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Halleck Creek Scoping Study Technical Report

Revision 1

American Rare Earths, Ltd.
Halleck Creek
Rare Earths Scoping Study
Project No. 182923824

15 March 2024

Stantec

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EXECUTIVE SUMMARY

INTRODUCTION

American Rare Earths Pty. Ltd. (ARR) has engaged Stantec Consulting Services Inc. (Stantec) to conduct a scoping study under the Australian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code or JORC) standards for the Halleck Creek Rare Earth Deposit, located in Albany County and Platte County, Wyoming. Halleck Creek is in the Central Laramie Mountains, approximately 70 km northeast of Laramie and 30 km southwest of Wheatland, Wyoming. The Halleck Creek project (the "project") is composed of the Cowboy State Mine in the company's southern land holdings and the Overton Mountain Resource area in the north.

American Rare Earths, Limited (ASX: ARR, OTCQB: ARRNF) (ARR or the Company), through its wholly-owned subsidiary Wyoming Rare (USA) Inc has performed detailed exploration mapping, surface sampling, and exploration drilling at Halleck Creek to develop mineable rare earth elements. Plans include beginning baseline hydrological and environmental studies to start the permitting process.

ARR provided Stantec with previous work on mineral resources, metallurgy, and environmental work completed by Odessa Resources and Wood PLC (Wood) (Table A).

This scoping study is a preliminary assessment based on a low accuracy technical and economic assessments (Class 5 AACE +/- 25-35% and includes a contingency factor of 20%).

Table A: Overview of Report Sections

Section	Subject Matter	Author and QP Sign-off
0	General Information / Executive Summary	Stantec (and others)
1.0	Introduction	Stantec
2.0	Property Description	ARR
3.0	Accessibility, Climate, Local Resources, Infrastructure, and Physiography	ARR
4.0	History	ARR
5.0	Geological Setting, Mineralization, and Deposit	ARR
6.0	Exploration and Drilling	ARR
7.0	Sample Preparation, Analyses, and Security	ARR
8.0	Data Verification	ARR
9.0	Mineral Processing and Metallurgical Testing	Tetra Tech
10.0	Mineral Resource Estimates	ARR, Odessa
12.0	Mining Methods	Stantec
13.0	Processing and Recovery Methods	Tetra Tech
14.0	Facilities and Infrastructure	Stantec
15.0	Market Analysis	ARR
16.0	Environmental	ARR
17.0	Capital and Operating Cost Estimate	Stantec, Tetra Tech

Section	Subject Matter	Author and QP Sign-off
18.0	Economic Analysis	Stantec
19.0	Adjacent Properties	ARR
20.0	Other Relevant Data and Information	Stantec
21.0	Interpretation and Conclusions	Stantec
22.0	Recommendations	Stantec
23.0	Reliance on Information Provided by the Registrant	Stantec
24.0	References	Stantec
Appendix A	JORC Table 1 Reporting	Stantec (and others)
Appendix B	Metal Pricing	ARR
Appendix C	Qualified Person Certification	Stantec, Tetra Tech

CONCLUSIONS

Wyoming is a mining friendly state with a good base of skilled labor from the oil and gas and mining industries, both on the technical and operational side. The Cowboy State Mine resides on state mineral leases fully controlled by ARR; mining is straightforward and will be performed by open pit methods using conventional rubber-tired trucks and front-end loaders and supported by basic mine site infrastructure consisting of a waste dump, tailings impoundment, line power and a natural gas line and prefabricated buildings.

Processing will begin at the mine site with comminution, and mineral separation producing a concentrate which will be trucked on state and federal highways to refining facilities probably near Wheatland Wyoming. The refining facility will perform leaching, impurity removal and solvent extraction to produce payable rare earth metal oxides, specifically NdPr, La, Dy, Tb and SEG (mixed samarium europium and gadolinium). Tailings will likely be hauled back to the mine site using the same fleet of trucks.

Project capital and operating costs are based on Stantec's and Tetra Tech's prior experience on mine and mill operations of this size and scale. Tetra Tech, Inc. is an American consulting and engineering services firm that provides consulting, engineering, program management, and construction management services in the areas of water, environment, infrastructure, resource management, energy, and international development. Tetra Tech's scope of work included all mineral processing including tailings storage facilities for the project.

Economics for the project are robust, due in part to the large scale of resources, which occurs at surface with a very low strip ratio (0.03). The project is easily scalable due to the modest production rate assumed in this report and can respond to increased market demand for rare earth metals. Likewise, a modular approach to refining allows for expansion as demand increases.

CAPITAL AND OPERATING COST ESTIMATES

The scoping study for the Cowboy State Mine is based on an annual mining and processing rate of 3.0 Mtpa for a period of 20-years (Table B). It is important to note, that due to the extensive mineralization at the site, and low strip ratio, Stantec has shown mining could occur over 150 years based on the resource estimates, at the current planned production rate and using current economics. A preproduction construction schedule of 2.5 years has been assumed and total mill feed processed is 63.2 Mt.

Stantec based capital and operating costs for a 3.0 Mtpa open pit mining operation from the appropriate cost model from Costmine's Mining Cost Service. Based on Stantec's mining experience, these costs were applied to the mine design and conditions at Halleck Creek and are appropriate at this level of study. Stantec also calculated infrastructure costs based on site specifics and costs from Costmine's Mining Cost Service. Stantec assumed constant 2023 US dollars, metal pricing, recoveries and costs as stated in the specific sections of this report.

Process capital estimates were provided by Tetra Tech and considered infrastructure, equipment, and field costs assuming a portion of processing facilities will be located at Cowboy State Mine with the remainder located near Wheatland. Tetra Tech used an analogous rare earth processing project as the basis for this cost estimate.

ECONOMIC ANALYSIS

Cautionary Statement: Stantec is not aware of any other specific risks or uncertainties that might significantly affect the Mineral Resource or the consequent economic analysis. Estimation of costs and rare earth prices for the purposes of the economic analysis over the life of mine production is by its nature forward-looking and subject to various risks and uncertainties. No forward-looking statement can be guaranteed, and actual future results may vary materially.

An economic analysis was performed by Stantec using the assumptions presented in this technical report. The Halleck Creek base case cash flow is preliminary in nature and based on Measured, Indicated, and Inferred Mineral Resources (Figure A and Figure B).

Table B: Summary of Costs and Economic Metrics

Project	Unit	Value
Phase 1 Mine Plan	yr	20+
Processing Run-of-Mine (ROM)	Mtpa	3.0
Total Production	Mt	64,263,399
Construction Period	yr	2.5

Capital Expenditures	Unit	Value
Initial Mine Capital	USD	5,423,976
Initial Processing Capital	USD	374,644,403
Contingency (20%)	USD	76,013,676
Total Initial Capital	USD	456,082,054

Operating Costs	Unit	Value
NdPr Oxide	USD$/kg	38.38
Tb Oxide	USD$/kg	632.56
Dy Oxide	USD$/kg	168.68
SEG Concentrate	USD$/kg	4.22
La	USD$/kg	0.84
Total	USD$/kg	25.66

Pricing	Unit	Value
NdPr Oxide	USD$/kg	91.00
Tb Oxide	USD$/kg	1,500.00
Dy Oxide	USD$/kg	400.00
SEG Concentrate	USD$/kg	10.00
La	USD$/kg	2.00
Total		60.85

Before Tax Financials	Unit	Value
Free Cash Flow	USD	2,081,100,045
NPV	at 8%	673,886,445
NPV	at 10%	505,055,903
IRR (%)	%	23
Payback Period	yr	2.9

Recovery	Unit	Value
NdPr	%	63.9%
Tb	%	70.2%
Dy	%	66.5%
SEG	%	70.1%
La	%	68.6%

After Tax Financial	Unit	Value
Free Cash Flow	USD	1,845,074,127
Federal & State Taxes Paid	USD	(236,025,918)
NPV	at 8%	582,244,832
NPV	at 10%	429,954,875
IRR (%)	%	21
Payback Period	yr	3.1

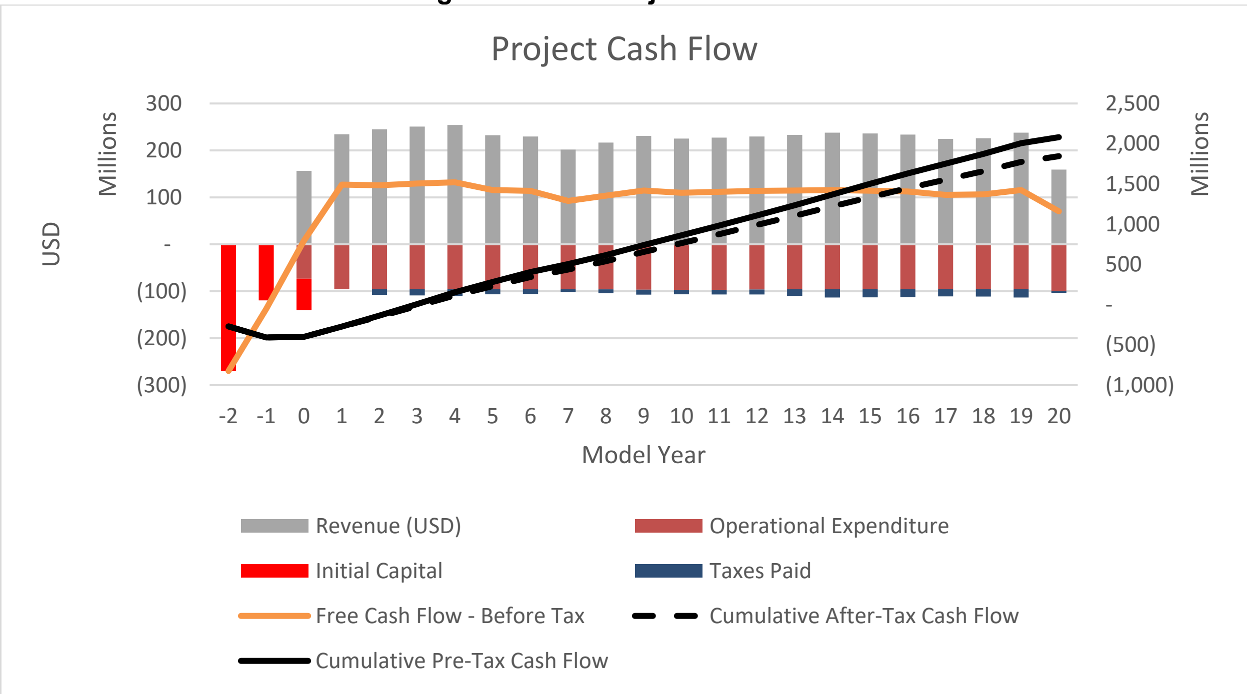
Annual production (average)	Unit	Value
NdPr Oxide	mt	1,529
Tb Oxide	mt	17
Dy Oxide	mt	91
SEG Concentrate	mt	383
La Carbonate	mt	1,486
Total	mt	3,506

Stantec assessed Halleck Creek to be subject to four separate royalties and a federal income tax and pays no state income tax. Total income taxes paid over the life of the mine are $236 M.

As part of the tax treatment, the economic evaluation includes a production tax credit, known as the *Advanced Manufacturing Production Tax Credit, part of the Inflation Reduction Act (IRA),* better known as 45X. The production tax credit is equal to 10% of the costs incurred by critical minerals producers, including rare earth producers.. The tax credit is applied to processing processes with exclusions for mining, chemical reagents. Future modifications may include mining and chemical reagent costs be added to the IRA.

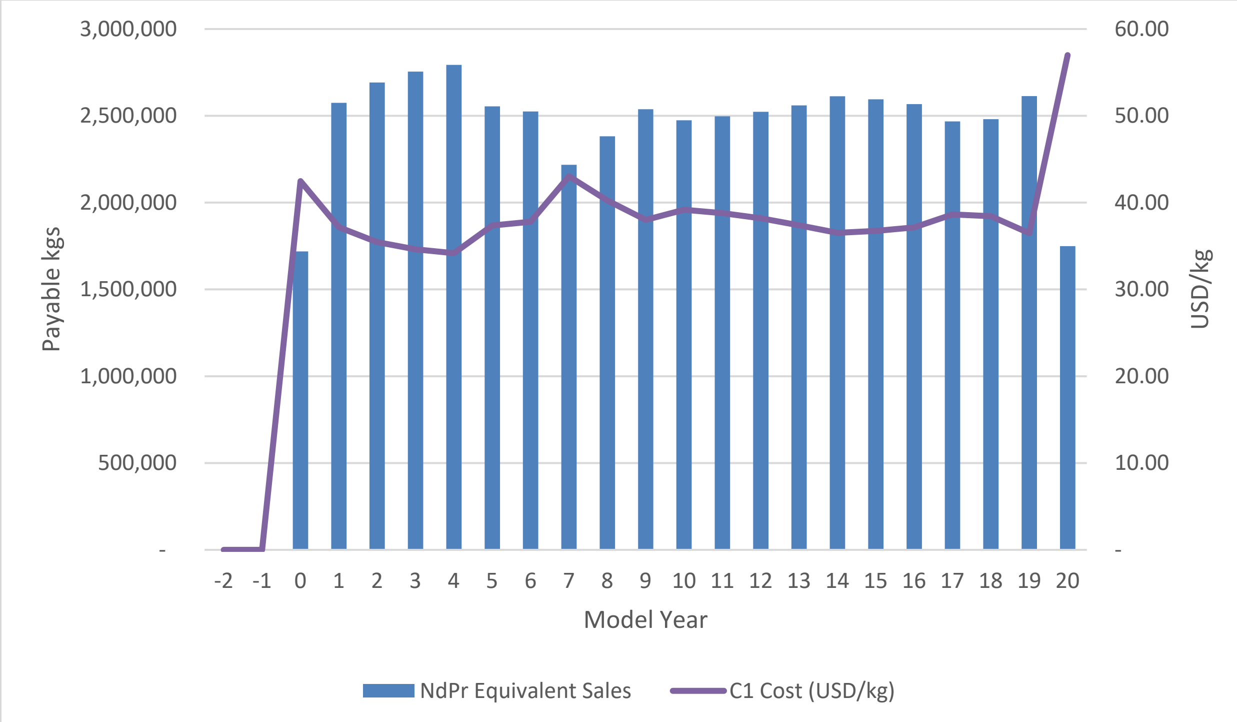
Royalties applied to the economics of the project include a Wyoming State Royalty, a severance tax, an Albany County ad valorem tax, and an industrial property tax. Total royalties paid over the life of mine equal $193.7 M.

Figure A: Project Cash Flow



The mining production schedule currently being considered generates the production profile of equivalent NdPr Sales with a C1 cost as shown in Figure B.

Figure B: Production Profile



Stantec completed an alternative schedule to evaluate a higher, 6.0 Mtpa, production rate, factoring mining and milling OPEX and CAPEX with associated downstream economics. Results of the alternative scenario yielded better NPV and IRR when compared to the 3.0 Mtpa base case. A comparison between the two cases is shown in Table C.

Table C: Production Scenario Summary

LOM Mining Stats	3.0 Mtpa Base Case	6.0 Mtpa Alt. Case
Total Ore Mined (Mt)	62.3	124.5
Total Waste Mined (Mt)	1.9	2.9
Total Material Mined (Mt)	64.3	127.4
Strip Ratio	0.03	0.02
Recovered Rare Earths	**3.0 Mtpa Base Case**	**6.0 Mtpa Alt. Case**
La (Mkg)	32.1	56.7
NdPr (Mkg)	34.5	62.0
SEG (Mkg)	8.6	15.6
Tb (Mkg)	0.4	0.8
Dy (Mkg)	1.9	3.4
NdPr_Eq (Mkg)	51.9	92.5
NdPr_Eq (g/t)	832	743
LOM Cash Flow	**3.0 Mtpa Base Case**	**6.0 Mtpa Alt. Case**
Total Revenue (MUSD)	4,722	8,416
OPEX Mining (MUSD)	305	567
OPEX Milling (MUSD)	1,648	2,986
CAPEX Mining (MUSD)	7	10
CAPEX Milling (MUSD)	450	727
After Tax Metrics	**3.0 Mtpa Base Case**	**6.0 Mtpa Alt. Case**
Free Cash Flow (MUSD)	1,845	3,335
Federal and State Taxes Paid (MUSD)	236	411
NPV at 8% (MUSD)	582	1,065
NPV at 10% (MUSD)	430	795
IRR (%)	21.1%	22.3%
Payback Period	3.1 yr	3.0 yr

SENSITIVITY ANALYSIS

Stantec evaluated sensitivities to price, mining cost, processing cost and processing capital. Ranges from 60% to 120% (-40% to +20%) were evaluated for each case. The after-tax cash flow sensitivities are shown in Figure C and Figure D for the 3.0 Mtpa base case, and Figure E and Figure F for the 6.0 Mtpa alternative case.

Figure C: 3.0 Mtpa Base Case – After-tax NPV

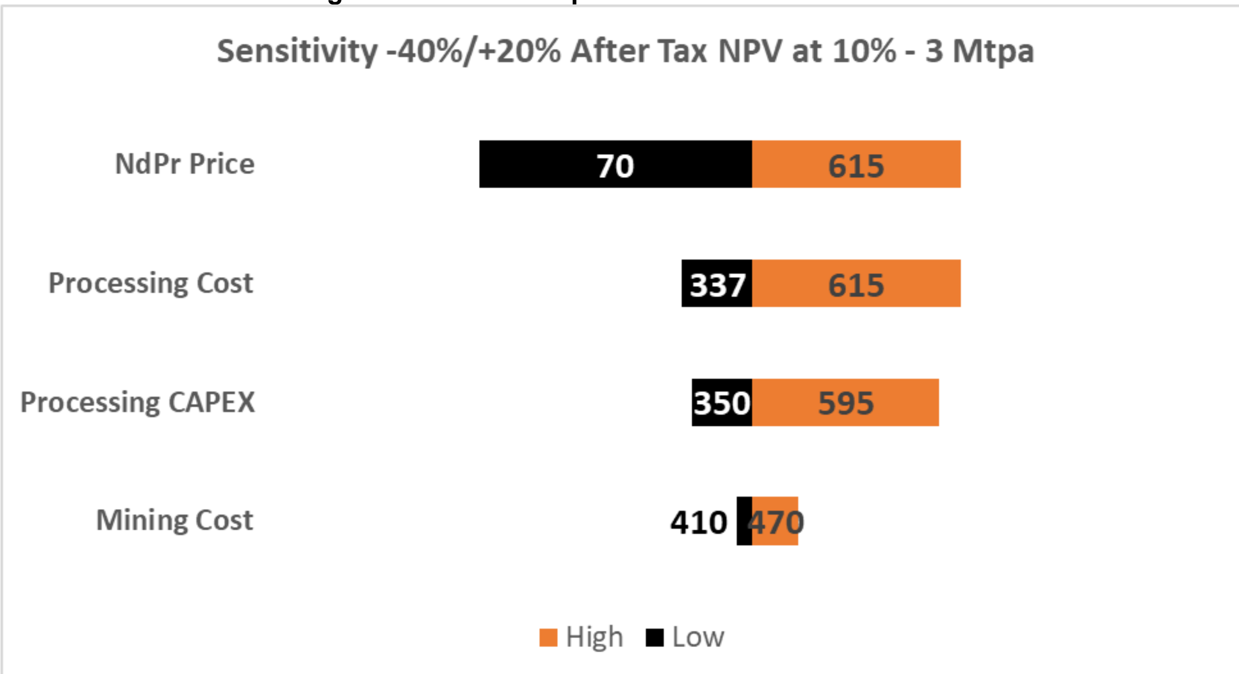


Figure D: 3.0 Mtpa Base Case – After-tax IRR

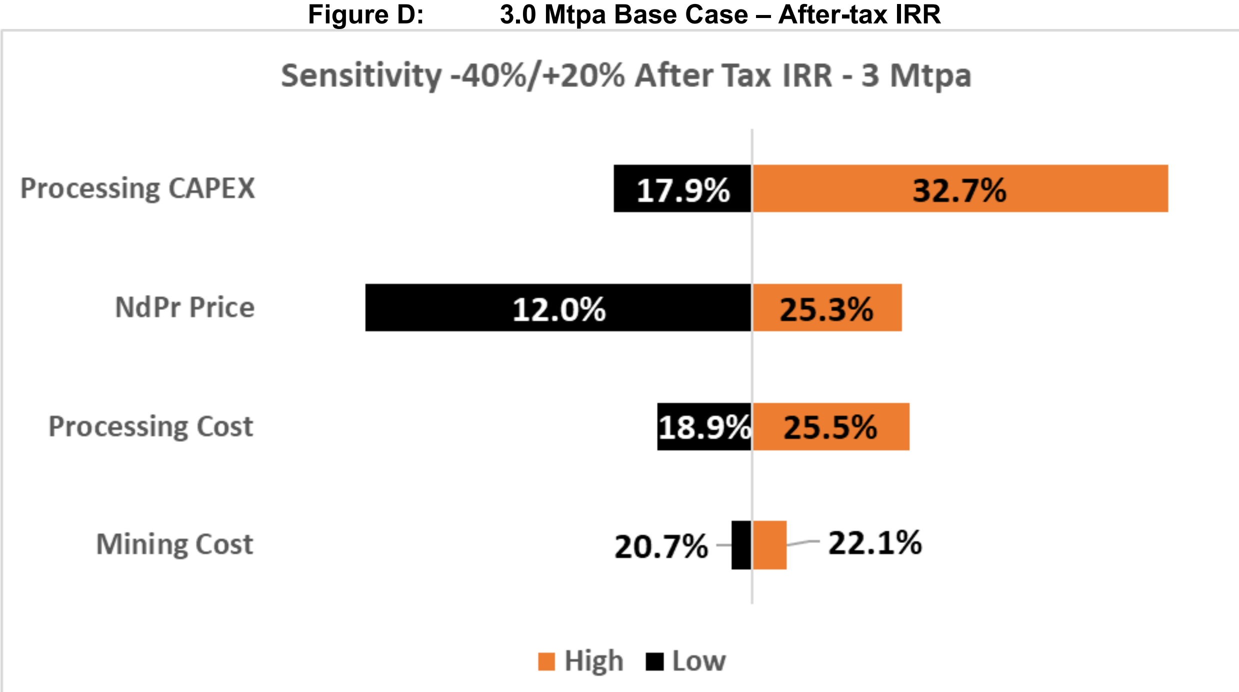


Figure E: 6.0 Mtpa Base Case – After-tax NVP

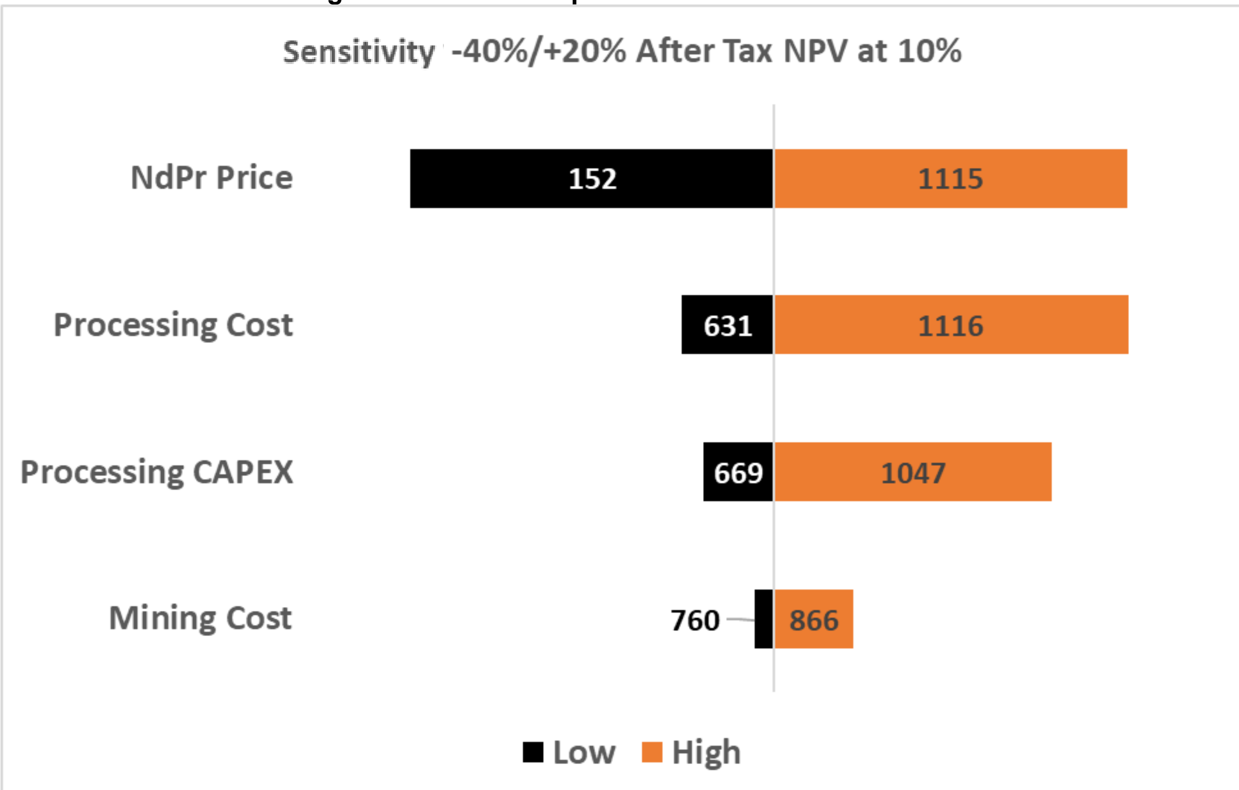
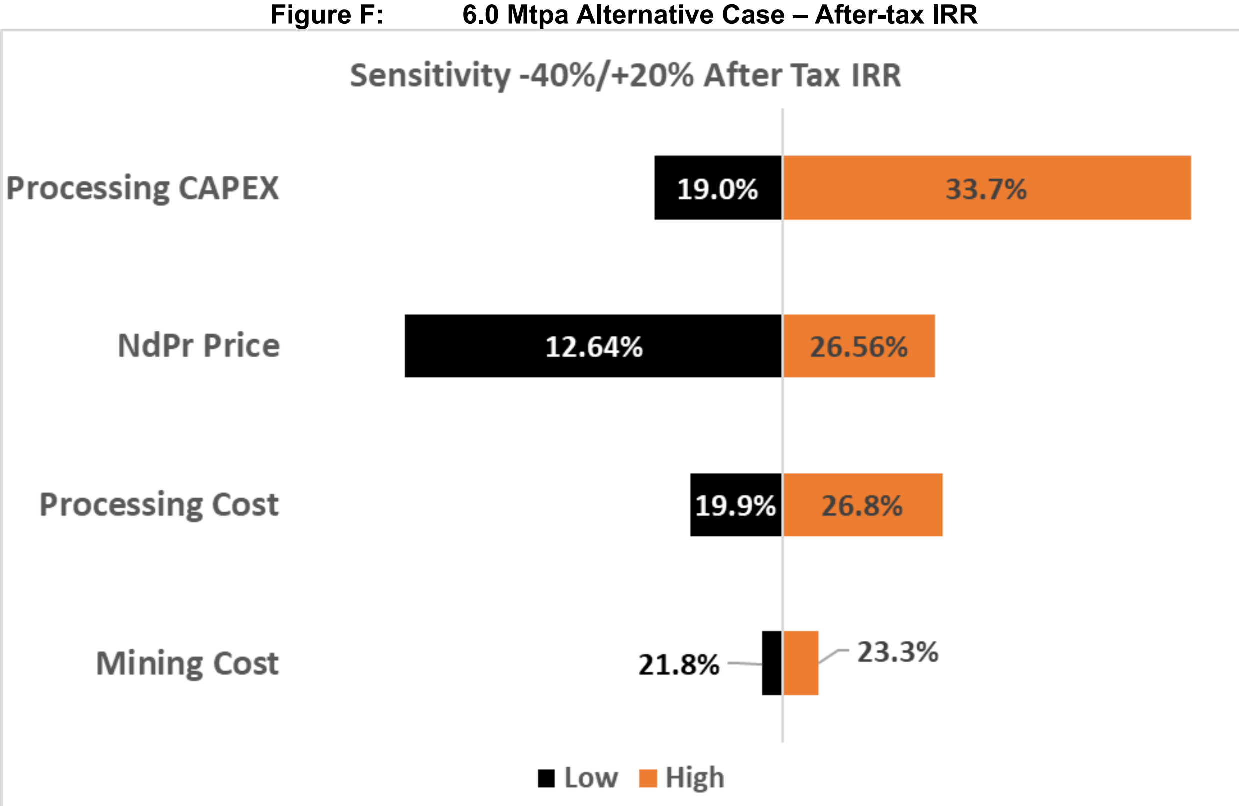


Figure F: 6.0 Mtpa Alternative Case – After-tax IRR



TERMS OF REFERENCE

All measurements herein will be given in Metric system units (meters, metric tons, degrees centigrade, etc.) except where they are designated as Imperial units. All currency values are in United States Dollars except where specified otherwise.

PROPERTY SETTING

The Project is in the Central Laramie Mountains, approximately 70 km northeast of Laramie, a sparsely populated area of Albany and the Platte Counties in southeastern Wyoming, USA.

OWNERSHIP

The Project is owned by Wyoming Rare (USA) Inc., a wholly owned subsidiary of ARR.

MINERAL TENURE, SURFACE RIGHTS, WATER RIGHTS, ROYALTIES AND AGREEMENTS

Through Wyoming Rare (USA) Inc., ARR controls 367 unpatented federal lode mining claims totaling 6,320 acres (2,558 ha) across the Halleck Creek Project area. ARR controls four Wyoming State Mineral Leases which total 1,844 acres (745 ha). Total mineral control held by ARR in the Halleck Creek district is 8,165 acres (3,304 ha).

GEOLOGY AND MINERALIZATION

Halleck Creek resides in Red Mountain Pluton (RMP) as part of the 1.43 Ga Laramie anorthosite complex (LAC) in the Laramie Mountains, a Laramide aged uplift, in southeastern Wyoming.

Primary rare earth bearing rock types within the RMP consist of clinopyroxene quartz monzonite (CQM), and biotite-hornblende quartz syenite (BHS). Allanite is the primary rare earth element (REE) host mineral at the Halleck Creek Project. Allanite is a sorosilicate within the epidote group which contains a significant number of REEs in its primary mineral structure. Allanite usually occurs in association with clinopyroxene, hornblende, olivine and zircon agglomerated as “mafic clots” within CQM.

HISTORY AND EXPLORATION

During the 1950s uranium prospecting rush some rare earth elements (REE), thorium, and uranium occurrences were discovered in pegmatite bodies throughout the Laramie range. None of these were seriously explored (drilling, trenching, etc.) and apparently none locally mined.

In 2010 Blackfire Minerals, now defunct, acquired State mineral leases at Halleck Creek for REE exploration activities. In 2011, after initial sampling was completed, Blackfire dropped the state leases due to low REE prices.

In 2018, the project was re-activated by Zenith Minerals, Ltd. (Zenith), an Australian Mining Company who acquired the State leases formerly held by Blackfire. Zenith also staked five unpatented lode claims on federally owned land. ARR acquired the mining claims and state leases in 2020.

The Wyoming Office of State Lands and Investments assigned ARR the aforementioned Wyoming state mining leases in June 2021. From June 2021 through November 2022, ARR staked an additional 362 unpatented federal lode claims at Halleck Creek. Since the acquisition in 2020, ARE has expanded the land package to 8,164 acres (3,303 ha) across the Halleck Creek Project area.

DRILLING AND SAMPLING

Maiden exploration drilling at the Halleck Creek Resource Area during March and April of 2022 consisted of nine core holes, with five drilled on Overton Mountain and four on Red Mountain. Total length drilled resulted in 3,008 ft (917 m), and a total of 822 core samples were collected and sent to American Assay Labs, in Sparks Nevada for assay.

A larger reverse circulation (RC) exploration program from October to December 2022 consisted of 38 RC holes and a total length drilled of 5,574.5 m (18,292 ft). Eighteen holes were drilled on Red Mountain, and twenty were drilled on Overton Mountain. RC samples were collected at 1.5-meter intervals and sent to ALS Global for REE analysis.

During 2023, Company geologists conducted mapping and sampling in the County Line, Trail Creek, and Red Mountain prospect areas. Contemporaneous with the geologic mapping effort, ARR geologists collected 189 surface samples which were analyzed using XRF and assayed by ALS global.

ARR conducted a reverse circulation and diamond core drilling program at the Halleck Creek Project during Q3 and Q4 of 2023. ARR completed a total of 15 RC holes with a total length drilled of 1,530 m (5,019.69 ft). ARR completed eight core holes to the depths shown below. One core hole was completed to a depth of 302 m (990.81 ft). All assay samples were sent to ALS Global for REE analysis.

DATA VERIFICATION

Drill holes were sampled at 1.5 m (~5ft) intervals, with detailed samples collected at lithological breaks. ARR developed a strict quality assurance / quality control (QA/QC) program using certified reference materials (CRM) from OREAS Labs for blanks and REE standards. Duplicate samples were also systematically inserted as sample assays.

