureau of Air Pollution Control	Not needed for exploration activity but will be required for mining operation.	Required prior to construction or operation.
Water pollution control permit	Nevada Division of Environmental Protection; Bureau of Mining Regulation and Reclamation	Not needed for exploration but will be required for mining operations.	Will be needed for mining and processing activities prior to development and operation.
State groundwater permit	Nevada Division of Environmental Protection	Would be required if using groundwater for a source of process water or for dewatering of the pit.	Prior to Construction
Mining reclamation permit	Nevada Division of Environmental Protection; Bureau of Mining	Will require this permit for mining operations, which will include calculation	A bond is currently in place for exploration activity but will

Permit	Regulatory Agency	Status	Notes
	Regulation and Reclamation	and submittal of a reclamation bond.	require additional permit for mining operation.
Hazardous waste management permit and EPA identification	Nevada Division of Environmental Protection: Bureau of Waste Management	May be needed for mining operations. The mine currently has a detailed Hazardous Waste Management Plan that follows all federal, state and local laws regarding handling, storing, and transporting waste materials.	Prior to construction of facility for management or recycling of hazardous waste as identified by NAC 444.8850
NPDES permit	Nevada Division of Environmental Protection: Bureau of Water Pollution Control	Likely not needed unless discharging process water to a Waters of the US or state water.	If operated as a no discharge facility an NPDES would not be required
Stormwater NPDES general permit	Nevada Division of Environmental Protection: Bureau of Water Pollution Control	Will be required for mining operation.	Prior to land disturbing activity.
Temporary discharge permit	Nevada Division of Environmental Protection: Bureau of Water Pollution Control	Likely not applicable to a mine operation.	May be issued for a maximum of 180 days, at which time a Permanent Discharge Permit is required.
Groundwater discharge application for reclaimed water use	Nevada Division of Environmental Protection: Bureau of Water Pollution Control	Likely not needed unless discharging water to a groundwater table.	Prior to discharge of reclaimed water.
Underground injection control permit	Nevada Division of Environmental Protection: Bureau of Water Pollution Control	Likely not applicable.	Prior to Injection to groundwater.
Permit to appropriate the public waters	Nevada Division of Water Resources	Likely not be applicable.	Needed if surface water will be diverted
Protection of wildlife, artificial pond permit	Nevada Department of Wildlife	If constructing and using process ponds including tailings storage facility, the artificial pond permit from NDOW will be required.	Method (netting, fencing, bird balls, etc.) to exclude access to ponds is required if water is considered harmful to wildlife

Key Environmental Issues

Although no key environmental issues have been identified at this stage in the permitting and planning process, several special status species were observed within or near the project area. These included burrowing owls, raptors, several bat species and greater sage-grouse, all of which could result in environmental issues during the permitting process. The agency scoping and preparation of the NEPA document will include the identification of issues that will guide the analysis to appropriately address any concerns or questions that may arise in relationship to the implementation of the proposed action.

20.3 Stockpiles

A low-grade stockpile area holding approximately 4 Mst will be located adjacent to the processing plant. This stockpile will be built up throughout the life of the mining operation and then processed in the final four years of operation. The underlying ground will be built up and sloped such that run-off will be routed towards the TSF and seepage would move towards the open pit.

20.4 Waste Rock Storage Facilities

A WRSF will be established in the Cole Creek valley adjacent to the open pit (refer to Figure 18-1). A drain, running the full length of the facility and consisting of large boulders, will be built in the natural low point of the valley to channel any stormwater under the WRSF.

The WRSF was designed with the expectation that the waste rock and tailings stored in the WRSF do not have the potential to generate acid, or to leach contaminants. The design will need to be revised if this is not the case.

20.5 Tailings Storage Facility

A conceptual location for the TSF was selected north of the pit (refer to Figure 18-1) for the purposes of the 2020 PEA, and is planned to contain 11 years of tailings from the processing plant. The conceptual site is located upstream of the pit, at the head of the valley in which the pit is located. This conceptual location helps to minimize both the Project footprint and the catchment reporting to the TSF, thereby facilitating water management. The Cole Creek valley was also considered for the TSF, but that location would have had a bigger impact on existing streams, and First Vanadium also expressed a preference to locate the WRSF in the Cole Creek valley. The TSF will be a cross-valley impoundment, with the tailings being stored in the valley upstream of an embankment constructed across the valley.

The final four years of plant operation will discharge tailings into the open pit.

The mine will produce two tailings streams:

- Coarse upgrade tailings fraction that is high in acid-consuming minerals, which will be removed during the upgrading of the mineralized stream prior to the mineralized stream being processed through the recovery plant. This stream will be co-disposed with the waste rock after dewatering
- Fine tailings from material that is will be processed through the recovery plant and blended with the fine fraction of the upgrade tailings. This will be deposited in the TSF and in the open pit.

These two tailings streams will have different geochemical and physical properties, and the tailings deposition plan has been developed to optimize the deposition of both streams.

Wood proposes that the following tailings disposal strategy be followed:

- The conventional TSF would be used for the storage of fine tailings during the first 11 years of operation, when the pit is being mined. This will accommodate all the fine tailings from the recovery plant and 50% of the fine fraction of the upgrade tailings generated over this period
- In-pit disposal of the fine tailings during the last four years of operations when the pit is no longer being mined, and stockpiled material is being processed. This will accommodate all the fine tailings from the recovery plant and 50% (the fine fraction) of the upgrade tailings generated over this period
- Co-disposal (after dewatering by filtration) of 50% (the coarse fraction) of the upgrade tailings with the waste rock in the Cole Creek valley during the first 11 years of operation. Disposal of this portion of the upgrade tailings will be on top of the WRSF after mining is finished in year 11, and waste rock is no longer being produced.

The conceptual TSF design has been prepared using the expected subsurface conditions, embankment fill materials that are expected to be available, water and tailings storage requirements and the expected physical characteristics of the tailings. The design includes the following features:

- A rockfill/earthfill embankment with an upstream, low-permeability, clay-core zone, underlain by filters and transition zones, and a blanket drain to control the phreatic surface
- Staged construction of the TSF, with the first stage providing sufficient volume to store one year's worth of fine tailings storage, and subsequent raises every year
- Downstream constructed embankment to maximize stability
- Storage capacity for all recovery plant fine tailings and 50% (the fine fraction) of the upgrade tailings generated over the first 11 years of mine life. After year 11, mining in the pit will stop and the mine will process stockpiled material for the remaining four years of mine life, with fine tailings being disposed of in the mined-out pit during that time.

The tailings are expected to be benign, and at present there is no plan to line the TSF basin. Additional geochemical characterization will be required to verify the assumption that the tailings are benign. Seepage collected by the embankment drainage system will be conveyed to a HDPE-lined seepage pond located downstream of the TSF from where it will be pumped back to the TSF.

20.6 Water Management

As far as possible, non-contact water will be diverted past mining operations and released downstream of mining operations.

The TSF will be located in the upper regions of the valley, with a very small upstream catchment. Precipitation falling on the TSF and in the upstream catchment will be contained in the TSF and used in the process plant.

A rock drain will be constructed at the base of the WRSF, in the valley low point, to allow the non-perennial stream in the Cole Creek valley to drain below the WRSF. This water will be released downstream of the WRSF. The waste rock is expected to be non-acid generating and to not have potential for the leaching of heavy metals or other contaminants of interest. No containment of this seepage water is therefore planned at this stage of the Project, as discharge is expected to meet water quality requirements. Additional geochemical characterization will be required to verify that the waste rock and tailings stored in the WRSF are benign, and the facility design will need to be revised if the geochemical characterization indicates elevated levels of contaminants of interest that could be leached, or if there is the potential for ARD to be generated.

Best management sediment control practices (BMPs) will be deployed downstream of the WRSF to manage sediment. If necessary, a sediment pond will be constructed to manage sediment, but it is expected that BMPs will be sufficient. Stormwater collected in the pits will be pumped to the TSF from where it will be pumped to the plant for use in the process.

20.7 Closure Considerations

First Vanadium will need to meet BLM objectives for post mining land uses, which will likely include mineral exploration and development, livestock grazing, wildlife habitat and dispersed recreation.

Following closure, the Project area will need to support multiple land uses, such as mineral exploration and development, livestock grazing, wildlife habitat, and recreation. First Vanadium will work with the agencies and local governments to evaluate alternative land uses that could provide long-term socioeconomic benefits from the mine infrastructure. Post-closure land uses will be in conformance with the BLM Elko Resource Management Plan and Elko County Land Use Plan.

Because neither the PoO for the mining operation nor the NEPA process have been initiated with the BLM, reclamation bonding estimates have not been completed or approved by the authorizing agencies (BLM and NDEP). Key aspects of the future reclamation plan would include the following:

- Long-term goals for reclamation of exploration and mining disturbances are to:
- Ensure public safety
- Stabilize the site
- Establish a productive vegetative community based on the post-exploration and mining land uses of selected wildlife habitat, domestic grazing, dispersed recreation activities, and mineral exploration and development.

With these goals in mind, reclamation activities are designed to:

- Stabilize the disturbed areas to a safe condition
- Protect both disturbed and undisturbed areas from unnecessary and undue degradation.

As much as practicable, concurrent reclamation will be practiced during operations. Reclamation will consist of recontouring disturbed areas to return those areas to near pre-disturbance topography. Disturbed areas will then be seeded with a BLM-approved seed mix.

First Vanadium will be required to submit updated reclamation plans and surety estimates based on requirement of the BLM and BMRR. In addition, as part of the Water Pollution Control Permit application, First Vanadium will be required to submit a plan for temporary closure due to planned or unplanned conditions described in NAC 445A.444. These conditions include planned seasonal closure, planned periods of interruption of active beneficiation or operation, closure due to unforeseen weather events, system component failure, or stoppage of facility operation due to litigation. A Tentative Permanent Closure Plan (TPCP) will be required as part of the WPCP application. This plan must include the following:

- Procedures for characterizing spent process materials
- Procedures to stabilize process components
- Estimated cost for the procedures.

Based on the conceptual mine plan, closure costs are estimated by Wood to be US$30 million. This assumes a mine life of 16 years and production rates of approximately 1 Mst per year. The total disturbed area of the mine, tailings impoundment, waste rock facility, stockpile, processing plant and roads is estimated at 540 acres.

20.8 Permitting Considerations

20.8.1 Permit Requirement Assumptions

The review of permit requirements for the project assumes the specific development scenario outlined in this PEA which is based on the following assumptions:

- New project activities would occur on unpatented claims and public lands administered by the BLM
- NDEP concurs that the Project can be operated and closed in a manner protective of human health and the environment.

20.8.2 Permitting Requirements

Anticipated environmental and other permits associated with the proposed project would include those identified in Table 20-2. The permits with the longest lead times are discussed individually in the following subsections.

BLM Plan of Operations and NEPA Compliance

Prior to commencing any mining operations on public lands administered by the BLM, a PoO must be submitted to the BLM and NDEP that describes the proposed operation, environmental control, and reclamation plans. Once the PoO is deemed completed, the NEPA process will be initiated. The BLM will determine the level of NEPA analysis required and will develop data adequacy standards (DAS) that will identify the necessary information and data that will be required to adequately assess the potential impacts in the NEPA document. Based on the DAS, additional baseline surveys and data may be required.

It is assumed for the purposes of this Report that BLM will decide that the appropriate level of analysis will be an EIS to be prepared by a third-party contractor. A NEPA kick-off meeting will be held with representatives from First Vanadium, the EIS contractor, and the BLM to discuss the Project and the content of the document. The contractor will prepare an administrative draft document for internal review by First Vanadium and the BLM.

Once the BLM has approved the Draft EIS, it will be made available to the public for comment for a 30-day period. Following the 30-day public comment period, comments will be reviewed and addressed to produce the Final EIS. The BLM will then prepare a Record of Decision (RoD) providing authorization to proceed.

The EIS process can take between one and 10 years, with an average of 3.4 years, depending on the complexity and nature of the proposed action and variability among the BLM offices. Under Executive Order 13807, consolidations of the timeframe for infrastructure projects, specifically that "each bureau should have a target to complete each Final EIS for which it is the lead agency within two years from the issuance of Notice of Intent to prepare an EIS and issue the RoD". It is Wood's understanding that the Nevada BLM has determined that mining projects are considered to be infrastructure projects. This may result in less time needed to complete the NEPA process.