The Qualified Person (QP) routinely verified geological data collection and analysis throughout the drilling and analytical programs. The QP reviewed geological descriptions against core photos and RC cuttings photos. The QP monitored analytical progress through ALS's online low intensity magnetic separation (LIMS) system. The QP prepared and reviewed striplogs of assay data and geologic data for each drill hole at Halleck Creek.

METALLURGICAL TESTWORK

Overview of Metallurgical Testing

In 2022 and 2023, Wood PLC in Perth, WA, Australia designed and supervised a metallurgical testwork program on behalf of ARR. The testwork included the following.

- Hydrostatic testing of core to determine specific gravity (SG).
- Mineralogical Characterization (performed by SGS Lakefield)
- Grinding, Comminution and Dewatering
- Flotation
- Leaching
- Wet High Intensity Magnetic Separation (WHIMS)
- Gravity Separation

Testwork by Subcontractors include the following.

- Feed mineralogy – undertaken at SGS Montreal using their automated TIMA analyzer on a separate sample to the master composite but geochemically similar.
- Nagrom – head analysis, comminution, and WHIMS
- Auralia Metallurgy – direct and reverse flotation testing on ore and WHIMS magnetics, sighter gravity separation, settling testwork.
- Watts and Fisher – pyrophosphoric acid leaching of sighter gravity concentrate and flotation concentrate.
- ALS – assessment of acid and alkali routes for processing WHIMS magnetics and flotation concentrate, mineralogy on WHIMS magnetics.
- Mineral Technologies – HLS and electrostatic separation on WHIMS magnetics
- Bureau Veritas – Falcon C series proxy testing of WHIMS magnetics.

In late 2023, ARR contracted with the University of Kentucky to perform additional magnetic and gravity separation piloting. The work focused on Heavy Liquid Separation (HLS) to simulate Dense Medium Separation (DMS) with the goal of concentrating the REE's before the leaching step.

Mineralogical Characterization

SGS determined that allanite is the primary rare earth bearing mineral at Halleck Creek. Allanite makes up 1.31% of the total feed mass, with significant bias to the +212 micron fraction, indicating coarse crystal structure. The average grain size of allanite was 232 µm. Minor amounts of rare earth bearing minerals, zircon, chevkinite and tornebohmite, were also observed via TIMA-X electron microscopy and electron microprobe analyses. By contrast to allanite, chevkinite / tornebohmite averaged 42 µm in size, which require significantly more grinding to achieve liberation. Trace amounts of fluorocarbonate minerals bastnaesite and synchysite were also detected.

As beneficiation work progressed, additional mineralogical work was undertaken by Diamantina Mineralogy in Perth, Australia, who identified the amphibole mineral hastingsite, a member of the hornblende family. It was found that hastingsite was enriched along with allanite by the WHIMS process, followed by gravity separation and flotation. Chemical formulae and physical properties for each mineral is presented as follows.

- Allanite(Y): (Y,Ce,Ca)2(Al,Fe^{3+})3(SiO4)3(OH)
- Hastingsite: $NaCa_2(Fe^{2+}{}_4Fe^{3+})Si_6Al2O_{22}(OH)_2$

Comminution

The combination of values suggest that Halleck Creek mineralization should be suitable for processing in a semi-autogenous grind (SAG)-Ball mill configuration without the need for pebble crushing; alternatively, the material could also be processed in a single stage SAG mill providing the target product size is not too fine, which is determined in primary WHIMS testwork. Additional testwork is needed to determine viability of High-Pressure Grinding Rolls (HPGRs) and vertical roller mills (VRMs) grinding equipment in the process design. The coarse grain structure of the rare earth mineralization coupled with low competency should translate to high unit capacities.

Gravity Separation

On behalf of ARR, the University of Kentucky (UK) conducted a series of HLS tests to evaluate the use of DMS as a unit operation to concentrate the rare earth content in the mineralization as well as rejecting a large portion of the rare earth mass. The results showed that more than 76% of gangue material can be rejected using a 2.7 SG cut. Furthermore, testwork showed that the Total Rare Earth Oxides (TREO) grade is increased by a factor of 3.8 with a TREO recovery of 87%.

Magnetic Separation

WHIMS have shown to be effective in separation of rare earth minerals. WHIMS has been tested using Halleck Creek material by Zenith and by ARR.

Wood supervised a thorough WHIMS testing program using Halleck Creek core during the 2023 testing program. Primary WHIMS batch testing was conducted to determine basic responses of the rare earths using WHIMS. A secondary WHIMS program was tested using a continuous WHIMS unit to simulate plant conditions.

Passing first-stage 3,000 Gauss non-magnetic materials through the WHIMS unit at 6,000 Gauss saw spikes in the TREO + yttrium grade as well as recovery, which is a more predictable response and supports mineralogical findings of a high degree of allanite liberation. Cumulative recoveries became normalized in a narrow band of 87–91%.

For continuous WHIMS operation, 300 kg of mineralized material was ground to a P_{80} of 500 µm. The results showed that REO recovery was poor using only two stages of WHIMS. Wood included two additional scavenging stages to boost yield and recovery. However, overall TREO+Y recovery did not reach the levels achieved in batch testing.

Preliminary Leach Testing

Wood engaged ALS Global in Perth Australia to perform preliminary leaching testwork using Halleck Creek WHIMS concentrate. Five methods were used for leach testing: Acid bake-water leach (ABWL), High Pressure Acid Leach (HPAL), Alkali bake-water leach-HCl leach, Sulfuric acid tank leach, and a proprietary process from Watts & Fisher. Leach testing showed determined that sulfuric acid tank leach testwork was the most effective process for the material. Solids for all tests were wet milled to a P_{80} size of 38 microns.

Wood sulfuric acid tank leaching tests showed by using 250 kg/t acid dosage at 90 °C for 12 hr that recoveries of 82.8% and 89.5% could be achieved for Nd and Pr, respectively.

Recovery Estimates

A combination of different DMS and WHIMS testing demonstrated overall TREO recoveries between 77% to 78%. Preliminary leaching results using WHIMS concentrate showed an overall TREO recovery of approximately 85%. Tetra Tech estimated the recovery for five potential rare earth products (Lanthanum carbonate, Nd/Pr oxide, SEG oxide concentrate, Tb oxide, and Dy oxide) as approximately 67% from ore to final product.

Deleterious Elements

Thorium and Uranium, and associated daughter products, occur naturally at Halleck Creek at low levels, approximately 68 ppm in the mineralized material. A conceptual impurity removal plant is designed to remove Th and U applying commonly used methods of a precipitation reaction, filtration, and ion exchange.

Iron (Fe^{++} and Fe^{+++}) occurs within allanite and hastingsite minerals. Fe_2O_3 occurs in allanite at 19.69%. Hastingsite typically contains 8.1% Fe_2O_3 but 29.0% FeO. Fe is removed during processing using conventional methods.

MINERAL RESOURCE ESTIMATION

Estimation Methodology

Odessa Resources Ltd., from Perth Australia, updated the Halleck Creek resource model incorporating drilling data collected in late 2023 by ARR. Using all drill hole data, Odessa updated variograms and block model parameters. Grade estimation was carried out using an Ordinary Kriging (OK) interpolant.

A cut-off grade of 1,000 ppm TREO was used to estimate in situ resources. As part of Stantec's work, a net smelter return was calculated based on saleable rare earth element oxides: La_2O_3, Nd_2O_3, Pr_6O11, Sm_2O_3, Dy_2O_3, and Tb_4O_7. The net smelter return value demonstrates that a 1,000 ppm TREO cut-off grade meets the conditions for reporting of a Mineral Resource with reasonable prospects of eventual economic extraction.

Mineral Resource Statement

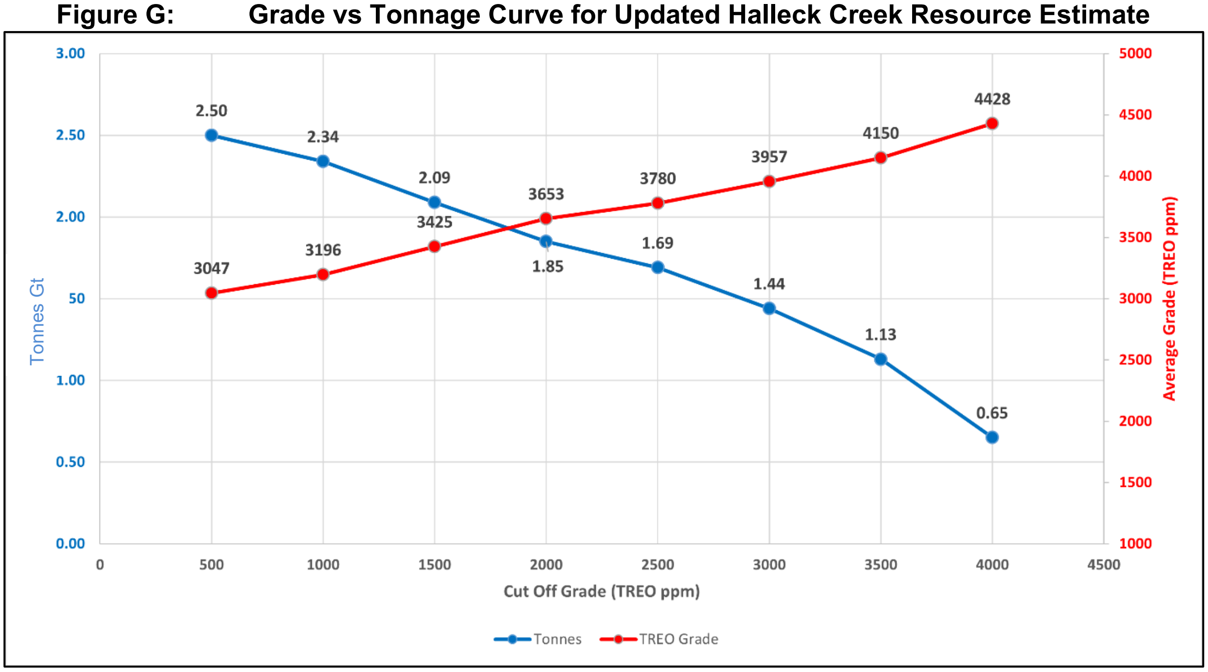
Using the 1,000 ppm TREO cut-off grade the estimated in situ resource estimate at Halleck Creek is 2.34 billion tonnes (Gt) with an average grade of 3,195 ppm (0.32%) TREO (Table D and Figure G). This is an increase of 64% in in situ tonnes compared to the March 2023 maiden resource estimate for Halleck Creek. The estimated average Magnet Rare Earth Oxide (MREO) comprises 24% of TREO. The total in situ measured and indicated resources at Halleck Creek are 1.4 Gt with an average TREO grade of 3,295 ppm (0.33%).

It should be clearly noted that Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability. There is no certainty that all or any part of the Mineral Resource will be converted into a Mineral Reserve. Areas where ARR does not control mineral resources have been excluded from resource estimates.

Table D: Estimated Rare Earth Resources at Halleck Creek (1000 ppm TREO cut-off)

Classification	Tonnage	*Grade*				*Contained Material*			
		TREO	LREO	HREO	MREO	TREO	LREO	HREO	MREO
	t	ppm	ppm	ppm	ppm	t	t	t	t
Measured	206,716,068	3,720	3,352	370	904	769,018	692,935	76,550	186,836
Indicated	1,210,173,301	3,223	2,838	349	780	3,899,931	3,434,947	422,124	943,421
Meas + Ind	**1,416,889,369**	**3,295**	**2,913**	**352**	**798**	**4,668,949**	**4,127,881**	**498,674**	**1,130,257**
Inferred	924,698,618	3,041	2,696	339	737	2,812,121	2,493,178	313,187	681,138
Total	**2,341,587,986**	**3,195**	**2,828**	**347**	**774**	**7,481,070**	**6,621,059**	**811,861**	**1,811,395**
Rounded	**2,342,000,000**	**3,195**	**2,828**	**347**	**774**	**7,481,000**	**6,621,000**	**812,000**	**1,811,000**

Figure G: Grade vs Tonnage Curve for Updated Halleck Creek Resource Estimate



ARR 2024

Between 2022 and 2023, total estimated resources increased by approximately 0.91 Gt (64%). The estimated TREO grade decreased by 133 ppm TREO (-3%). Measured + Indicated resource increased by 0.79 Gt (128%). Inferred resources increased by 0.18 Gt (15%).

Factors That May Affect the Mineral Resource Estimate

Factors which may affect the mineral resource estimates include the following.

- Metal price and currency exchange rate assumptions
- Changes to the assumptions used to generate the equivalent cut-off grade
- Changes in local interpretations of mineralization geometry and continuity of mineralized zones
- Changes to geological and mineralization shape
- Changes to geological and grade continuity assumptions
- Density and domain assignments
- Changes to geotechnical, mining, and metallurgical recovery assumptions
- Changes to the mining and processing input and design parameter assumptions
- Assumptions pertaining to site access, completion of proposed exploration programs, and maintaining the social license to operate.

MINERAL RESERVE ESTIMATION

The Halleck Creek REE Project is still in the preliminary stages of exploration and development, and as such, no mineral reserves have been defined, calculated, or implied.

MINING METHODS

Open pit mining at Halleck Creek will be done using the conventional rubber-tired and tracked diesel powered equipment at a steady state production rate of 3.0 Mtpa of mineralized material with an average strip ratio of 0.03. Open pits at the Cowboy State mine, near Red Mountain, and at the Overton Mountain resource areas were designed with 6 m high double benches with 3 m wide catch benches.

RECOVERY METHODS

Recovery Process Summary

Conceptually, comminution and concentration will occur at the proposed mine site, followed by extraction, impurity removal, and rare earth separation at a second location, most likely near Wheatland, Wyoming.

The proposed Halleck Creek rare earth processing components consists of the following.

- Comminution Circuit – utilizing HPGR.
- Concentration Circuit – using gravity or density separation and Wet High Intensity Magnetic Separation (WHIMS) to separate gangue from REE minerals.
- Extraction Circuit – Tank leaching of mixed rare earth concentrate using dilute sulfuric acid. Cerium is rejected by calcining prior to leaching.

- Impurity Removal Circuit – to remove Fe, Th, Al, and U, using a partial neutralization precipitation and Ion Exchange (IX).
- Separation and Finishing Circuit – using Solvent Extraction (SX) to refine finished products.
- Associated plant infrastructure (wastewater treatment plant, tailings storage facility, etc.)

Production Capacity

The comminution circuit will be designed to process 3.0 Mtpa on a dry basis, or 9,132 metric tonnes per day (tpd) assuming a 90% uptime (329 days per year) of run of mine material. The concentration circuit will be designed to match the comminution circuit and process 3.0 Mtpa of REE material on a dry basis, or 9,132 tpd assuming a 90% uptime (329 days per year) of crushed REE material. The extraction circuit will be designed to process 231,945 tpa on a dry basis or 705 tpd on a dry basis assuming a 90% uptime (329 days per year) of concentrate. The impurity removal circuit will be designed to match output of the refinery, or 243 gpm of Pregnant Leach Solution (PLS). The separation and finishing circuit will be designed to match the output of the Impurity Removal circuit of 276 gpm of Uranium Removal discharge.

Estimated Products

Separation and Finishing will be designed to produce the following five finished products for sale with approximate average annual production rates:

1. Lanthanum (La) in the form of lanthanum carbonate or hydroxide – 1,486 tpa on a TREO basis
2. Neodymium/Praseodymium (Nd/Pr) Oxide (didy Oxide) – 1,529 tpa
3. SEG Oxide Concentrate – 383 tpa on a TREO basis
4. Terbium (Tb) Oxide – 17 tpa
5. Dysprosium (Dy) Oxide – 91 tpa

The product specifications will be developed in upcoming design work using computer simulations and laboratory testing.

INFRASTRUCTURE

Locally, the Project will be supported out of Wheatland, Wyoming. Because the Project is in the early stages of development, mining-related infrastructure has yet to be constructed at the Site. Comminution and separation will occur at the mine site, while subsequent processing and refining will occur at a second location, most likely near Wheatland, Wyoming.

The infrastructure planned for this scoping study report includes access roads, fresh water wells, powerlines, buildings, temporary waste rock storage and tailings storage.

ENVIRONMENTAL, PERMITTING AND SOCIAL CONSIDERATIONS

ARR acquired exploration drilling notices from the WDEQ-LQD for all drilling activities performed to date.

ARR is developing a permitting needs assessment with local environmental consulting groups to present to each division at WDEQ to identify comprehensive environmental baseline studies needed to permit a mining operation at Halleck Creek.

At this stage of project development, no social impact studies have been completed.

RECOMMENDATIONS

Due to the level of detail and effort invested in this scoping study, a prefeasibility study should be realized in approximately 12 months based on the collection of additional data to support the permitting process, hydrology, geotechnical engineering, and geologic mapping including sampling. Mine engineering and further processing testwork is needed to better understand, design, and cost the Halleck Creek Project.

Geologic sampling and mapping is needed to determine extents of mineral resource and to identify additional high-grade areas, and to guide future exploration efforts at the Project. Infill drilling is recommended within the Cowboy State Mine area to increase resource classification, and to collect hydrological and geotechnical information to provide data for design parameters, engineering factors and associated economics at the prefeasibility level.

Bulk sampling and core drilling is needed to advance metallurgical testwork, specifically comminution and concentration testing. Comminution testing is recommended to define crushing and grinding processes featuring HPGR to identify particle size distribution, energy consumption and associated costs.

Concentrate testing is recommended to determine equipment required for primary gravity separation to validate mass balance and concentration efficiency. Gravity separation testing at specific gravities above and below 2.7 is recommended to remove less-dense gangue material from REE ore which represents about 77% of the mineralized material.

Extensive extraction and refining testwork is recommended to define practical methods for leaching, possible calcining, impurity removal, and solvent extraction (SX) to produce specific rare earth oxides. These tests will determine base-case parameters (temperature, pH, residence time, molarity, etc.) and reagents (sulfuric acid, sodium hydroxide, etc.) for a future demonstration plant. The SX testing will begin with initial batch tests moving toward continuous testing when the quantity of feedstock allows. SX test parameters include feed acidity, separation coefficients, and settling time among others. Waste water streams need to be quantified and analyzed to aid in the mass balance.

It is recommended that ARR begin developing permitting and baseline environmental needs in conjunction with regulatory agencies. It is also recommended that ARR develop a framework for community engagement while reaching out and understanding the community needs.

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List of Acronyms/Abbreviations

AAL	American Assay Laboratories
ABWL	Acid bake-water leach
ARR	American Rare Earths Pty. Ltd
BHS	Biotite-hornblende quartz syenite
BLM	Bureau of Land Management
CAPEX	Capital expenditure
CQM	Clinopyroxene quartz monzonite
CREE	Critical Rare Earths Elements
CREO	Critical Rare Earths Oxides
CRM	Certified Reference Material
DHDB	Drill hole database
DMS	Dense medium separation
DTR	Davis Tube Recovery
Dwi	Drop weight index
EPMA	Electron probe micro analysis
ERGB	Elmer's Rock Greenstone Belt
FM	Fayalite monozonite
FOB	Freight on demand
HLS	Heavy Liquid Separation
HPAL	High pressure acid leach
HPGR	High pressure grinding rolls
HREE	Heavy Rare Earths Elements
HREO	Heavy Rare Earths Oxides
IRA	Inflation Reduction Act
IRR	Internal Rate of Return
LAC	Laramie anorthosite complex
LiDAR	Light detection and ranging
LIMS	Low intensity magnetic separation
LLD	Liquid line of descent
LOM	Life of Mine
LQD	Land Quality Division
LREE	Light Rare Earths Elements
LREO	Light Rare Earths Oxides
NSR	Net smelter return
NVP	Net Present Value

List of Acronyms/Abbreviations

OPEX	Operational expenditure
ppm	Parts per million
QA/QC	Quality assurance/quality control
QP	Qualified Person
RC	Reverse circulation
RDQ	Rock quality density
REE	Rare Earths Element
REO	Rare Earths Oxide
RMG	Red Mountain granite
RMP	Red Mountain pluton
ROM	Run of mine
SAG	Semi-autogenous grind
SCSE	SAG Circuit Specific Energy
SG	Specific gravity
SMC	SAG Mill communition
SME	Soceity of Mining, Metallurgy and Exploration
SMU	Selective mining unit
SX	Solvent extraction
TREE	Total Rare Earths Elements
TREO	Total Rare Earths Oxides
TSF	Tailings storage facility
USGS	United States Geological Survey
VRM	Vertical roller mill
WDEQ	Wyoming Department of Environmental Quality
WHIMS	Wet high intensity magnetic separation
WIM	World Institute Minerals
WRSF	Waste rock storage facility
XRD	X-ray diffraction
XRF	X-ray flourescence

Units of Measure

°	Degrees
°C	Degrees Celsius
°F	Degress Fahrenheit
cm	Centimeter
ft	Foot, feet
g	Gram
Gt	Billion tonne
ha	Hectare
kg	kilogram
km	kilometer
kVA	kilo volt amperes
m	Meter
masl	Meters above sea level
µm	Micrometer
mm	Millimeter
Mt	Million tonne
Mtpa	Million tonnes per annum
ppm	Parts per million
t	Metric tonne
t/m^3	Tonners per cubic meter
tpa	Metric tonnes per annum
tpd	Metric tonnes per day

1.0 INTRODUCTION

American Rare Earths Pty. Ltd. (ARR), a mining company specializing in exploring and developing rare earth elements, has engaged Stantec Consulting Services Inc. (Stantec), a global consulting firm with extensive experience in the mining industry, to conduct a scoping study for the Halleck Creek Rare Earth Deposit located in Wyoming. The study was be carried out according to the standards set by the Australian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code or JORC). Halleck Creek is in the Central Laramie Mountains in Albany County and Platte County, Wyoming. It is approximately 70 km northeast of Laramie and 30 km southwest of Wheatland, Wyoming.

1.1 Terms of Reference

1.1.1 Report Purpose

This technical report aims to provide ARR, its investors, and potential investors a clear understanding of the Project based on existing data and development of the Project at a scoping level with recommendations for further work to advance the Project.

1.1.2 Terms of Reference

All measurements herein will be given in Metric system units (meters, metric tons, degrees centigrade, etc.) except where they are designated as Imperial units. All currency values are in United States Dollars except where specified otherwise.

1.2 Qualified Persons

The mining engineering and related data in this technical report were prepared under the supervision of and approved by Gordon Sobering, Professional Engineer (Colorado) and Qualified Person by the Society of Mining, Metallurgy and Exploration (SME) and Senior Project Manager at Stantec. Specifically, Stantec is responsible for the following report sections.

- Mine Design and Plans (Section 12.0),
- Facilities and Infrastructure (Section 14.0),
- Market Analysis (Section 15.0)
- Capital Cost Estimate (not including metallurgy, Section 17.0)
- Operating Costs Estimate (also not including metallurgy, Section 17.0)
- Financial Analysis (Section 18.0)

Mr. Sobering has sufficient experience that is relevant to the style of mineralization and type of deposit under consideration. There is no other relationship between Mr. Sobering, Stantec, or ARR which could be perceived as a conflict of interest.

Other qualified persons who contributed to this report are: Alf Gillman, of Odessa Resources who completed the mineral resource estimate the Project and is responsible for *Section 11.0 – Mineral Resource Estimates*, and Kelton Smith, Process Department Lead at Tetra Tech, who was responsible for *Section 9.0 – Mineral Processing and Metallurgical Testing* and *Section 13.0 – Recovery Methods*. All qualified persons also contributed to the Executive Summary, Conclusions (Section 21.0) and Recommendations (Section 22.0).

ARR personnel under the direction of Mr. Dwight Kinnes compiled information for *Section 2.0 – Property Description*, *Section 3.0 – Accessibility, Climate, Local Resources, Infrastructure and Physiography*, *Section 4.0 – History*, *Section 5.0 – Geological Setting, Mineralization and Deposit*, *Section 6.0 – Exploration and Drilling*, *Section 7.0 – Sample Preparation*, *Section 8.0 – Data Verification*, *Section 16.0 – Environmental Studies, Permitting and Social or Community Impact*. ARR personnel under the direction of Mr. Don Swartz compiled information for *Section 15.0 – Market Studies and Contracts* and Appendix B.

1.3 Site Visits and Scope of Personal Inspection

Mr. Gordon Sobering, Senior Project Manager of the Halleck Creek Scoping Study, completed a site visit on Wednesday, 29 November 2023 with executives and geologists from ARR, including Mr. Dwight Kinnes and Mr. Donald Swartz. The visit included an inspection of the land at both Red Mountain and Overton Mountain and the project geology. Messrs. Alf Gillman and Kelton Smith visited the site with ARR Executives on 07 March 2024.

1.4 Report Date

The effective date of this report is 08 March 2024.

1.5 Information Sources and References

Information made available to Stantec from previous studies completed by ARR consultants and publicly available data. All information and data used in this study is listed in *Section 23.0 – References.*

1.6 Previous Technical Report Summaries

Stantec is aware of the following publicly available technical report summaries published by ARR:

- *Technical Report of Exploration and Maiden Resource Estimates of the Halleck Creek Rare Earths Project*, American Rare Earths, March 2023.
- *Technical Report of Exploration and Updated Resource Estimates of the Halleck Creek Rare Earths Project*, American Rare Earths, January 2024.

2.0 PROPERTY DESCRIPTION

The Project site is situated in the Central Laramie Mountains, approximately 70 km northeast of Laramie. The area falls within the Albany and the Platte Counties in southeastern Wyoming, USA, as Figure 2-1 indicates. The region is sparsely populated, and the landscape is characterized by short grass and sparse sagebrush. The Project area's elevations range from 1,900 meters above sea level (masl) on the plains to over 2,135 m on the Red Mountain and Overton Mountain, providing a diverse topography.

2.1 Ownership

The Project is indirectly 100% held by ARR through Wyoming Rare (USA) Inc., a wholly-owned subsidiary of ARR.

2.2 Mineral Title

The Wyoming Office of State Lands and Investments assigned ARR the aforementioned Wyoming state mining leases in June 2021. From June 2021 through November 2022, ARR staked an additional 362 unpatented federal lode claims at Halleck Creek. Since the acquisition in 2020, ARE has expanded the land package to 8,164 acres (3,303 ha) across the Halleck Creek Project area.

2.2.1 Unpatented Lode Claims

Halleck Creek is comprised of 367 unpatented lode mining claims totaling 6,320 acres (2,558 ha) and are located as follows (Figure 2-2).

- Township 22 North, Range 71 West Sections 13, 23, 24, 25, 26, 35
- Township 22 North, Range 70 West Sections 07, 18, 19, 30, 31
- Township 21 North, Range 70 West Section 06

- Albany County
  - Township 22 North, Range 70 West Sections 08,17,20,29

- Platte County
  - Township 22 North, Range 70 West Section 31
  - Township 22 North, Range 71 West Sections 26,34,36
  - Township 21 North, Range 71 West Sections 26,34,36

2.2.2 Wyoming State Mineral Leases

The Company controls four Wyoming State Mineral Leases totaling 1,844 acres (746 ha) which are in Township 22 North, Range 70 West Sections 16 and 28 (Figure 2-2).

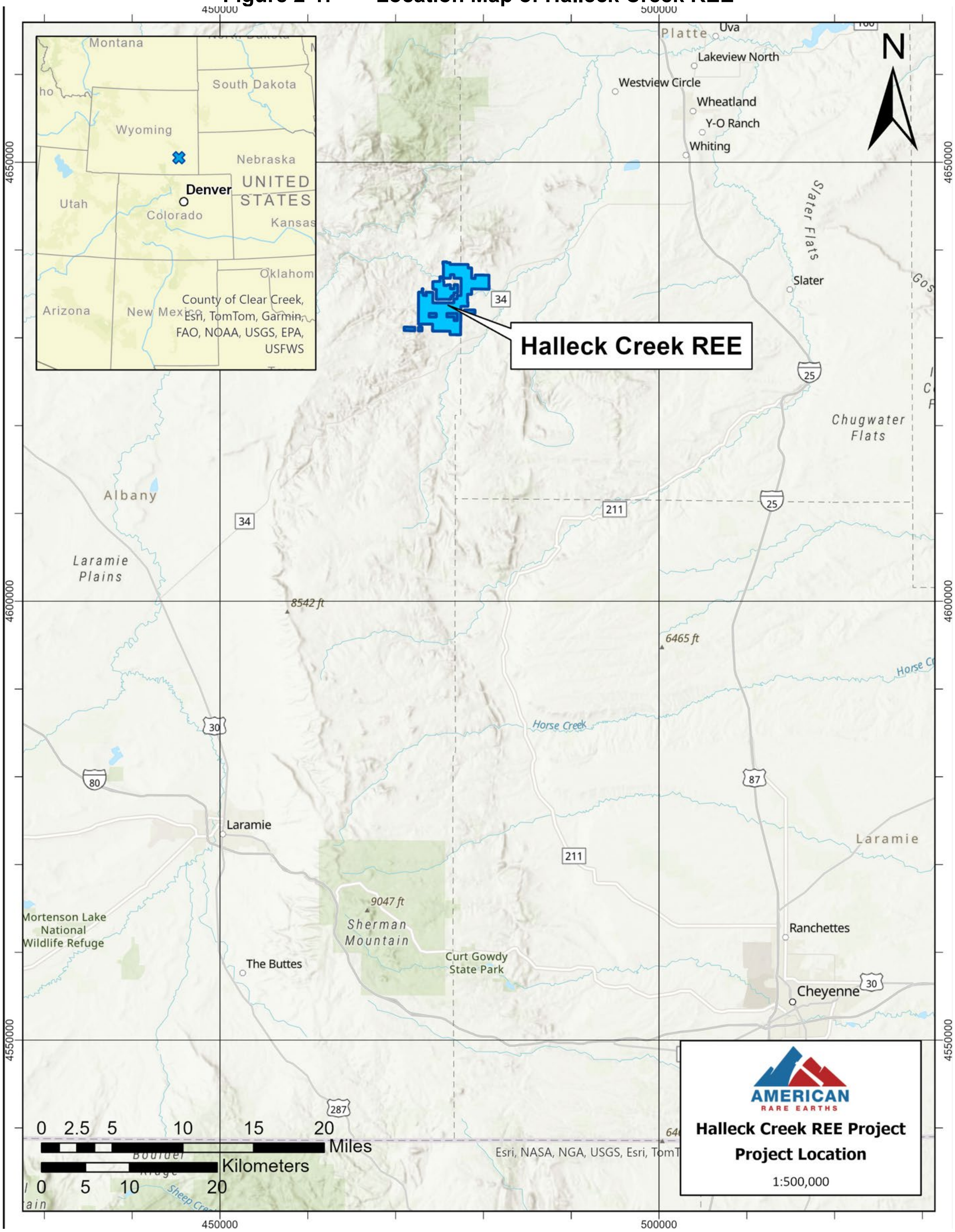
2.3 Surface Rights

The surface lands within the Halleck Creek project area are predominantly state and privately owned, however a small portion of land in the region is administered by the Bureau of Land Management (BLM) (Figure 2-3).

2.4 Water Rights

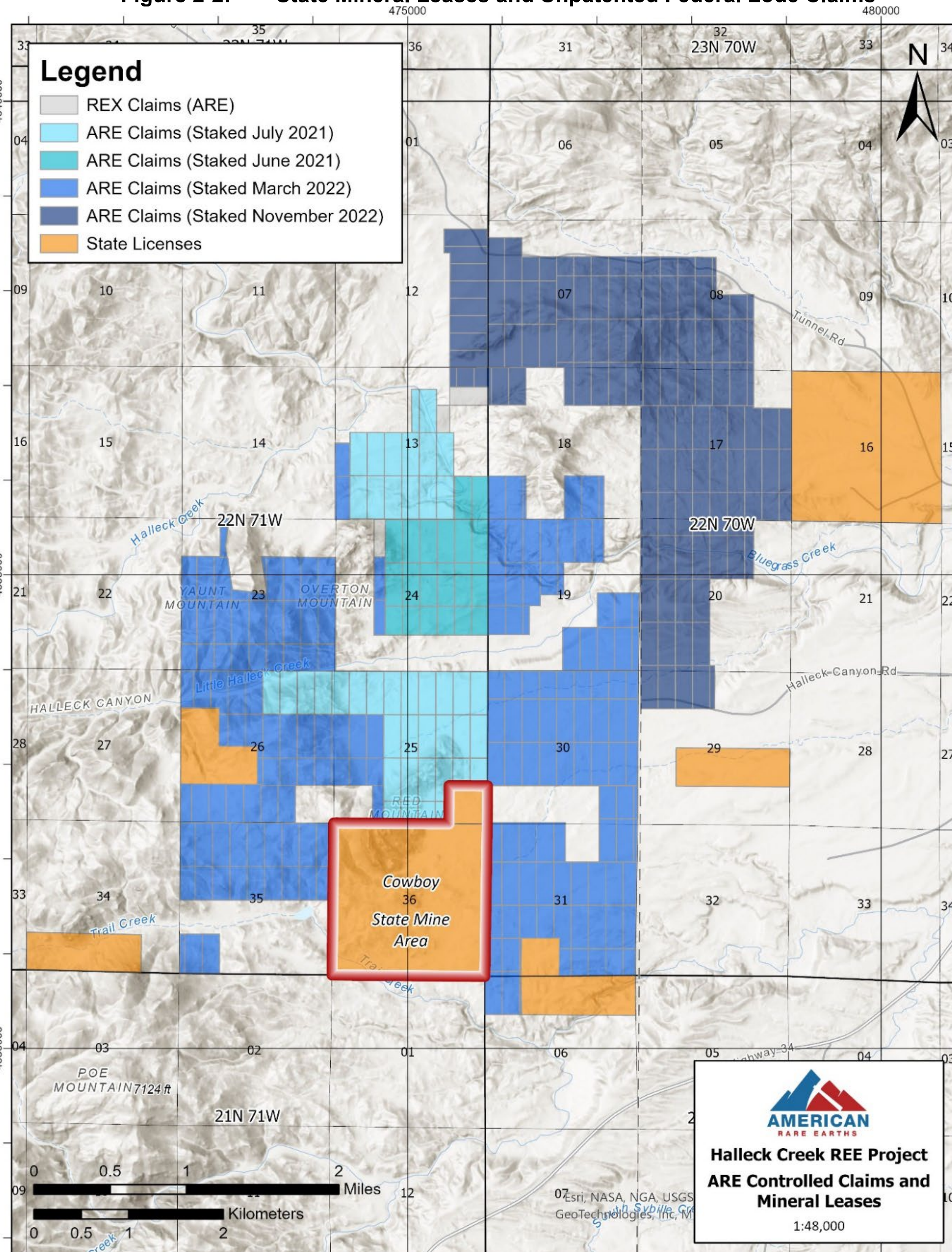
Water rights have not been adjudicated for the Project at this time. The mine and associated processing facilities need water obtained from regional surface and/or groundwater resources, each of which require adjudication through the Wyoming State Engineer's Office and agreements from existing water rights holders or landowners. ARR is actively reviewing potential water sources for the project. With further definition of the location of the associated mining, milling, and processing operations, the company will seek to obtain geographically proximate sources of water. Short-term water requirements to development the Project can likely be supplied through temporary use agreements with regional landowners.

Figure 2-1: Location Map of Halleck Creek REE



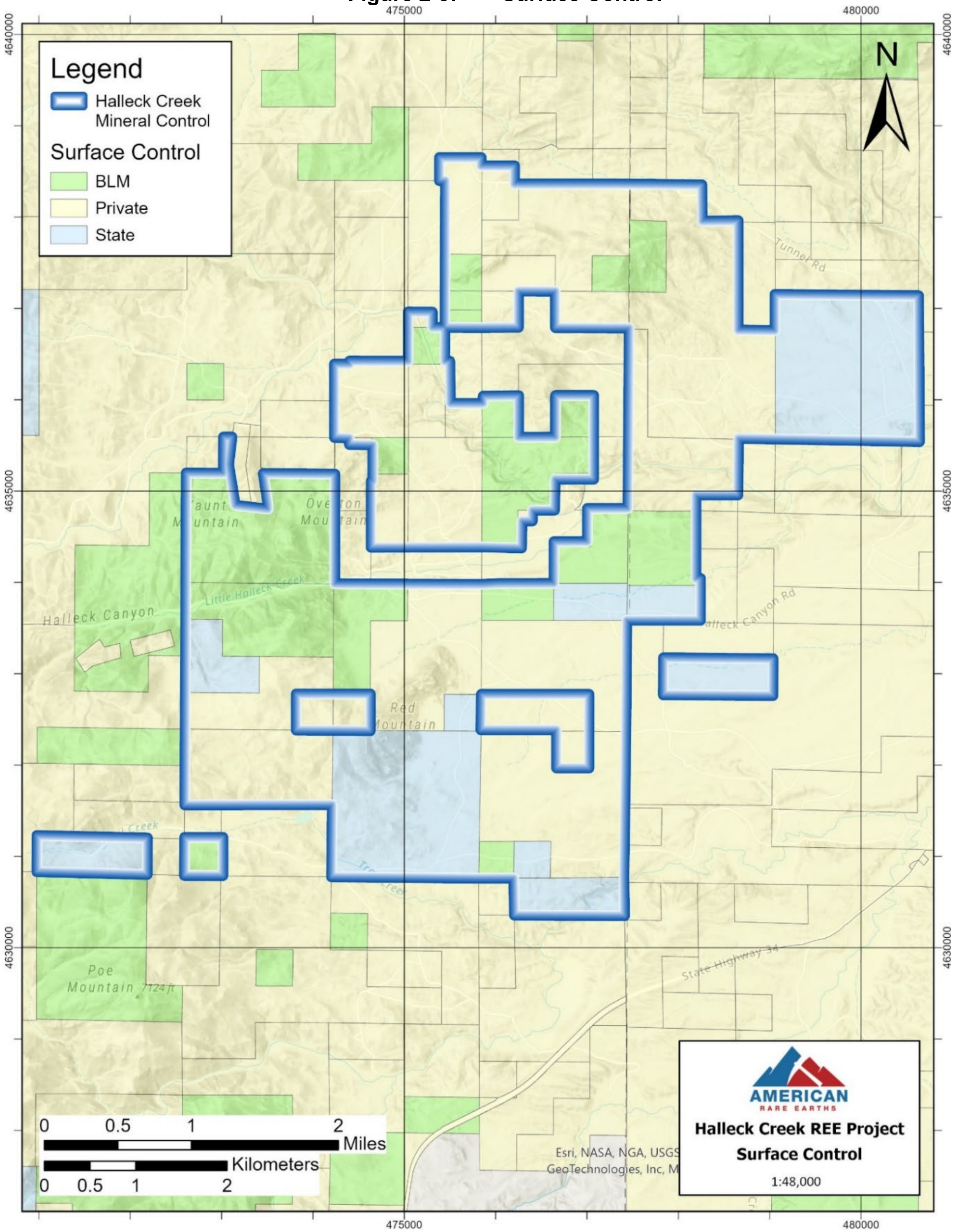
ARR, 2024

Figure 2-2: State Mineral Leases and Unpatented Federal Lode Claims



ARR 2024

Figure 2-3: Surface Control



ARR, 2024

2.5 Royalties

Stantec knows of no known royalty on the Project's properties, beyond a 5% royalty on gross revenue payable to the State of Wyoming.

2.6 Encumbrances

2.6.1 Permitting Requirements

ARR has not started the permitting process with the State of Wyoming.

2.6.2 Violations and Fines

Stantec is unaware of any violations nor fines which ARR has received from the State of Wyoming, nor the Federal government.

2.7 Significant Factors and Risks That May Affect Access, Title, or Work Programs

ARR closely monitors lease and claim control across the entire Halleck Creek project area. ARR contracted with Burgex, Inc. in Salt Lake City, UT to monitor and manage ARR's federal lode claims and state mineral leases. If annual maintenance fees and leases fees are paid prior to annual renewal dates, then the claims and leases remain in good standing.

ARR has developed good working relationships with local surface owners and have secured long-term exploration access across the project area. ARR is working with these people to secure additional access agreements for the duration of the Project.

3.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

3.1 Physiography

The Project is located at the edge of the high plains of Wyoming characterized by short grass and sparse sagebrush. Elevations range from over 2,135 m on mountain tops (Overton Mountain, Red Mountain) to 1,900 m on average in the rolling hills portion of the Project.

3.2 Accessibility

The Halleck Creek Project is approximately 70 km northeast of Laramie, and 30 km southwest of Wheatland, Wyoming. Road access from Wheatland is via Wyoming State Highway 34 southwest for approximately 29 km followed by an additional 10 km west on a County maintained gravel road, number 720.

3.3 Climate

The climate is semi-arid and continental. The region experiences four seasons and is drier and windier in comparison to most of the United States, with greater temperature extremes. Summers in Wyoming are warm and dry with high temperatures in July averaging between 29 and 35 °C in most of the state. Winters are cold and moderately snowy, averaging around 381 mm of moisture with temperatures ranging from -15 °C to +2 °C. Spring can be variably mild to very snowy. Fall is the mildest time of year, with little moisture and generally warm days. The prevailing vegetation consists of pine trees, prairie grasses and sagebrush.

3.4 Infrastructure

Local infrastructure is based out of the town of Wheatland (population 3,560), located 39 km east of the Property by Wyoming State Highway 34. The Burlington Northern Santa Fe railroad mainline runs through Wheatland as does Interstate highway 25, linking the city to the entire United States. Residential power runs along County Road 720. A 46 kV substation is located along Highway 34 and is approximately 3.7 km from the western side of the Halleck Creek state mineral leases.

Because the Project is in the early stages of development, no mining related infrastructure has been constructed at site.

4.0 HISTORY

In the 1960s or 1970s, a small mine that extracted fuchsite (ornamental stone), operated to the northwest of the Halleck Creek claim area. Otherwise, mining has yet to occur in this portion of the Laramie range. During the 1950s rush for uranium prospecting, several occurrences of thorium and uranium containing Rare Earths Elements (REEs) were discovered in pegmatite bodies nearby and throughout the Laramie range. None of these were seriously explored (drilling, trenching, etc.), and none were mined. The region has received little attention since.

In 2010, Blackfire Minerals acquired the current set of state leases ARR now controls for REE exploration activities. Based on research completed by World Industrial Minerals (WIM), areas of anomalous REE values were discovered in Red Mountain as part of a Ph.D. thesis (Anderson, 1995). Much of Red Mountain was covered by a State Mineral Lease that was subsequently acquired. Blackfire dropped the leases in 2011 due to low REE prices.

In 2018, the project was re-activated by Zenith who applied for the same state leases that Blackfire held and staked five federal unpatented lode claims. Additional sampling was completed on both the Wyoming State Leases and unpatented lode claims. Results from 87 samples collected in 2019 showed broad areas of REE mineralization exceeding 2,000 parts per million (ppm) Total Rare Earths Oxides (TREO).

Previous exploration in the region was limited and never amounted to reporting of a mineral resource.

5.0 GEOLOGICAL SETTING, MINERALIZATION AND DEPOSIT

5.1 Deposit Type

The Red Mountain pluton (RMP) of the Halleck Creek Rare Earths Project is an example of a magmatic allanite hosted REE deposit composed of rocks ranging from monzonitic to syenitic.

A-type granites are formed by partially melting mantle rock within stable continental blocks or rift zones. Mantle magma ascends through the crust and changes chemically in response to various factors, including temperature, pressure, and chemistry of wall rock. The term alkaline infers that the parent magma has a primary enrichment of Na_2O and K_2O and, as such, contains abundant Na- and K-bearing minerals such as feldspathoids, alkali pyroxenes, and alkali amphiboles. These magmas are not only enriched in REEs but are typically enriched in zirconium, niobium, strontium, barium, and lithium (Balaram, 2019). Primary alkaline deposits are commonly associated with elevated levels of uranium and thorium. The RMP deposit, however, is unusually depleted of radioactive elements.

It is also common for primary magmatic mineralization to be overprinted by late magmatic and/or hydrothermal fluids (Balaram, 2019). Hydrothermal alteration at the RMP deposit is minimal and has not affected REE mineralization.

REE mineralization in deposits such as observed at Halleck Creek is directly attributed to fractional crystallization in the late stages of magma body evolution.

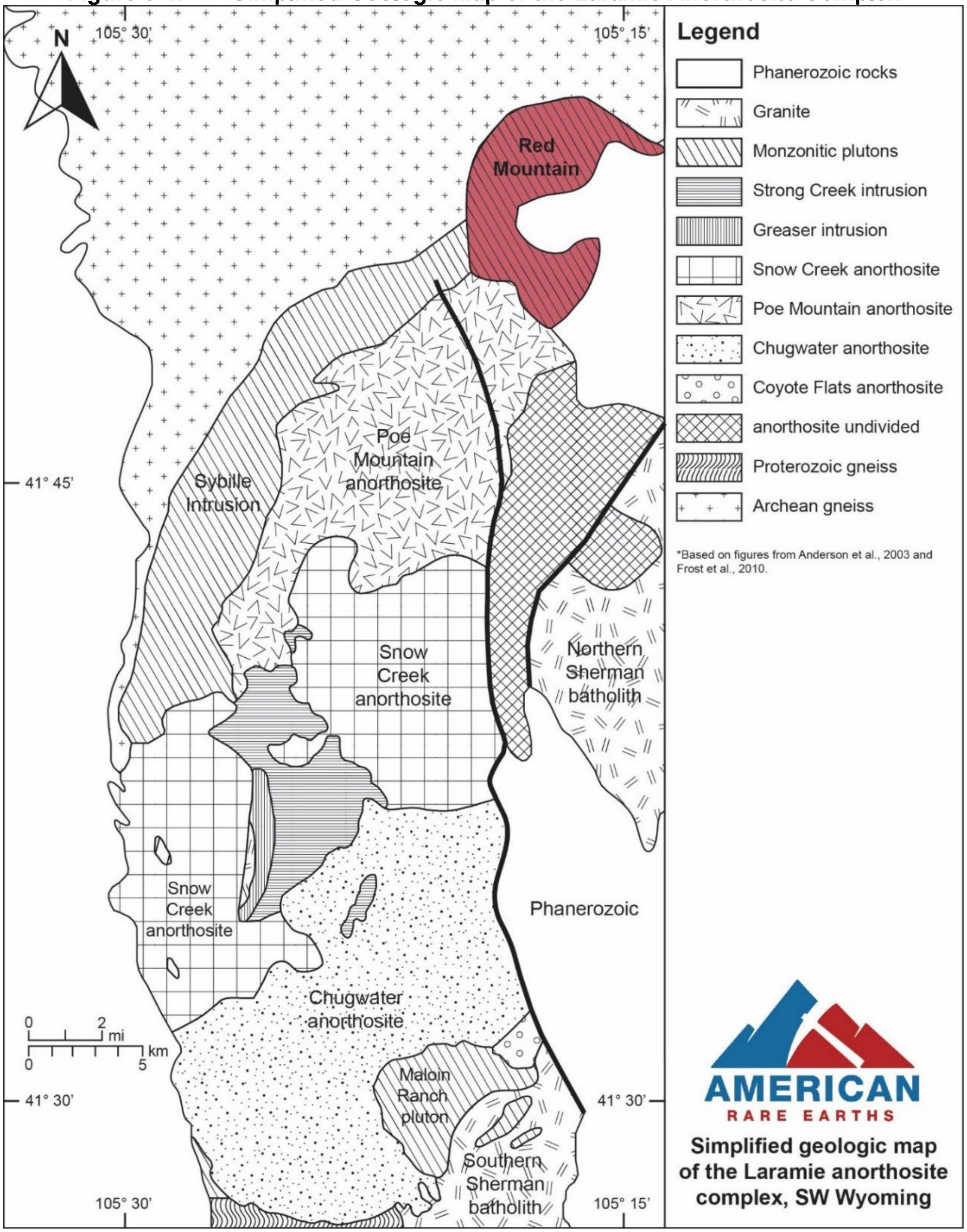
5.2 Regional Geology

The Halleck Creek Project is located within the RMP, which is a residual granitic melt associated with the Laramie anorthosite complex (LAC). The LAC represents the northernmost component of widespread 1.4 Ga magmatism in the western United States. The LAC was emplaced ca. 1437 ± 2.4 Ma and forms the core of the central Laramie Range, a Laramide-aged uplift in southeastern Wyoming (Anderson et al., 2003).

The Halleck Creek project area is located within the Red Mountain pluton, which is the youngest and smallest monzonitic intrusion associated with the Laramie anorthosite complex (Anderson et al., 2003).

A regional geology map is provided in Figure 5-1.

Figure 5-1: Simplified Geologic Map of the Laramie Anorthosite Complex



after Anderson et al., 2003

5.3 Local Geology

5.3.1 Lithologies

Four primary rock units comprise the RMP: a fayalite monzonite (FM) (zircon dated at 1431.3 ± 1.4 Ma), clinopyroxene quartz monzonite (CQM), biotite-hornblende quartz syenite (BHS), and the Red Mountain granite (RMG). The FM, CQM, and BHS are nearly indistinguishable from one another in the field, being equigranular, medium-grained, and red-weathering. The RMG is the only readily distinguishable unit and forms a steeply dipping ring around the northern margin of the pluton. Three types of dikes also occur within the pluton, including fine quartz monzonite, medium quartz monzonite, and biotite-hornblende monzonite (Anderson et al., 2003). The CQM and BHS units are the primary REE bearing lithotypes at the Halleck Creek Project.

Historically, the CQM, similar to the FM, also forms a discontinuous rim around the pluton (Anderson et al., 2003). The literature has previously stated that the FM and CQM represent less than 10% of the outcrop exposed at the surface within the RMP. The CQM is nearly petrographically identical to the FM; however, the CQM lacks the presence of fayalite. The CQM also has a greater abundance of biotite, quartz, and allanite (Anderson et al., 2003). Olivine and clinopyroxene occur as individual grains and glomeroclasts (mafic clots), which are typically rimmed by hornblende. Trace biotite is secondary after hornblende. Zircon is abundant, whereas quartz and allanite occur in trace amounts. Ilmenite has been identified as the only Fe-Ti oxide within the unit (Anderson et al., 2003) .

The most abundant rock type found within the RMP is the BHS. It is more quartz-rich than both the CQM and the FM, and the only ferromagnesian minerals present within the unit are hornblende and biotite. Similar to the other units, perthitic microcline is the dominant alkali feldspar phase and ilmenite is the only Fe-Ti oxide present (Anderson et al., 2003).

The fourth rock type, the RMG, resides at the outer margin of the RMP where it forms dikes and bodies concordant with the pluton margins (Anderson et al., 2003). The RMG is easily distinguished from the other three units due to its abundance of quartz. The RMG also has lower abundances of hornblende, biotite, plagioclase, and allanite than the FM, CQM, and BHS (Anderson et al., 2003).

As mentioned above, CQM and BHS are the primary REE-bearing units within the RMP. The FM unit contains variable levels of REE, and the RMG is typically devoid of REE enrichment. In the RMP, REE abundances correlate with modal abundances of allanite and zircon. The CQM typically contains the highest abundances of these minerals, whereas the BHS and FM contain lesser, but still significant, amounts of allanite.

The RMP intrudes rocks of the Archean (ca. 2.6 Ga) Elmer's Rock Greenstone Belt (ERGB) to the west and north. The ERGB consists of amphibolite facies supracrustal rocks, which include marble, calc-silicate, amphibolite, pelitic gneiss, granite gneiss, quartzites, banded iron formation, and minor amounts of ultramafic rock (Anderson, 1995). Marble, calc-silicate, and pelitic gneisses are most common near the RMP contact (Spicuzza, M.J., 1990). To the south and southwest, the RMP is in direct contact with the Sybille intrusion (ca. 1.434 Ma) (Scoates et al., 1996). Historically, the contact between the two plutons has been noted as sharp. However, recent work has shown that this contact may be gradational in nature. Regardless, the lack of evidence of brittle deformation at the contact indicates that the Sybille Formation was still hot at the time of the RMP intrusion (Anderson, 1995). To the east, the RMP is covered by tertiary sediments which consist of unconsolidated gravels and fine-grained sediments derived from LAC sources (Anderson, 1995). A geologic map of the Project Area can be observed in Figure 5-2, and a detailed stratigraphic column is provided in Figure 5-3. Geological cross sections can be observed in Figures 5-4 through 5-6.

Figure 5-2: Halleck Creek Project Geology

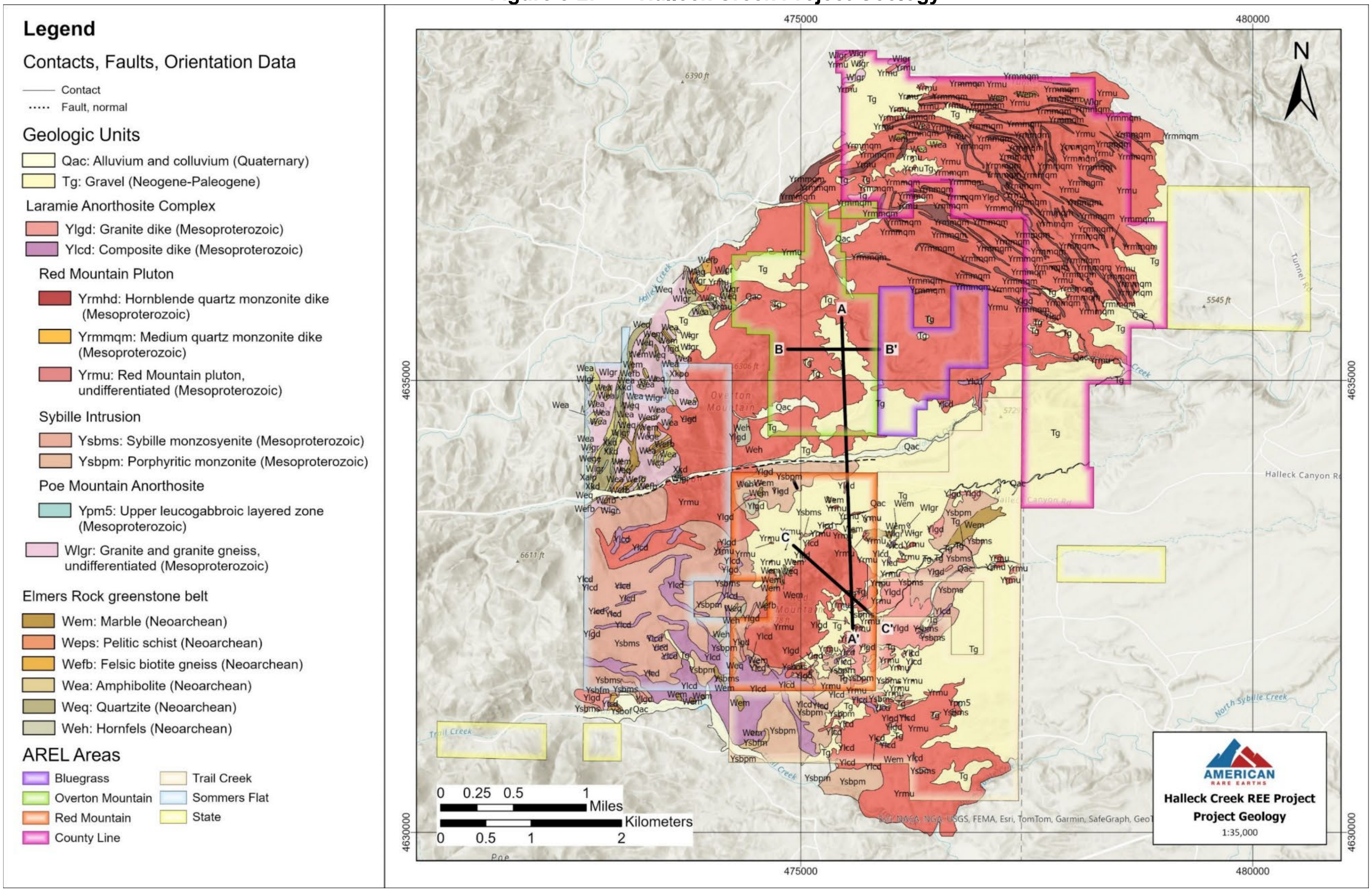


Figure 5-3: Stratigraphic Column for Halleck Creek Project Area

Eon	Period	Formation	Code	Lithology
Cenozoic	Quaternary	Alluvium and colluvium	Qac	Consists of silt, sand, and gravel; may contain well-rounded clasts dominated by resistant Precambrian lithologies.
	Neogene-Paleogene	Gravel	Tg	Poorly exposed, unconsolidated to weakly consolidated, poorly sorted gravels and boulders in a silty and sandy matrix; locally tuffaceous.
Major unconformity				
Proterozoic	Mesoproterozoic	Laramie Anorthosite Complex ca. 1.43 Ga — Granite dike	Ylgd	Includes pink leucogranite dikes and irregular small intrusions as well as several large inclusions of coarse-grained biotite-hornblende granite in the Sybille monzosyenite.
		Laramie Anorthosite Complex ca. 1.43 Ga — Composite dike	Ylcd	Pink granite dike similar to Ylgd but contains pillows and irregular blobs of fine-grained, mafic monzonitic magma. Various degrees of mixing between the two melts common. Inlcudes isolated K-feldspar megacrysts in the mafic magma and dispersed grains of biotite and hornblende extending from the mafic magma into the granitic magma.
		Laramie Anorthosite Complex — Red Mountain Pluton 1,431.3 ± 1.4 Ma (Scoates and Chamberlain, 2003) — Biotite-hornblende monzonite dike	Yrmhd	Typically red-brown in color, markedly darker than the main pluton constituents. Very fine-grained, with an average grain size of 0.25 mm. Contains high modal abundances of hornblende and biotite. Petrographically similar to the BHS, but is much more fine-grained and contains lower modal quartz.
		Red Mountain Pluton — Fine quartz monzonite dike	Yrmfqm	Mineralogically similar to the CQM, with slightly increased abundances of hornblende and biotite. Typical grain size of 0.5-0.75 mm.
		Red Mountain Pluton — Medium quartz monzonite dike	Yrmmqm	Nearly mineralogically identical to the FQM dikes, but with slightly lower modal plagioclase. Mean grain size of >1.0 mm.
		Red Mountain Pluton — Fayalite monzonite	Yrmfm	Red weathering, equigranular, and medium grained. Olivine and clinopyroxene occur as individual grains or glomerocrysts associated with hornblende. Minor biotite is secondary after hornblende. Quartz and allanite may be present in small quantities, whereas zircon is abundant. Orthoclase and microline often appear perthitic.
		Red Mountain Pluton — Clinopyroxene quartz monzonite	Yrmcqm	Red weathering, equigranular, and medium grained. Petrographically similar to the fayalite monzonite, but allanite is more abundant and olivine is absent. Glomerocrysts of clinopyroxene, hornblende, and allanite are observed. Zircon and ilmenite are rare, but increased biotite, quartz and microcline in comparison to fayalite monzonite.
		Red Mountain Pluton — Biotite hornblende quartz syenite	Yrmbhs	Dominant rock type within the RMP. The BHS lacks fayalite and clinopyroxene: the only ferromagnesian phases present are hornblende and bioltite. As with the other units, perthitic microcline is the major alkali feldspar.
		Red Mountain Pluton — Red Mountain granite	Yrmg	Occurs as concordant ring-like dikes interleaved with supracryustal rocks on the north and northwest margins of the pluton. Red weathering, equigranular, and medium-grained similar to other RMP rocks, but has high abundance of quartz. The unit also exhibits more abundant microcline and increased perthite. Clinopyroxene tends to be rare, occuring only as relict cores in hornblende.
		Laramie Anorthosite Complex — Sybille Intrusion 1,435.6 ± 2.5 Ma (Scoates and Chamberlain, 2003) — Sybille monzosyenite	Ysbms	Orange-weathering rock that is black on fresh surfaces, consisting of interlocking alkali-feldspar megacrysts. Ferromagnesian minerals include fayalite, hedenbergite, and rarely hornblende which occur in the interstices between the megacrysts. Contains about 5% quartz, but is seldom seen in hand specimen.
		Sybille Intrusion — Sybille porphyritic monzonite	Ysbpm	Brown-weathering rock that is black on fresh surfaces consisting of alkali feldspar megacrysts in a finer-grained matrix of plagioclase, alkali feldspar, olivine, and hedenbergite. Rarely contains quartz.
		Sybille Intrusion — Ferromonzonite or ferrodiorite	Ysbfm	Fine-grained, dark-brown-weathering rock that is black on fresh surfaces consisting of interlocking feldspars. Proportions of feldspars range from mainly plagioclase to an equal proportion of plagioclase and highly exsolved alkali feldspar. In a few occurences, the alkali feldspars from small phenocrysts identifiable in hand sample. Ferromagnesian minerals present may be ferroaugite, olivine, and in some rocks pigeonite.
		Sybille Intrusion — Oxide ferrodiorite	Ysbof	Fine-grained, black rock on both weathered and fresh surfaces, rich in Fe-Ti oxides. Plagioclase, olivine, ferroaugite, and rarely pigeonite are identifiable in thin section.
Archean	Neoarchean	Granite and granite gneiss	Wlgr	Medium- to coarse-grained, massive to highly foliated granitic gneisses that are pink on both weathered and fresh surfaces. Biotite is prominent and muscovite might be present locally. Includes large, partially melted inclusions within the Sybille intrusion.
		Elmers Rock Greenstone Belt 2,637 ± 10 Ma (Snyder et al., 1998) — Marble	Wem	White, coarse-grained marble. Locally may contain cm-scale blades of tremolite.
		Elmers Rock Greenstone Belt — Pelitic schist	Weps	Quartz, biotite, and muscovite schist, generally black to dark brown on fresh and weathered surfaces. Outside the contact aureole of the Sybille intrusion the schist commonly has the assemblage kyanite, sillimanite, and garnet, but within the aureole, it contains andalusite and cordierite. Adjacent to the intrusion it has melted and may contain streaks of granitic melt.
		Elmers Rock Greenstone Belt — Felsic biotite gneiss	Wefb	Speckled gray feldspar, quartz, and biotite gneiss and schist, possibly derived from clay bearing silts, sands, or gravels.
		Elmers Rock Greenstone Belt — Amphibolite	Wea	Medium-grained, green to black, layered amphibolite. In low-strain areas, pillow structures may be observed. Commonly interlayrered with calc-silicate rocks. In the contact aureole of the Sybille pluton, the amphibolite has been converted to a fine-grained brown hornfels with the assemblage orthopyroxene, clinopyroxene, hornblende, and plagioclase.
		Elmers Rock Greenstone Belt — Quartzite	Weq	Massive white, greenish-white, or brown quartzite.
		Elmers Rock Greenstone Belt — Hornfels	Weh	Undifferentiated fragments of the Elmers Rock greenstone belt that occur as inclusions in the Sybille monzosyenite and Red Mountain pluton. Protolith for these rocks may include pelitic, semi-leitic, calc-pelitic, or mafic lithologies.
		Elmers Rock Greenstone Belt — Calc-silicate hornfels	Wecs	White to pale-green weathering hornfels consisting of calcite, dolomite, and pale-green sperentine. The serpentine was produced by hydration of olivine.