Table 20-2: Key Permit Requirements

Permit	Regulatory Agency	Status	Notes
Plan of Operations	BLM	Not developed yet	Approved through development of an EIS.
Clean Water Act 404 Permit	USACE	Not currently needed for exploration activity as streams, springs, seeps, and wetlands will be avoided. With development of a mine, permitting through the USACE would likely be required.	Current 2018 baseline survey area did not identify any wetland areas. Impacts to drainages with implementation of a mine would likely require a 404 dredge and fill permit.
Explosives Permit	U.S. Bureau of Alcohol Tobacco and Firearms (BATF)	To be submitted	Authorizes the storage and use of explosives on the mine site
Notification of Commencement of Operations	U.S. Mine Safety and Health Administration (MSHA)	To be submitted	MSHA enforces rules regarding mine safety, through use of regulations, requirements for mine training plans and mine registrations
FCC Frequency Registrations for Radio/Microwave Communication and/or Telemetry	Federal Communications Commission (FCC)	To be submitted	Registration and/or licenses required for two-way radio communication and for telemetry purposes
Air Quality Operating Permit	Nevada Division of Environmental Protection, Bureau of Air Pollution Control	Not needed for exploration activity but will be required for mining operation.	Required prior to construction or operation.
Water Pollution Control Permit	Nevada Division of Environmental Protection; Bureau of Mining Regulation and Reclamation	Not needed for exploration but will be required for mining operations.	Will be needed for mining and processing activities prior to development and operation.
State Groundwater Permit	Nevada Division of Environmental Protection;	Would be required if using groundwater for a source of process water or for dewatering of the pit.	Prior to Construction
Mining Reclamation Permit	Nevada Division of Environmental	Will require this permit for mining operations, which will	A bond is currently in place for exploration activity but

Permit	Regulatory Agency	Status	Notes
	Protection; Bureau of Mining Regulation and Reclamation	include calculation and submittal of a reclamation bond.	will require additional permit for mining operation.
Hazardous Waste Management Permit and EPA identification	NDEP: Bureau of Waste Management	May be needed for mining operations. The mine currently has a detailed Hazardous Waste Management Plan that follows all federal, state and local laws regarding handling, storing, and transporting waste materials.	Prior to construction of facility for management or recycling of hazardous waste as identified by NAC 444.8850
NPDES Permit	NDEP: Bureau of Water Pollution Control	Likely not needed unless discharging process water to a Waters of the US or state water.	If operated as a no discharge facility an NPDES would not be required
Stormwater NPDES General Permit	NDEP: Bureau of Water Pollution Control	Will be required for mining operation.	Prior to land disturbing activity.
Temporary Discharge Permit	NDEP: Bureau of Water Pollution Control	Likely not applicable to a mine operation.	May be issued for a maximum of 180 days, at which time a Permanent Discharge Permit is required.
Groundwater Discharge Application for Reclaimed Water Use	NDEP: Bureau of Water Pollution Control	Likely not needed unless discharging water to a groundwater table.	Prior to discharge of reclaimed water.
Underground Injection Control Permit	NDEP: Bureau of Water Pollution Control	Likely not applicable.	Prior to Injection to groundwater.
Permit to Appropriate the Public Waters	Nevada Division of Water Resources	Likely not be applicable.	Needed if surface water will be diverted
Protection of Wildlife, Artificial Pond Permit	Nevada Department of Wildlife	If constructing and using process ponds including tailings storage facility, the artificial pond permit from NDOW will be required.	Method (netting, fencing, bird balls, etc.) to exclude access to ponds is required if water is considered harmful to wildlife
Dam Safety Permit	Nevada Division of Water Resources	Will need to submit TSF design and permit application	Need for dams more that 20 feet high or retain greater than 20-acre feet of water/solution.

Permit	Regulatory Agency	Status	Notes
Petroleum Contaminated Soil Management Plan	NDEP, BMRR	Not developed yet	Required for management of soils contaminated with petroleum products
Solid Waste Class III Landfill Waiver	NDEP-Bureau of Waste Management (BWM)	To be submitted	Authorizes on-site disposal of non-mining, non-hazardous solid wastes
Potable Water System Permit	NDEP-Bureau of Safe Drinking Water (BSDW)	To be submitted	Allows installation and operation of a non-community, non-transient potable water system
Onsite Sewage Disposal System Permit	NDEP- BWPC	To be submitted	Authorized construction and operation of either an Onsite Sewage Disposal System (Septic System) or a permanent holding tank for domestic sewage.
Radioactive Material License	Nevada Division of Public and Behavioral Health	To be submitted	Licenses the use of nuclear flow and mass measurements, level indicators, etc.
Hazardous Materials Storage Permit	Nevada Fire Marshal	To be submitted	Authorizes the storage of hazardous materials and provides an inventory to the agency for public safety and hazard communication purposes.
Liquefied Petroleum Gas License	Nevada Board for the Regulation of Liquefied Petroleum Gas	To be submitted	Licenses tank installation and prescribes LPG handling and safety requirements
Working in Waterways Temporary Permit	NDEP-BWPC	To be submitted if necessary	Required for temporary working in surface water channels This permit is required for operating earthmoving equipment in any body of water.
Building Permits	Building Planning Department, Elko County	To be submitted	Required for facility construction and issuance of occupancy certificate

Permit	Regulatory Agency	Status	Notes
Special Use Permit	Planning and Zoning Department, Elko County	To be submitted	May be required for zoning changes, variances, etc., that may be required to comply with local and state regulations.
Road Right of Way	BLM, and/or Eureka County	To be submitted	Road use right of way if required to use or improve BLM or county roads

The Project is located on lands within the jurisdiction of the Tuscarora Field Office of the Elko District which regularly processes exploration and mining plans of operations and NEPA documents.

Water Pollution Control Permit and Reclamation Permit

The BMRR will need to issue a Mining Reclamation Permit and a WPCP. The PoO document fulfills the requirements of the application for the Mining Reclamation Permit. Application review generally takes the BMRR approximately 180 days from submittal and includes a public notice. The BLM and the BMRR will jointly agree on the reclamation bond amount.

An application for issuance of a WPCP must also be submitted and will included detailed design for process and contact water control features such as processing facilities, waste rock, and tailing storage facilities. By statute, the BMRR is allowed a minimum of 180 days to issue a permit.

It is likely that the timeline for issuance of a permit will extend to 240 days or longer if requests for additional information are made.

Anticipated Permitting Time

Generally, the longest lead item with regard to permitting is the PoO and NEPA compliance, which are likely to take two years under Executive Order 13807. Estimated best-case timeframe assumptions include:

- Air Quality Permit (Class II Operating Permit): 100 days
- Water Pollution Control Permit: 180 to 240 days
- Reclamation Permit: 180 days

- NDOW Industrial Artificial Pond Permit: 30 days
- Class III Landfill Waiver: 30 days
- NSFM Hazardous Materials Storage Permit: 35 days
- Explosives Permit: 60 days
- Hazardous Waste Generator Filing Status: 20 days
- NDEP-Bureau of Safe Drinking Water Domestic Water Supply Permit: 45 days.

In addition to the approvals discussed in this sub-section, First Vanadium must notify the Mine Safety and Health Administration (MSHA) prior to the commencement of mining operations. In addition to the notification of operations, the facility must also submit a training plan to MSHA for approval 30 days prior to operations and obtain a Mine Identification number.

20.9 Social Licence Considerations

First Vanadium will take steps to engage the local community to create awareness regarding the Project. During the NEPA process, the public will have multiple opportunities to comment on the project and express support or concerns.

As required by federal law, the BLM will coordinate with local Native American tribes throughout the permitting and NEPA process as part of the government to government consultation. The NEPA document will analyze how the Project will affect the social and economic values of the community.

The relatively small number of workforce members required for the anticipated mining facilities will likely be drawn from the regional workforce and will not substantially change the regional workforce numbers. No substantial impact to the communities in terms of housing, schools or infrastructure are anticipated. The Project is expected to provide an economic benefit to the local communities and the county.

20.10 Comments on Section 20

The QP notes:

- The Project is at a very early stage. There do not appear to be any significant impediments to obtaining environmental or operating permits

- Because the Project is in its early stages, First Vanadium does not yet have appropriate permits in place for mining operations. The company is currently conducting exploration under an NOI, which limits the disturbance to under five acres. An exploration PoO has been submitted to the BLM, but NEPA compliance has not been completed, and thus, the PoO has not been approved.
- There is a reasonable expectation that the company can obtain the necessary permits. First Vanadium is considering a waste disposal method of commingling waste (upgrade tailings and waste rock) and placing plant tailings and fine fraction upgrade tailings in the open pit as backfill. Since this is an unusual method for waste disposal in Nevada, it is anticipated that additional testing and modeling will be required to satisfy the regulatory agencies that this can be done without degrading waters of the State
- Additional baseline studies and geochemical characterizations of mineralized material and waste rock materials will likely be required by BLM and NDEP. Since this is in the early stages of development, these additional data are not likely to delay commencement of operation. An EIS will likely be required prior to BLM authorization of mining and processing activities. Preparation of the document will likely take at least two years, and thus should be taken into account during the development of a timeline for start of operations
- The closure costs seem reasonable, and appear to cover what is regulatorily required, pursuant to pertinent sections of NAC 519A. Because the mine PoO is yet to be developed and approved, the reclamation bond has not yet been determined. At the time the bond is approved, appropriate mechanisms for funding will be in place. The long lead times needed to secure the major permits should be taken into account when developing a timeline for the start of operations.

21.0 CAPITAL AND OPERATING COSTS

21.1 Introduction

The capital and operating cost estimates fall under the AACE International Class 5 Estimate classification where a Class 5 estimate cost estimate accuracy is defined as within +50%/-30% of the final project cost, including contingency.

21.2 Capital Cost Estimate

21.2.1 Basis of Estimate

The capital cost estimates are based on the following:

- Mine plan and open pit layout
- Overall site layout including
  - Plant location and plant feed stockpile
  - TSF
  - WRSFs
  - Road layout
- Process block flow diagram
- Plant equipment list (packages and major equipment).

21.2.2 Mining Cost

A trade-off study to determine whether contract or Owner-mining would be used in the 2020 PEA was conducted. This indicated that Owner-mining would be the preferred scenario for the economic analysis in Section 22.

The scope of the mining capital cost estimate includes:

- The purchase of mining fleet, maintenance, and mine support equipment
- Miscellaneous equipment
- Mine operating cost during pre-production periods.

Estimates for mining equipment are based on mining fleet equipment schedules and equipment pricing from Wood's database for supply, delivery, assembly, and testing. Estimates for miscellaneous equipment are also based on Wood's internal database.

Mine operating costs are based on mining quantities, major consumable costs and equipment operation costs from Wood's database, and labor rates from the Cost Mine Service, adjusted to account for inflation. Fuel consumption, like other consumables, is taken from Wood's database, equipment handbooks, and equipment utilization factors. Mining quantities were derived from mine-phased planning to achieve the planned production rates.

Total mine capital costs are US40.8 M (Table 21-1). The initial capital costs include US$12.6 M in pre-production operating costs for a one-year pre-production period, and US$11.8 M in initial capital expenditures for mobile equipment. An amount of US$3.3 M is estimated as a contingency for the initial capital cost estimate.

Following the pre-production period, a sustaining capital cost allocation of US$13 M is required primarily for additions to the truck fleet, and to replace equipment beyond its manufacturer's recommended service life.

21.2.3 Earthworks

Earthwork material take-offs for the plant site, plant feed stockpile area, TSF and haul and access roads were derived from draft designs in Civil3D and MineSight. Base and sub-base quantities were estimated on the basis of the road surface area.

The topography of the site is challenging. Various locations of the TSF, WRSFs and access routes were investigated.

The only viable location for the plant site with its extensive stockpile area is located on the undulating plateau to the east of the pit.

Potential locations for the TSF were evaluated and included:

- Cole Creek valley
- At the northern end of the pit valley
- A combination of the northern end of the pit valley and the mined-out pit (preferred option).

Table 21-1: Initial Mine Capital and Sustaining Capital Costs

Cost Area	US$ M
Pre-production mining	12.6
Engineering and management	0.4
Drilling	0.7
Blasting	0.3
Loading	2.2
Hauling	5.1
Support	2.7
Maintenance	0.3
Dewatering	0.1
Total Initial Capital	*24.4*
Sustaining capital	13.1
Total Initial and Sustaining Capital	*37.5*
Contingency	3.3
Total Capital Cost with Contingency	***40.8***

Note: Totals may not sum due to rounding.

Potential locations for the WRSF were reviewed, including

- The southeast corner of the property
- Cole Creek valley (preferred option).

The site roads would include the following:

- Plant access road from public highway 278 running approximately 1.5 miles to the south of the property
- North–south private ranch track. As the pit lies directly on the existing ranch track, a through-route will be maintained using the plant access road and a track around the eastern edge of the process plant and TSF, to link up with the existing ranch track on the northern end of the property
- Haul road–commercial vehicle road from the pit to the process plant and the plant feed stockpile area
- Haul road from the pit to the WRSF

- Pioneer roads to gain access to the mining area, and to connect each pit phase with the WRSF and process plant.

21.2.4 Process Plant

The plant estimate is based on the mechanical equipment costs multiplied by a factor which accounts for the structural, piping, electrical and instrumentation equipment and the overall construction costs.

Mechanical equipment was specified using the process design criteria, the process flow diagram, and a mass and energy balance.

Equipment was costed using budgetary vendor quotes and Wood's database, on an area-by-area basis, which included major tankage and pumps. This equipment cost was then multiplied by a factor derived from Wood's historical data bases. This factor takes into account whether the area is housed in a building, the ratio of cost versus size of the equipment, and the complexity of the process. The factor covers the structural, piping, electrical, instrumentation and foundation and containment requirements and direct construction costs.

The acid plant and the solvent extraction plant were considered as stand-alone items. Specific budgetary quotations were obtained from vendors and these were bench-marked against historical quotations (less then two years old). In the case of the acid plant, it was necessary to scale the plant costs using the 0.6 power rule. This is considered acceptable for a PEA level of study.

In order to price the mechanical equipment, budgetary quotations were obtained for most of the major pieces of equipment. Use was also made of Wood's inhouse database for similar projects which included pressure oxidation and ion exchange process steps.

21.2.5 Contingency

A contingency based on the individual plant areas was included in the direct cost estimate and was allocated depending on the level of process information available. This generally ranged from 20–30%.

A total contingency of US$93 M is included in the capital cost estimate for direct costs.

21.2.6 Initial Capital Cost Estimate

The initial capital cost estimate, inclusive of contingency, is summarized in Table 21-2. Table 21-3 provides estimate details by area.

21.2.7 Sustaining Capital

The sustaining capital forecast for the LOM is provided in Table 21-4.

21.2.8 Indirect Costs

Indirect costs were estimated as a percentage of the total direct costs (i.e. process plant and infrastructure). The percentages are defined in Table 21-5. A contingency of 30% was applied to each indirect cost estimate item except Owners' costs.

21.2.9 Closure Costs

An estimate of US$30 M is assumed to be financed via a bond consisting of a 10% deposit and carrying an interest payment of 1.5%. The interest is included as an operating cost. This interest rate was provided by First Vanadium in consultation with their Nevada-based tax consultants.

This covers the potential remediation of the tailings and the demolition and removal of the process plant. The remediation of the initial TSF will start in year 12, once the mining operation has ceased, and the tailings are thereafter deposited in the open pit.

21.3 Operating Cost Estimate

21.3.1 Mining Costs

Mine operating costs average US$2.30/st moved, including stockpile rehandling. Excluding the pre-production period, the average mining cost is US$2.29/st. Total tons moved includes 5 Mst of primary production.

During the pre-production period, the mining costs are above average due to the low amount of material mined that year. From Year 1 forward, the mining costs increase as the haul profiles increase with the deepening of Phases 1 and Phase 2 of the open pit, and the mining of Phase 3, which is most distal pit phase, located in the north area of the deposit. Mining costs then decrease in Year 5 as Phase 4 starts.

Table 21-2: Initial Capital Cost Estimate Summary

Area	Value (US$ M)
Mining	27.7
Process plant directs	340.6
Infrastructure directs	67.3
Indirects, including property rights	99.7
Total Initial Capital	***535.5***

Table 21-3: Capital Cost Estimate

Discipline	Area	Value (US$ M)
Mining	Equipment	13.6
	Pre-stripping	14.1
	Sub-total	*27.7*
Process plant directs	Comminution	16.9
	Classification	11.6
	Flotation	3.1
	Rejects	13.1
	Acidulation	16.2
	Pressure oxidation	83.6
	Counter-current decantation and tails	39.2
	Ion exchange	18.0
	Solvent extraction	30.5
	Precipitation and calcine	24.2
	Reagents	3.2
	Acid plant	78.8
	Plant utilities	2.2
	Sub-total	*340.6*
Infrastructure directs	Office equipment	0.2
	Laboratory and workshop equipment	5.4
	Buildings	7.6

Discipline	Area	Value (US$ M)
	Plant mobile equip	1.3
	Earthworks and access roads	20.2
	Haul roads and pioneer roads	14.7
	Tailings, electrical and communications	17.8
	Sub-total	*67.3*
Indirects	Contractors indirects	8.6
	Freight	8.0
	Spares	5.3
	First fills	3.3
	Vendors representatives	1.4
	Owners' costs	16.5
	EPCM	46.6
	Commissioning	2.7
	On site construction facilities	1.4
	Sub-total	*93.8*
Property rights	Royalties, option exercise	5.9
	Sub-total	*5.9*
Total Initial Capital		***535.3***

Note: EPCM = engineering, procurement and construction management.

Table 21-4: Sustaining Capital Cost Estimate

Area	Value (US$ M)
Mining – fleet replacement	13.1
Tailings – impoundment lifts	18.0
Process plant – centrifuge bowls	28.0
Total Sustaining Capital	***59.1***

Table 21-5: Indirect Cost Estimate

Area	Unit	Value	Purpose
Contractors' indirects	%	3.0	Total direct cost
Freight	%	3.0	Mechanical equipment
Spares	%	2.0	Mechanical equipment
First fills	US$ M	3.3	Estimate
Vendors	%	0.5	Mechanical equipment
EPCM	%	15	Total direct cost
Commissioning	%	1.0	Mechanical equipment
On site construction facilities	%	0.5	Mechanical equipment
Owners' cost	%	5	Total direct cost
Property rights	US$ M	5.9	Estimate

Note: EPCM = engineering, procurement and contract management.

After Year 11, the open pit is mined out completely and only rehandling material from the stockpile will be fed to the processing plant for the next five years.

Estimated mining costs are provided in Table 21-6.

21.3.2 Process Costs

All process costs excepting acid costs are based on the MT7 and MT4 composite testwork results. Acid costs are based on interpolation of acid-consuming minerals into the resource block model on a block by block basis. To reflect the difference in the base data assumptions, this section reports the acid costs estimated in the block model as a separate item to the process costs that were based on the composite testwork.

Process operating costs over LOM are estimated to average US$36.74/st of processed oxide mill feed material, inclusive of acid costs, and US$52.74/st of non-oxide mineralization, inclusive of acid costs, based on the assumptions listed in Table 21-7.

Table 21-6: Mining Operating Costs

Period	Mining Cost (US$ M)	Primary Production		Total Mined*	
		(Mst)	(US$/st)	(Mst)	(US$/st)
PP 1	12.62	5.05	2.50	5.05	2.50
Y1	14.30	7.05	2.03	7.05	2.03
Y2	13.46	6.34	2.12	6.34	2.12
Y3	15.10	7.00	2.16	7.00	2.16
Y4	15.13	7.00	2.16	7.00	2.16
Y5	14.32	7.00	2.05	7.00	2.05
Y6	14.30	7.00	2.04	7.21	1.98
Y7	15.08	7.00	2.15	7.41	2.03
Y8	14.19	5.66	2.51	5.66	2.51
Y9	13.78	4.89	2.82	4.89	2.82
Y10	11.20	3.63	3.09	3.63	3.09
Y11	8.86	1.44	6.17	2.01	4.40
Y12	2.32	—	—	1.05	2.21
Y13	2.32	—	—	1.11	2.08
Y14	2.32	—	—	1.00	2.32
Y15	2.32	—	—	1.15	2.02
Y16	1.35	—	—	0.64	2.11
Total	***172.95***	***69.05***	***2.50***	***75.19***	***2.30***

Note: * Total material mined includes stockpile re-handle. Inputs have been rounded. Totals may not sum due to rounding.

Table 21-7: Process Plant Operating Cost Estimate Inputs

Basis	Unit	Non-Oxide	Oxide
LOM throughput	Mst	7.04	9.33
LOM	years	7.7	8.0
Throughput rate	st/d	2,500	3,200
	Mst/a	0.91	1.17
Availability	%	92	92
Power cost	US$/kWh	0.05	0.05

Note: Inputs have been rounded.

Process operating costs estimates were developed from first principles, metallurgical testwork, database salary/benefit guidelines and recent vendor quotations, and benchmarked against historical data for similar process plants. The operating costs includes reagents, consumables, personnel, electrical power and laboratory testing. The consumables accounted for in the operating costs include spare parts, autoclave brick lining, grinding media and liners.

The annualized operating costs were based on the mine plan. The feed to the plant consists of a combination of oxide and non-oxide mill feed material, with the higher-grade material being processed in the early years of operation. The lower-grade material is stockpiled and will be fed to the plant at the end of the mine life.

The major reagent cost is sulphuric acid. The annualised acid cost derived in the economic model is calculated based on concentrations of the main acid-consuming minerals. There are calcium and magnesium assays available for the blocks in the block model; values of which were used in estimation of those elements' related acid consumption (refer to Section 14.14). Aluminium, however, was not estimated. An aluminium grade was calculated from the two samples which form the basis of the oxide and non-oxide material testwork (composites MT7 and MT4), and assigned as an average grade to the blocks in the block model. The final estimates were then used for acid cost calculation purposes. This calculation is based on stochiometric calculations and extents of reactions correlated with the MT7 and MT4 composite testwork.

A trade-off study indicated the viability of installing an on-site acid plant. In addition to producing acid at a substantially reduced cost, the plant also allows for the generation of the majority of the on-site power load and provides steam to heat the autoclave when it is not operating autogenously. The acid plant capacity is matched to the average acid consumption. Thus, there are periods when additional acid is required and periods when there is an excess. This variation is built into the annualised operating cost in the financial model.

The second-largest cost component is labour. This will be a complex hydrometallurgical plant and thus requires increased numbers of personnel with advanced technical skill levels. A total of 133 personnel operating on a four-shift basis was included. Wood's in-house database taken from recent Nevada projects was used for the salary rates and burden.

The estimated LOM operating costs for the process plant, excluding the acid costs, which are variable, are provided in **Error! Not a valid bookmark self-reference.**.

Table 21-8: Operating Cost Summary, Process Plant (excludes variable acid costs)

Area	Non-Oxide Mill Feed Material (US$/st milled)	Oxide Mill Feed Material (US$/st milled)
Reagents	18.1	7.8
Wear parts and maintenance	5.6	4.4
Grinding media	1.8	0.45
Personnel	15.7	12.3
Electrical power	1.0	1.3
Mobile equipment	0.9	0.7
Assaying	0.88	0.68
Total Cost	***43.94***	***27.59***

Note: Costs in this table are based on testwork results from metallurgical composites MT7 and MT4.

Process operating costs in the financial model are the costs in Table 21-8, to which the financial model adds variable acid costs (based on the estimation of magnesium, calcium and aluminium grades into the block model) to derive the overall process operating costs on an annualized basis.

The average LOM oxide material process cost, including acid consumption, is US$36.74st of processed oxide mineralized material and the average LOM non-oxide material process cost, including acid consumption, is US$52.74/st of non-oxide mill feed material.

21.3.3 General and Administrative Costs

General and administrative costs are estimated at US$2.01/st mineralization. The estimate includes provision for personnel, supplies and services, and vehicles.

21.3.4 Operating Cost Estimate

Mine operating costs average US$2.30/st moved, including stockpile rehandle. Excluding the pre-production period, the average mining cost is US$2.29/st moved or US$9.80/st processed.

Process operating costs for oxide and non-oxide material over LOM are estimated to average US$44.98/st processed. The average LOM oxide material process cost, excluding acid consumption, is US$27.59/st of processed oxide mineralized material and the average LOM non-oxide material process cost, excluding acid consumption, is

US$43.94/st of non-oxide mill feed material. The average LOM oxide material process cost, including acid consumption, is US$36.74/st of processed oxide mineralized material and the average LOM non-oxide material process cost, including acid consumption, is US$52.74/st of non-oxide mill feed material.

General and administrative costs are estimated at US$2.01/st mineralization.

Operating cost estimates for the 2020 PEA LOM are provided in Table 21-9.

21.4 Comment on Section 21

The estimated initial capital costs total US$535.3 M. There is an additional $51.9 M in sustaining capital over the LOM.

Mine operating costs average US$2.30/st moved, including stockpile re-handle.

Process operating costs for oxide and non-oxide material over LOM are estimated to average US$44.98/st processed.

General and administrative costs are estimated at US$2.01/st processed.

Table 21-9: Operating Cost Estimate

Item	Units	LOM Base Value
Average mining cost (Owner operation)	US$/st $_{moved}$	2.29
Average mining cost (Owner operation)	US$/st $_{processed}$	9.80
Processing oxide cost (excluding acid)	US$/st $_{processed}$	27.59
Processing non-oxide cost (excluding acid)	US$/st $_{processed}$	43.94
Sulphuric acid cost	US$/st $_{processed}$	10.36
G&A cost	US$/st $_{processed}$	2.01
Total Operating Cost	***US$/st*** $_{processed}$	***56.79***

22.0 ECONOMIC ANALYSIS

22.1 Caution Statements

The 2020 PEA is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the 2020 PEA based on these Mineral Resources will be realized. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.