Figure 5-4: Cross-Section of the Halleck Creek Project Area: A to A

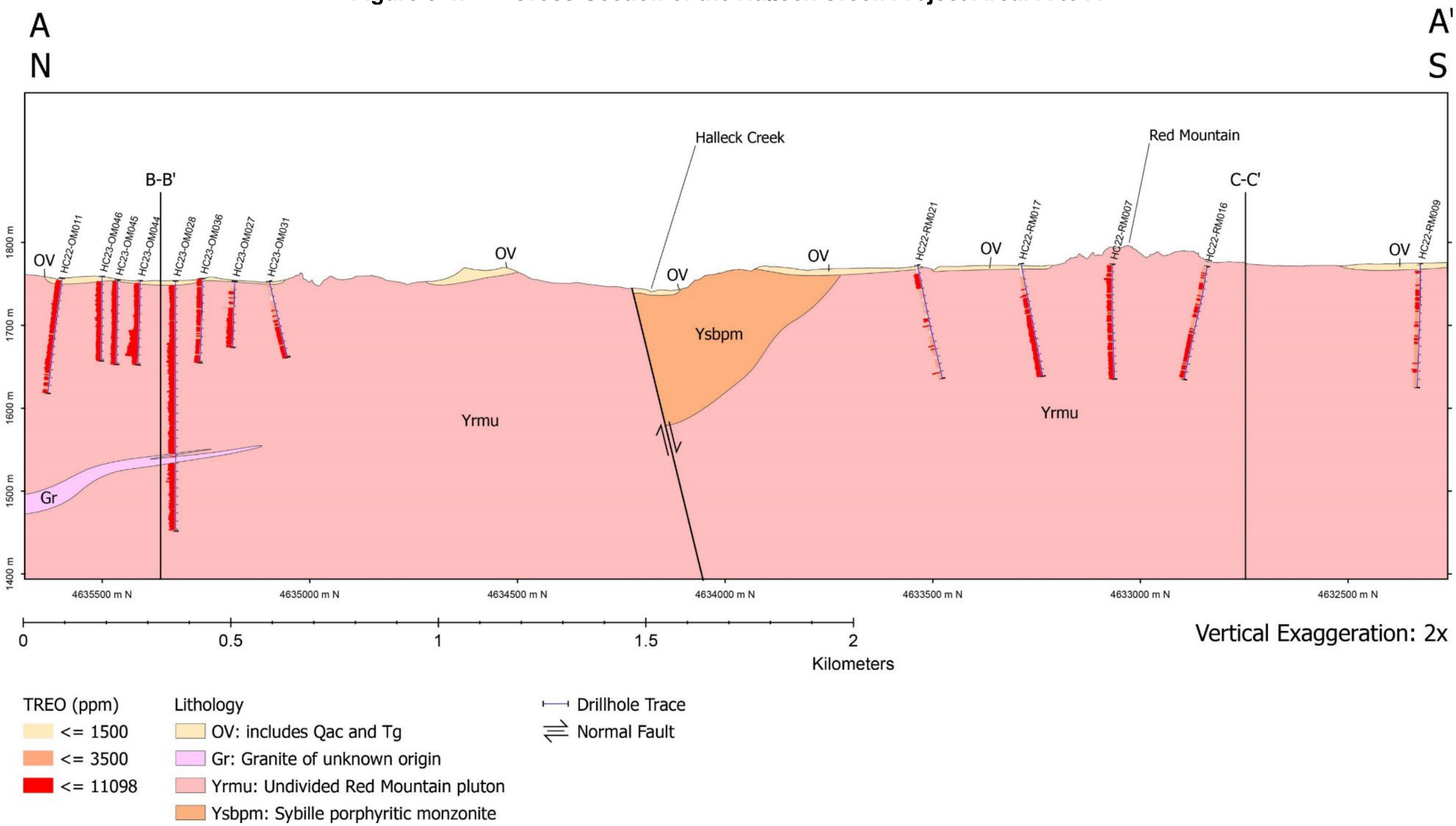


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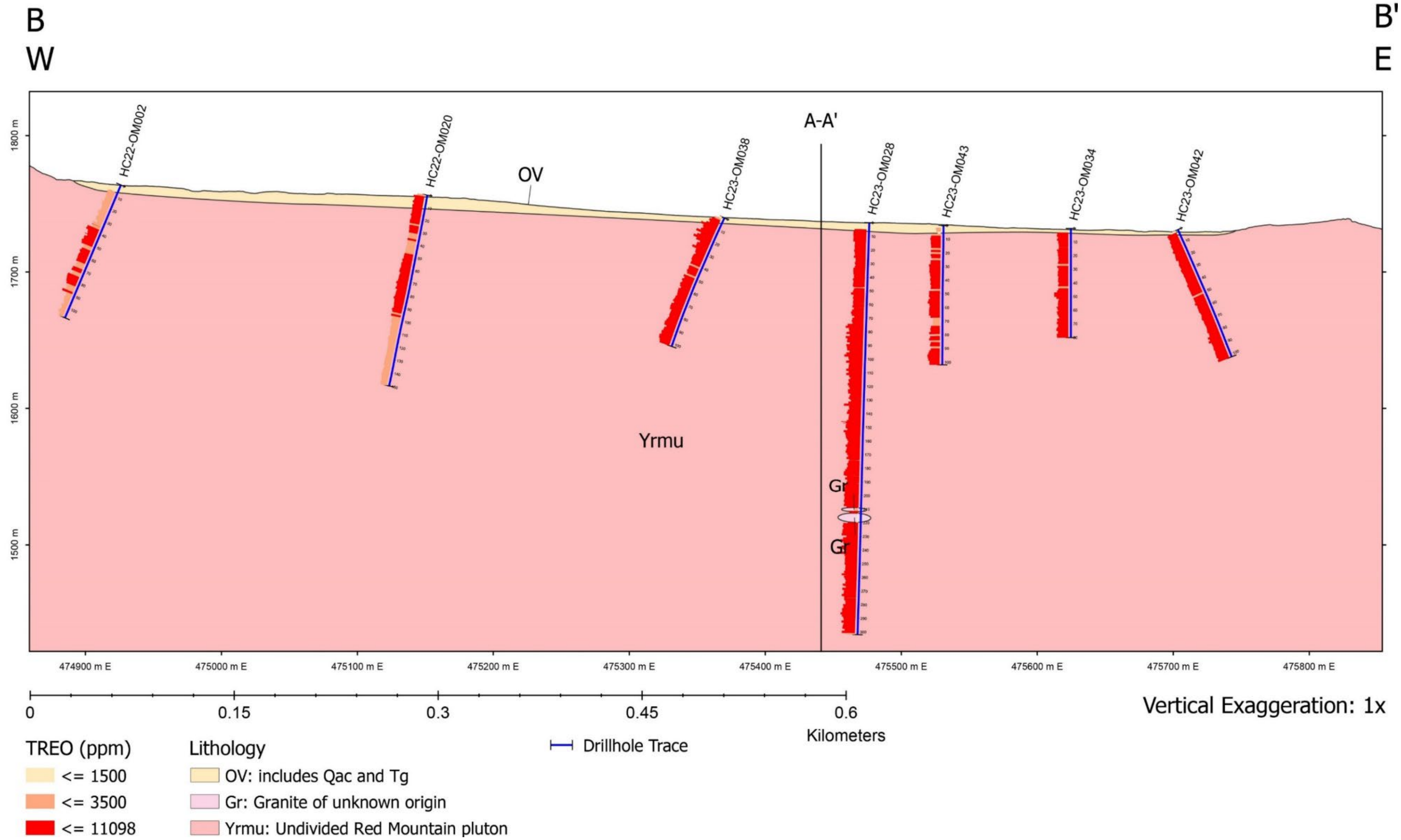
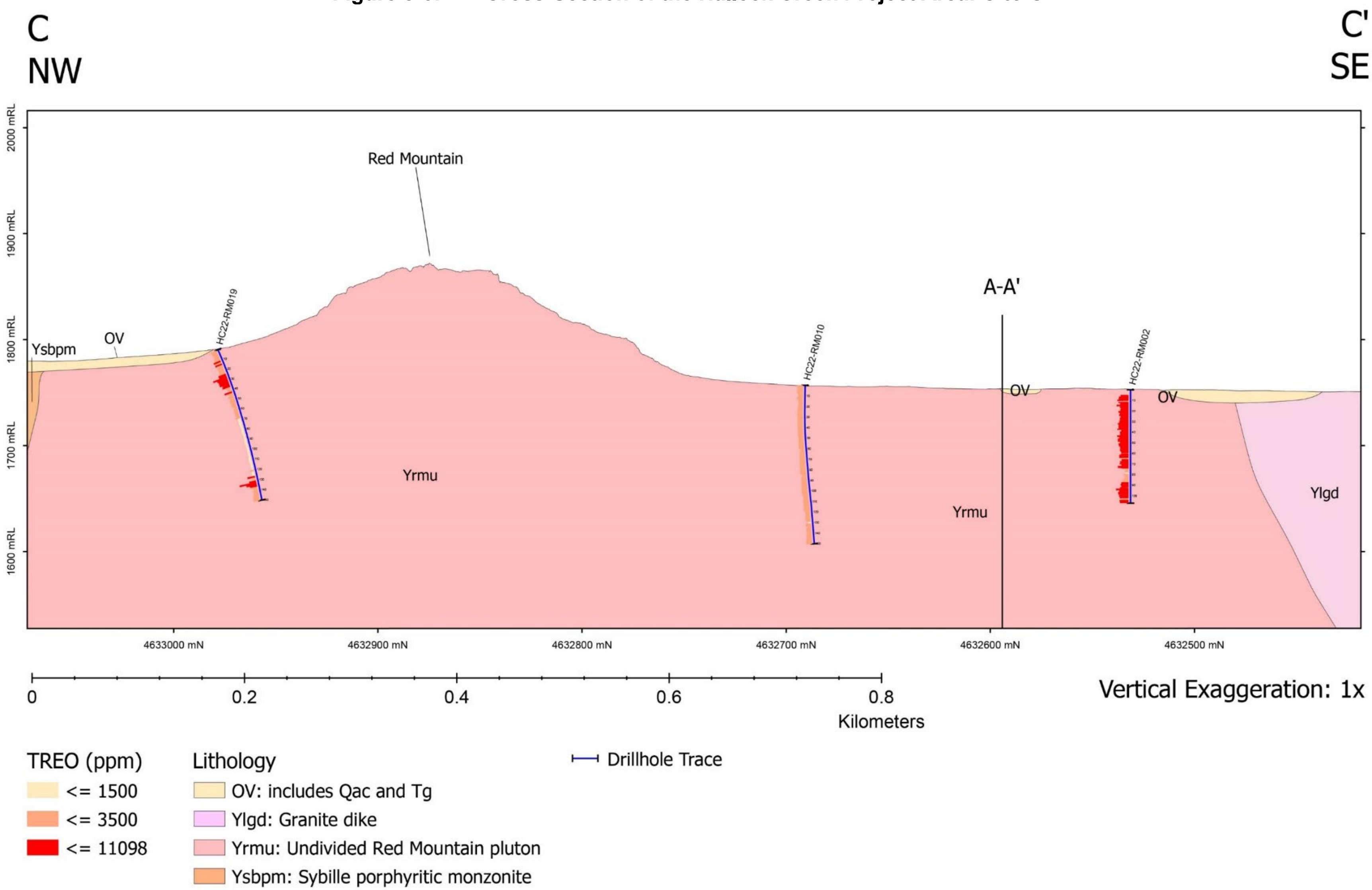
Figure 5-5: Cross-Section of the Halleck Creek Project Area: B to B



(ARR 2024)

Figure 5-6: Cross-Section of the Halleck Creek Project Area: C to C



(ARR 2024)

5.3.2 Structure

Contacts between units of the RMP are intrusive. There are few country rock inclusions within the RMP, and the foliations in the surrounding Archean schists of the ERGB concordantly wrap the pluton. This suggests that the RMP was most likely emplaced by forcibly shouldering aside the country rock as part of late-stage development of the pluton (Anderson et al., 2003).

The only prominent structure in the region is the Halleck Canyon fault which generally parallels County Road 720, bisecting the Halleck Creek Project Area.

5.4 Deposit Evolution

Monzonitic plutons, such as the RMP, are believed to be the result of open-system fractionation of a ferrodioritic parent magma, which is typical residual after the crystallization of the primary anorthosite bodies (Anderson et al., 2003). Scoates et al. (1996) conducted crystallization experiments using one of the LAC ferrodiorites and demonstrated that extensive crystallization of a ferrodioritic parent magma can produce potassium-rich monzonitic liquids. Based on isotopic similarities between the RMP and the least-contaminated rocks of the LAC, it is believed that a similar ferrodioritic parental magma is appropriate for the RMP (Anderson et al., 2003).

Continued fractional crystallization was critical in forming the RMP and its various units. The liquid line of descent (LLD) from monzodiorite to fayalite monzonite was driven by the crystallization of olivine, clinopyroxene, plagioclase, apatite, magnetite, and ilmenite. The crystallization sequence for the REE-bearing units of the RMP is zircon, apatite, olivine, clinopyroxene, allanite, plagioclase, K-feldspar, hornblende, biotite, and quartz (Anderson et al., 2003). Petrographic work suggests that olivine, clinopyroxene, plagioclase, apatite, zircon, and allanite are accumulative, whereas alkali feldspar, hornblende, biotite, and quartz crystallized from intercumulus liquid (Anderson et al., 2003).

Allanite is the primary REE host mineral at the Halleck Creek Project. Allanite is a sorosilicate within the epidote group, which contains a significant number of REEs in its primary mineral structure. The presence of allanite is the main reason that the RMP has higher REE content than any of the coeval monzonitic bodies in southeastern Wyoming. In other regional plutons, REEs were carried in phosphates, primarily apatite (Anderson et al., 2003). It is speculated that the REEs went into allanite instead of apatite is due to increased water and lower P2O5 content relative to other monzonitic plutons in the region. The major chemical constraint on the formation of allanite within the RMP is the abundance of Fe_2O_3 in the parent magma. Ilmenite is typically the primary competing phase for Fe_2O_3. However, the RMP contains low amounts of TiO_2, therefore iron is more widely available for allanite formation (Anderson et al., 2003).

5.5 Property Geology

5.5.1 Deposit Dimensions

The deposit can be subdivided into two Project Areas: Overton Mountain and Red Mountain. The deposit at the Red Mountain Project Area is approximately 1,620 m x 1,610 m, and the deposit at the Overton Mountain Project Area is approximately 2,335 m x 1,075 m. Both deposits remain open at depth: mineralization has been observed to a depth of 302 m at Overton Mountain, and 150 m at Red Mountain.

5.5.2 Lithologies

The three major mineralized phases within the RMP are the clinopyroxene quartz monzonite, the biotite hornblende quartz syenite, and the fayalite monzonite. The lesser mineralized phases include the medium quartz monzonite dikes and the biotite-hornblende monzonite dikes (Figure 5-3).

5.5.3 Structure

Mineralization in the RMP is not structurally controlled. However, the deposit does exhibit significant jointing and minor faulting associated with Laramide aged uplift as well as general exfoliation of the monzonitic body.

Mapping revealed no major structural features or controls within the mapped areas except for prominent joint sets within the RMP rocks. The strike and dip measurements of the joint sets were recorded during mapping (Figure 5-7). The remaining joint measurements that fall outside the conjugate set are presumed to be associated with exfoliation of the intrusive body. One minor fault within the Sybille Intrusion north of Red Mountain was observed. Stereonets reveal a prominent conjugate joint set and jointing related to exfoliation of the Red Mountain body (Figure 5-8). All mapped features are assumed to be in igneous contacts, not structural ones.

Figure 5-7: Stereonet Exhibiting All Joint Measurements and Associated Rose Diagram

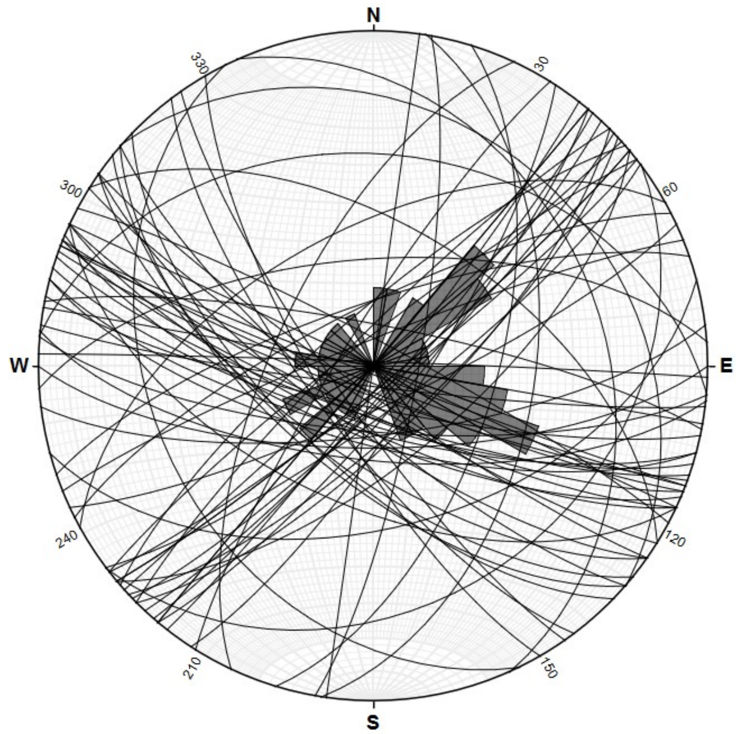


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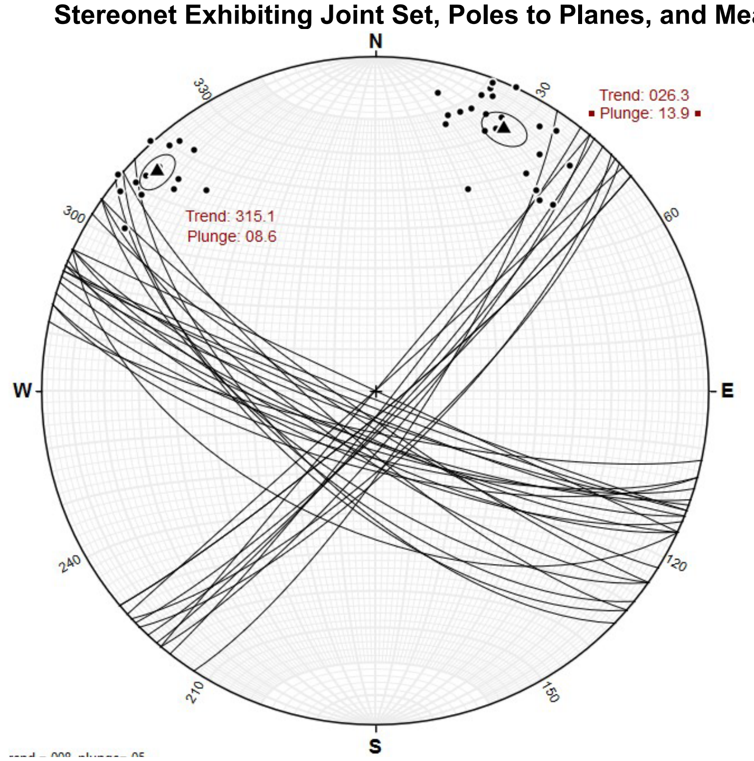
Figure 5-8: Stereonet Exhibiting Joint Set, Poles to Planes, and Mean Vectors



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5.5.4 Alteration

The RMP exhibits differing types of alteration of varying intensity. Most observed alteration is low to moderate. Alteration has not been shown to affect grades. More work is required to determine an exact relationship between alteration and grade, but preliminary results show there is no effect.

Regardless, the prominent style of alteration observed throughout the pluton is weak potassic alteration and oxidation. Lesser amounts of epidote alteration have been observed. Alteration is most prevalent along joint and minor fault surfaces.

Metamict structures are observed in micrographs of allanite, displaying the decomposition of allanite crystal structure to amorphous solids and radial fractures emanating from allanite crystal cores.

5.5.5 Mineralization

Rare earth element mineralization within the pluton is hosted within allanite [Ce,Ca,Y,La)2(Al,Fe^3)3(SiO4)3(OH)], a sorosilicate of the epidote group, and zircon. Mineralization occurred due to fractional crystallization of the RMP bodies over time.

5.5.5.1 PETROGRAPHY

Most allanite grains occur as inclusions in and around aggregates of fractured amphibole. Allanite measurements range from 400 µm up to 2.5 mm in diameter. Allanite occasionally exhibits thin rinds of epidote (iron oxide), metamict and isotropic cores. Metamict allanite often exhibits radial fracturing in the surrounding minerals due to the hydration of the crystal structure during metamictization.

Feldspars are the dominant silicate phase in all units within the RMP. Late-stage grid twinned microcline is most commonly observed, followed by plagioclase, often weakly sericitized. Microcline ranges in composition from Or65 to Or95, and plagioclase ranges in composition from An7 to An24 (Anderson et al., 2003). Microcline is typically anhedral and ranges in diameter from 500 µm to 4 mm, whereas plagioclase occurs as anhedral to subhedral grains which vary in size from 500 µm to 5.5 mm (DCM, 2019).

Green amphibole is the second most abundant silicate, and typically comprises no more than 25% of the samples by volume. Amphibole typically occurs as aggregates and prisms up to 5 mm in size and exhibits mild to moderate decay to iron-oxide along cleavage planes.

Quartz content comprises no more than 10–15% in the thin section observed. Typically, anhedral / rounded grains occur interstitially between feldspar and amphibole. Myrmekitic quartz is present yet confined to the margins of smaller plagioclase grains.

Zircon is common throughout the RMP as fractured euhedral prisms and is commonly hosted within amphibole and is less commonly included in feldspars (DCM, 2019). Zircons range in diameter from 50–600 µm. Trace, rounded apatite occurs as inclusions within feldspar and quartz. Trace biotite occurs as aggregates associated with amphibole. Trace pyrite or pyrrhotite was observed in one sample and was identified using EDS spectrometry. Sulfides, when present, typically occur around the edges of allanite grains (DCM, 2019).

All examined petrographic samples exhibited varying amounts of Fe-oxide which occur as fracture fill or as replacement of amphibole. Ilmenite is the most common variety observed, albeit in trace amounts.

5.5.5.2 MINERALOGICAL CHARACTERIZATION

In 2022, SGS in Lakefield, Ontario performed detailed mineralogical characterization of some of the highest REE bearing samples observed during the maiden drilling program to determine liberation and association attributes of the REE. Work completed included TESCAN integrated mineralogical analyzer (TIMA-X), electron probe micro-analysis (EMPA), X-ray diffraction (XRD) analysis, an electron-microscope, and chemical assays.

XRD analysis revealed the bulk crystalline mineralogy of the clinopyroxene-rich quartz monzonite to be albite (30%), microcline (34%), actinolite (12%), quartz (9%), and lower amounts of other silicates, Fe-(Ti) oxides, and carbonates (Table 5-1). Modal mineralogy from TIMA-X analysis revealed similar results with orthoclase (39.9%), plagioclase (29.6%), amphibole (16.3%; includes minor pyroxene), quartz (6.6%), garnets / epidote (2.3%), biotite (1.2%), and trace amounts of carbonates, other silicates, apatite, sulphides, Fe-oxides, ilmenite, and other minerals.

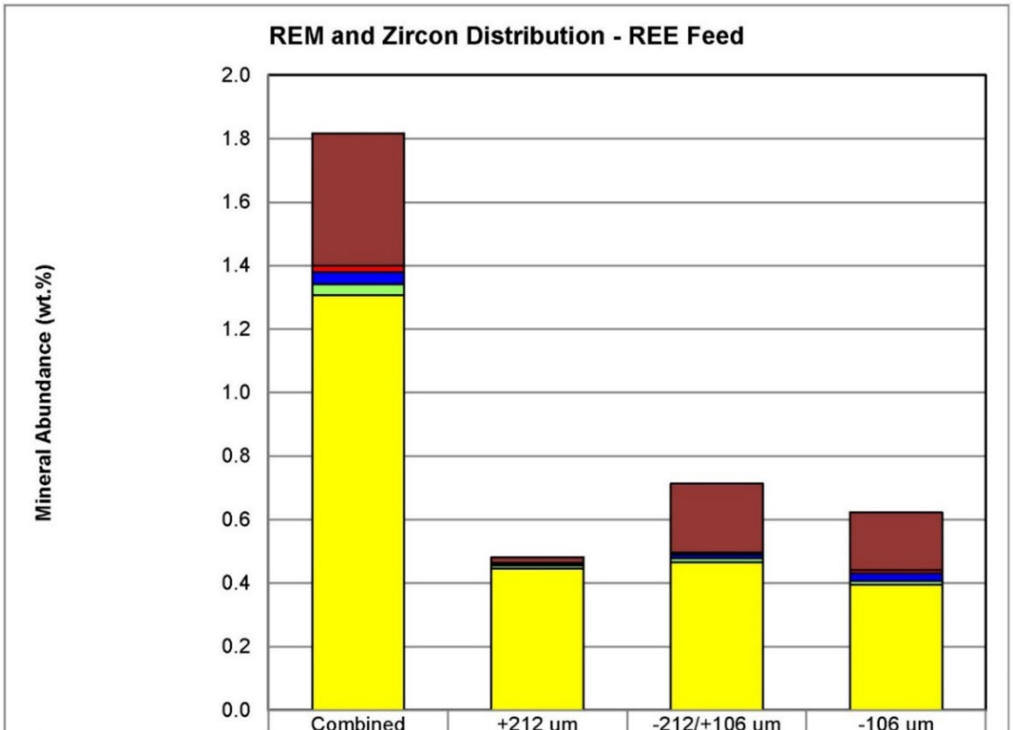
Table 5-1: XRD Results

Mineral / Compound	REE Feed
Quartz	9.3
Albite	30.2
Microcline	34.0
Actinolite	11.8
Ilmenite	0.1
Magnetite	1.6
Biotite	1.5
Chlorite	1.1
Stilpnomelane	2.4
Diopside	2.8
Forsterite	1.5
Almandine	0.8
Zircon	0.9
Calcite	0.7
Ankerite	0.0
Epidote	1.3
Total	100

Allanite is the dominant REE-bearing mineral, and approximately 87.5% of all allanite occurred as free, pure, or liberated forms (due to grinding). The remaining 12.5% of the allanite was associated with matrix minerals, such as intergrowths with silicate gangue. The free, pure, and liberated allanite percentage increased to 90.2% for material exceeding 212 µm. Other minor REE bearing minerals were observed: Synchysite / bastnasite comprised 0.02% of modal mineralogy, and chevkinite / tornebohmite comprised about 0.07% (Figure 5-9).

Liberated (pure, free, and liberated) allanite accounted for 87.5% of the samples, and the remainder occurred as complex particles (2.4%), middlings with quartz / feldspars (5.4%), amphibole (1.1%) and other minerals in trace amounts (<1%). Liberated chevkinite / tornebohmite accounted for 50.2% in the samples, and synchysite / bastnasite for 23% (Figure 5-10).

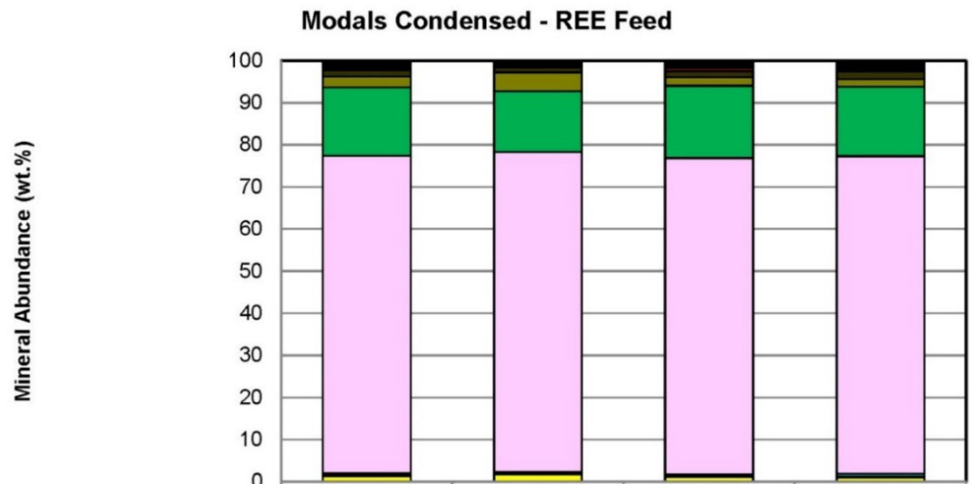
Figure 5-9: REE Mineral and Zircon Mineral Mass by Size Fraction and Calculated Head



	Combined	+212 um	-212/+106 um	-106 um
Zircon	0.42	0.02	0.22	0.18
Synchysite/bastnasite	0.02	0.00	0.01	0.01
Tornebohmite	0.04	0.00	0.01	0.02
Chevkinite	0.03	0.01	0.01	0.01
Allanite	1.31	0.45	0.46	0.40

SGS, 2022

Figure 5-10: Modal Mineralogy by Size and Calculated Head



	Combined	+212 um	-212/+106 um	-106 um
Other Minerals	0.16	0.14	0.15	0.18
Fe-(Ti)-Oxides	1.53	1.20	1.67	1.60
Zircon	0.42	0.07	0.57	0.49
Apatite	0.18	0.14	0.12	0.25
Other Silicates	1.53	1.22	1.40	1.88
Garnets/Epidote	2.52	4.42	2.04	1.76
Amphibole	16.3	14.5	17.2	16.5
Quartz/Feldspars	75.5	76.1	75.1	75.4
Carbonates	0.51	0.35	0.42	0.70
Niobates	0.00	0.00	0.00	0.00
Other REM	0.00	0.00	0.00	0.00
Synchysite/Bastnasite	0.02	0.01	0.02	0.03
Xenotime/Monazite	0.00	0.00	0.00	0.00
Chevkinite/Tornebohmite	0.07	0.06	0.06	0.09
Allanite	1.31	1.81	1.22	1.07

SGS, 2022

6.0 EXPLORATION AND DRILLING

6.1 Exploration

6.1.1 Grids and Surveys

Drill hole, trench and surface sample locations are stored in the Project database using the NAD 1983, UTM Zone 13 coordinate system.

WGS 1984 latitude and longitude coordinates are stored as secondary coordinates in the Project database.

6.1.2 Geological Mapping

Most recently, during the Summer of 2023, ARR Geologists conducted mapping and sampling of the Halleck Creek resource area. The campaign focused on further characterizing and locating the rare earth element-enriched RMP. Mapping and sampling focused on ARR claim areas where previous geologic mapping was sparse and speculative. Specifically, mapping occurred in the County Line, Trail Creek, and Red Mountain prospect areas (Figure 5-2). Contemporaneous with the geologic mapping effort, ARR geologists collected 189 surface samples, which were analyzed using X-ray fluorescence (XRF) and assayed by ALS Global.

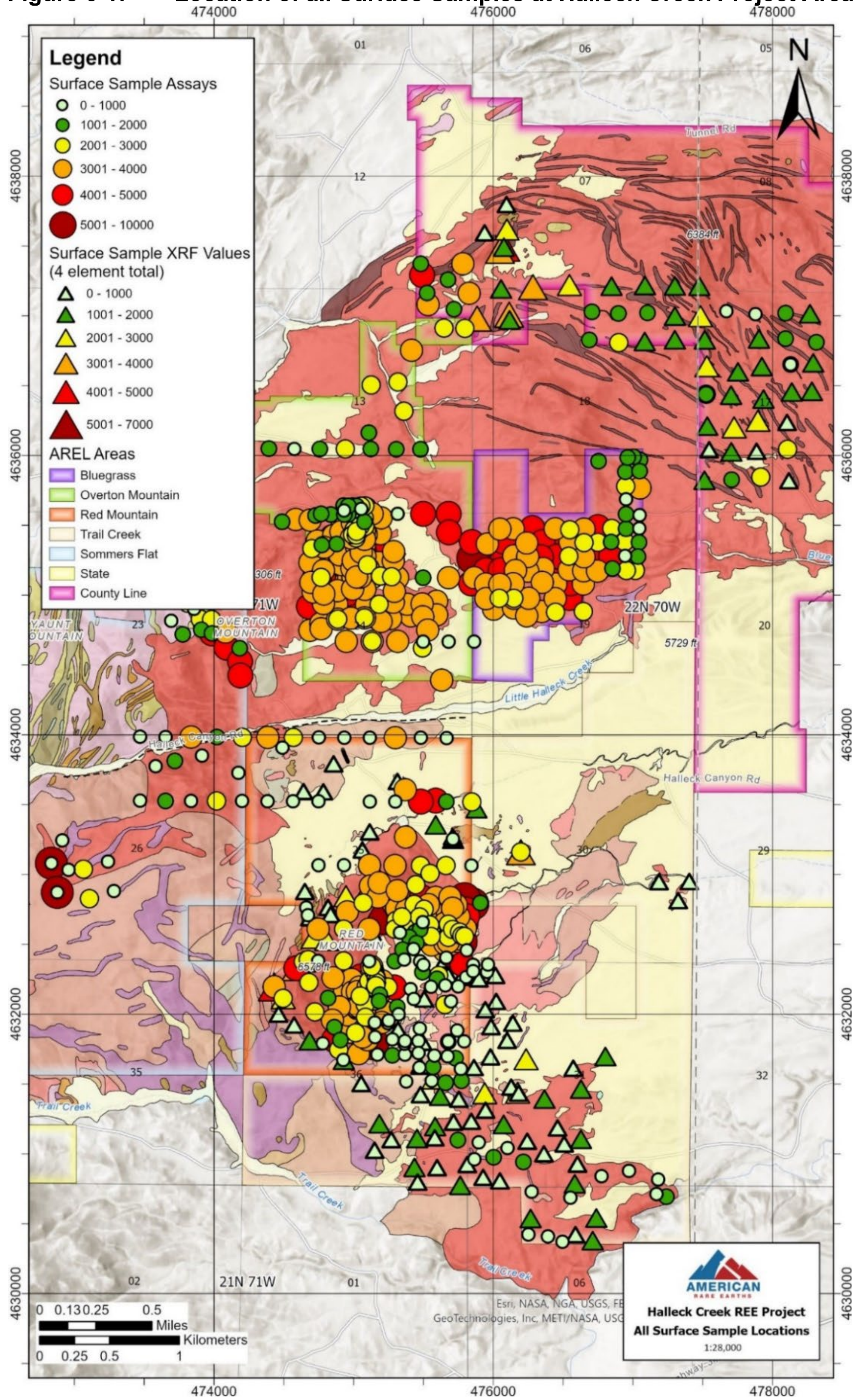
ARR Geologists found that previous geologic contacts were not accurately located. ARR Geologists determined tighter constraints on contact locations between geologic units. The historical maps were completed by pacing, while the new mapping was completed using GPS for more accurate observation locations. Some of these map differences may also be attributed to original mapping at a 1:24,000 scale, which prohibits a certain level of detail. In contrast, company Geologists have been mapping at an infinite scale. Importantly, GPS-confirmed geology will help provide greater accuracy when choosing new drill hole locations and will aid in the placement of conceptual mine facilities.

6.1.3 Geochemistry

ARR Geologists have collected approximately 756 surface samples across the Halleck Creek mineral holdings since 2021 (Figure 6-1). American Assay Laboratories (AAL) and ALS Global have assayed these samples. The RMP outcrops throughout the Project Area allow for thorough surface sampling of the Project Area. ARR Geologists found that surface geochemistry (TREO) corresponds very well with TREO grades observed in rocks below the samples.

ARR relied upon surface geochemistry to define drill hole locations and to assist in resource modeling to define resource extents.