The results of the economic analyses discussed in this section represent forward-looking information as defined under Canadian securities law. The results depend on inputs that are subject to a number of known and unknown risks, uncertainties and other factors that may cause actual results to differ materially from those presented here. Information that is forward-looking includes:

- First Vanadium's ability to meet its obligations and the conditions required to exercise in full its option to acquire the Project
- Mineral Resource estimates
- Assumed commodity prices. The commodity price assumptions are based on market analyses and benchmarking with recent studies; however, future pricing could vary due to the volatile pricing nature of the commodities included in the cashflow analysis
- The proposed mine production plan and projected mining rates
- Infrastructure locations as envisaged in the 2020 PEA
- First Vanadium's ability to sell sulphuric acid and energy for the four years after the conclusion of the processing plant operation
- Metallurgical samples may not be representative and metallurgical recovery assumptions may not be achievable
- A processing facility of this configuration has not been used for recovery of vanadium. However, the individual unit processes selected are common to, and conventional in, the mining industry, each having multiple installations
- Capital and operating cost estimates
- Assumptions as to closure costs and closure requirements

- Assumptions as to environmental, permitting and social risks, and the ability to permit the type of project envisaged in Nevada.

22.2 Methodology Used

The economic analysis was carried out using a discounted cashflow (DCF) approach. This method of valuation requires projecting yearly cash inflows, or revenues, and subtracting yearly cash outflows such as operating costs, capital cost, royalties, and taxes. The resulting net annual cashflows are discounted back to the date of valuation and totaled to determine the NPV of the project at selected discount rates.

The internal rate of return (IRR) expresses the discount rate at which the NPV equals a zero value. The payback period is the time calculated from the start of production until all initial capital expenditures are recovered.

All monetary amounts are expressed in US$. All cashflows have been discounted to the start of project construction, which has a duration of two years. Cashflows are assumed to occur at the end of the year. All pricing is stated in constant Q1 2020 US$.

22.3 2020 PEA Financial Model Parameters

22.3.1 Products and Project Life

The Project has a life of 20 years as envisaged in the 2020 PEA. The operation will produce the following:

- Vanadium pentoxide: by processing a mineral resource mined by open pit methods for the first 16 years of life of the project (11 years of mining, plus five years of stockpile feed to plant), producing V_2O_5 flakes at 98% purity
- Sulphuric acid: produced by a 550 st/d capacity plant to be installed on site. The sulphuric acid plant will be used for V_2O_5 production from Year 1 to Year 16. After V_2O_5 production ends, the acid plant will operate for another four years, Year 17 to Year 20, and the sulphuric acid will be marketed to third parties
- Energy: 7 MW of electric power will be produced from the combustion of sulphur to produce sulphuric acid in the sulphuric acid plant. An exothermic process will take place in the furnace/boiler, where waste heat will be used to generate steam, which will then be fed to a turbine that will drive an electrical generator. From Year 1 to Year 16, this energy will be consumed by the mine and processing operation. From

Year 17 to Year 20, the power generated from the acid plant will be marketed to third parties.

22.3.2 Mineral Resource Estimates

The 2020 PEA mine plan is based on Indicated and Inferred Mineral Resources that are contained within a pit shell that used a US$9.36/lb V_2O_5 price.

The subset of the Mineral Resource estimate within the PEA mine plan is included in Table 16-2.

The mine plan uses a strategy of cut off grade optimization, with direct feed to the plant of 10.2 Mst, and rehandling from stockpiles of 6.1 Mst.

22.3.3 Metallurgical Recoveries

The mining operation is scheduled to feed the plant at a rate of 1.0 Mst annually, which will include both oxide and non-oxide material. The average total recovery for oxide material is forecast to be 78.6%, and for non-oxide material, the recovery forecast is 77.4%. The LOM recovery forecast averages 78%, with an anticipated acid consumption of 318 lb/st.

22.3.4 Exchange Rates

No exchange rates have been defined. The study is developed in US dollars only.

22.3.5 V_2O_5 Commercial Terms

The V_2O_5 commercial term assumptions include:

- Railing cost of US$140/st, based on railing the product to Pittsburgh, considering a unit cost of US$0.06/st/m (from Mine Cost Services)
- Trucking cost from mine to a railhead at Carlin and thence to a specified delivery point, of US$18/st
- Loading, handling, and storage costs at the Carlin railhead, unloading and storage costs at a Pennsylvania rail terminal, and loading and truck transportation costs to a Pennsylvania processing facility of US$50/st
- The flakes will be transported dry, and will have no (zero) moisture content

- It is assumed for transport calculations that V_2O_5 flakes are 98% pure, with 2% of the weight considered as impurities. A selling cost of US$0.04/lb to cover department sales cost, assuming that sales will be without intermediaries
- Payable at 99%.

The anticipated commercial terms are summarized in Table 22-1.

22.3.6 Commodities Selling Prices

The selection of commodity prices for the vanadium flake, sulphuric acid and power are provided in Section 19.2.

22.3.7 Capital Costs

Capital cost estimates are as outlined in Section 21.2.

22.3.8 Operating Costs

Operating cost assumptions are as outlined in Section 21.3.

22.3.9 Consumables Costs

Table 22-2 contains the cost of consumables used in the financial model. Diesel and energy cost were estimated by Wood based on current pricing in Nevada. Sulphuric acid costs were estimated by Wood, based on an acid plant with capacity of 550 st/d. For years in which in-house sulphuric acid production is insufficient, the balance will be purchased and when the production exceeds the internal demand, it will be sold (see discussions in Section 19).

22.3.10 Royalties

A payment of US$4 M to Golden Predator at the beginning of the economic analysis is the selected option over an NSR royalty of 2% that would be paid throughout the LOM. Additionally, a payment of US$1.91 M for a 100% exercise of the option agreement is included in the model. Both payments are considered as initial capital costs, under the property rights expenses provision in the economic model.

Table 22-1: Commercial Terms

Term	Unit	Value
Product transport cost	US$/st	208
Selling cost	US$/lb	0.04
Payable	%	99
Moisture content	%	—
V_2O_5 flake grade	%	98

Table 22-2: Consumables Price (LOM)

Item	Units	LOM Base Value
Power cost	US$/kWh	0.05
Diesel cost	US$/US gal	2.58
Sulphuric acid produced	US$/st	64
Sulphuric acid purchased	US$/st	144

22.3.11 Working Capital

Working capital is the capital required to fund operations prior to receiving revenue from the finished product. It is defined as the current assets minus the current liabilities. The financial model estimates working capital by subtracting 60 days of direct operating cost from 45 days of revenue. Over the Project life, working capital nets to zero.

22.3.12 Taxes

Tax calculation within the financial model was completed by Mining Tax Plan LLC (Mining Tax Plan), a company specializing in U.S. Federal, State, local and foreign taxation of precious metal, non-metallic ores, coal and quarry mining, which is based in Centennial, Colorado.

The U.S Federal income tax is based on the Internal Revenue Code of 1986, as amended and the relevant state and local statutes, the regulations thereunder, and judicial and administrative interpretations thereof, on the following assumptions and tax return elections by the taxpayer, based on the 2020 PEA cashflows and capital expenditures.

As of May 6, 2020, the U.S. corporate income tax rate is 21% and the Federal income tax is based on the following assumptions and tax elections:

- The Carlin Vanadium Project is owned by a Nevada Corporation (taxpayer) that is a wholly-owned direct or indirect First Vanadium subsidiary
- The Carlin Vanadium Project has acquired an economic interest in the minerals in place and is operated and treated as a single mine under Section 614
- The Carlin Vanadium Project will elect to expense exploration expenditures under Section 617 (a) as incurred
- The Carlin Vanadium Project will deduct mine development costs as incurred under Section 616 (a)
- The Carlin Vanadium Project will elect out of Section 168(k) bonus depreciation
- The Carlin Vanadium Project will elect to accrue and deduct reclamation costs under Section 468.

The Nevada Net Proceeds of Mines (NPT) is a tax imposed under Nevada Revised Statute 362 and Administrative Code thereunder on the severance of minerals. The NPT rate as of May 6, 2020 was 5%.

Nevada Property Tax is imposed under Nevada Revised Statute 361 and Administrative Code thereunder on real and personal property based upon the municipality and county where the mine is located.

A depletion rate of 22% is considered by Mining Tax Plan as part of the tax calculation.

22.3.13 Reclamation Cost

A bond of US$30 M will be put in place at the beginning of the Project for the total reclamation amount. An upfront deposit of 10% of the bond will be made at the beginning of the Project. The remaining amount will be subject to a coupon payment of 1.5% annually. Reclamation expenditure is estimated to be expended in two parts:

- 50% in Years 12–15
- 50% in Years 16–20.

22.3.14 Financing

The financial model is presented on a 100% equity basis. No debt financing costs are assumed.

22.3.15 Inflation

The financial analysis assumes constant 2020 dollars as the underlying assumption is that inflation is offset for both revenue and costs.

22.4 Economic Analysis

The economic analysis returned the following results:

- Pre-tax
  - Undiscounted cashflow of US$356 M
  - NPV at 6% discount rate of US$56 M
  - IRR of 7.9%
  - Payback period of 7.5 years
- After-tax
  - Undiscounted cashflow of US$301 M
  - NPV at 6% discount rate of US$29 M
  - IRR of 7%
  - Payback period of 7.7 years.

Cashflows on an annualized basis are shown in Table 22-5, with the 6% discount rate base case highlighted.

The LOM cash operating costs average US$5.17/lb V_2O_5 payable. Figure 22-1 shows the LOM cash cost estimate.

The after-tax break-even price for the NSR is

- 6% discount rate: US$10.33/lb V_2O_5
- 8% discount rate: US$10.96/lb V_2O_5.

Table 22-3: Economic Results – Pre-Tax (base case is highlighted)

Pre-Tax Economic Results	Unit	Value
Cashflow	US$ M	356
NPV@6%	**US$ M**	**56**
NPV@8%	US$ M	(2)
NPV@10%	US$ M	(48)
IRR	%	7.9
Payback- years from startup	Years	7.5

Table 22-4: Economic Results – After-Tax (base case is highlighted)

After-Tax Economic Results	Unit	Value
Cashflow	US$ M	301
NPV@6%	**US$ M**	**29**
NPV@8%	US$ M	(25)
NPV@10%	US$ M	(67)
IRR	%	7.0
Payback- years from startup	Years	7.7

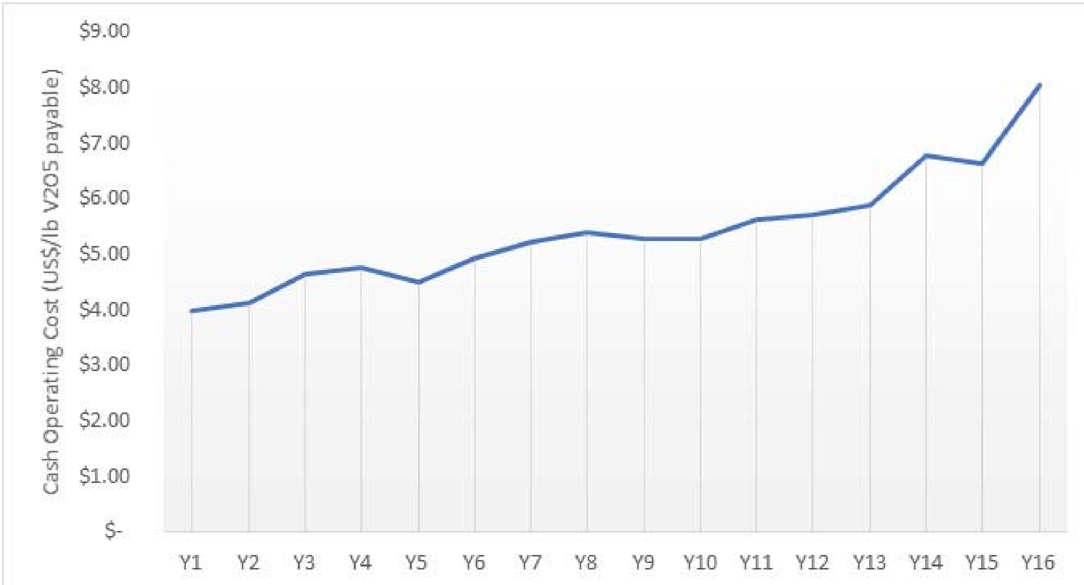
Table 22-5: Cashflow on an Annualized Basis (US$ M)