Figure 6-1: Location of all Surface Samples at Halleck Creek Project Area



ARR 2024

6.1.4 Geophysics

Surface geophysical programs have yet to be employed at Halleck Creek. The homogenous nature of the lithology and the low levels of radionuclides, metallic oxide minerals, and sulphide minerals do not lend themselves to conventional geophysical exploration. Surface geochemical samples have proven to provide valuable exploration data.

6.1.5 Qualified Person's Interpretation of the Exploration Information

The Qualified Person (QP) believes that the extent of mapping and sampling across the Project Area provides a comprehensive view of the geology at Halleck Creek. The mapped area and extensive database of surface samples provide substantial value to the Project. Mapping programs have greatly increased levels of confidence in geologic contacts.

6.1.6 Exploration Potential

Additional mapping and sampling in claim areas west of Red Mountain and Overton Mountain might locate additional RMP material with elevated concentrations of allanite. This work is planned for Summer 2024.

6.2 Drilling

6.2.1 Overview

Between March 2022 and October 2023, ARR completed three exploration drilling campaigns at Halleck Creek. These drilling programs are a mix of 17 HQ core drilling and 53 reverse circulation (RC) holes. To date 70 drill holes have been drilled for a total meterage of 9,031 (Table 6-1).

Table 6-1: Halleck Creek Drilling Statistics

Area	Hole Type	No. Holes	Meters
Overton Mountain	HQ core	13	1394.5
	RC	35	4,530
Total		**48**	**5,925**
Red Mountain	HQ core	4	381
	RC	18	2,726
Total		**22**	**3,106**
Total		**70**	**9,031**

ARR Geologists logged all core and RC chip cuttings in detail. All core was photographed with rock quality designation (RQD) measured and calculated. 2023 core holes were also geotechnically logged by ARR Geologists. RC samples were collected using a rotary sampler that provided three samples for each 1.5-meter interval. Core and RC samples were sampled and assayed at 1.5-meter intervals. All core and RC samples are stored in secure storage facilities and chains of command have been followed through laboratory analysis.

All drill hole collar information, surveys, lithology, alteration, assays, and geotechnical data were entered into the drill hole database (DHDB). The database has exclusive access to ARR Geologists. Photographs of surface samples, core, and RC cuttings are cross-referenced to drill holes in DHDB. Likewise, certified assay results are also cross-referenced to drill holes in DHDB.

ARR developed and implemented daily safety protocols for drilling, drillers and ARR staff. Daily work plans and safety meetings were held and recorded for each drilling campaign.

6.2.2 Drilling Supporting Mineral Resource Estimates

All 70 drill holes at Halleck Creek have been included in resource estimates.

6.2.3 Drill Methods

Table 6-1 summarizes the drilling at Halleck Creek, showing 9,031 meters of total drilling. To date, ARR drilled 17 HQ core holes for a total of 1,775 m. ARR drilled 53 RC holes for a total of 7,256 m.

6.2.4 Logging

ARR Geologists logged all HQ core. HQ core logging consists of measuring RQD, logging lithology and alteration, photographing all core, and defining samples. For the Fall 2023 Exploration Program, ARR enlisted Geotechnical Engineers from WSP to train ARR Geologists to geotechnically log core. ARR Geologists also geotechnically logged the Fall 2023 core as part of logging protocols.

RC cuttings were collected into three splits using a rotary splitter attached to the drill rig. One portion of the RC chips were placed in cutting trays for logging by ARR Geologists. The other sample portions were placed in bags for XRF analysis and for assay. ARR Geologists logged the RC cuttings under 10x binocular microscopes. ARR Geologists logged lithology, alteration, and took photographs of cuttings trayed for each RC hole.

6.2.5 Recovery

The total core recovery at Halleck Creek is approximately 97%. Recovery for RC has not been calculated Table 6-2. However, no recorded zones of loss or no sample recovery occurred during RC drilling.

Table 6-2: Halleck Creek Core Recovery

DHID	TD (m)	Length Cored (m)	Length Recovered (m)	% Recovery
HC22-OM001	107	103.5	103.8	100.3
HC22-OM002	107	101	100.6	99.5
HC22-OM003	107	100.6	100.2	99.6
HC22-OM004	107	105.5	103.7	98.3
HC22-OM005	107	103.8	101.8	98.1
HC22-RM001	107	105.5	103.7	98.4
HC22-RM002	107	102	99.4	97.5
HC22-RM003	107	97.7	97.1	99.4
HC22-RM004	59.1	57.3	54.8	95.6
HC23-OM026	80	71.5	66.6	93.1
HC23-OM027	80	72	64.1	89
HC23-OM028	302	294	291.6	99.2
HC23-OM030	80	77.5	71.2	91.9
HC23-OM032	76.5	73.5	65	88.4
HC23-OM034	80	75.5	73.8	97.7
HC23-OM037	80	77	74	96.1
HC23-OM039	80	74.5	74	99.3
Total	**1,773.60**	**1,692.30**	**1,645.30**	**97.2**

6.2.6 Collar Surveys

All drill hole collars were surveyed by Laramie Land Surveying out of Laramie, Wyoming who are professional land surveyors. Surveys were collected and reported using the NAD 1983 UTM 13 North projection system.

6.2.7 Down Hole Surveys

Down hole surveys were collected for all drill holes for the Fall 2022 and Fall 2023 exploration programs. The down hole survey data is stored in DHDB and was used in resource models.

6.2.8 Comment on Material Result and Interpretation

Drilling at Halleck Creek has been performed with a high degree of detail. Recovery of core and RC cuttings has been excellent. Detailed logs and photographs exist for all holes.

The QP believes that the drilling data collection methods, drilling recoveries, and the drilling data collected is adequate for this study and for use in developing geological models and resource models.

6.3 Hydrogeology

ARR has not started detailed hydrogeological characterization work at Halleck Creek. Water associated with the RMP has not been assigned to specific aquifers. Hydrogeological characterization work is proposed for Summer 2024.

6.4 Geotechnical

ARR collected 65 geotechnical core samples during the Fall 2023 drilling program (Table 6-3). ARR sent the samples to WSP in Burnaby, British Columbia for strength testing. Table 6-4 summarizes tests performed by WSP.

Table 6-3: Geotechnical Samples

DHID	No. Samples
HC23-OM026	8
HC23-OM027	9
HC23-OM028	10
HC23-OM030	7
HC23-OM032	7
HC23-OM034	7
HC23-OM037	10
HC23-OM039	7
Total	**65**

Table 6-4: Geotechnical Tests

Geotechnical Test	No. Tests
Brazilian Tensile Strength	18
Unconfined Compression Test	25
Triaxial Compressive Strength	17
Direct Shear	5
Total	65

The results of these tests have not been interpreted by a geotechnical engineer to determine slope angles and other geotechnical parameters in pit designs for this study. This will be completed with additional geotechnical drilling prior to the next technical study on the Project.

7.0 SAMPLE PREPARATION

7.1 Sampling Methods

Sample material from the Halleck Creek Project includes rock chip outcrop samples collected by ARR Geologists, RC drilling and Diamond Drill coring. All sampling methods are appropriate for exploratory work and are considered industry standards.

7.1.1 Rock Chip

ARR Geologists collect surface rock chip samples from outcrop using rock hammers as part of geological mapping programs. In the field, each sample is assigned a unique sample ID. Locations of samples are recorded using a handheld Garmin GPSMap 66i device. Samples are geologically described and placed in sample bags.

In the office, rock chip samples are photographed and broken into two parts. One part is ground using a pneumatic hammer P_{100} -180-mesh sieve (0.08 mm) and analyzed using an Olympus Vanta handheld XRF analyzer in triplicate. The other part is prepared for shipment to an external lab (usually ALS) for assay.

Sample collection densities range from 50 m x 50 m up to 200 m x 200 m spacing, depending on the location and rock types being mapped.

7.1.2 Reverse Circulation

Rock chips are collected in 1.5 m (~5 ft) intervals. Using a rotary sample splitter, the RC drilling produced three separate rock chip samples for each 1.5 m (~5 ft) of depth of the drill hole. These included a sample for the chip trays, one sample for in-house XRF analysis, and one sample for external REE assay. Each sample interval was given a unique, pre-labeled sample ID that is shared between the identical chip tray, XRF, and lab assay samples. Chip trays and XRF samples have been retained and stored for ARR records and future usage. Rock chip trays and assay samples were retrieved from the drill sites daily to be logged and prepared for shipment, respectively. Samples were stored within locked storage units, or in ARR offices at all times until shipped by bonded carrier to ALS Global labs.

7.1.3 Core

Rock core was divided into 1.5 m (~5 ft) sample intervals, except for when lithologic breaks occurred down hole. As a result, sample intervals never crossed lithology boundaries to ensure assays accurately reflected potential differences in REE mineralization associated with different rock types within the RMP. Each sample was given a unique sample ID and tag, labeled with the drill hole ID number, sample number, and sample interval depths.

7.1.4 Qualified Person's Opinion on Sampling Methods

The QP believes that sampling protocols and methods employed by ARR are comprehensive and are adequate for geological modeling and resource estimation, within specific modifying factors outlined in Section 10.0.

7.2 Sample Security Methods

Prior to sample shipping, all drill cores resided in the storage yard which was securely locked when there were no ARR employees on site.

RC chips were stored in a locked shipping container prior shipment.

Core and RC were shipped to the labs via bonded carrier. ARR personnel prepared each shipment and supervised the loading of each shipment.

7.3 Density Determination

Nagrom Labs in Perth, Australia, performed hydrostatic testing on 10 core samples to determine the specific gravity of the Halleck Creek core. Specific gravity was determined for untreated and wax-impregnated samples. Table 7-1 summarizes the results of the hydrostatic testing.

Table 7-1: Specific Gravity Determination

Sample ID	Bag No.	Mass (kg)	SG	SG RPT	SG (Wax)	SG (Wax) RPT
HC22-RM002	1	0.5	2.68		2.69	
HC22-RM002	3	0.49	2.67		2.64	
HC22-RM003	5	0.31	2.66	2.68	2.65	2.64
HC22-RM003	7	0.38	2.71		2.75	
HC22-RM003	9	0.31	2.68		2.65	
HC22-OM003	11	0.59	2.79	2.79	2.78	2.77
HC22-OM003	13	0.4	2.69		2.67	
HC22-OM003	15	0.37	2.7		2.7	
HC22-OM004	17	0.37	2.72	2.71	2.69	2.7
HC22-OM004	19	0.35	2.68		2.66	
Wt. Avg.		4.05	2.7	2.74	2.69	2.72

Overall, the range of specific gravity values was very low. This is because the rock types at Halleck Creek are very homogeneous. Based on the results of hydrostatic testing a specific gravity of 2.70 was used to compute resource tonnage.

7.4 Analytical and Test Laboratories

For the maiden core drilling program, core samples were sent for assay at AAL in Sparks, Nevada which has ISO 17025 Accreditation and is approved by the Nevada Division of Environmental Protection.

Subsequent rock chip, RC and core samples from 2022 and 2023 were sent to ALS Global in Twin Falls, Idaho for processing and sample prep, but were subsequently assayed at ALS Global in Vancouver, British Columbia. ALS Vancouver has an ISO 17025 Accreditation and is also accredited by the Canadian Association for Laboratory Accreditation, Inc. Core samples from the 2023 program were sent to ALS Global in Reno, Nevada for splitting and sample preparation. Like the RC samples, the core samples were then assayed by ALS Global in Vancouver, British Columbia.

7.5 Sample Preparation Methods

Listed below are the RC chip and core sample preparation methods provided by ALS.

- Samples undergo fine crushing to 70%, passing 2 mm.
- Excessively wet samples undergo drying in drying ovens.
- Samples are pulverized up to 250 g to 85%, passing 75 µm.
- Samples marked for duplicates are split using a riffle splitter.
- Samples undergo lithium borate fusion prior to acid dissolution.
- Samples are analyzed on ICP-MS for ME-MS81 package.

7.6 Quality Assurance and Quality Control

Quality assurance / quality control (QA/QC) protocols were similar for the RC and diamond core drilling. Certified reference material (CRM) was inserted at a rate of 4.94% (1 CRM per 19 samples) for the diamond core samples, and a rate of 5.12% (1 CRM per 19–20 samples) for the RC samples (Tables 7-2 and 7-3).

Table 7-2: CRM Insertion Rates for Diamond Core Drilling

QA/QC Type	Number of Each	Insertion Rate
CDN-RE-1201	8	1.28%
Blank	8	1.28%
Duplicate	8	1.28%
CDN-RE-1202	8	1.28%
TOTAL	**32**	**5.12%**

Table 7-3: CRM Insertion Rates for RC Drilling

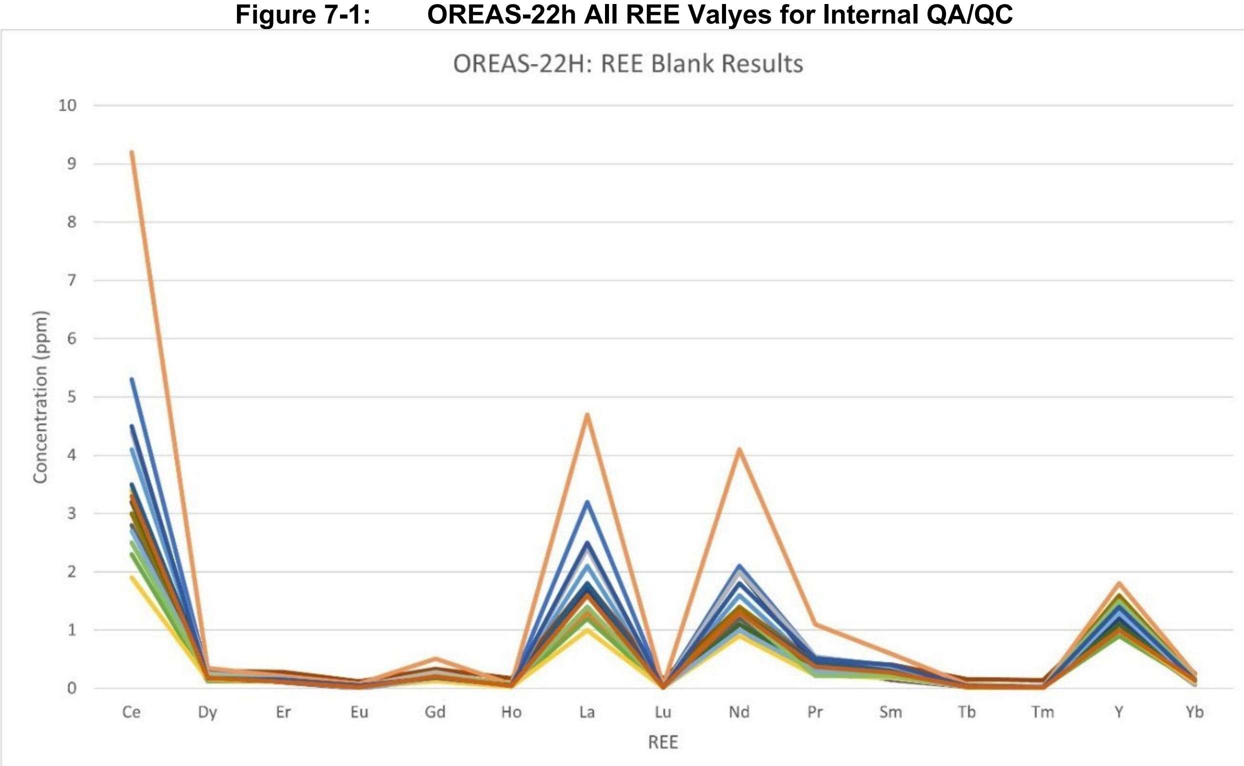
QA/QC Type	Number of Each	Insertion Rate
CDN-RE-1201	9	0.84%
Blank	19	1.68%
Duplicate	17	1.58%
CDN-RE-1202	9	0.84%
TOTAL	**53**	**4.94%**

7.6.1 Blanks

7.6.1.1 ARR BLANKS

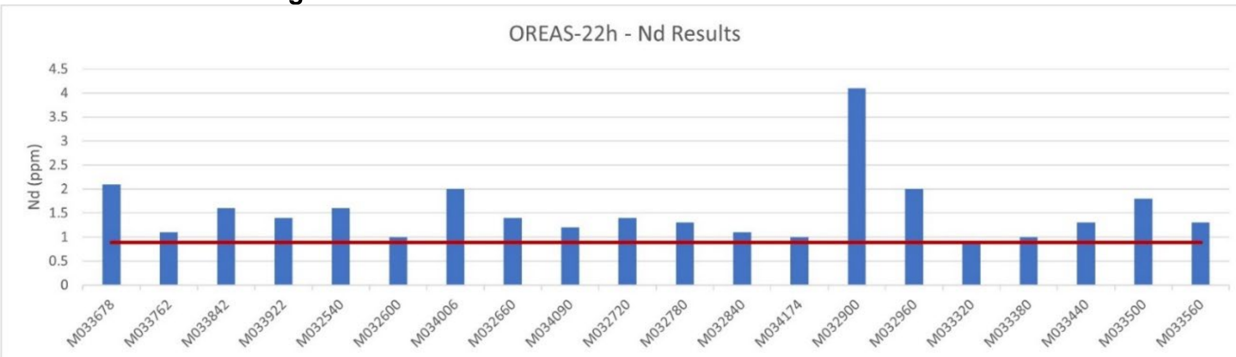
ARR sourced blank material from OREAS North America in Sudbury, Ontario CA. The blank material, OREAS-22h, is a quartz sand blank to which 0.5% Fe-oxide has been added to produce a pale grey pulp. The blanks contain very low levels of REEs (Figure 7-1). Only one sample exhibited possible contamination. Regardless, the potential contamination of that sample (M032900) only exhibited low REE concentrations and is not cause for concern (Figure 7-2). The red lines on the following graph represent the indicative value as reported by OREAS.

Figure 7-1: OREAS-22h All REE Valyes for Internal QA/QC



ARR, 2024

Figure 7-2: Chart of Internal OREAS-22h Blank for Nd

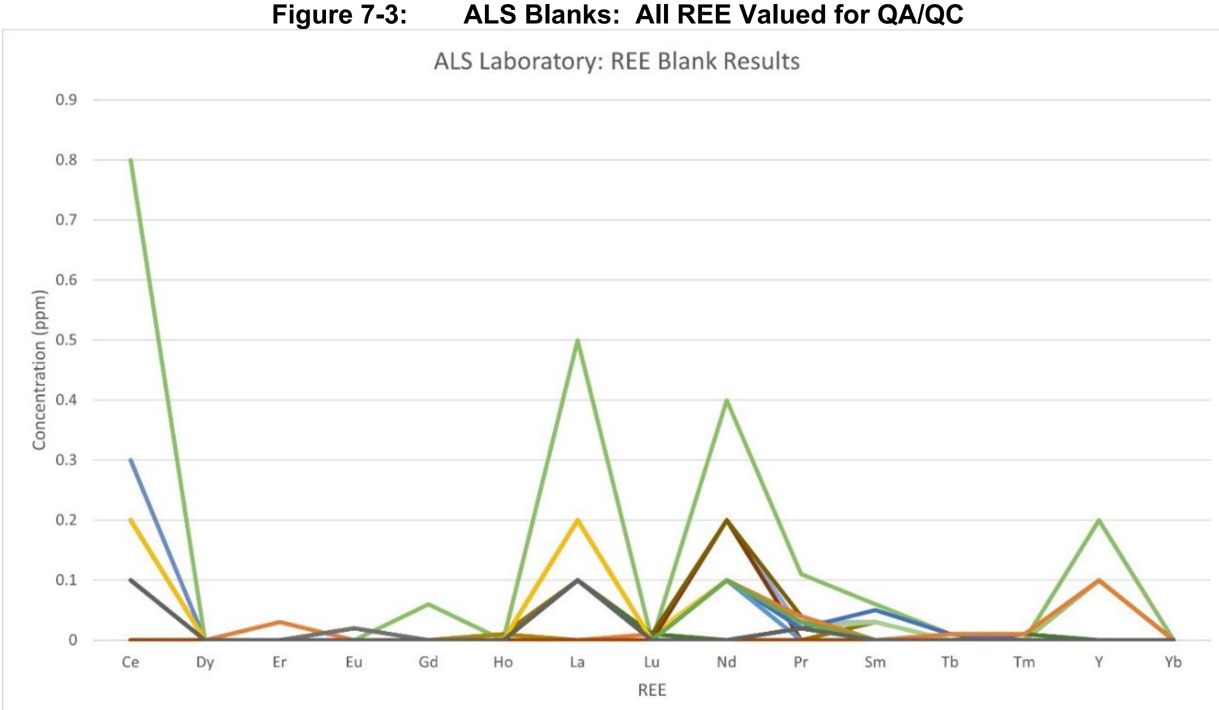


ARR 2024

7.6.1.2 LABORATORY BLANKS

ALS Laboratories in Vancouver, British Columbia, utilized their own internal QA/QC procedures and inserted blanks into the sample stream. The blanks utilized by ALS also contain very low quantities of REEs. ALS blanks were within acceptable tolerances (Figure 7-3).

Figure 7-3: ALS Blanks: All REE Valued for QA/QC



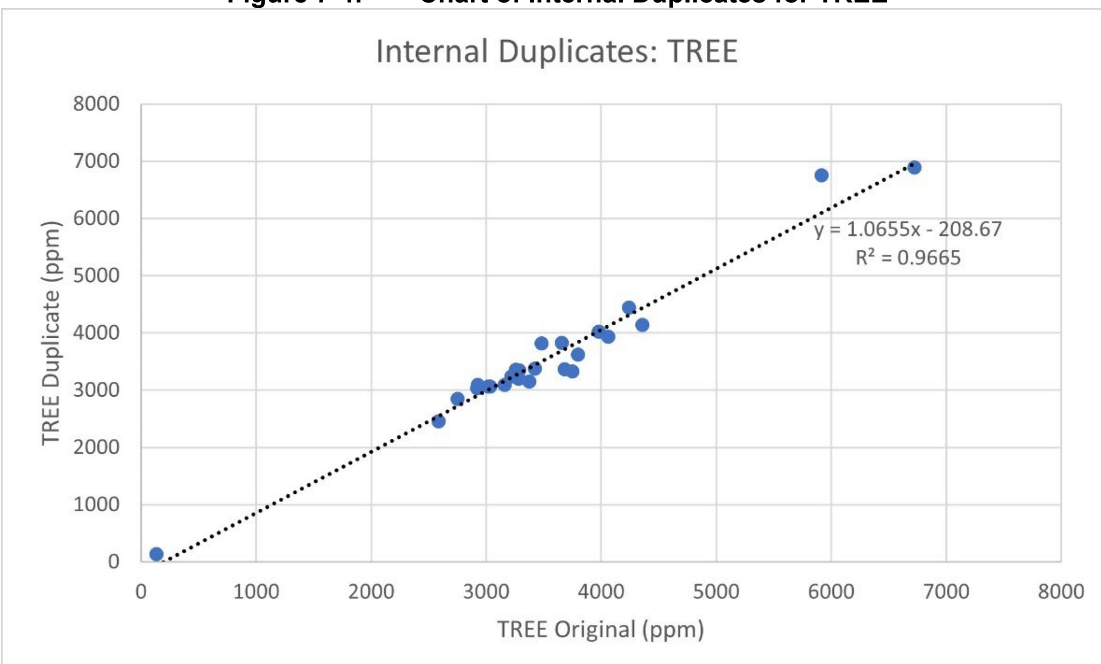
ARR 2024

7.6.2 Duplicates

7.6.2.1 ARR DUPLICATES

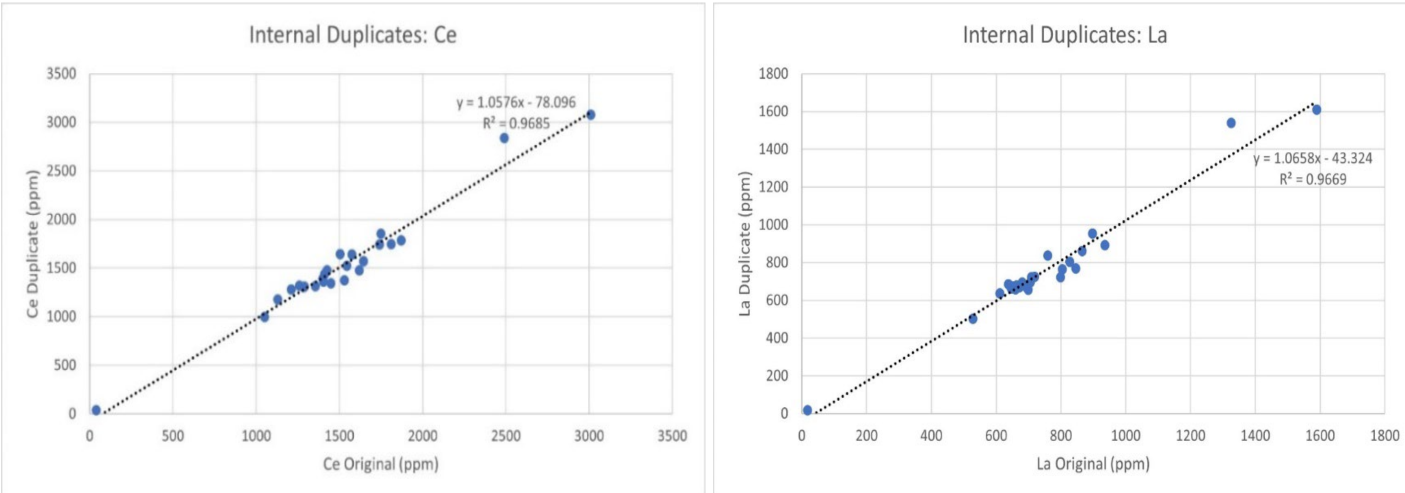
ARR assigned duplicate samples during logging and sample preparation. ALS took riffle splits of coarse rejects based on ARR's instructions. The results show that the duplicates indicate acceptable precision with minor variance on the high and low ends. ARR plotted a regression curve and R^2 factor for Total Rare Earths Elements (TREE), Ce, La, Nd, and Pr, shown in Figures 7-4 through 7-6, respectively. The R^2 value exceeded 0.95 for all factors and elements, indicating a very high level of correlation in the duplicate samples.

Figure 7-4: Chart of Internal Duplicates for TREE



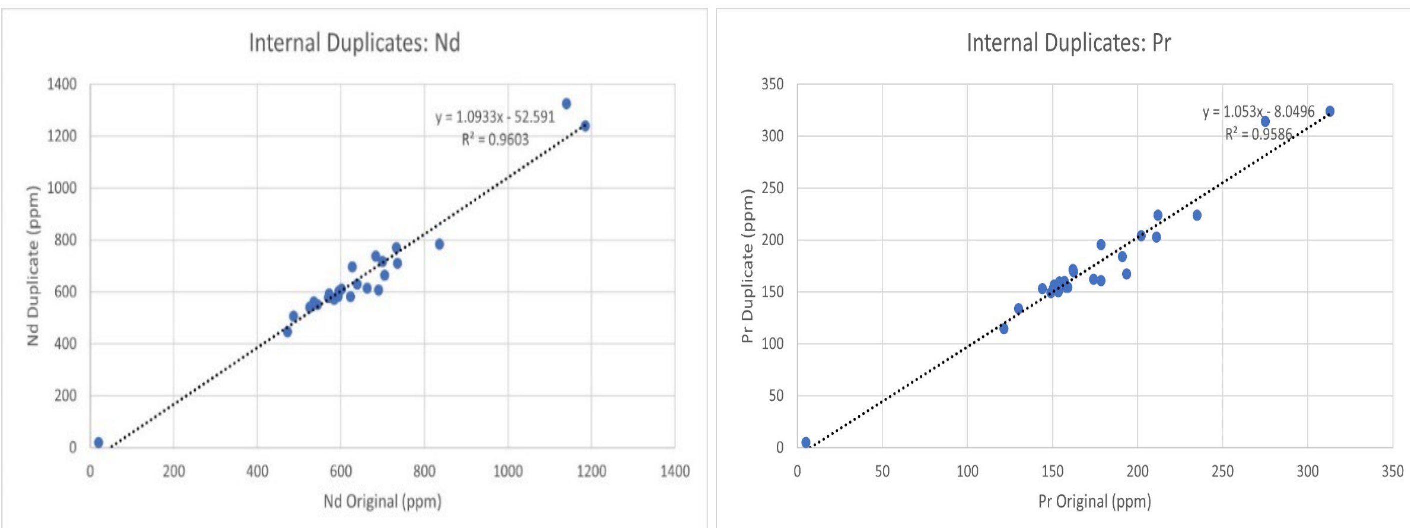
ARR 2024

Figure 7-5: Chart of Internal Duplicates for Ce and La



ARR 2024

Figure 7-6: Chart of Internal Duplicates for Nd and Pr

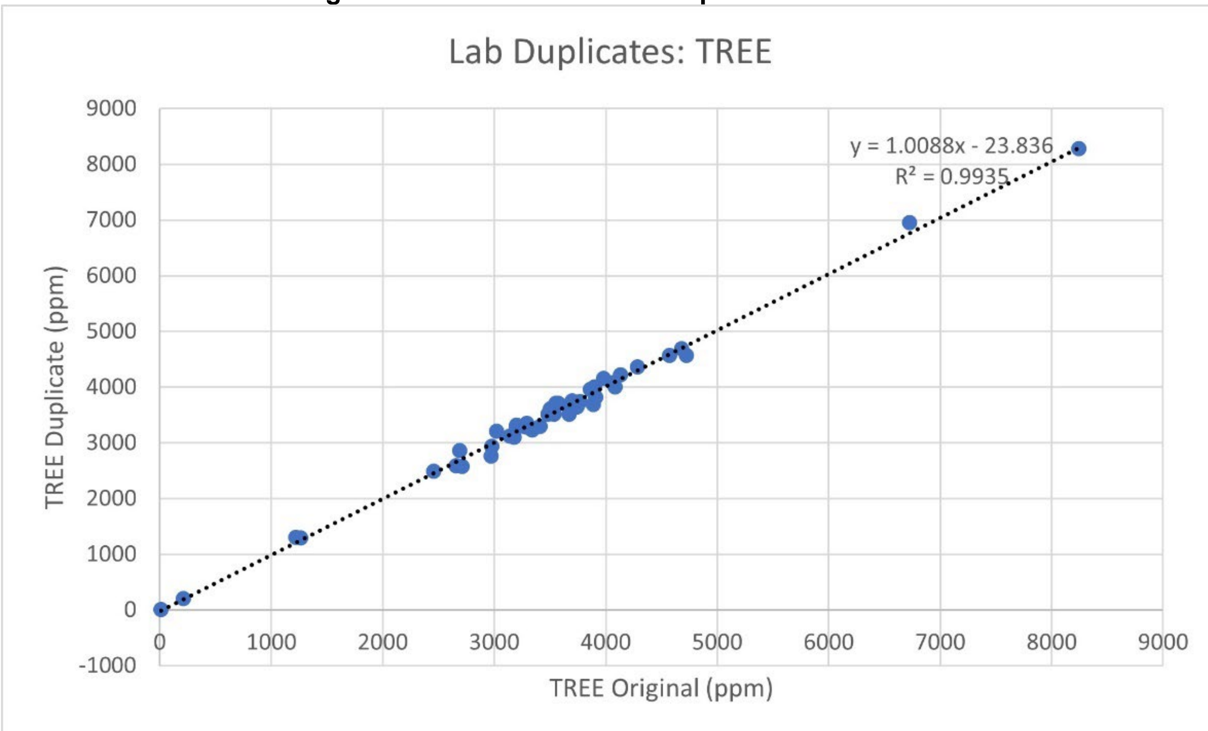


ARR 2024

7.6.2.2 LABORATORY DUPLICATES

ALS created their own internal duplicates from randomized samples for each sample batch submitted. These duplicates, similar to the ones requested by ARR, were also made from coarse sample rejects utilizing a riffle splitter. ARR plotted a regression curve and R^2 factor for TREE shown in Figure 7-7. The R^2 value exceeded 0.99 for all factors and elements, further indicating a very high level of correlation in the duplicate samples.