	Total	PP2	PP1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20
Sales																							
V_2O_5 sales	1,916	0	0	166	153	146	139	146	139	132	128	131	127	111	95	91	83	82	48	0	0	0	0
Extra sulphuric acid sales	113	0	0	0	5	3	1	3	3	0	2	5	4	1	2	0	1	0	7	19	19	19	19
Extra energy sales	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3
Total Sales	*2,041*	*0*	*0*	*166*	*159*	*150*	*140*	*148*	*142*	*132*	*130*	*135*	*130*	*111*	*97*	*91*	*84*	*82*	*55*	*22*	*22*	*22*	*22*
Sales Costs																							
V_2O_5 refining cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V_2O_5 transport cost	19	0	0	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
V_2O_5 selling cost	7	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Extra acid production cost	70	0	0	0	3	2	1	2	2	0	2	3	2	0	1	0	1	0	4	12	12	12	12
Total Sales Costs	*96*	*0*	*0*	*2*	*5*	*4*	*3*	*4*	*4*	*2*	*3*	*5*	*4*	*2*	*2*	*1*	*2*	*1*	*5*	*12*	*12*	*12*	*12*
Revenue																							
V_2O_5 revenue	1,889	0	0	163	151	144	137	144	137	131	126	129	125	109	94	90	81	81	47	0	0	0	0
Sulphuric acid selling revenue	44	0	0	0	2	1	1	1	1	0	1	2	1	0	1	0	1	0	3	7	7	7	7
Energy revenue	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3
Total Revenue	*1,944*	*0*	*0*	*163*	*153*	*145*	*137*	*145*	*138*	*131*	*127*	*131*	*126*	*110*	*95*	*90*	*82*	*81*	*50*	*10*	*10*	*10*	*10*
Cash Operating Costs																							
Mining (mineralized material to process plant)	24	0	0	2	2	2	2	2	2	1	2	3	3	2	0	0	0	0	0	0	0	0	0
Mining (mineralized material to stockpile)	14	0	0	1	1	3	3	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Mining (waste)	108	0	0	11	10	10	10	11	12	12	11	10	7	4	0	0	0	0	0	0	0	0	0
Mining (stockpile to plant)	14	0	0	0	0	0	0	0	0	1	0	0	0	3	2	2	2	2	1	0	0	0	0

	Total	PP2	PP1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20
Processing oxide (excluding sulphuric acid cost)	257	0	0	34	18	13	26	21	8	27	8	1	1	16	17	25	11	29	5	0	0	0	0
Processing non-oxide (excluding sulphuric acid cost)	309	0	0	0	17	24	8	15	31	7	31	39	39	20	19	9	27	4	21	0	0	0	0
Sulphuric acid cost for process	170	0	0	12	8	10	11	10	10	14	10	9	9	11	11	12	11	14	7	0	0	0	0
G&A	33	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cash Operating Costs	*929*	*0*	*0*	*62*	*60*	*64*	*62*	*62*	*64*	*65*	*65*	*65*	*63*	*58*	*51*	*50*	*53*	*51*	*36*	*0*	*0*	*0*	*0*
Total Cash Costs																							
Total cash operating costs	929	0	0	62	60	64	62	62	64	65	65	65	63	58	51	50	53	51	36	0	0	0	0
Interest payment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Property tax	23	0	0	1	4	3	3	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Land tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Holding fees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cash Costs	*952*	*0*	*0*	*63*	*64*	*67*	*65*	*64*	*66*	*66*	*65*	*66*	*63*	*59*	*52*	*51*	*53*	*51*	*36*	*0*	*0*	*0*	*0*
Total Production Costs																							
Total cash costs	952	0	0	63	64	67	65	64	66	66	65	66	63	59	52	51	53	51	36	0	0	0	0
Reclamation & closure cost	36	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	15	0	0	0	0
Total Production Costs	*988*	*0*	*0*	*63*	*64*	*68*	*65*	*64*	*67*	*66*	*66*	*66*	*64*	*60*	*67*	*51*	*53*	*52*	*52*	*0*	*0*	*0*	*0*
Earnings Before Taxes																							
Net revenue	1,944	0	0	163	153	145	137	145	138	131	127	131	126	110	95	90	82	81	50	10	10	10	10
Production costs	988	0	0	63	64	68	65	64	67	66	66	66	64	60	67	51	53	52	52	0	0	0	0
Earnings Before Taxes	***956***	***0***	***0***	***100***	***89***	***78***	***72***	***80***	***72***	***64***	***61***	***65***	***62***	***50***	***28***	***39***	***29***	***29***	***(2)***	***10***	***10***	***10***	***10***

	Total	PP2	PP1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20
Earnings After Taxes																							
Federal corporate tax	36	0	0	1	0	0	0	0	0	0	0	4	5	4	4	3	2	3	1	2	2	2	2
Nevada net proceeds tax	19	0	0	3	2	1	1	1	1	1	0	1	1	2	1	2	1	1	0	0	0	0	0
Earnings After Taxes	*901*	*0*	*0*	*97*	*87*	*76*	*71*	*79*	*71*	*63*	*61*	*60*	*56*	*44*	*23*	*34*	*25*	*25*	*(3)*	*8*	*8*	*8*	*8*
Capital Cost																							
Total capital	600	156	379	3	5	6	5	5	9	6	5	4	5	4	2	2	2	2	0	0	0	0	0
Reclamation & closure accrual	0	3	0	0	0	0	0	0	0	0	0	0	0	0	(2)	0	0	0	(2)	0	0	0	0
Working Capital																							
Working capital	0	0	0	10	(1)	(2)	(1)	1	(1)	(1)	0	0	0	(1)	(1)	0	(1)	0	(1)	1	0	0	0
Cashflow Before Tax	***356***	***(159)***	***(379)***	***88***	***86***	***73***	***68***	***75***	***64***	***59***	***57***	***60***	***58***	***47***	***28***	***37***	***28***	***27***	***1***	***9***	***10***	***10***	***10***
NPV @ 6%	**56**																						
NPV @ 8%	(2)																						
NPV @ 10%	(48)																						
IRR %	7.9%																						
Payback (Years)	7.5																						
Cashflow After Tax	***301***	***(159)***	***(379)***	***84***	***84***	***72***	***66***	***73***	***63***	***59***	***56***	***56***	***52***	***40***	***23***	***32***	***24***	***23***	***0***	***7***	***8***	***8***	***8***
NPV @ 6%	**29**																						
NPV @ 8%	(25)																						
NPV @ 10%	(67)																						
IRR (%)	7.0%																						
Payback (Years)	7.7																						

Figure 22-1: Cash Operating Cost



Note: Figure prepared by Wood, 2020.

22.5 Sensitivity Analysis

A sensitivity analysis was completed over a ±45% range for capital costs, operating costs, vanadium grade, and vanadium price. Vanadium grade sensitivity mirrored that of the vanadium price sensitivity.

The Project cashflow is most sensitive to fluctuations in vanadium price and vanadium grade. It is less sensitive to operating costs, and least sensitive to variations in capital costs.

Project sensitivities are included in Table 22-6 to Table 22-8, and illustrated in Figure 22-2 to Figure 22-5.

Table 22-6: Sensitivity Analysis to Metal Price (US$/lb V_2O_5; base case is highlighted)

	Unit	-45% 5.86	-30% 7.46	-15% 9.05	Base Case 10.65	15% 12.25	30% 13.85	45% 15.44
Cashflow pre-tax	US$ M	(506)	(218)	69	356	644	931	1,218
NPV@6% pre-tax	US$ M	(456)	(285)	(114)	56	227	397	568
NPV@8% pre-tax	US$ M	(442)	(295)	(149)	(2)	144	290	436
IRR pre-tax	%	0.00	0.00	1.72	7.90	13.13	17.82	22.15
Cashflow after-tax	US$ M	(507)	(222)	57	301	543	783	1,020
NPV@6% after-tax	US$ M	(457)	(286)	(121)	29	174	316	457
NPV@8% after-tax	US$ M	(442)	(296)	(154)	(25)	100	222	343
IRR after-tax	%	0.00	0.00	1.43	7.02	11.71	15.85	19.63

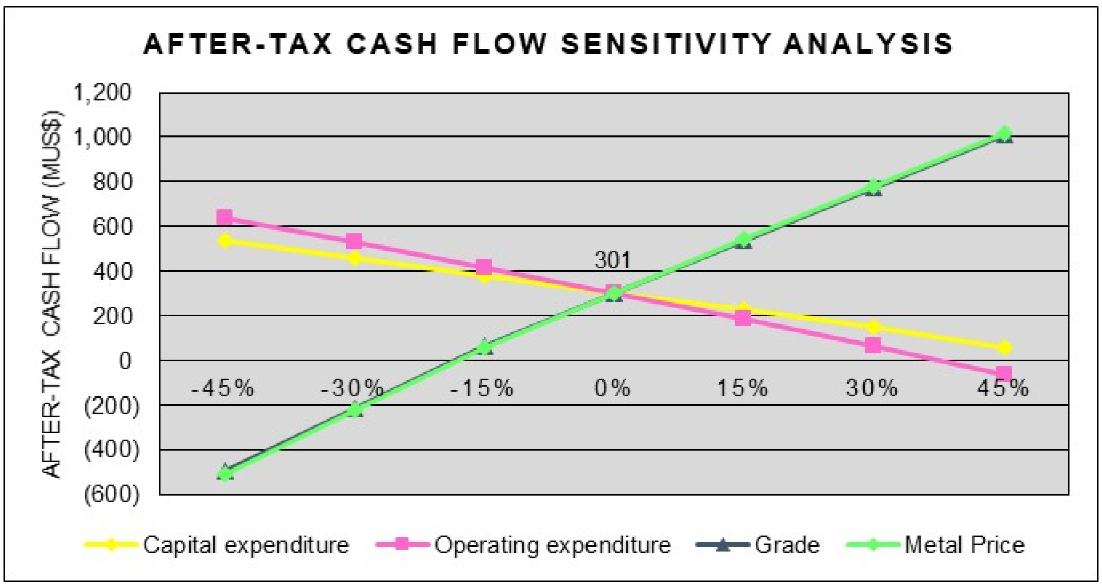
Table 22-7: Sensitivity Analysis – Capital Cost (base case is highlighted)

	Unit	-45%	-30%	-15%	Base Case	15%	30%	45%
Cashflow pre-tax	US$ M	636	543	450	356	263	170	76
NPV@6% pre-tax	US$ M	298	218	137	56	(24)	(105)	(186)
NPV@8% pre-tax	US$ M	230	152	75	(2)	(80)	(157)	(234)
IRR pre-tax	%	22.16	15.74	11.26	7.90	5.26	3.10	1.29
Cashflow after-tax	US$ M	538	459	379	301	226	150	60
NPV@6% after-tax	US$ M	243	172	101	29	(42)	(115)	(194)
NPV@8% after-tax	US$ M	183	114	45	(25)	(94)	(166)	(241)
IRR after-tax	%	19.71	14.03	10.03	7.02	4.69	2.78	1.02

Table 22-8: Sensitivity Analysis – Operating Cost (base case is highlighted)

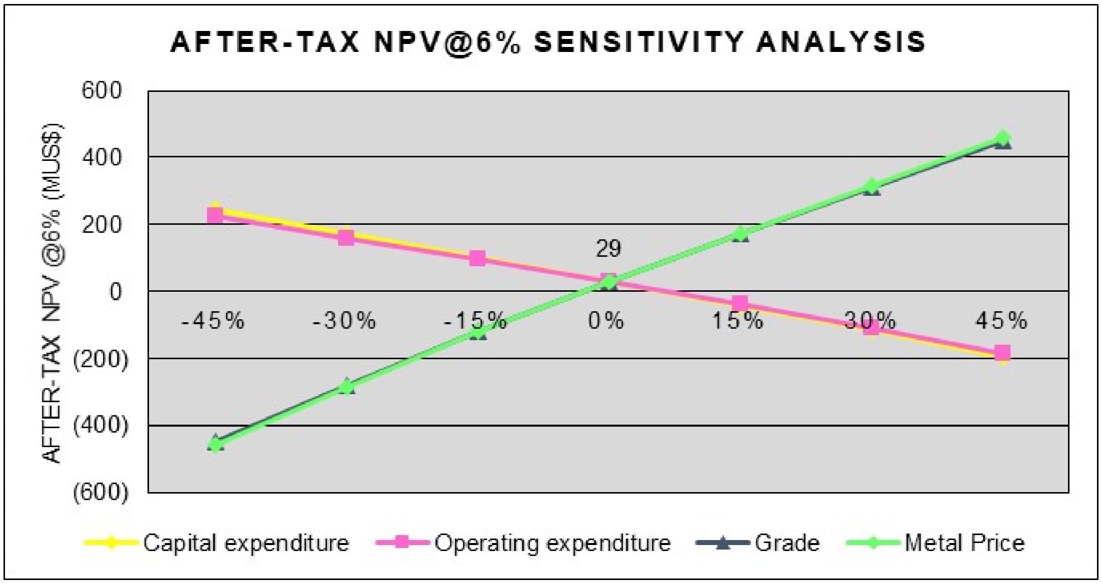
		-45%	-30%	-15%	Base Case	15%	30%	45%
Cashflow pre-tax	US$ M	775	635	496	356	217	78	(62)
NPV@6% pre-tax	US$ M	295	215	136	56	(23)	(103)	(182)
NPV@8% pre-tax	US$ M	199	132	65	(2)	(70)	(137)	(204)
IRR pre-tax	%	14.74	12.63	10.36	7.90	5.16	2.01	0.00
Cashflow after-tax	US$ M	636	527	415	301	187	65	(68)
NPV@6% after-tax	US$ M	224	160	95	29	(38)	(110)	(186)
NPV@8% after-tax	US$ M	141	87	32	(25)	(82)	(143)	(208)
IRR after-tax	%	13.04	11.19	9.21	7.02	4.61	1.72	0.00