Figure 7-7: Chart of ALS Duplicates for TREE



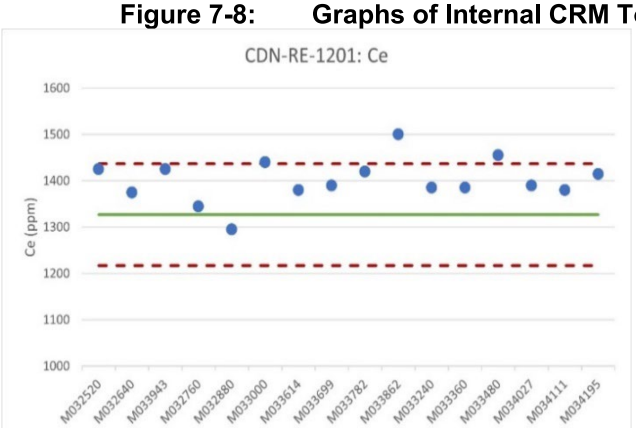
ARR 2024

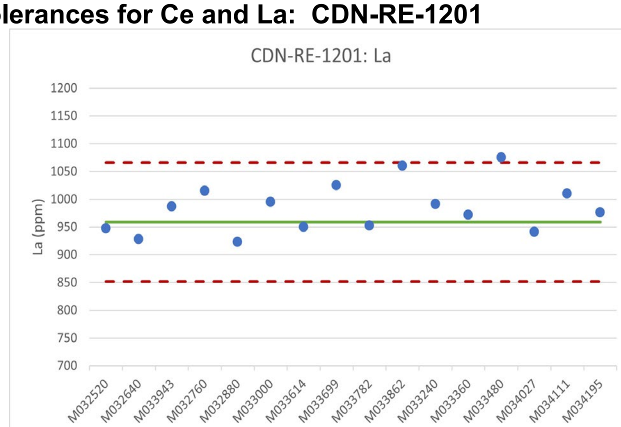
7.6.3 Standards

7.6.3.1 ARR STANDARDS

ARR acquired rare earth standard CRM from CDN Labs in Langley, British Columbia. The two REE standards used were CDN-RE-1201 and CDN-RE-1202. CDN-RE-1201 is most representative of the grades observed in the RMP, whereas CDN-RE-1202 is slightly higher grade. The majority of all CRM standards from internal QA/QC fell within an acceptable range, with the exception of a few minor outliers as observed in Figures 7-8 through 7-11.

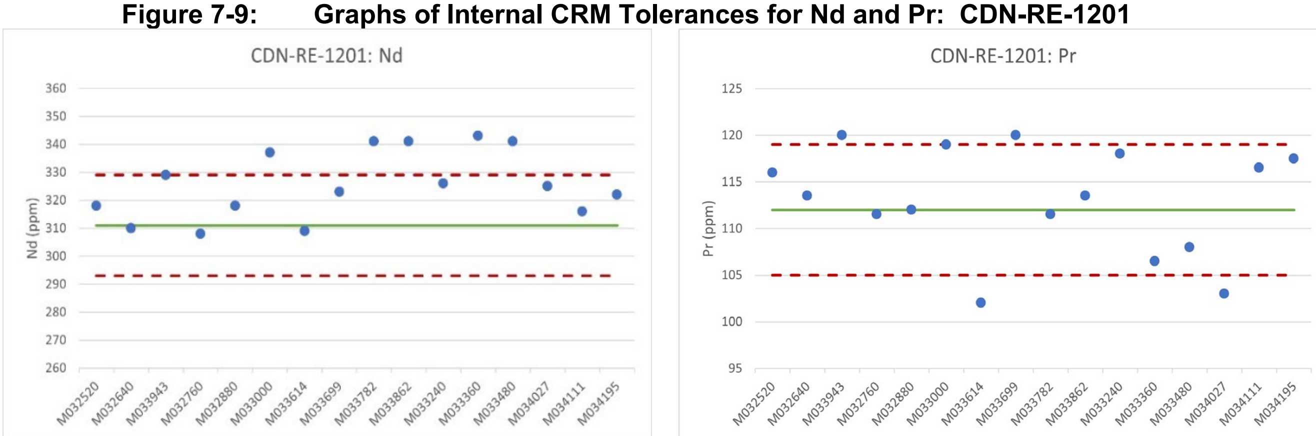
Figure 7-8: Graphs of Internal CRM Tolerances for Ce and La: CDN-RE-1201





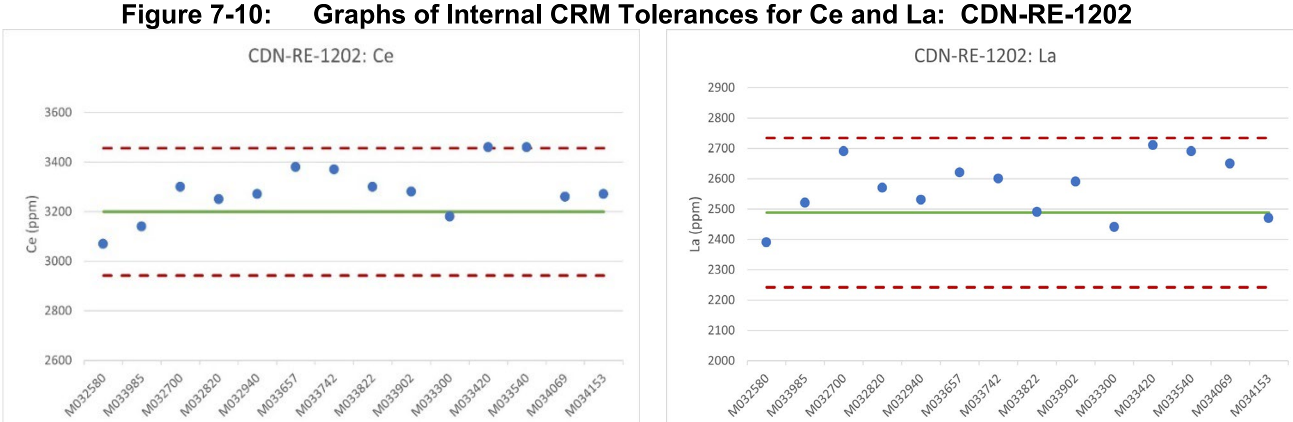
ARR 2024

Figure 7-9: Graphs of Internal CRM Tolerances for Nd and Pr: CDN-RE-1201



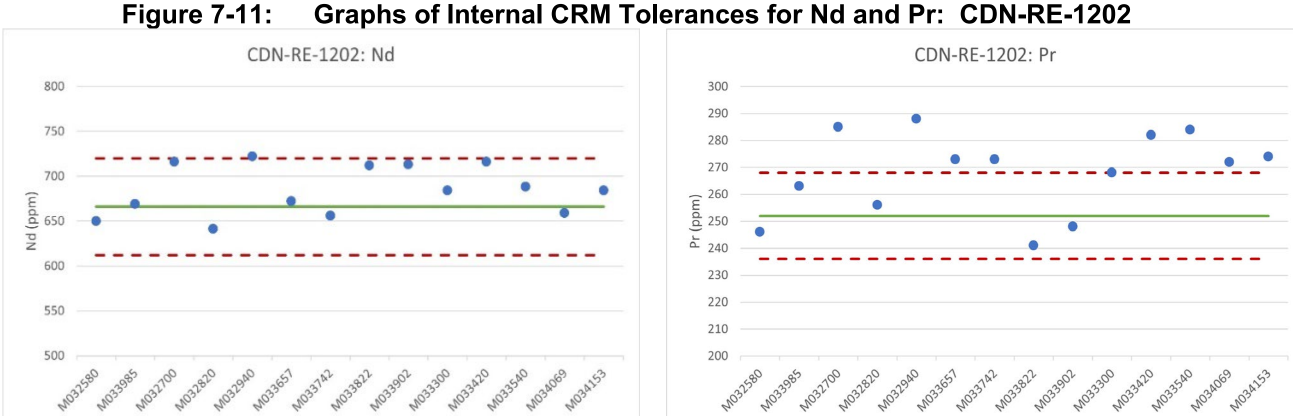
ARR 2024

Figure 7-10: Graphs of Internal CRM Tolerances for Ce and La: CDN-RE-1202



ARR 2024

Figure 7-11: Graphs of Internal CRM Tolerances for Nd and Pr: CDN-RE-1202

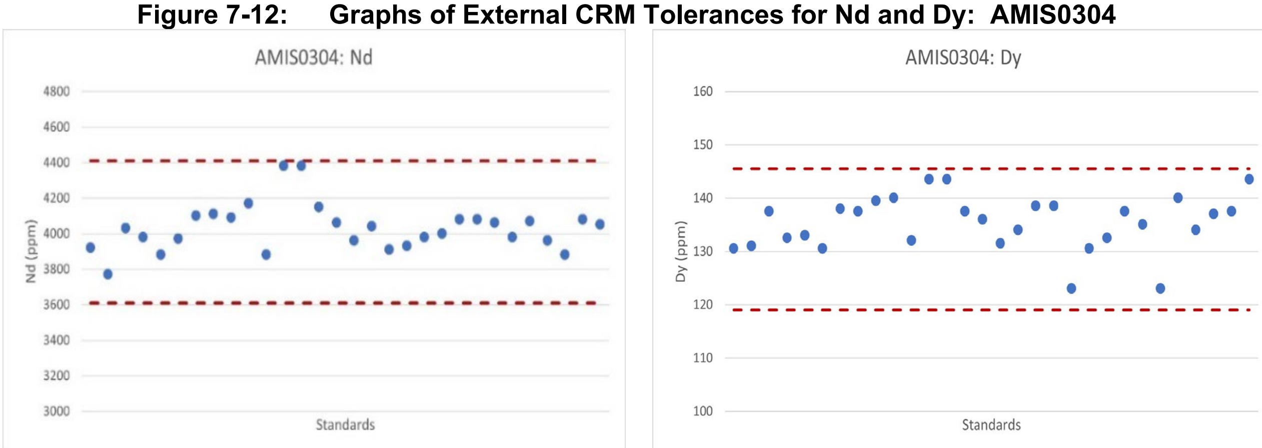


ARR 2024

7.6.3.2 LABORATORY STANDARDS

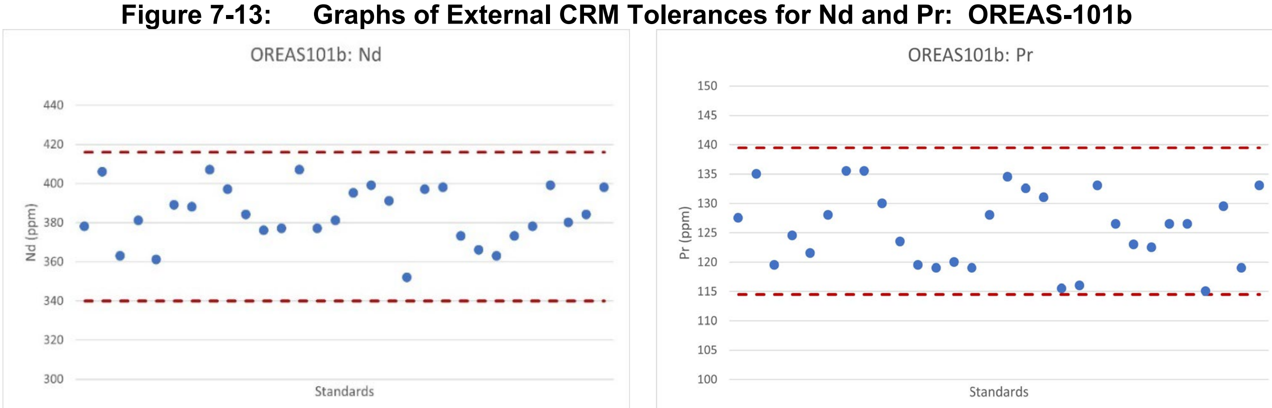
ALS additionally utilized their own CRMs to insert into the sample stream. These CRMs include AMIS0304, OREAS-101b, OREAS-146, and SY-5. Most CRM standards from internal QA/QC fell within an acceptable range, with the exception of a few minor outliers, as observed in Figures 7-12 through 7-15. The ALS CRMs were within acceptable limits. The dashed red lines in the following figures represent upper and lower tolerances as provided by ALS.

Figure 7-12: Graphs of External CRM Tolerances for Nd and Dy: AMIS0304



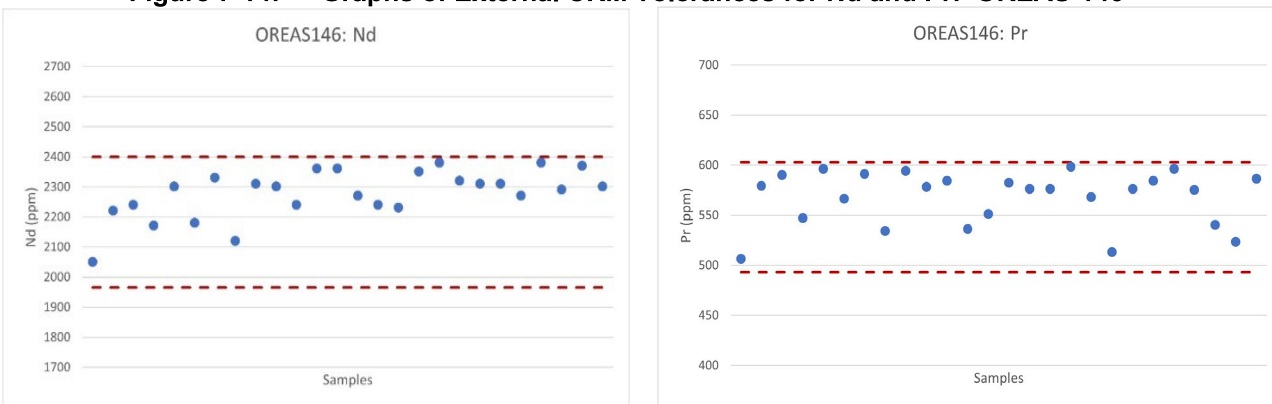
ARR 2024

Figure 7-13: Graphs of External CRM Tolerances for Nd and Pr: OREAS-101b



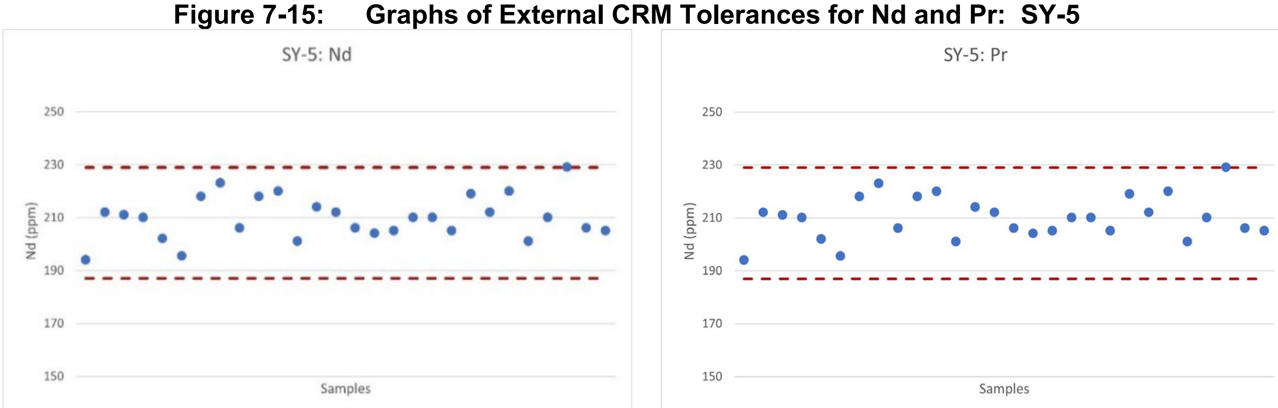
ARR 2024

Figure 7-14: Graphs of External CRM Tolerances for Nd and Pr: OREAS-146



ARR 2024

Figure 7-15: Graphs of External CRM Tolerances for Nd and Pr: SY-5



ARR 2024

7.7 Database

All drill hole and surface sample data for the Halleck Creek project was imported into the DHDB drill hole database system. The DHDB was written and maintained by Dwight Kinnes, formerly of Highland GeoComputing, LLC, and has been used by various mining companies since 2004. Highland GeoComputing, LLC tailored the DHDB to store and process rare earth element data. The DHDB provides complete access to all drilling records, scanned field logs, and analytical data and allows for processing and reporting of the Halleck Creek drill hole data Table 7-4.

Table 7-4: Data Type and Counts in DHDB

Data Type	Number
Core Holes	17
Reverse Circulation Holes	53
Channel Samples	14
Surface Samples	792
Core Assays	1301
RC Chip Assays	5146
Blanks (ARR/Lab)	280
Duplicates (ARR/Lab)	271
CRM Standards (ARR/Lab)	345

7.7.1 Data Management

DHDB provides secure user access and audit tracking within the database. Assay and QA/QC data are imported directly from certified data supplied by laboratories. Therefore, data entry errors are minimal. Detailed validation queries are applied to the drill hole data to minimize data entry errors.

Validation includes the following.

- Checking for gaps and overlaps in lithology, alteration and assay data.
- Cross-referencing total depths of collar and lithologic data.
- Cross-referencing to data dictionaries to restrict data entry to approved values.

Original field logs, core and chip sample photos, certified assay certificates, and other drill hole specific data is stored with DHDB and cross-referenced with each drill hole. This data is directly accessible from DHDB.

7.7.2 General Database Components

Drill hole, trench and surface sample locations are stored in DHDB using the NAD 1983, UTM Zone 13 coordinate system. WGS 1984 latitude and longitude coordinates are stored as secondary coordinates in DHDB. Lithologic and Assay sample depths are stored in feet and meters.

Assay data is stored in DHDB as elemental data in units of parts per million (ppm).

7.8 Qualified Person's Opinion on Sample Preparation, Security and Analytical Procedures

ARR Geologists developed and implemented detailed protocols for sample preparation, security, and for analytical QA/QC. Professional laboratories used by ARR also maintain rigorous QA/QC procedures.

The DHDB contains comprehensive storage of drilling and assay data with links to original logs, core and sample images, and certified copies of analytical results. User specific access and audit tracking of changes allows ARR to monitor database manipulation.

The QP believes that ARR procedures and practices noted above are appropriate for a scoping study.

8.0 DATA VERIFICATION

8.1 Data Verification by Qualified Person

The QP routinely verified geological data collection and analysis throughout the drilling and analytical programs. The QP reviewed geological descriptions against core photos and RC cuttings photos. The QP monitored analytical progress through ALS's online low intensity magnetic separation (LIMS) system. The QP prepared and reviewed striplogs of assay data and geologic data for each drill hole at Halleck Creek.

8.2 Qualified Person's Opinion on Data Adequacy

The QP believes that data collected and maintained by ARR is comprehensive and is adequate for geological modeling and resource estimation, within specific modify factors outlined in Section 10.0.

9.0 METALLURGY

9.1 Introduction

The data provided in this chapter was compiled by the ARR technical staff based on testwork performed by Zenith and detailed testwork designed and supervised by Wood in Perth, WA, Australia.

Preliminary testwork performed on drill hole samples collected from Halleck Creek was undertaken to explore beneficiation methods for producing a concentrate for downstream treatment, as well as undertaking small scale batch leaching testwork to support assessment of viable rare earth extraction technologies.

Findings from this testwork are presented below with recommendations for further flowsheet development to support future engineering studies. Descriptions of proposed recovery methods exist in Section 13.0 below.

9.2 Test Laboratories

Zenith, previous owner of Halleck Creek claims, used Nagrom, a metallurgical facility located in Kelmscott, Western Australia to conduct minor testwork regarding the ore (microscopy, XRD and magnetic separation.

ARR has used the following laboratories.

- SGS, Lakefield, Ontario: mineralogical characterization testing (2022)
- Nagrom: hydrostatic testing for SG, grinding and comminution, magnetic separation, and leach testing. (2022 / 2023)
- Auralia, a metallurgical facility located in Perth WA conducted the following tests / analyses: sighter flotation, bulk flotation testing, wet high intensity magnetic separation (WHIMS) (Falcon C centrifugal magnetic separator), electrostatic separation, WHIMS mags mineralogy, gravity separation and sighter leaching (2023).
- Auralia subcontracted certain tests to the following laboratories: ALS, Bureau Veritas (BV), Mineral Technologies, Watts and Fisher (2023)
- ALS Global in Perth Australia performed preliminary leach testing. (2023 / 2024)
- University of Kentucky, Dr. Rick Honaker, Principal Investigator (2023 / 2024)
- All of the laboratories are independent of ARR. There is no international standard of accreditation provided for metallurgical testing laboratories or metallurgical testing techniques.

9.3 Metallurgical Testwork

9.3.1 Overview

Mining claims and mineral leases at Halleck Creek have been owned by two entities, Zenith and ARR. Zenith completed minor testwork which included microscopy, semi quantitative XRD, and magnetic separation. ARR conducted more exhaustive testwork which was supervised and directed by Wood in Perth, Australia and is detailed below.

The following list summarizes laboratories and tests performed as part of Wood's testwork.

- SGS Canada – Feed mineralogy using automated TIMA analyzer on separate samples to the master composite but geochemically similar.
- Nagrom – head grade analysis, comminution, and WHIMS.
- Auralia Metallurgy – direct and reverse flotation testing on ore and WHIMS magnetics, sighter gravity separation, settling testwork.
- Watts and Fisher – pyrophosphoric acid leaching of sighter gravity concentrate and flotation concentrate.
- ALS – assessment of acid and alkali routes for processing WHIMS magnetics and flotation concentrate, mineralogy on WHIMS magnetics.
- Mineral Technologies – HLS and electrostatic separation on WHIMS magnetics
- Bureau Veritas – Falcon C series proxy testing of WHIMS magnetics

The testwork and design conducted by Wood was summarized in two documents, *Document No. 206139-0000-DC00-RPT-0001 – Halleck Creek Rare Earths Project, Preliminary Testwork Interpretation*, December 2023; and *Document No. 206076-0000-BA00-RPT-0002 – Halleck Creek Rare Earths Project, Desktop Study, Acid Tank Leach Option*, December 2023.

The preliminary testwork resulted in a flowsheet consisting of the following.

- Semi-autogenous grinding (SAG) Mill for comminution
- WHIMS for pre-concentration
- Sulfuric acid tank leaching
- Partial neutralization for impurity removal
- Carbonate precipitation to produce a mixed rare earth concentrate for sale

Different separation strategies were tested on the primary WHIMS concentrate including the following.

- Flotation
- Electrostatic separation
- Gravity separation
- Additional magnetic separation

Preliminary leaching strategies were employed including the following.

- Acid Bake – Water Leach
- High Pressure Acid Leach
- Alkali Bake – Water Leach
- Proprietary phosphoric acid leach

9.3.2 Zenith Testwork

Zenith completed the following testwork.

- Townsend Mineral Laboratory: Optical / scanning electron microscopy of four allanite-bearing products
- Townsend Australia: Semi-quantitative XRD analysis
- Nagrom: sizing and WHIMS.

Nagrom performed preliminary processing and metallurgical tests on sample pulps from 87 surface samples and channel samples collected in 2019.

The only available information from this work was reported in a news release dated 11 February 2020.

"Mineral separation by magnetic methods recovered 87% of the REE minerals into 27% of the mass whilst rejecting 73% of the waste material at a crush size of -0.5 mm. The magnetic separation results were from rougher magnetic separation and two scavenger passes. Mineral separation using gravity methods recovered 76% of the REE minerals into 22% of the mass whilst rejecting 78% of the waste material at a crush size of -2 mm."

9.3.3 ARR Testwork

In 2022 and 2023 ARR completed a metallurgical testwork program. 648 kg of core samples from four core holes (HC22-RM002, HC22-RM003, HC22-OM003, and HC22-OM004) were shipped to Nagrom. This testwork was designed and supervised by Wood personnel (Figure 9-1).

- Hydrostatic testing of core to determine SG.
- Mineralogical Characterization (performed by SGS Lakefield).
- Grinding, Comminution and Dewatering.
- Flotation.
- Leaching.
- Magnetic Separation (WHIMS).
- Gravity Separation.

Further explanation of key program modules is provided here.

- Feed mineralogy – undertaken at SGS Montreal using their automated TIMA analyzer on a separate, but geochemically similar, sample to the master composite.
- Nagrom – head grade analysis, comminution, and WHIMS.
- Auralia Metallurgy – direct and reverse flotation testing on ore and WHIMS magnetics, sighter gravity separation, settling testwork.
- Watts and Fisher – pyrophosphoric acid leaching of sighter gravity concentrate and flotation concentrate.
- ALS – assessment of acid and alkali routes for processing WHIMS magnetics and flotation concentrate, mineralogy on WHIMS magnetics.

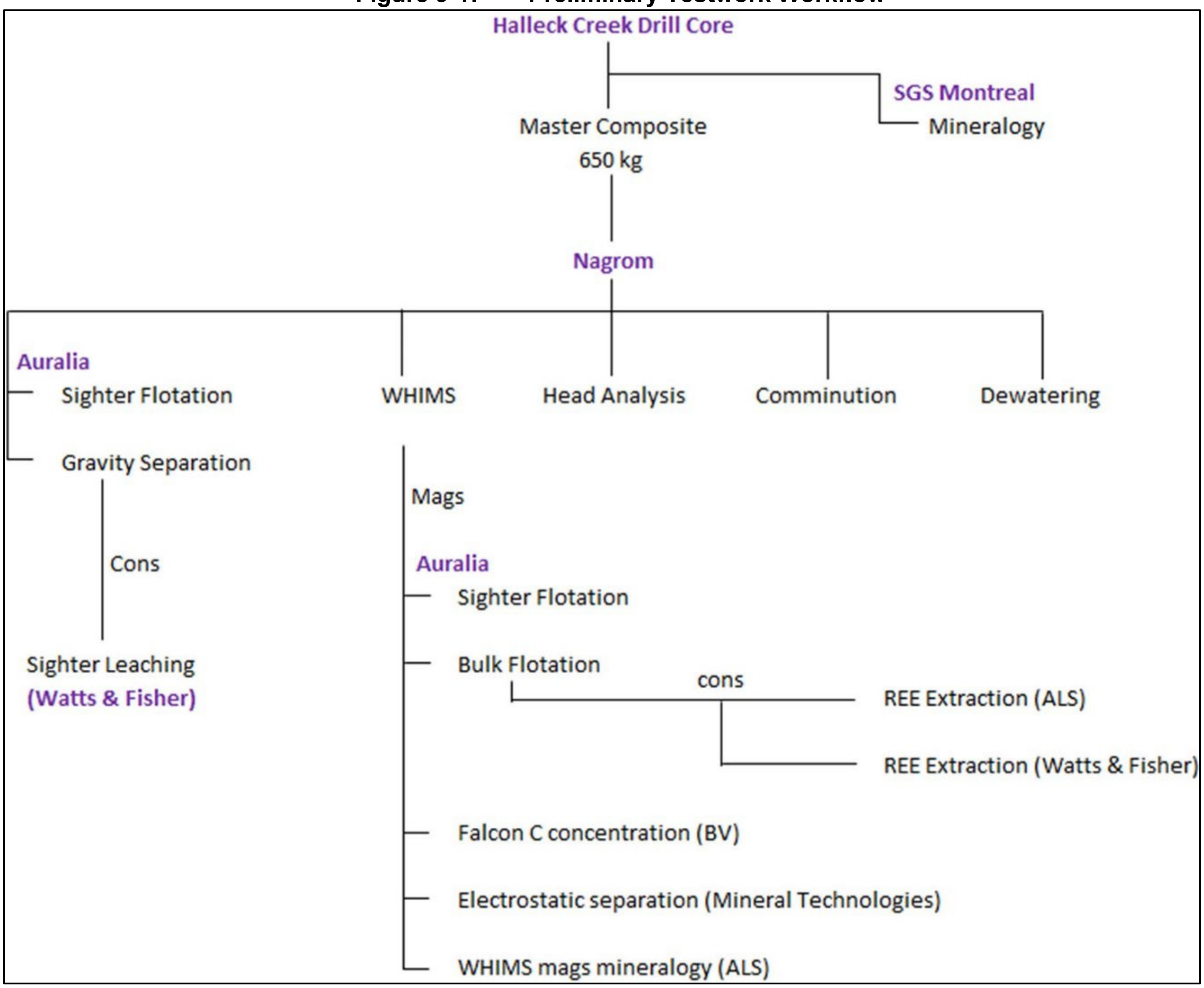
- Mineral Technologies – HLS and electrostatic separation on WHIMS magnetics.
- Bureau Veritas – Falcon C series proxy testing of WHIMS magnetics.

In late 2023, ARR contracted with the University of Kentucky to perform additional magnetic and gravity separation experiments. The work focused on Heavy Liquid Separation (HLS) to simulate Dense Medium Separation (DMS) to concentrate the REEs before the leaching step.

ARR is pursuing modifications and improvements to the initial process flowsheet to produce separated rare earth products. These modifications require more robust impurity removal and facilitate ARR's desire to produce a more effective pre-concentration step after grinding.

In addition to the preliminary testwork, ARR commissioned Dr. Rick Honaker of the University of Kentucky (UK) to investigate the impacts of DMS prior to WHIMS.

Figure 9-1: Preliminary Testwork Workflow



Wood, 2023

9.3.4 Specific Gravity

Nagrom performed SG testing on 10 core samples (Table 9-1). SG was determined for untreated and wax impregnated samples. Overall, the range of SG values was very low.

Table 9-1: Specific Gravity of Halleck Creek Core

Sample ID	Mass (kg)	Specific Gravity	Specific Gravity Repeat	Specific Gravity (Wax)	Specific Gravity (Wax) Repeat
HC22-RM002	0.5	2.68		2.69	
HC22-RM002	0.49	2.67		2.64	
HC22-RM003	0.31	2.66	2.68	2.65	2.64
HC22-RM003	0.38	2.71		2.75	
HC22-RM003	0.31	2.68		2.65	
HC22-OM003	0.59	2.79	2.79	2.78	2.77
HC22-OM003	0.4	2.69		2.67	
HC22-OM003	0.37	2.7		2.7	
HC22-OM004	0.37	2.72	2.71	2.69	2.7
HC22-OM004	0.35	2.68		2.66	
Wt. Avg.	4.05	2.7	2.74	2.69	2.72

9.3.5 Feed Mineralogy

A composite of Halleck Creek core was provided by ARR to SGS Montreal for mineralogical investigations in order to provide guidance for metallurgical testwork. For the mineralogical characterization study, SGS performed:

- Sample preparation, stage crushing to a P_{80} of 200 to 250 µm and riffling.
- Chemical analysis of the head sample including XRF.
- TIMA-X analysis of the sample to provide mineral identifications; REE deportment.
- Chemical analysis including XRF, ICP-MS to determine the REE, Y, Th, U, Zr, Nb, Ta, and Sc.
- Semi-Quantitative XRD analysis by Rietveld refinement to determine the bulk crystalline composition.
- Electron microscopy to evaluate the REE minerals.
- Mineral chemistry by electron microprobe to determine the major and trace elements of the minerals of interest.
- Davis Tube testwork to assess the presence of ferromagnetic minerals such as magnetite which will need to be removed ahead of WHIMS beneficiation.

9.3.5.1 HEAD ANALYSIS

SGS did not undertake an elemental head analysis of the test sample, instead focusing on mineral abundance, deportment and locking characteristics. A full head analysis of the composite is included in summary reports by Nagrom an abridged summary with significant components is presented here as Table 9-2.

Table 9-2: Head Sample Assays

Rare Earth Oxide	Value, ppm	Gangue	Value, %
Y2O3	221	SiO2	61.8
La2O3	751	Fetot	5.11
CeO2	1583	FeO	5.2
Pr6O11	189	Al2O3	15.9
Nd2O3	644	P2O5	0.072
SEGs2	187	CaO	2.87
HREOs3	105	K2O	6.03
CREOs4	887	Na2O	4.24
TREO+Y	3668	TiO2	0.5

9.3.5.2 DAVIS TUBE RECOVERY

Sub-samples of feed were subjected to Davis Tube Recovery (DTR) assessment to determine if significant magnetite or other ferromagnetic minerals were present to an extent that would require insertion of LIMS ahead of WHIMS. Table 9-3 presents the results of this analysis which indicates very minor presence of ferromagnetic minerals are present at coarse grind sizes, becoming less as the iron minerals are liberated from coarser gangue minerals. Based on these results a LIMS stage is not warranted.

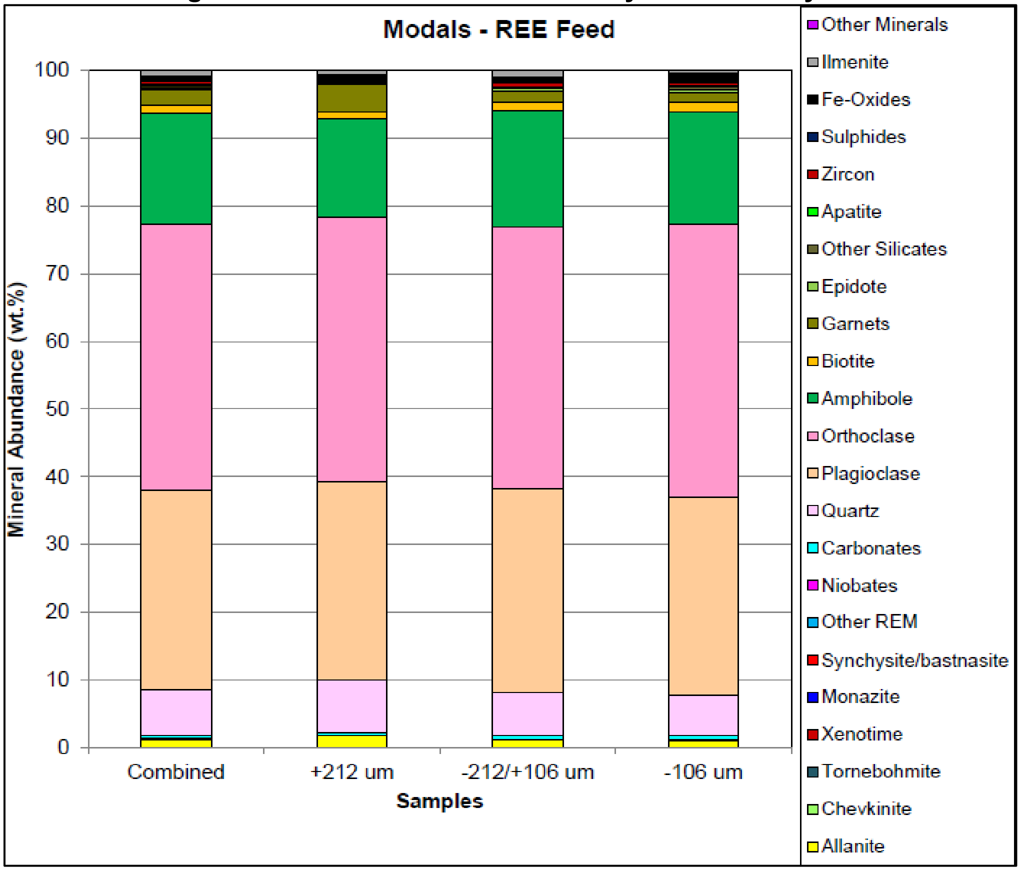
Table 9-3: Particle Size and Mag Yield

Particle P80 Size (μm)	Magnetics Yield (%)
604	0.8
116	0.3
58	0.2
41	0.1
<20	0.1

9.3.5.3 MINERAL ABUNDANCE

Detailed mineralogy and geology are described in Section 5.5.5 above. Relative mineral abundance for the test sample is presented as Figure 9-2.