Figure 22-2: Sensitivity Cashflow After-Tax



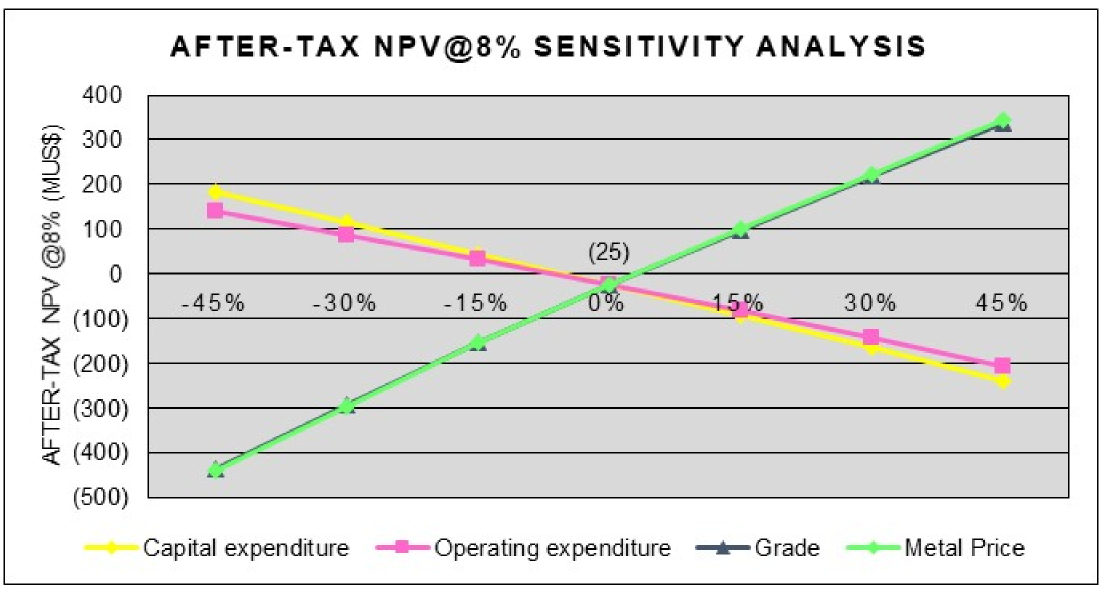
Note: Figure prepared by Wood, 2020

Figure 22-3: Sensitivity NPV@6% After-Tax



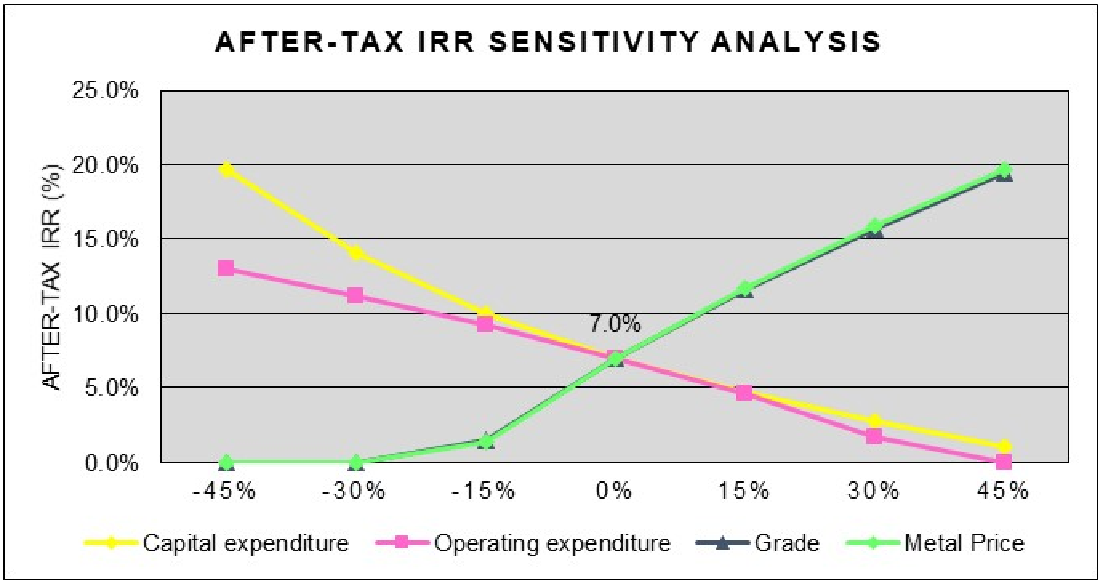
Note: Figure prepared by Wood, 2020

Figure 22-4: Sensitivity NPV@8% After-Tax



Note: Figure prepared by Wood, 2020

Figure 22-5: Sensitivity IRR After-Tax



Note: Figure prepared by Wood, 2020

The Project is most sensitive to fluctuations in metal price and vanadium grade. It is less sensitive to operating costs, and least sensitive to variations in capital costs.

The price of V_2O_5 used in the study is based on market analyses by Roskill in 2019, and a limited number of recent vanadium project studies. The assumed price is in the middle range of these projections. It is significantly higher than the current market price. A sensitivity analysis has been carried out with the objective of assessing the vanadium price impact on the project economics.

The 2020 PEA includes an extension of the Project for a four-year period after the processing is completed, during which time the Project will sell sulphuric acid and energy. This assumption results in an increase of 13% and 36% to the after-tax cashflow and NPV @6% , respectively. Wood has used conservative commodity prices for the sulphuric acid and energy costs during this period to support a conceptual estimate. Future studies will require a deeper analysis of the sulphuric acid and energy market to confirm the assumptions. Actual results from those studies may vary from the assumptions in the 2020 PEA.

22.6 Comments on Section 22

The Project as envisaged in the 2020 PEA shows a positive cashflow. On an after-tax basis, the undiscounted cashflow is US$301 M; the NPV at 6% discount rate is US$29 M, the IRR is 7%, and the payback period is 7.7 years.

Under the assumption detailed in this Report, the Project shows positive after tax NPV at a discount rate of 6%, but not at 8% or above.

23.0 ADJACENT PROPERTIES

This section is not relevant to this Report.

24.0 OTHER RELEVANT DATA AND INFORMATION

This section is not relevant to this Report.

25.0 INTERPRETATION AND CONCLUSIONS

25.1 Introduction

The QPs note the following interpretations and conclusions in their respective areas of expertise, based on the review of data available for this Report.

25.2 Mineral Tenure, Surface Rights, Water Rights, Royalties and Agreements

The Project is held under option. All required statutory expenditure and reporting requirements had been met as of 30 April, 2020.

The Cole Creek property is held under lease and agreement. All required statutory expenditure and reporting have been made as of 30 April, 2020.

There are two project royalties. One, on the Carlin Vanadium property, payable to Golden Predator, consists of a 2.0% NSR that is payable once the First Vanadium option is exercised. The second, on the Cole Creek property, is payable to Julian Tomera Ranches, Inc., Stonehouse Division, and will be incurred once mining starts on that property.

A mining claimant has the right to use the surface estate of the lands to develop the mineral interest of the claim. These lands have guaranteed public access which is governed by United States law. No easements or rights of way are required for access over public lands. First Vanadium has an access agreement with the owner of the fee simple land.

There is currently no developed water supply, or grant of water rights attached to the project. Water rights can be granted following application to the State.

There is an expectation of environmental liabilities associated with historical mining and exploration activity.

First Vanadium advised that to the extent known, there are no other significant factors and risks that may affect access, title or right or ability to perform work on the Project.

25.3 Geology and Mineralization

The Carlin Vanadium deposit is interpreted to be a syngenetic-type vanadium deposit. Exploration programs that use a syngenetic-type model are considered to be applicable to the Project area.

The geological understanding of the settings, lithologies, and structural and alteration controls on mineralization in the different zones is sufficient to support estimation of Mineral Resources. The geological knowledge of the area is also considered sufficiently acceptable to inform conceptual mine planning.

The mineralization style and setting are well understood and can support declaration of Mineral Resources and support conceptual mine planning.

25.4 Exploration, Drilling and Analytical Data Collection in Support of Mineral Resource Estimation

The exploration programs completed to date are appropriate for the deposit style.

RC chip and core logging meets industry standards for vanadium exploration.

No down hole surveys were performed on the legacy drill holes or the First Vanadium core drill holes. The lack of down-hole surveys is not considered to be a significant concern.

The quantity and quality of the lithological, collar and down-hole survey data collected during the exploration programs are sufficient to support Mineral Resource estimation.

Sampling methods are acceptable for Mineral Resource estimation. Core is sampled on 1.5 m intervals, and legacy and RC drilling on 5 ft intervals.

Sample preparation, analysis and security were generally performed in accordance with exploration practices and industry accepted standards at the time the data were collected.

The collected sample data adequately reflect deposit dimensions, true widths of mineralization, and the deposit style. Sampling is representative of the vanadium grades in the deposit, reflecting areas of higher and lower grades.

Twin core and RC holes confirmed the location and tenor of vanadium grades defined by the legacy drilling and testwork.

No material factors were identified with the data collection from the drill programs that could affect Mineral Resource estimation or conceptual mine planning.

25.5 Metallurgical Testwork

Recognized testing facilities conducted the metallurgical work and associated analytical procedures for First Vanadium.

Metallurgical testwork and associated analytical procedures are appropriate to the mineralization type, appropriate to establish the conceptual processing routes, and were performed using samples that are typical of the mineralization styles.

Variability of sample composites used in metallurgical tests were representative of both oxide and non-oxide material in the deposit.

The basic elements of the acidulation, pressure oxidation, uranium removal by ion exchange, oxidation, solvent extraction, scrubbing and stripping, iron removal, AMV precipitation and calcination have been demonstrated. There is a requirement to optimize the conditions to refine the process design. Nevertheless, it is possible to process oxide or non-oxide material for production of a vanadium pentoxide final product from the Project.

Metallurgical recoveries were estimated at:

- Overall oxide material recovery: 78.6%
- Overall non-oxide material recovery: 77.4%

Information on comminution testwork on the non-oxide material was not included in the PEA design criteria for the milling circuit and represents an opportunity.

At an approximate "cut" of 5 µm, only 23.44% w/w of the mass is pulled to the centrate. This indicates a significant improvement over the hydrocyclones where the mass pull is 55.6% w/w. This may lead to an opportunity to reduce overall mass through the process. The caveat is that it is mass only, and would need to be carefully considered with corresponding analytical data to determine the vanadium recovery and carbonate rejection.

The percent solids in the centrate is also higher, at 10.6%, as opposed to 2% for the hydrocyclone concentration product. This may be an opportunity for optimization of the concentrate thickener, starting with a nominally higher feed density.

If high recoveries are to be achieved using a decanter, it may be necessary to consider the use of flocculants. Additional testing using a flocculant in conjunction with the decanter is recommended.

The elution of the resin and the use of multiple loading and elution cycles should be tested in the next Project phase. It is also recommended that the loading test be repeated with the resin starting in the sulphate form to avoid the use of acid conditioning. Higher initial pH values for vanadium extraction should be evaluated. Further work should be performed on loading, scrubbing and stripping of vanadium.

25.6 Mineral Resource Estimates

Mineral Resources are reported using the 2014 CIM Definition Standards, and assume open pit mining methods.

Factors that may affect the Mineral Resource estimate include: changes to commodity price assumptions; changes to metallurgical recovery assumptions and assumptions that the proposed metallurgical recovery process will operate as envisaged; changes to interpretations of geological continuity due to changes in lithological, weathering or structural interpretations; changes to assigned density values in the estimation domains; changes to the input assumptions in the conceptual open pit shape that constrains the estimate; and changes to environmental, permitting and social licence assumptions.

25.7 Mine Plan

The 2020 PEA is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the 2020 PEA based on these Mineral Resources will be realized.

The 2020 PEA mine plan is based on a subset of the Mineral Resource estimate.

The 2020 PEA assumes conventional open pit mining using a conventional Owner-operated equipment fleet. The planned open pit will be mined in four phases.

The mining operations will have an 11-year life, with one year of pre-production. A stockpiling strategy is planned, which will provide process plant feed after the cessation of mining operations.

25.8 Recovery Plan

The process design assumes mineralization supply from an active mining operation for the first 11 years (plus one year of pre-production), followed by five years of stockpile treatment, then a final four years of acid-plant only operation.

The process plant is designed to treat the mill feed materials separately on a campaign basis using common equipment, assuming 3,200 st/d for oxide material only, and 2,500 st/d for non-oxide material.

The higher-grade mill feed material will be processed during the initial years of the Project, while the lower-grade mineralization will be stockpiled close to the processing plant. The oxide and non-oxide mill feed material will be stockpiled separately. The final four years of operation will be fed exclusively from these lower-grade stockpiles.

The process plan consists of: stockpiling and crushing; milling and classification; fines classification; carbon flotation of the kerogen-containing non-oxide mill feed material; acidulation; pressure oxidation; thickening and counter-current washing; ion exchange; solvent extraction; precipitation; calcination; and product handling.

A processing facility of this configuration has not been used for recovery of vanadium. However, the individual unit processes selected are common to, and conventional in, the mining industry, each having multiple installations.

Vanadium pentoxide will be produced as a 1 t bagged product.

25.9 Infrastructure

The project as envisaged in the 2020 PEA will include: one open pit; processing facilities (grinding/classification and extraction process areas, a stand-alone sulphuric acid plant including acid storage and a contracted oxygen plant); specific mining facilities (truck workshop, wash bay, explosives magazine, diesel storage and distribution); combined mine and process offices (administration, management and engineering, change house, workshop, warehouse); assay laboratory; gate house, first aid facility and induction and training facility; haul roads and commercial vehicle access roads; low-grade stockpile; WRSF; TSF; water management facilities; well field for fresh water supply; sewage and gray water treatment facility; hazardous waste handling and despatch facility; and an incoming power supply and acid plant turbine generator set.

All mine personnel are expected to commute from Carlin or other towns located in the region.

25.10 Environmental, Permitting and Social Considerations

First Vanadium, under its subsidiary of Copper One, filed an NOI in November 2017, with the reclamation bond approval provided by the BLM on December 8, 2017. First Vanadium contracted EM Strategies to prepare a PoO for additional exploration activity with a proposed disturbance of up to 100 acres, which would occur in phases. This PoO was prepared in June 2019 and submitted to the BLM in May 2020. Approval of the PoO is pending completion of NEPA compliance.

A number of baseline and supporting environmental surveys have been conducted. Additional studies will be required.

The TSF will be a conventional, downstream constructed, cross-valley impoundment, with the tailings being stored in the valley upstream of an embankment constructed across the valley. The design assumes staged construction of the TSF, with the first stage providing sufficient volume to store one year's worth of tailings storage, and subsequent raises every year. The tailings are expected to be benign, and at present there is no plan to line the TSF basin.

The TSF would be used for the storage of fine tailings during the first 11 years of operation, when the pit is being mined. This will accommodate all the fine plant tailings and 50% (the fine fraction) of the upgrade tailings generated over this period.

During the last four years of operations when the pit is no longer being mined, and stockpiled material is being processed, fine tailings will be discharged into the open pit. This will accommodate all the fine plant tailings and 50% (fine fraction) of the upgrade tailings generated over this period.

The WRSF will be a co-disposal facility. A total of 50% (the coarse fraction) of the separated and filtered upgrade tailings will be co-disposed with the waste rock in the Cole Creek valley during the first 11 years of operation. For the last four years of operation, after mining is finished in year 11, and waste rock is no longer being produced, the separated and filtered coarse fraction of the upgrade tailings will be placed on top of the WRSF.

Additional geochemical characterization of the tailings and waste rock will be required to confirm that they are non-acid generating and do not have the potential to leach contaminants. Adjustments to the design of the TSF, the tailings management plan and WRSF will be required if the materials contained in the TSF or WRSF have the potential to release contaminants to the environment.

As far as possible, non-contact water will be diverted past mining operations and released downstream of mining operations. Precipitation falling on the TSF and in the upstream catchment will be contained in the TSF and used in the process plant.

First Vanadium will need to meet BLM objectives for post mining land uses, which will likely include mineral exploration and development, livestock grazing, wildlife habitat and dispersed recreation. Because neither the PoO for the mining operation nor the NEPA process have been initiated with the BLM, reclamation bonding estimates have not been completed or approved by the authorizing agencies. Based on the conceptual mine plan, closure costs are estimated by Wood to be US$30 million. This assumes a mine life of 16 years and production rates of approximately 1 Mst per year. The total disturbed area of the mine, tailings impoundment, waste rock facility, stockpile, processing plant and roads is estimated at 540 acres.

In addition to NEPA compliance, numerous federal, state and local permits and approvals will need to be obtained prior to the start of operations. A preliminary list of the key permits was developed and a more detailed review of the longer-lead permit items undertaken. Long-lead permits include the PoO, NEPA process, Mining Reclamation Permit, WPCP, and potentially, if required, a Nuclear Regulatory Commission Materials License. Generally, the longest lead items with regard to permitting are the PoO and NEPA compliance.

First Vanadium will take steps to engage the local community to create awareness regarding the Project. During the NEPA process, the public will have multiple opportunities to comment on the project and express support or concerns.

25.11 Markets and Contracts

First Vanadium sourced a vanadium market study and update by Roskill Consulting Group Ltd (Roskill) to understand vanadium's uses, global and country-by-country supply and demand, pipeline of projects, market outlook and their price forecasts.

Wood and First Vanadium reviewed the Roskill and publicly-available pricing data, and selected a long-term price forecast of US$10.65 per pound of V_2O_5 sold as an appropriate target metal price for the economic analysis. This price selection is bracketed by the peak and low of the five-year trailing average, by the pricing used by peers in publicly-available studies, and by the pricing forecast probabilities from Roskill. It is significantly higher than the current market price.

Due to the early stage of development, no rail or port contracts have been entered into. No off-take agreements are in place. There may be potential to supply vanadium battery manufacturers, but no testwork has been undertaken to determine if this provides a Project upside opportunity. First Vanadium expects that the eventual terms, rates or charges that will be associated with contracts when they are concluded, will be within industry norms for a relatively non-freely traded commodity such as vanadium.

For the purposes of the 2020 PEA economic model, Wood assumed a sulphuric acid purchase price of US$144/st, and a sulphuric acid selling price of US$104/st. Wood has assumed sulphur prill costs of US$178/st, on a delivered to site, freight-on-board Los Angeles or San Francisco basis.

First Vanadium has had initial discussions with acid providers in the Carlin area, and these providers could meet projected supply shortfalls and would be able to purchase excess acid production.

No contracts have been entered into. First Vanadium expects that the eventual terms, rates or charges that will be associated with contracts when they are concluded, will be within industry norms for relatively non-freely traded commodities such as sulphuric acid and prilled sulphur supply.

Some of the power requirements for processing will be generated from a turbine-generator set which will use waste heat from the acid plant in parallel with a new distribution line to be constructed for the Project. In the last four years of the projected operating life, the turbines produce excess power, superfluous to operational requirements. The excess power would be on-sold to a third party.

Wood assumed for 2020 PEA purposes that supply into the existing grid of a Nevada power supplier from the Project turbines would attract a payment of about US$0.05/kWh/hr.

No contracts have been entered into for the supply of electrical power. First Vanadium expects that the eventual terms, rates or charges that will be associated with contracts when they are concluded, will be within industry norms for supply of electrical energy in Nevada.

25.12 Capital Cost Estimates

The capital cost estimates fall under the AACE International Class 5 Estimate classification where a Class 5 estimate cost estimate accuracy is defined as within +50%/-30% of the final project cost, including contingency.

The estimated initial capital costs total US$535.3 M. There is an additional US$51.9 M in sustaining capital over the LOM.

25.13 Operating Cost Estimates

The operating cost estimates fall under the AACE International Class 5 Estimate classification where a Class 5 estimate cost estimate accuracy is defined as within +50%/-30% of the final project cost, including contingency.

Mine operating costs average US$2.30/st moved, including stockpile re-handle. Excluding the pre-production period, the average mining cost is US$2.29/st moved or US$9.80/st processed.

Process operating costs for combined oxide and non-oxide material over LOM are estimated to average US$44.98/st processed. The average LOM oxide material process cost, including acid consumption, is US$36.74/st of processed oxide mineralized material and the average LOM non-oxide material process cost, including acid consumption, is US$52.74/st of non-oxide mill feed material.

General and administrative costs are estimated at US$2.01/st processed.

25.14 Economic Analysis

The 2020 PEA is partly based on Inferred Mineral Resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the 2020 PEA based on these Mineral Resources will be realized. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability.

The economic analysis returned the following results:

- Pre-tax
  - Undiscounted cashflow of US$356 M
  - NPV at 6% discount rate of US$56 M
  - IRR of 7.9%
  - Payback period of 7.5 years
- After-tax
  - Undiscounted cashflow of US$301 M
  - NPV at 6% discount rate of US$29 M
  - IRR of 7%
  - Payback period of 7.7 years

The LOM cash operating costs average US$5.17/lb V_2O_5.

A sensitivity analysis was completed over a ±45% range for capital costs, operating costs, vanadium grade, and vanadium price. Vanadium grade sensitivity mirrored that of the vanadium price sensitivity. The Project cashflow is most sensitive to fluctuations in the vanadium price and vanadium grade. It is less sensitive to operating costs, and least sensitive to variations in capital costs.

The 2020 PEA includes an extension of the Project for a four-year period after the processing is completed, during which time the Project will sell sulphuric acid and energy. This assumption results in an increase of 13% and 36% to the after-tax cashflow and NPV @6% results, respectively. Wood has used conservative commodity prices for the sulphuric acid and energy and costs during this period to support a conceptual estimate. Future studies will require a deeper analysis of the sulphuric acid and energy market to confirm the assumptions. Actual results from those studies may vary from the assumptions in the 2020 PEA.

25.15 Risks and Opportunities

No formal risk and opportunity analysis was undertaken on the 2020 PEA. The QPs note the following in their areas of expertise:

25.15.1 Geology and Exploration

Geophysical and structural interpretations indicate the potential for gold mineralization with affinities to Carlin Trend deposits, which warrants further investigation.

25.15.2 Metallurgical Testwork

There are differences in comminution testwork results between ALS Metallurgy and Bureau Veritas. Upon review, it was determined that the sample tested at ALS Metallurgy was not a good representation of the non-oxide mineralization. The Bureau Veritas Bond ball mill work index was lower. The information was not included in the PEA design criteria for the milling circuit and represents an opportunity to modify the comminution design and reduce cost estimates.

A test to determine if the use of decanter centrifuges represented a viable solution for physical beneficiation of the Carlin vanadium material was conducted. It was concluded from this preliminary evaluation that it would be worthwhile progressing to small-scale decanter centrifuge tests as a future opportunity.

At an approximate “cut” of 5 µm, only 23.44% w/w of the mass is pulled to the centrate. This indicates a significant improvement over the hydrocyclones where the mass pull is 55.6% w/w. This may lead to an opportunity to reduce overall mass through the process. The caveat is that it is mass only, and would need to be carefully considered with corresponding analytical data to determine the vanadium recovery and carbonate rejection. A reduction in overall mass would result in an upside to the process cost estimate and process design.

The percent solids in the centrate is higher, at 10.6%, as opposed to 2% for the hydrocyclone concentration product. This may be an opportunity for optimization of the concentrate thickener, starting with a nominally higher feed density. This could result in a reduction in concentrate thickener-related cost estimates.

Beneficiation and de-sliming of the oxide and non-oxide material warrants further investigation to establish vanadium concentrate recovery, mass, and carbonate rejection rates. Based on the relative efficiency of centrifuges versus hydrocyclones this may be an opportunity to increase vanadium recovery and rejection rate of carbonates while reducing the overall mass pull.

25.15.3 Mine Plan

A small portion of the pit design assumes that an agreement will be reached with the adjacent tenement holder, Nevada Gold Mines to allow a portion of the pit to extend for a distance of about 25–30 m onto ground held by Nevada Gold Mines. There is approximately 0.72 Mt, grading 0.62% V_2O_5 in the pit design that crosses the Project boundary, and is the only portion of the mine plan that would be at risk if an access agreement could not be concluded. The subset of the Mineral Resource estimate in the 2020 PEA mine plan does not include these mineralized blocks from the Nevada Gold Mines ground; the blocks are treated as though they were waste in the mine plan and are sent to the WRF.

Although sulphides are present, there is no information in the block model to determine PAG characteristics for the waste material. A better understanding of the PAG characteristics may impact the cost estimates if mitigation strategies need to be incorporated in updated mine designs.

Changes to the NSR values or NSR input values used to determine the low-grade and medium-grade stockpile tonnages and grade will have an effect on the mine and throughput plan assumptions, cost estimates, and economic analysis.

Drill factor assumptions are based on the rock to be mined being soft to medium. There were no unconfined compressive strength test results available at the Report effective date; such data may not confirm these rock hardness assumptions, and may result in changes to the cost estimates.