Figure 9-2: Mineral Abundance by TIMA-X Analysis



SGS 2022

The primary minerals at Halleck Creek consist of feldspars (orthoclase and plagioclase predominantly), quartz, amphibole, garnets, and biotite. Quartz and feldspars make up around 75% of total mass, with amphiboles contributing another 16% mass.

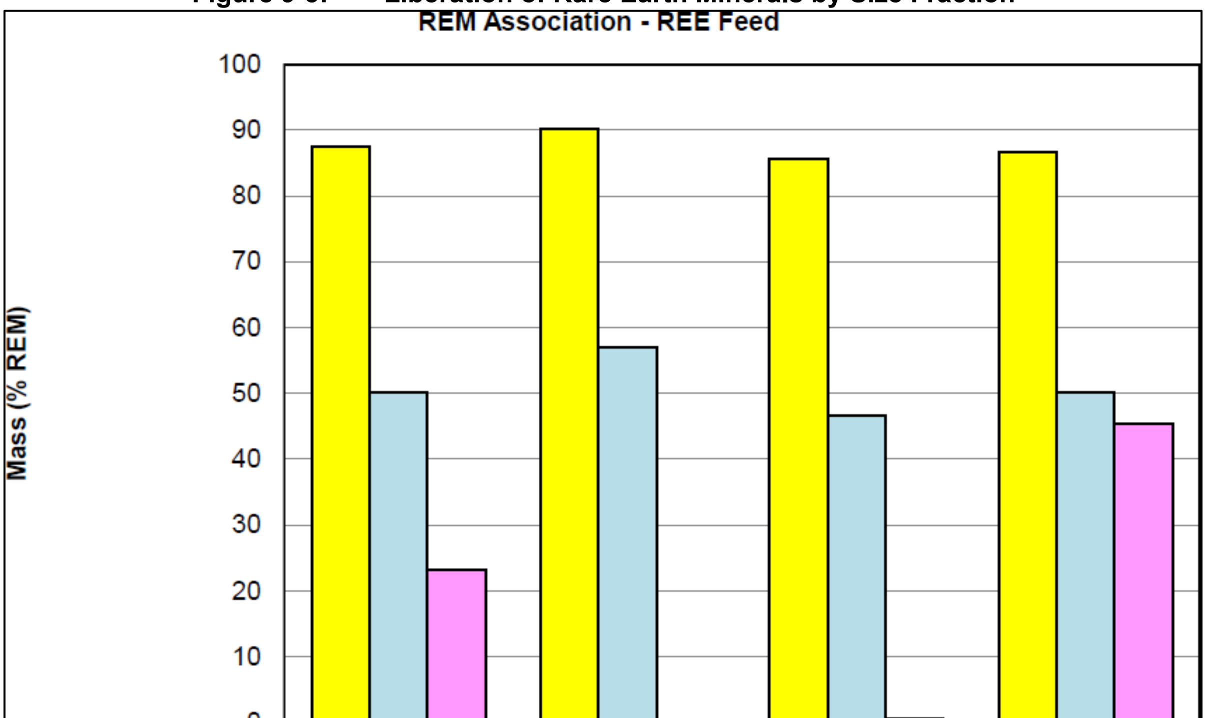
SGS determined that allanite is the primary rare earth bearing mineral at Halleck Creek. Allanite makes up 1.31% of the total feed mass, with significant bias to the +212 micron fraction, indicating coarse crystal structure. The average grain size of allanite was 232 µm. Minor amounts of rare earth bearing minerals, zircon, chevkinite and tornebohmite, were also observed via TIMA-X electron microscopy and electron microprobe analyses. By contrast to allanite, chevkinite / tornebohmite averaged 42 µm in size, so would require significantly more grinding to achieve liberation. Trace amounts of fluorocarbonate minerals bastnaesite and synchysite were also detected.

Epidote is only present in trace amounts, which favors upgrade with fatty acid flotation since both epidote and allanite are orthosilicates and separation is notoriously difficult. Flotation would be applied for further upgrading of WHIMS magnetics, containing paramagnetic allanite, after quartz and feldspar minerals have largely been rejected.

9.3.5.4 ALLANITE ASSOCIATION

SGS determined allanite association with matrix minerals in the supplied sample, reporting that approximately 87.5% of all allanite exists as free, pure, or liberated forms (due to grinding), as depicted in Figure 9-3. The remaining 12.5% of allanite is associated with matrix minerals (intergrowths with silicate gangue). The percentage of free, pure, and liberated allanite increases to 90.2% for material exceeding 212 µm in size. Preliminary magnetic separation testwork performed on Halleck Creek surface samples in 2019 demonstrating the ease of upgrade with WHIMS is consistent with reported liberation characteristics for the current composite of the deeper core material.

Figure 9-3: Liberation of Rare Earth Minerals by Size Fraction



	Combined	+212 um	-212/+106 um	-106 um
Allanite	87.5	90.2	85.6	86.6
Chevkinite/Tornebohmite	50.2	57.0	46.6	50.1
Synchysite/Bastnasite	23.3	0.1	0.7	45.4

SGS 2022

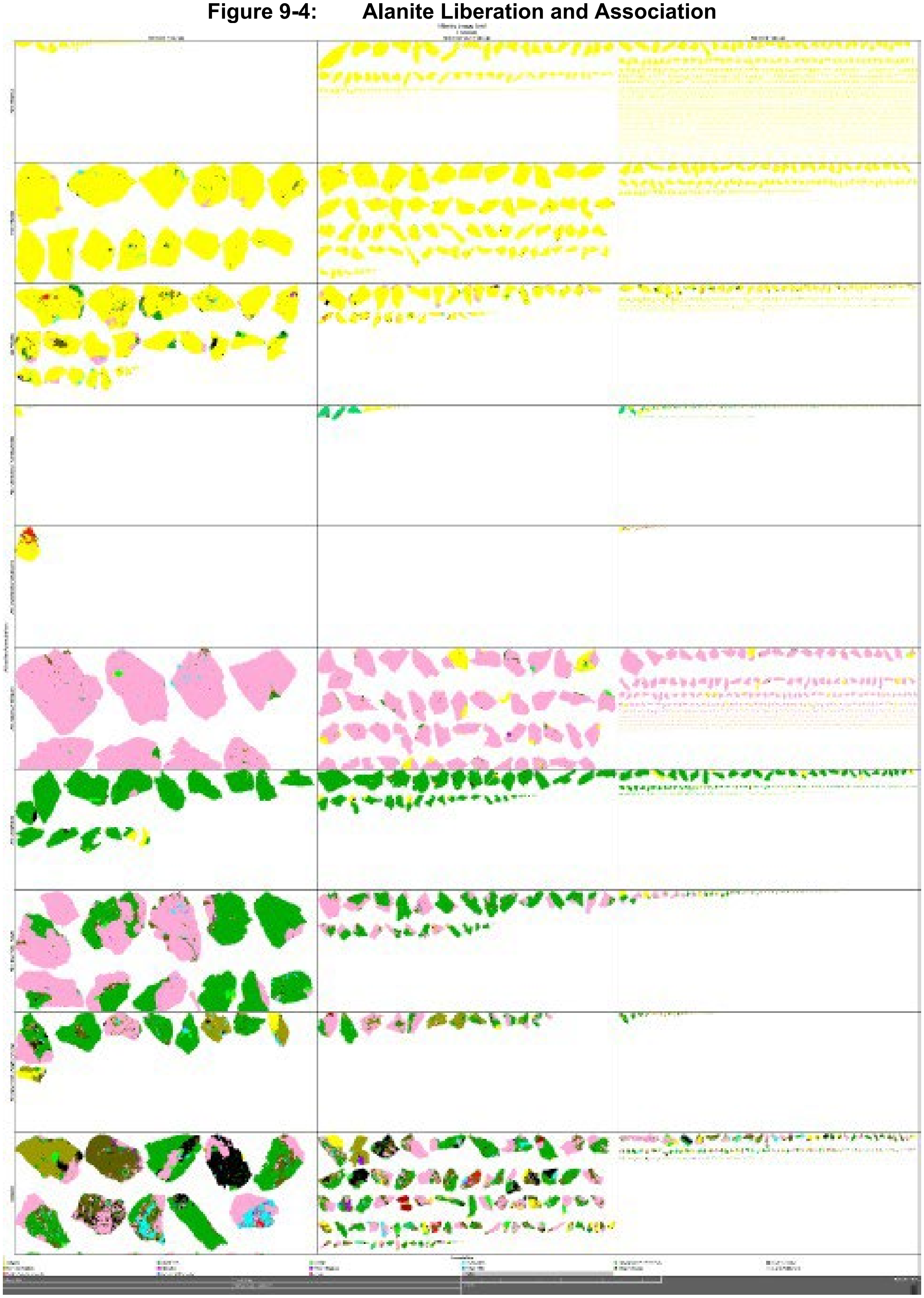
9.3.5.5 THEORETICAL GRADES FOR CERIUM, LANTHANUM AND NEODYMIUM

Grade-recovery relationships were developed by SGS to indicate theoretical ultimate beneficiation potential for cerium, lanthanum, and neodymium. SGS predicted a cerium grade of 9.3% for 94% recovery, a lanthanum grade of 4.6% for 94% recovery and a neodymium grade of 3.8% for 95% recovery. In practice, achieving such high upgrades would be difficult due to inevitable operational losses as well as challenges associated with minerals of similar properties, but the data indicated good potential for upgrade through physical beneficiation.

9.3.5.6 ALLANITE LIBERATION AND ASSOCIATION BY TIMA-X

Images of sorted particles provide a visual record of allanite liberation and association with other minerals, presented in Figure 9-4. Allanite grains are colored yellow, and it is evident that a large amount of the mineral is pure or free, with few inclusions of gangue minerals at coarse sizes. There are allanite inclusions within quartz and feldspars (pink color) and occlusions (particle attachment) with amphiboles with a high level of exposure (>50%), which would allow it to be recovered by flotation. Regrinding these middling particles would provide the necessary degree of liberation to recover allanite and reject the gangue minerals from a physical perspective.

Figure 9-4: Alanite Liberation and Association



SGS 2022

9.3.5.7 ALLANITE CHEMISTRY

Sixty-one allanite grains were analyzed with electron probe micro analysis (EPMA). Average REE oxide contents were as follows.

- Ce_2O_3 at 11.22%
- La_2O_3 at 5.46%
- Nd_2O_3 at 4.63%
- Pr_2O_3 at 1.25%
- Gd_2O_3 at 0.30%, Sm2O3 at 0.56%, and Y_2O_3 at 0.25%.
- ThO2 at 0.49% and UO2 at 0.07% UO2

9.3.5.8 SIMILARITY OF ALLANITE TO HASTINGSITE

As beneficiation work progressed, additional mineralogical work was undertaken by Perth mineralogical consultancy Diamantina Mineralogy, who identified the amphibole mineral mentioned by SG as hastingsite, a member of the hornblende family. It was found that hastingsite enriched along with allanite with WHIMS, gravity separation and flotation. Chemical formulae and physical properties for each mineral is presented aa follows.

- Allanite(Y): (Y,Ce,Ca)2(Al,Fe^{3+})3(SiO4)3(OH)
- Hastingsite: $NaCa_2(Fe^{2+}{}_4Fe^{3+})Si_6Al2O_{22}(OH)_2$

Fe_2O_3 makes up the second highest elemental abundance in allanite at 19.69%, after silica. This is unusually high as web database mindat.org indicates a typical content of 10.5%.

Hastingsite typically contains 8.1% Fe_2O_3 but 29.0% FeO, the latter being a reduced form of Fe. The mixed Fe(II) / Fe(III) oxidation state of hastingsite is expected to have ferromagnetic properties, akin to magnetite. The high Fe content is important to note when evaluating separation efficiency from other Fe gangue minerals such as hastingsite since total Fe is reported, not by mineral type.

Similarly, both allanite and hastingsite contain high levels of silica (41.11% and 36.38% respectively) so measuring success of gangue rejection based on silica content is also made more complicated.

The two minerals are expected to behave similarly, with both containing Ca and Al. Discussion on challenges encountered with separating these two minerals is presented later.

9.3.6 Comminution Testwork

SAG Mill comminution (SMC) testing was performed by JKTech, a research laboratory and consultant arm of the University of Queensland, to produce data for the potential sizing of a SAG mill.

The SMC test work results indicate low mineralization competency, which would translate to low specific energy consumption in a SAG mill. Compared to SMC Testing Pty Ltd's (SMCT's) global database of over 2,000 deposits, Halleck Creek material was rated in the 14th percentile for competency.

The Bond abrasion index test returned a value of 0.24, which is below the average of Wood Australia's database. The Bond ball mill work index test result of 15.6 kWh/t is close to the average hardness of the data in Wood's database.

The SMC test results indicate there could be significant energy savings due to the low competency mineralized material, and likely coarse primary grind as indicated by mineralogy. Apart from energy savings, the less abrasive mineralization will lead to reduced wear and tear on equipment and lower maintenance costs.

Sub-samples of ore were subjected to basis comminution testing at Nagrom to allow a preliminary characterization of ore competency, hardness and abrasively. The results were used to guide comminution circuit selection and equipment sizes. Results of testing are summarized in Table 9-4.

Table 9-4: Summary of Communition Characteristics

Parameter	Unit	Value	JKTech Database Percentile (%)	Comments
SMC parameters				
Axb		78.7	17.6	Below average competency
Dwi	kWh/m3	3.45	14	Below average competency
ta		0.75	21.5	Above average auto-attritioning
Apparent SG		2.71		
Mih	kWh/t	7.4		Low competency
Mia	kWh/t	11.4		Average grindability
Mic	kWh/t	3.8		Low crushing resistance
SCSE	kWh/t	7.46		
Bond indices				
Ball mill work index	kWh/t	15.6		Average grindability
Abrasion index		0.24		Below average abrasivity

The SMC test produces data that is used for the sizing of SAG mills, using small samples of quarter core or screened crushed rock. It was originally designed to support Mine-to-Mill studies but has largely replaced the JKMRC Drop Weight test which requires up to 100 kg of core. SMCT has tested ores from over 2,000 different orebodies worldwide.

The following is some commentary on the various SMC test suite parameters.

- Drop Weight Index (Dwi) – the Dwi value of 3.45 kWh/m^3 is below average relative to SMCC's database. It indicates below-average ore competency in a SAG mill (low impact resistance, easy to process).
- A x b – the product of the A and b values (impact and rebound energy in the drop weight machine) is a dimensionless value that allows predicting specific energy in a SAG mill. It is derived from the Dwi value and the tested ore-apparent SG. Values of 40 to 60 are considered "SAG friendly," while lower values may indicate the need for in-circuit pebble crushing or feed

manipulation to reduce competency. Higher values, 70 or more, indicate low competency, and a moderate ball charge will be needed to provide adequate grinding media. In the case of Halleck Creek, with a value of 78.7, below-average specific energy demand is expected.

- ta – this is a dimensionless value that describes the degree of auto abrasion of ore particles. Initially, the value was determined from autogenous abrasion of an ore sample in a special mill, but it is now derived only from the SMC test data. Values of 0.4 to 0.6 are considered likely to indicate good power efficiency in grinding, with lower values indicating increasing impairment to grinding efficiency. High values of 70 or more corelate with high A x b products and indicate ease of pebble "skin loss" with abrasion by grinding media.
- The Mi functions are used for the estimation of various grinding operations:
  - Mia represents coarse particle grinding down to 750 µm, in conjunction with the Mib (Bond Bwi) for fine grinding to the target product size. SMCC uses these parameters to calculate the specific energy of an ore in a SAG mill.
  - Mih is used by SMCC to estimate the specific energy in an HPGR operation. However, HPGR vendors typically do not use this parameter in their calculations, preferring to undertake pilot runs on representative ore.
  - Mic describes specific energy for conventional crushing used in SMCC's power equations.
  - The three values indicate low ore competency, translating to low specific energy consumption in a SAG mill.
- SAG Circuit Specific Energy (SCSE) index calculated using equations developed by SMCC, reflecting the use of a pebble crusher. The calculated 7.46 kWh/t value indicates below-average power demand in a SAG mill.

The combination of values suggest that Halleck Creek ore should be suitable for processing in a SAG-Ball mill configuration without the need for pebble crushing and could also be processed in a single stage SAG mill provided the target product size is not too fine, which is determined in primary WHIMS testwork.

It is more challenging to estimate the size of grinding equipment such as HPGRs and vertical roller mills (VRMs) due to a poor correlation with SMC and Bond grindability data, requiring piloting of bulk sample to obtain design parameters. However, the coarse grain structure of ore coupled with low ore competency should translate to high unit capacities.

9.3.7 Dense Medium Separation

The University of Kentucky (UK), under the direction of Rick Honaker, Ph.D., performed a series of Heavy Liquid Separation (HLS) tests to evaluate the use of DMS as a unit operation to concentrate the rare earth content in the ore as well as rejecting a large portion of the ore mass (Figure 9-7). UK received a split core from the Halleck Creek core drilling campaign and made a rough size reduction using a laboratory scale jaw crusher with a setting of 9 mm gap followed by a roll crusher with a setting of 1 mm gap. The material was then screened on the following size splits: 500, 250, and 150 microns, resulting in the profile below (Table 9-7). Each size fraction was then tested via HLS using liquids of the following specific gravities: 2.7, 2.9, 3.1, 3.4, and 3.5 (Table 9-8).

Figure 9-5: HLS/DMS Test Procedure

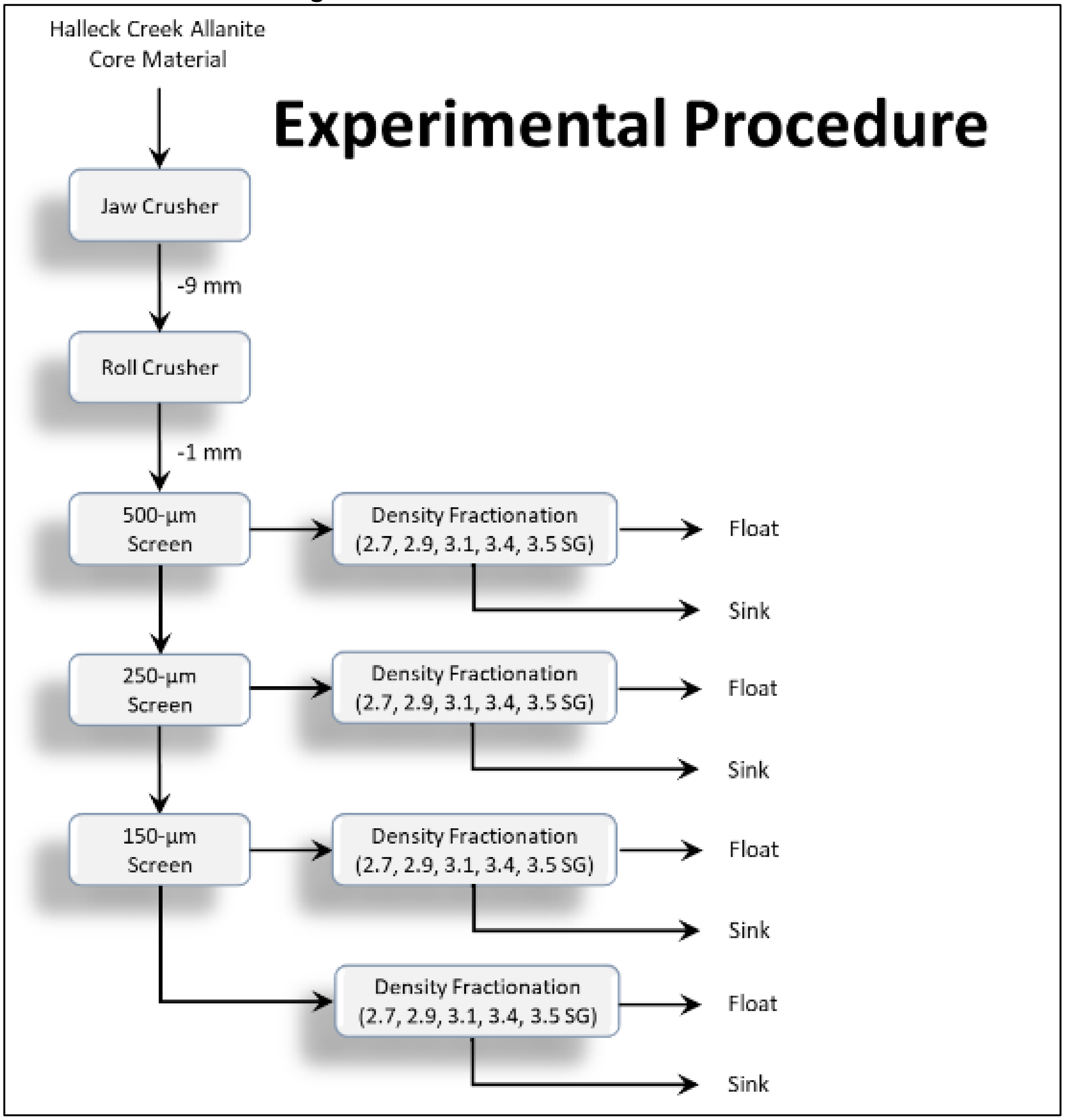


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Table 9-5: Roll Crusher Product (-1 mm) – Particle Size Distribution

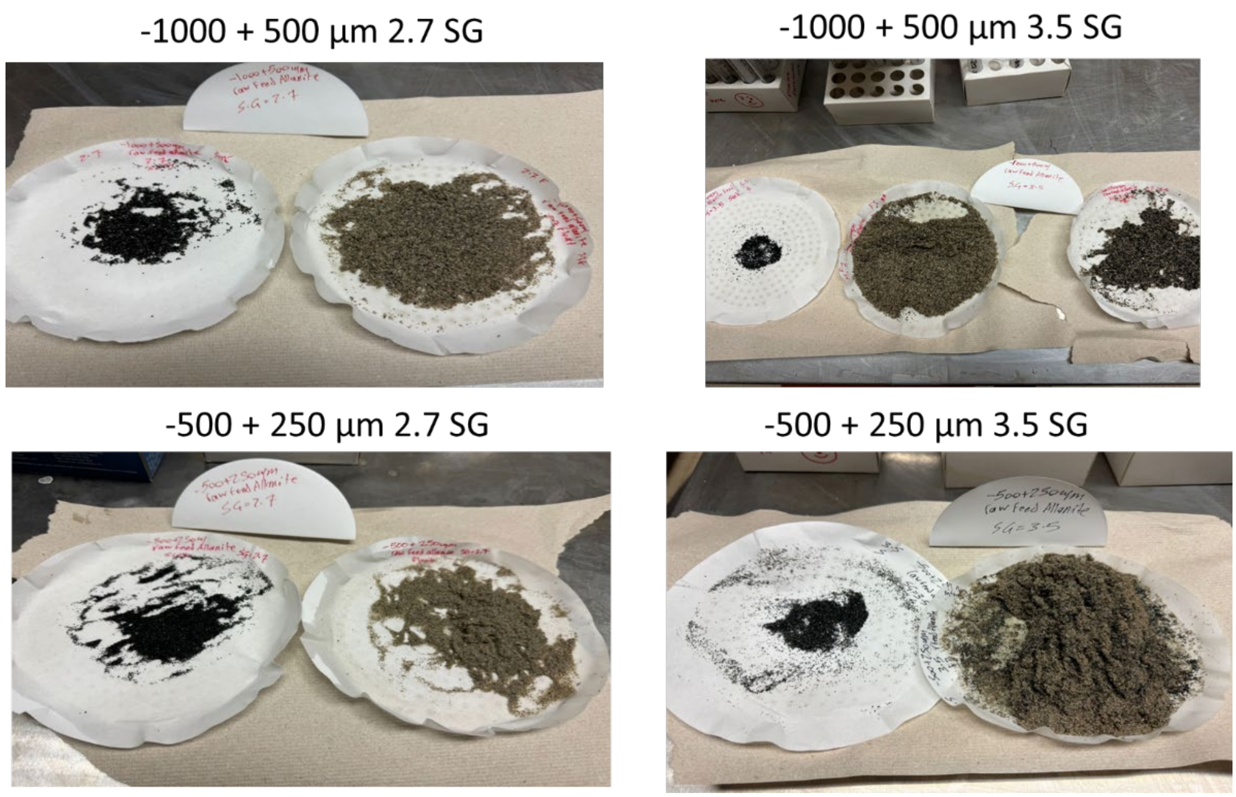
Particle Size, microns	Percentage, %
-1000+500	42.4
-500+250	25.6
-250+150	15.9
-150	16.1
Total	**100**

Table 9-6: Particle Size by Density Distribution

Specific Gravity		Incremental Weight (%)				
Sink	Float	-1000 + 500	-500 + 250	-250 +150	-150	-1000 + 150 Composite
-	2.70	77.9	78.2	73.4	72.3	77.14
2.70	2.90	6.4	2.4	3.3	4.2	4.59
2.90	3.10	6.7	4.5	2.2	0	5.18
3.10	3.40	4.1	5.5	7.0	10.1	50.08
3.40	3.50	2.2	6.7	9.9	13.4	5.03
3.50	-	2.7	2.7	4.2		2.98
Total		100.0	100.0	100.0	100.0	100.0

Two densities were chosen based on the above information for HLS testing, 2.7 and 3.5 SG (Figure 9-6). The float off the 2.7 would result in rejection of approximately 77% of the total mass with close to zero rare earth yield loss. The size fraction chosen to feed the HLS and therefore DMS was -1000 +150 micron material. The fines (<150 microns) represent 16.1% of the total roll crusher output but pose a processing issue in the HLS/DMS systems fines would be screened prior to DMS and processed using WHIMS.

Figure 9-6: Sink and Float from HLS Testing



Note: Sink is the black material
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Figure 9-7 shows TREO increases relative to SG fraction. The results clearly show mineral and TREO separation between lower and higher SG. Tables 9-7 and 9-8 summarize the results of the HLS testwork. The tables show that more the 76% of gangue material can be rejected using a 2.7 SG. Furthermore, Table 9-7 shows TREO grade is increased by a factor of 3.8 with a TREO recovery of 87%.

Figure 9-7: TREO Content vs SG Fraction and Size Fraction

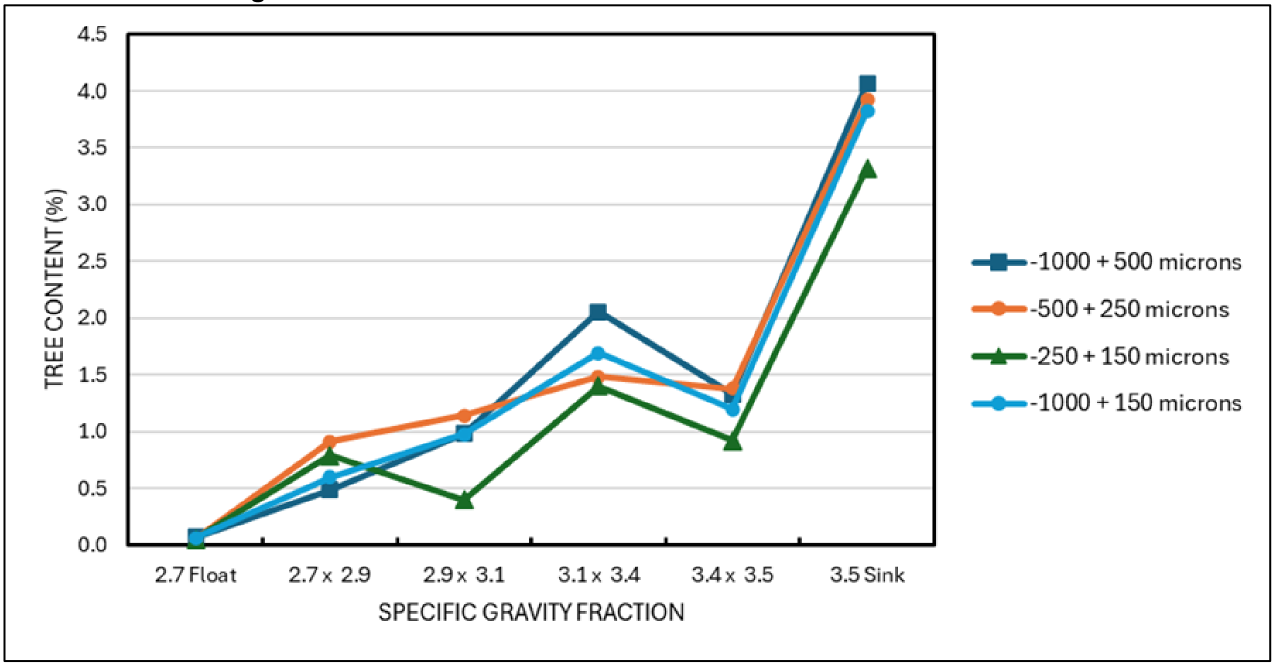

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Table 9-7: HLS Testing Results – 1000 x 150 microns

-1000 + 150 microns																	
Specific Gravity		Incremental			Cumulative Float					Cumulative Sink					Specific Gravity Fraction	TREE Wt Dist. (%)	Fe Wt Dist. (%)
Sink	Float	Wt (%)	Total REE (%)	Iron (%)	Wt (%)	Total REE (%)	Iron (%)	REE Recovery (%)	Iron Recovery (%)	Wt (%)	Total REE (%)	Iron (%)	REE Recovery (%)	Iron Recovery (%)			
2.65	2.7	77.16	0.0617	0.9435	77.16	0.0617	0.9435	12.32	13.57	100.00	0.386	5.367	100.00	100.00	2.7 Float	12.32	13.57
2.7	2.9	4.58	0.5987	13.3129	81.74	0.0917	1.6363	19.42	24.92	22.84	1.482	20.310	87.68	86.43	2.7 x 2.9	7.10	11.36
2.9	3.1	5.17	0.9774	15.9045	86.91	0.1444	2.4847	32.51	40.24	18.26	1.703	22.064	80.58	75.08	2.9 x 3.1	13.08	15.31
3.1	3.4	5.05	1.6944	24.1476	91.96	0.2296	3.6752	54.69	62.98	13.09	1.990	24.495	67.49	59.76	3.1 x 3.4	22.18	22.74
3.4	3.5	5.05	1.1963	26.1800	97.01	0.2799	4.8460	70.33	87.60	8.04	2.176	24.714	45.31	37.02	3.4 x 3.5	15.64	24.62
3.5		2.99	3.8270	22.2416	100.00	0.3860	5.3666	100.00	100.00	2.99	3.827	22.242	29.67	12.40	3.5 Sink	29.67	12.40
Total		100.00	0.3860	5.367												100.00	100.00

Table 9-8: HLS Testing Results – All Sizes

-1000 microns																	
Specific Gravity		Incremental			Cumulative Float					Cumulative Sink					Specific Gravity Fraction	TREE Wt Dist. (%)	Fe Wt Dist. (%)
Sink	Float	Wt (%)	Total REE (%)	Iron (%)	Wt (%)	Total REE (%)	Iron (%)	REE Recovery (%)	Iron Recovery (%)	Wt (%)	Total REE (%)	Iron (%)	REE Recovery (%)	Iron Recovery (%)			
2.65	2.7	76.39	0.0749	1.131	76.39	0.0749	1.1306	14.72	15.17	100.00	0.389	5.692	100.00	100.00	2.7 Float	14.72	15.17
2.7	2.9	4.50	0.5705	12.764	80.89	0.1025	1.7784	21.33	25.27	23.61	1.403	20.449	85.28	84.83	2.7 x 2.9	6.61	10.10
2.9	3.1	4.34	0.9774	15.904	85.23	0.1470	2.4970	32.24	37.38	19.11	1.600	22.260	78.67	74.73	2.9 x 3.1	10.91	12.11
3.1	3.4	5.84	1.4447	24.386	91.07	0.2302	3.9012	53.96	62.41	14.77	1.782	24.125	67.76	62.62	3.1 x 3.4	21.72	25.03
3.4	3.5	5.12	1.1880	25.823	96.19	0.2812	5.0687	69.62	85.65	8.93	2.003	23.954	46.04	37.59	3.4 x 3.5	15.66	23.24
3.5		3.81	3.0983	21.440	100.00	0.3886	5.6925	100.00	100.00	3.81	3.098	21.440	30.38	14.35	3.5 Sink	30.38	14.35
Total		100.00	0.3886	5.692												100.00	100.00

9.3.8 Magnetic Separation

WHIMS have been shown to be effective in the separation of rare earth minerals. Certain rare earth minerals have paramagnetic properties that allow separation from non-magnetic minerals (diamagnetic) using WHIMS. These minerals include bastnaesite, monazite, xenotime, synchysite, and allanite, typically being carriers of the four “magnet metals” – neodymium, praseodymium, terbium, and dysprosium in varying ratios.