25.15.4 Recovery Plan

Mineralization upgrade or gangue rejection using cyclones has been applied on projects in the past, albeit at a coarser grind. The ultra-fine grind and the use of centrifuges instead of cyclones in the talc industry is common. Sighting tests suggest that the process should work as intended. However, the use of cyclones in a vanadium project as proposed in the 2020 PEA has not been done under commercial production.

Solid–liquid separation of ultra-fine slurries carries risk in the ability to achieve meaningful thickener and centrifuge slurry densities, and the impact on the selection and sizing of equipment for solid liquid separation processes. Changes in the input assumptions could lead to changes in equipment sizing and selection, which would affect the process cost estimates.

The significant gangue acid consumption points to a high dissolved solids concentration and gypsum saturation, which would likely present challenges in the downstream processes. These elements require additional review in the next study phase. There could be an impact on the process design and process cost estimates.

Fluoride is present in the mineralization in low concentrations but could influence the selected materials of construction considering the high temperature and high acid concentrations in sections of the process. This would have an effect on process design and process cost estimates.

25.15.5 Co-Disposal of Waste Rock and Coarse Fraction Upgrade Tailings

First Vanadium is considering a waste disposal method of commingling waste (coarse fraction upgrade tailings and waste rock) and placing plant tailings and the fine fraction upgrade tailings in the open pit as backfill. Since this is currently an unusual method for waste disposal in Nevada, it is anticipated that additional testing and modeling will be required to satisfy the regulatory agencies that this can be done without degrading waters of the State. There is a risk to the Project cost and mine design assumptions if the regulatory authorities will not accept the commingling concept.

The 2020 PEA WRSF design was based on the estimate of waste rock tonnage to be stored. An assumption was made that the coarse upgrade tailings fraction would infill voids and spaces between the waste rocks. The WRSF design would need to be expanded to accommodate the additional 6.1 Mst of coarse upgrade tailings if this assumption is incorrect. There would be an increase in costs in conjunction with any WRSF expansion.

The WRSF has been designed assuming that the waste rock and tailings stored in it are non-acid generating, and do not have the potential to leach contaminants. Additional geochemical characterization of the waste rock and tailings planned to be stored in the facility will be required. The design of the facility may need to be adjusted if the tailings or waste rock have the potential to release contaminants into the environment, with the revised design possibly incorporating underliners, a drainage collection system and contact water ponds.

25.15.6 Tailings Storage Facility

The location of the TSF is conceptual. The site was selected so as to minimize both the Project footprint and the catchment reporting to the TSF, thereby facilitating water management. The TSF embankment lies in the Project area, but the upstream tailings disposal area is outside First Vanadium's mineral tenure.

First Vanadium does not hold any surface rights in the upstream portion of the conceptual TSF area. There is a risk that surface rights may not be able to be obtained, or that the costs for obtaining the surface rights are outside those envisaged in the 2020 PEA.

The upstream portion of the conceptual TSF location is within mineral tenure held by third parties. There is a risk that the owner of the mineral rights that cover the conceptual TSF location could object to the TSF location as selected. Depending on the particulars of any objection, there is potential that the mine plan and cost estimates could be affected.

The TSF was designed assuming that the tailings are non-acid generating and that they do not have the potential to leach contaminants. Additional geochemical characterization will be required to confirm this assumption. The design may need to be adjusted, possibly incorporating a liner in the impoundment area, if the tailings are acid generating or have the potential to leach contaminants.

25.15.7 Power Price Forecasting

There may be some minor upside potential for the operating cost estimate if the electricity that will be generated by First Vanadium's activities can qualify for a green energy bonus. The energy generation is carbon neutral.

There is a risk to the cost estimates if the resale price estimated in the 2020 PEA for power sold into the grid is too high.

25.15.8 Acid Plant

There may be an opportunity to reduce acid plant costs if the acid plant can be modularized. This should be investigated in the next project phase.

Definitive quotes may result in decreases or increases to the plant costs as envisaged in the 2020 PEA.

25.15.9 Acid Consumption

The acid consumption estimate is based on interpolation of calcium, magnesium, and sulphur grades into the block model, and on an average assignment of aluminium grades to the blocks in the block model that is based on the results of tests on two metallurgical composites. Additional testwork is required to confirm that these results are representative of the variability within the deposit as a whole. If the results are not representative, this could affect operating cost estimates, and the capital cost estimate for the acid plant.

The acid consumption formula is based on a combination of stoichiometry and extent of reaction derived from testwork results from the two metallurgical composites, which were matched to the testwork results. If these results are not representative of the variability within the deposit as a whole, there is a risk that the acid consumption will be higher than predicted, leading to increases in acid-related costs. Conversely the results may indicate that acid consumption will be lower than predicted, resulting in a project upside opportunity of acid-related cost reductions.

25.15.10 Acid Price Forecasting

Market conditions related to local or global acid pricing can be volatile. While the general assumption in the 2020 PEA is that acid is likely to be sold into the local market, this assumption primarily depends on activity within the local mining industry in Nevada. If the industry is in a downturn, the projected acid pricing may be too optimistic. If the industry is in an upturn, the projected acid pricing may be too low. If the acid is sold onto the global market, a similar risk and opportunity exist, depending on the state of the market and the FOB considerations pertaining at the time.

25.15.11 Acid Product

The assumption as to the ability to on-sell acid from the acid plant, particularly in the last years of the mine life as forecast in the 2020 PEA will be affected by the market conditions prevailing at the time. There is a risk that the market will be in oversupply, and the market assumptions may not be realized. There is an opportunity if the market is undersupplied, and there are more options for acid sales than are currently contemplated. These would primarily affect cost assumptions.

25.15.12 Blending of Oxide and Non-Oxide Mineralized Material

The oxide mill feed requires super-heated steam to achieve the operating temperature and pressure, whereas the non-oxide mill feed allows for autothermal operation. There may be potential to blend oxide and non-oxide material to reduce operating costs.

25.15.13 Vanadium Price Forecasting

Vanadium pricing is volatile, and there is a risk that the vanadium price will be lower than that envisaged in the 2020 PEA. Conversely, there have been historical periods where the vanadium price has been higher than that used in the 2020 PEA, and this is a potential Project upside if similar pricing highs occur during operations. The Project cashflow is most sensitive to fluctuations in the vanadium price and vanadium grade.

25.15.14 Vanadium Product

There may be potential to supply vanadium battery manufacturers, but no testwork has as yet been done to determine if this is an opportunity for the Project.

25.16 Conclusions

Under the assumptions set out in this 2020 PEA, the Project as envisaged shows a positive return.

26.0 RECOMMENDATIONS

26.1 Introduction

Recommendations have been made for two phases of work. The second work phase is dependent on the results of the first phase.

The first recommended work phase comprises drilling, which is designed to investigate the gold target, and provide drill core for future metallurgical and geotechnical investigations. The phase also includes a metallurgical testwork program that will be undertaken to investigate possible reductions in the 2020 PEA capital and operating cost estimates.

Phase 2 recommendations would only be conducted if positive results in terms of cost reductions are obtained from the Phase 1 metallurgical testwork program. If undertaken, this phase would include step-out/infill drilling, advanced metallurgical tests, hydrological and geotechnical work, market studies, review of acid plant assumptions, and consideration of the proposed waste–tailings co-disposal option.

Recommendations Phase 1 is budgeted at approximately US$0.93–1.08 M. Recommendations Phase 2 is estimated at a total cost of about US$1.425–1.85 M.

26.2 Recommendations Phase 1

26.2.1 Gold

First Vanadium advised Wood that an RC drill program is under consideration to test the gold target potential. This is suggested to comprise six drill holes, for approximately 12,000 ft of drilling, at an all-in drilling cost of about C$75/ft (approximately US$48/ft). The all-in drill costs factor in drilling costs for deep drill holes that will be more than 1,000 ft in length and will require large drill rigs to complete.

The program should initially focus on two vertical holes spaced approximately 1.5 km apart to intercept a key stratigraphic unit (Popovich Formation) for potential hydrothermal alteration, gold pathfinder metals, and gold mineralization. These two pilot holes will provide information for the location of the remaining four drill holes, based on the vectoring indications from that drilling. Completion of the program will depend on drill hole results.

The overall program cost is estimated at approximately US$780,000.

26.2.2 Metallurgical Testwork

Additional metallurgical testwork is recommended to focus on two key items that may reduce capital and operating costs:

- Classification testwork using centrifuges or other alternative technologies
- Solid–liquid separation testwork on flotation concentrates, fines slurry, POX feed and POX discharge slurry.

This work can be conducted using existing drill core, and is estimated to cost about US$150,000–300,000.

26.2.3 Vanadium

A core drill program is recommended to provide geotechnical information and to provide fresh drill core for advanced metallurgical testwork purposes. This program is envisaged as about six PQ-size core holes (approximately 1,800 ft), at an estimated all-in drilling cost of $170/ft.

A budget of about $306,000 is estimated for this program.

26.3 Recommendations Phase 2

26.3.1 Overview

Phase 2 recommendations would only be conducted if positive results in terms of cost reductions are obtained from the Phase 1 metallurgical testwork program.

26.3.2 Drill Program

First Vanadium advised Wood that a combined infill/step-out drill program would be conducted. This will consist of about eight core drill holes, for approximately 2,500 ft of drilling, and 39 RC drill holes (15,000 ft). Wood has assumed the core holes will be NQ size, at an all-in drilling cost of US$70/ft for core. The RC program assumes an all-in drilling cost of US$40 for RC. The lower RC all-in costs reflect shallower drill holes, and the use of smaller drill rigs than the gold target drilling in Phase 1.

The program aim is to provide sufficient data to potentially support upgrade of vanadium mineralization that is currently classified as Inferred to higher-confidence categories and to fully define the deposit extents.

The overall program cost is estimated at about US$775,000.

26.3.3 Geotechnical and Hydrological

Drill core generated in the vanadium drill program in Phase 1 should be subject to geotechnical logging, assessment and test work, such as unconfined compressive strength and point load tests. These data should then be used to generate pit slope recommendations by sector to support more detailed pit designs.

A review should be made of the drill data from the vanadium drill program to confirm that no perched water tables can be expected in the deposit area, and that the water table is lower than the projected pit base, to support dewatering and operational assumptions.

This work program has a budget estimate of approximately US$25,000–US$50,000.

26.3.4 Block Model

A review should be conducted to confirm that elements that may contribute to acid-consuming minerals have been correctly identified. Any elements that have not already been estimated in the block model, or which have been estimated using averages (such as aluminium) should be interpolated.

This work is estimated to cost about US$10,000–US$15,000.

26.3.5 Metallurgical Testwork

Once sufficient fresh drill core is available from the vanadium drill program recommended in Phase 1, the following metallurgical tests are recommended:

- Bench scale comminution testing
- Flotation testwork
- Acidulation and POX testing to include establishing optimum process conditions, reagent consumptions and recovery
- Ion exchange testing on pregnant leach solution to include adsorption and elution kinetics and equilibrium isotherms
- Solvent extraction testing on ion exchange raffinate to include loading and stripping kinetics, equilibrium isotherms and continuous solvent extraction mini-plant run

- Precipitation and calcine testwork to include kinetics, determining calcine parameters and product quality.

These programs are estimated at approximately US$350,000 to US$700,000.

26.3.6 Market Studies

Project-specific marketing studies should be conducted to support $V_2 0_5$, sulphur, and sulphuric acid pricing and marketability assumptions. Additional Project-specific research as to sulphur sources should be included.

This work program has a budget estimate of approximately US$75,000–US$100,000, assuming that the sulphuric acid and sulphur markets would be required from a minimum of two sources.

26.3.7 Acid Plant Package

Site-specific budgetary estimates for the supply and construction of the acid plant with all ancillaries should be obtained from suppliers. Depending on the size of the plant this may included modules as well as a stick-built (conventional build-on-site) plant.

This is budgeted at US$40,000–US$60,000, assuming that quotes would be required from a minimum of two suppliers.

26.3.8 Waste/Tailings Co-Disposal

Discussions should be initiated with the relevant regulatory authorities as to the feasibility of the co-disposal and in-pit disposal of the waste rock and tailings that are planned to be produced. Co-disposal and in-pit disposal of this type of tailings has not previously been conducted in Nevada, and the 2020 PEA envisages that the proposed facilities will be unlined.

26.3.9 Tailings and Waste Rock Geochemical Characterization

The TSF was configured assuming that the tailings are inert, and that the basin and upstream embankment face of the TSF do not need to be lined with a geomembrane. Likewise, disposal of tailings in the pit will likely not be viable if the tailings have the potential to leach metals, if it is acid, or if they have the potential to generate acid. The WRSF has also been designed under the assumption that the waste rock is not acid generating, and that it will not leach metals. Additional geochemical characterization of the tailings and waste rock will be required to verify that the assumption of inert tailings and waste rock is correct.

This program is budgeted at $150,000.

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