WHIMS has been tested using Halleck Creek material by Zenith and by ARR.

Historical testing undertaken at Nagrom when the Project was known as the Laramie Project under Zenith Minerals indicated that it was possible to achieve high mass rejection of non-magnetics with high allanite recovery to magnetics in batch testing. With four stages of sequential treatment (rougher plus three scavenger stages), a concentrate of 29.5% mass with 88% TREO+Y recovery was achieved at a very coarse grind size of 80%, passing 500 µm. Iron recovery was higher at 93.8% while silica recovery was very low at 23.9%, indicating strong amenability of WHIMS as a primary separation stage for Halleck Creek ore.

On behalf of ARR, Wood supervised a thorough WHIMS testing program using Halleck Creek core at Nagrom during the 2023 testing program. Primary WHIMS batch testing was conducted to determine the basic responses of ore using WHIMS. A secondary WHIMS program was tested using a continuous WHIMS unit to simulate plant conditions.

9.3.8.1 PRIMARY WHIMS

Sub-samples of crushed Halleck Creek drill core were subjected to wet rod mill grinding to three P_{80} grind sizes: 500, 250, and 106 µm. Mineralogy results, reported previously, indicated a high degree of liberation at these grind sizes. Progressive magnetic field strengths of 3,000, 6,000, 10,000, and 17,000 Gauss were applied to establish optimal bulk primary grinding and WHIMS processing conditions.

A plot of cumulative TREO + yttrium grade against recovery is shown in Table 9-7.

Recovery at 3,000 Gauss is high (50 to 61%) given that this is typically the realm of magnetite and pyrrhotite. Table 9-7 shows that recovery drops substantially at the finer 106 µm grind size, indicating allanite is becoming liberated and is lost to non-magnetics.

Passing first-stage 3,000 Gauss non-magnetic materials through the WHIMS unit at 6,000 Gauss saw spikes in the TREO + yttrium grade and recovery, which is a more predictable response and supports mineralogical findings of a high degree of allanite liberation. Cumulative recoveries became normalized in a narrow band of 87–91%.

At 10,000 Gauss the stage grade and recovery fell away, which indicated co-recovery of partially locked minerals and less magnetic iron minerals such as goethite and iron feldspars. TREO + yttrium recovery tapered off due to falling grades and stage mass yields. In this stage, allanite was most likely partially locked with silica / silicates.

At 17,000 Gauss, most of the remaining REO + yttrium and iron oxides were recovered, with all three tests returning similar cumulative recoveries of around 93.5%. However, this incremental recovery step had a deleterious effect on cumulative grade, primarily due to the increased addition of lower-grade material, likely to be mostly locked.

9.3.8.2 SECONDARY WHIMS

Wood selected a primary grind P_{80} size of 500 μm as optimal from sighter testing as the slight reduction in concentrate grade is more than compensated for by the energy savings at this coarse grind size. This grind size was adopted for continuous WHIMS testing with field strengths of 300 and 6,000 Gauss for rougher and scavenger stages.

For continuous WHIMS operation, 300 kg of ore was ground to a P_{80} of 500 μm. Initially only rougher and single scavenger stages were adopted, with field strengths of 3,000 and 6,000 Gauss, respectively. The results showed that with only two stages of WHIMS, REO recovery was poor. Wood decided to include two additional scavenging stages to boost yield and recovery. However, overall TREO+Y recovery did not reach the levels achieved in batch testing. Results for the bulk run are shown in Table 9-9.

Table 9-9: Bulk Primary and Secondary WHIMS Mass and Elemental Deportment Summary

Product	Yield	TREO + Y2O3		NdPrO		SiO2		Fe		Al2O3	
Fraction	**%**	**ppm**	**Dist. %**	**ppm**	**Dist %**	**%**	**Dist. %**	**%**	**Dist. %**	**%**	**Dist. %**
Primary WHIMS											
Ro Magnetic	7.6	10580	23.1	2638	24.3	43.9	5.3	21.4	33.2	9.0	4.3
Scav 1 Mags	5.9	11317	19.2	2747	19.6	47.1	4.4	18.0	21.6	10.6	3.9
Scav 2 Mags	5.3	11693	17.9	2772	17.8	50	4.2	15.1	16.4	11.9	3.9
Scav 3 Mags	4.6	9146	12.1	2165	12.1	56.5	4.1	9.7	9.1	14.1	4.1
Scav 3 Non-Mags	76.7	1247	27.7	280	26.2	66.5	81.9	1.3	19.7	17.4	83.8
Total Primary WHIMS	**23.4**	**10736**	**72.3**	**2603**	**73.8**	**49.0**	**18**	**17.0**	**80.3**	**11.0**	**16.2**
Secondary WHIMS											
Cl Magnetic	3.6	8206	8.3	1862	8.3	36.9	2.1	28.0	20.2	6.8	1.5
Cl-Sc 1 Mags	8.3	16632	39.3	3789	39.6	39.9	5.3	23.7	39.8	8.6	4.5
Cl-Sc 2 Mags	3.0	17693	14.9	4138	15.4	41.5	2.0	22.1	13.3	9.2	1.7
Cl-Sc 3 Mags	1.3	18404	6.8	3704	6	44.4	0.9	19.5	5.1	10.2	0.8
Cl-Sc 3 Non-Mags	7.3	1974	4.1	453	4.1	66.7	7.8	1.8	2.6	16.2	7.4
Total Secondary WHIMS	**16.1**	**15105**	**69.2**	**3420**	**69.3**	**39.9**	**10.3**	**24.0**	**78.4**	**8.46**	**8.59**
Combined WHIMS non-mags	83.9		30.8		30.7		89.7		21.6		91.4

9.3.9 Leaching

Wood engaged ALS Global in Perth Australia to perform preliminary leaching testwork using Halleck Creek WHIMS concentrate. Wood and ALS defined five technologies for leach testing: Acid bake-water leach (ABWL), High Pressure Acid Leach (HPAL), Alkali bake-water leach-HCl leach, Sulfuric acid tank leach, and a proprietary process from Watts & Fisher. Wood determined that sulfuric acid tank leach testwork was the most effective process for the material. Solids for all tests were wet milled to a P_{80} size of 38 microns.

9.3.9.1 SULFURIC ACID TANK LEACHING

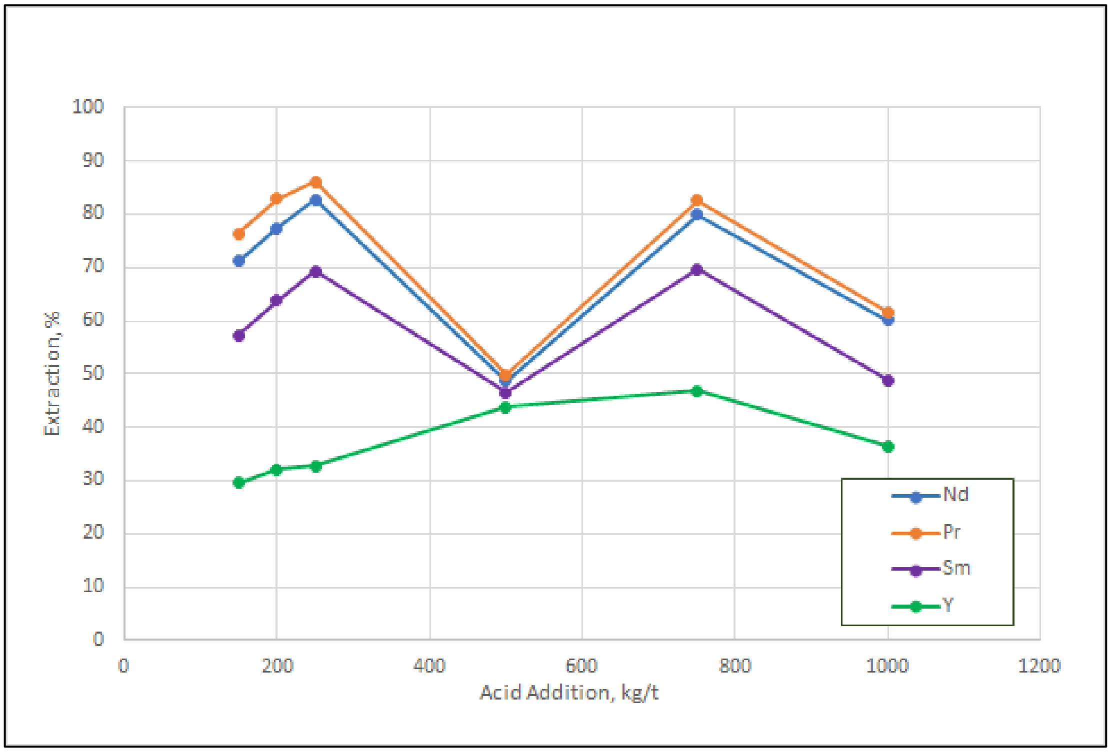
Sulfuric Acid Tank Leaching Acid Dosage Series Six Sulfuric acid tank leach tests were undertaken with varying acid contents, initially 250, 500, 750, and 1000 kg/t solids, then also evaluating 150 and 200 kg/t test conditions. The requisite amount of deionized water was added to the leach reactor for each test, followed by the measured acid dose. The contents were continuously agitated and brought up to the required 90 °C operating temperature before adding in the required feed solids mass. The combined slurry was leached for 6 hours, periodically checking the temperature and adding more deionized water as necessary to maintain the operating level. The leach slurry was then filtered, and the solids were rinsed and filtered again. Solids, filtrate, and washate were weighted and assayed separately for recovery calculation purposes. The final free acid of the leach slurry prior to filtration was measured and recorded. Results of the six tests are summarized in Table 9-10, with extraction trends included for REE elements and gangue minerals.

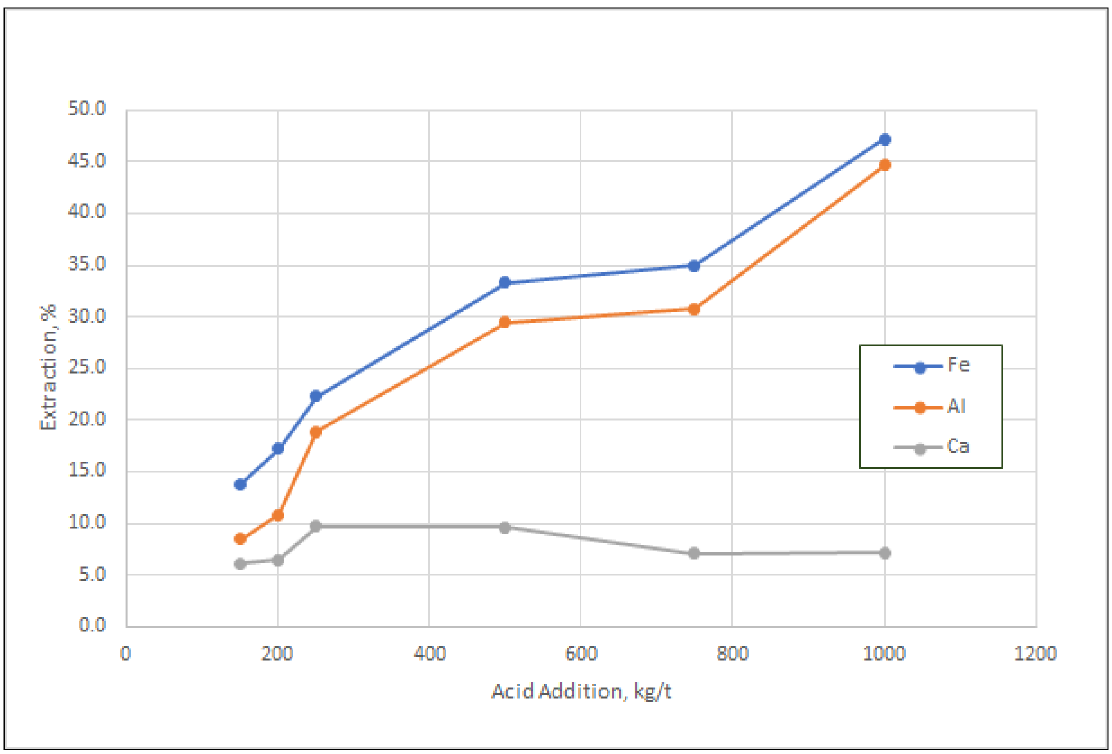
Table 9-10: Sulfuric Acid Tank Leach Test Results – Acid Dosage Series

Parameter	Unit	Test 5 HY578	Test 6 HY579	Test 1 HY16574	Test 2 HY16575	Test 3 HY16576	Test 4 HY16577
Acid leach							
Leach temperature	°C	90	90	90	90	90	90
Leach duration	h	6	6	6	6	6	6
Acid addition	kg H_2SO_4/t solids	150	200	250	500	750	1000
Pulp density	% solids w/w	30	30	30	30	30	30
Final free acid	g/L	1.3	2	39	101.4	179.8	366.9
Extraction[8]							
La	%	75	84.4	91.7	58.2	80.6	53.9
Ce	%	72.2	81.1	89.5	49.5	78.2	53.1
Pr	%	76.3	82.9	86.2	49.8	82.6	61.3
Nd	%	71.2	77.4	82.8	48.8	79.9	60
Sm	%	57.3	63.8	69.3	46.5	69.7	48.9
Dy	%	20.9	23.6	36.3	40.5	36.2	20.7
Y	%	29.5	32.1	32.7	43.7	46.8	36.4
Si	%	3.9	3.9	4.4	0.6	0.3	0.3
Fe	%	13.8	17.2	22.3	33.3	34.9	47.2
Al	%	8.5	10.8	18.9	29.4	30.8	44.6

Note: Recovery (%) = (solution assay x vol)/(solution assay x vol + residue assay x mass) x 100

Figure 9-8: Sulfuric Acid Tank Leach Extraction Trends





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9.3.9.2 GENERAL SULFURIC ACID TANK LEACH RESULTS

The results of the general sulfuric acid tank leach tests are as follows.

- Light REEs – La, Ce, Nd and Pr follow similar trends of increasing extraction up to 250 kg/t acid dosage, followed by a sharp fall away at 500 kg/t, then restored extraction at 750 kg/t and another drop at 1000 kg/t. The result for 500 kg/t is considered anomalous and extractions between 250 and 750 kg/t data points are expected if the test were to be repeated. With high acid dosage, free acid on completion of the leach is extremely high which may be forcing the REEs to precipitate as double sulphate salts.
- Mid REEs – represented by Sm, the mid REEs followed a similar trend to the LREEs but at an overall lower % extraction level.
- HREEs – represented by Y, the extraction profile was much shallower, peaking at 46.8% for 750 kg/t acid dosage. At 250 kg/t, extraction was 32.7%. The reason for the lower extraction should be explored further.
- Fe – iron extraction steadily increases with increasing levels of free acid. Without the oxyhydrolysis that occurs within autoclaves above 225 °C, iron remains in the ferrous sulphate form and does not precipitate as jarosite or hematite. The oxidation state was not confirmed for leach solutions and should be established in future work.
- Al – aluminum closely follows the Fe extraction profile, forming aluminum sulphate that is highly soluble.
- Ca – net calcium extraction is limited due to the solubility in the sulphate system, precipitating as calcium sulphate (gypsum). ALS advised that gypsum formation at the higher free acid levels may be encapsulating allanite particles, retarding leaching kinetics.

From the results, a lower acid dosage is desirable in terms of achieving optimum leach extraction while minimizing gangue reactions that could impair REE leach extraction.

9.3.9.3 LEACHING TIME AND TEMPERATURE OPTIMIZATION

Adopting 250 kg/t acid dosage, three timed leach tests were undertaken at temperatures of 50, 70, and 90 °C. Timed sample aliquots were taken from the leach vessel at times of 2, 4, 8 and 24 hr to assess leach extraction over time based on solution assays, and also to measure free acid levels. Extractions for selected REES and gangue elements are presented in Table 9-11.

Nd and Pr show trends of increasing extraction with time. Comparative plots for Nd and Pr are presented in Figure 9-9, demonstrating that retaining the current 90 °C operating temperature is beneficial for maximizing extraction.

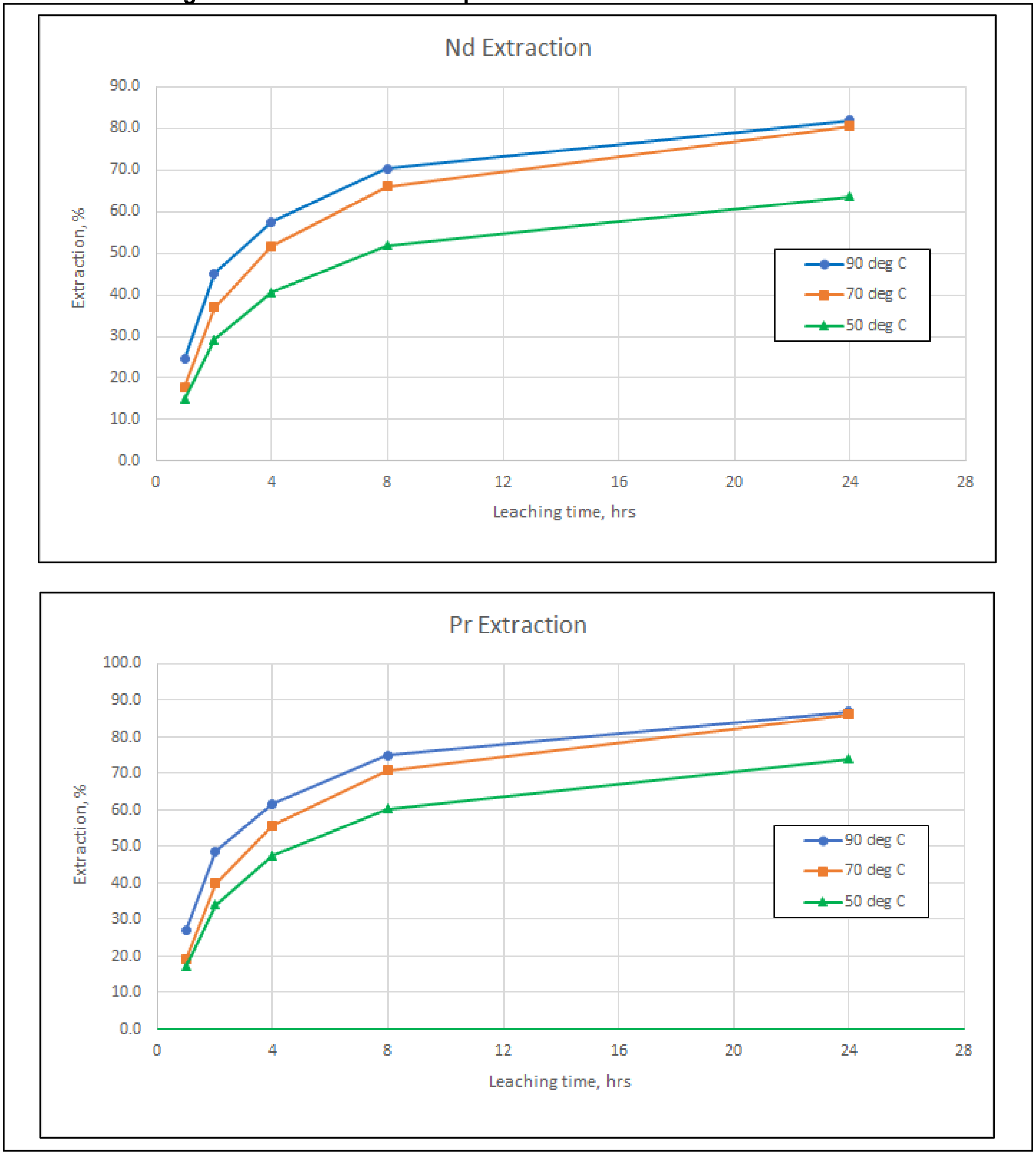
Al and Fe extraction show a similar trend but with much lower overall extractions and in a tighter band of ultimate extraction.

Y and Sm also show that the higher temperature is beneficial for leaching, though extraction is very low for Y. It was noted earlier that the HREE metal extractions were much lower than the mid and light REEs, which bears further investigation, especially if these elements contribute to the basket price of MREC. Investigation into the use of catalysts or accelerants is recommended.

Table 9-11: Kinetic Acid Leach Tests at Varying Temperatures

		Extractions (solution based), 90 °C Leach					
Time (h)	**Free Acid (g/L)**	**Nd (%)**	**Pr (%)**	**Y (%)**	**Sm (%)**	**Al (%)**	**Fe (%)**
1	117	24.6	26.9	4.2	18.3	4.8	5.2
2	114	45.2	48.8	9	35	10.4	10.9
4	97	57.6	61.7	12.8	46.4	14.8	15.4
8	24	70.4	75	17	57.7	20.1	20.8
24	12	81.9	86.9	20.6	67.6	24.8	25.1
		Extractions (solution based), 70 °C Leach					
Time (h)	**Free Acid (g/L)**	**Nd (%)**	**Pr (%)**	**Y (%)**	**Sm (%)**	**Al (%)**	**Fe (%)**
1	132	17.9	19.1	3.9	14	4.2	4.9
2	114	37	39.9	8.1	29	8.9	10.2
4	97	51.7	55.7	11.1	40.5	12.6	14.4
8	25	66.1	70.9	14.4	51.3	16.7	18.9
24	17	80.5	86.2	17.7	62.2	21	23.5
		Extractions (solution based), 50 °C Leach					
Time (h)	**Free Acid (g/L)**	**Nd (%)**	**Pr (%)**	**Y (%)**	**Sm (%)**	**Al (%)**	**Fe (%)**
1	142	14.8	17.2	2.7	12.7	3.5	3.9
2	136	29.2	34	5.4	25.1	7.5	8.4
4	100	40.6	47.5	7.6	35.1	10.7	12.2
8	33	51.8	60.3	9.7	44.6	14.1	16.3
24	22	63.7	74.1	11.9	54.4	18	20.8

Figure 9-9: Effect of Temperature on Leach Extraction with Time



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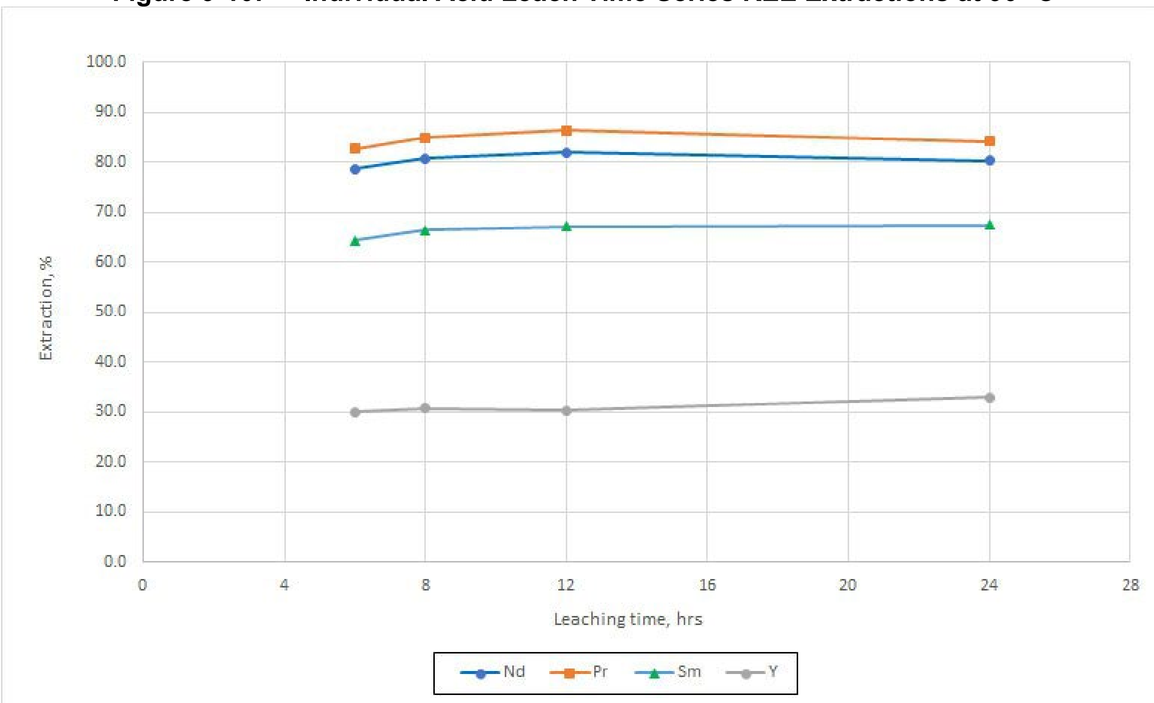
It was noted that unleached metals remained in filter cakes after washing for the times of 1 to 8 hr. The remaining metals were recovered in the 24-hr extraction time as shown. Further testwork at 90 °C was undertaken to evaluate individual batch leach extractions at times of 6, 8, 12, and 24 hr to firm up the optimum leach time. Comparative plots for Nd, Pr, Sm and Y are presented as Figure 9-10.

Figure 9-10: Individual Acid Leach Time Series REE Extractions at 90 °C



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Unlike the kinetic test with timed solution sampling that predicts increasing recovery with time up to 24 hr, Nd, Pr, and Sm extractions appear to peak at 12 hr, dropping away at 24 hr. The dip in recovery is related to extended calcium leaching, which forms gypsum and possibly provides a nucleation site for the precipitation of REE sulphates. The Nd and Pr extractions at 6 hr are 78.7 and 82.7%, compared with 82.8 and 86.2%, respectively, for the initial batch leach test at 6 hr, which are significant differences in performance for what are essentially the same conditions on the same feed material.

The initial results at 6 hr leaching time included in Table 9-11 were used to support the updated desktop study design basis. Further work is needed in the next phase of work to optimize conditions and obtain firm recovery figures with reliable assay reconciliation given the significant differences in results between these tests.

9.4 Recovery Estimates

The overall recovery of REO material is shown below in Table 9-12. The largest yield losses are experienced in Gravity Separation/WHIMS with a 78% overall TREO recovery and Leach with an overall TREO recovery of 85%. The basis of the DMS operation is the University of Kentucky HLS testing, while the basis for the WHIMS recovery is based on testing completed at Nagrom under the supervision of Wood. The basis for the sulfuric acid tank leach recovery is based on testing completed by Nagrom under the supervision of Wood as well as the leach testing completed by Virginia Tech. The 2% TREO yield loss in the Partial Neutralization operation is due to co-precipitation of the rare earth compounds as well as precipitation due to localized high pH in the area of the caustic injection into the tank. In the separation and finishing area there are two mechanisms of yield loss, yield loss due to solvent extraction efficiency (not being able to make two high purity products on the raffinate and strip at the same time) and incomplete precipitation. For instance, the Nd/Pr losses are 2% due to lost Nd/Pr to the raffinate (La stream) and 2% due to an incomplete precipitation. The yield losses downstream of the leach are estimated based on Kelton Smith's rare earth processing experience due to the lack of laboratory testing.

Table 9-12: Recovery Estimates by Unit Operation

	% Recovery (REO Basis)
Gravity/WHIMs	78%
Leach	85%
Partial Neutralization	98%
Separation and Finishing (Nd/Pr Oxide)	96%
Separation and Finishing (all other products)	98%

Table 9-13 shows the overall recovery of REO material.

Table 9-13: Element Recovery Estimates by Product

	Overall Cumulative Recovery (REO Basis)
Lanthanum (La)	69%
Nd/Pr Oxide (didy)	64%
SEG Concentrate	70%
Terbium Oxide (Tb)	70%
Dysprosium Oxide (Dy)	66%
TOTAL	**67%**

As noted in conclusions / recommendations, extensive refinery testwork is planned to confirm assumptions around the revised flowsheet – the early leaching tests were WHIMS-based and showed a lower leach recovery for Heavy Rare Earths, since that time the concentration work has improved and flowsheet modified. Our consultant(s) [metallurgist and chemical engineer] evaluated the dataset during continued design work and opined the results were an analysis error due to the extreme low concentrations of the heavies in the leach solution. The heavy rare earths are believed to be coming from allanite, as such all the REE will have the same chemical makeup and should behave the same.

9.5 Metallurgical Variability

Metallurgical and mineralogy studies have shown that REE recoveries are homogeneous across the resource areas at Halleck Creek. The representative core material was tested from the Red Mountain and Overton Mountain areas to determine the mineral beneficiation flowsheet presented in this report. The mineralogical study also used representative drill core to characterize the mineral speciation, textures, and gangue mineral associations and to identify factors that may influence REE recoveries during the process. Geologist's logs and REE assays also demonstrate the homogeneity of the deposit.

9.6 Deleterious Elements

Two radionuclide elements (thorium and uranium) and associated daughter products are present in Halleck Creek mine mineralization at low levels. The combined concentration of these two radionuclides is approximately 68 ppm in ROM ore.

Further simulation and laboratory testing in future engineering studies is needed to determine the deportment and concentration of the radionuclides within the proposed process and products. The impurity removal plant is designed to remove both Th and U via a precipitation reaction followed by filtration and ion exchange to remove and precipitate, respectively.

Iron (Fe^{++} and Fe^{+++}) occurs within allanite and hastingsite minerals. Fe_2O_3 makes up the second highest elemental abundance in allanite at 19.69%, after silica. Hastingsite typically contains 8.1% Fe_2O_3 but 29.0% FeO, the latter being a reduced form of Fe. Fe is removed during processing using conventional methods.

9.7 Qualified Person's Opinion on Data Adequacy

This section was compiled by ARR Mining technical staff and Stantec and reviewed by Kelton Smith who is a registered QP, as defined by the JORC Code 2012 Edition. The data provided is reasonable for this level of study and sufficient for resource estimation.

10.0 MINERAL RESOURCE ESTIMATE

ARR drilled 15 RC holes and 8 diamond core holes at Halleck Creek in 2023. ARR currently has 70 drill holes as known data points to determine an updated JORC resource estimate for the Halleck Creek Project (Figure 6-1).

ARR contracted Odessa Resources Pty, Ltd. (Odessa) in Perth, Western Australia, to update geological and rare earth grade models at Halleck Creek. Mr. Alf Gillman of Odessa is a Chartered Professional (Geology) and Fellow of the Australasian Institute of Mining and Metallurgy or the Australian Institute (AusIMM), number 107303. Mr. Gillman is a QP, as defined by the JORC Code 2012 Edition, having sufficient experience relevant to the style of mineralization and type of deposit described in this report.

Odessa prepared a summary report detailing the resource models and Halleck Creek resource estimates entitled *Halleck Creek REE Project, Wyoming Update Report Methodology and Resource Estimation Report*, January 2024. Excerpts of this report are presented in the sections below and are enclosed by quotations.

ARR exported locations, lithological descriptions, and assay data of surface samples across the Halleck Creek Project Area. While surface samples are not valid data points for resource estimation, they are used to improve modeling geological domains and building rare earth grades models.

ARR provided Odessa with drill hole assay data that included the drill hole ID, domain, from depth, to depth, sample type, and rare earth element oxide values.

Rare earth elements used for grade modeling include: TREO, LREO, HREO, MREO, $La2O_3$, $Ce2O_3$, $Pr6O_{11}$, $Nd2O_3$, $Sm2O_3$, $Eu2O_3$, $Gd2O_3$, $Tb4O_7$, $Dy2O_3$, $Ho2O_3$, $Er2O_3$, $Tm2O_3$, $Yb2O_3$, $Lu2O_3$, $Y2O_3$, ThO_2, and UO_2.

The block model used a parent block size of 20 m. The minimum block size was 5 x 5 x 5 m.

10.1 Topography

ARR acquired light detection and ranging (LiDAR) topographic data from the United States Geological Survey (USGS). This data was released to the public in August 2022 as part of the USGS Earth MRI project.

ARR personnel processed LiDAR imagery to prepare high resolution topographic models across Halleck Creek for use in ArcGIS and Leapfrog geological modeling software.

10.2 Geological Models

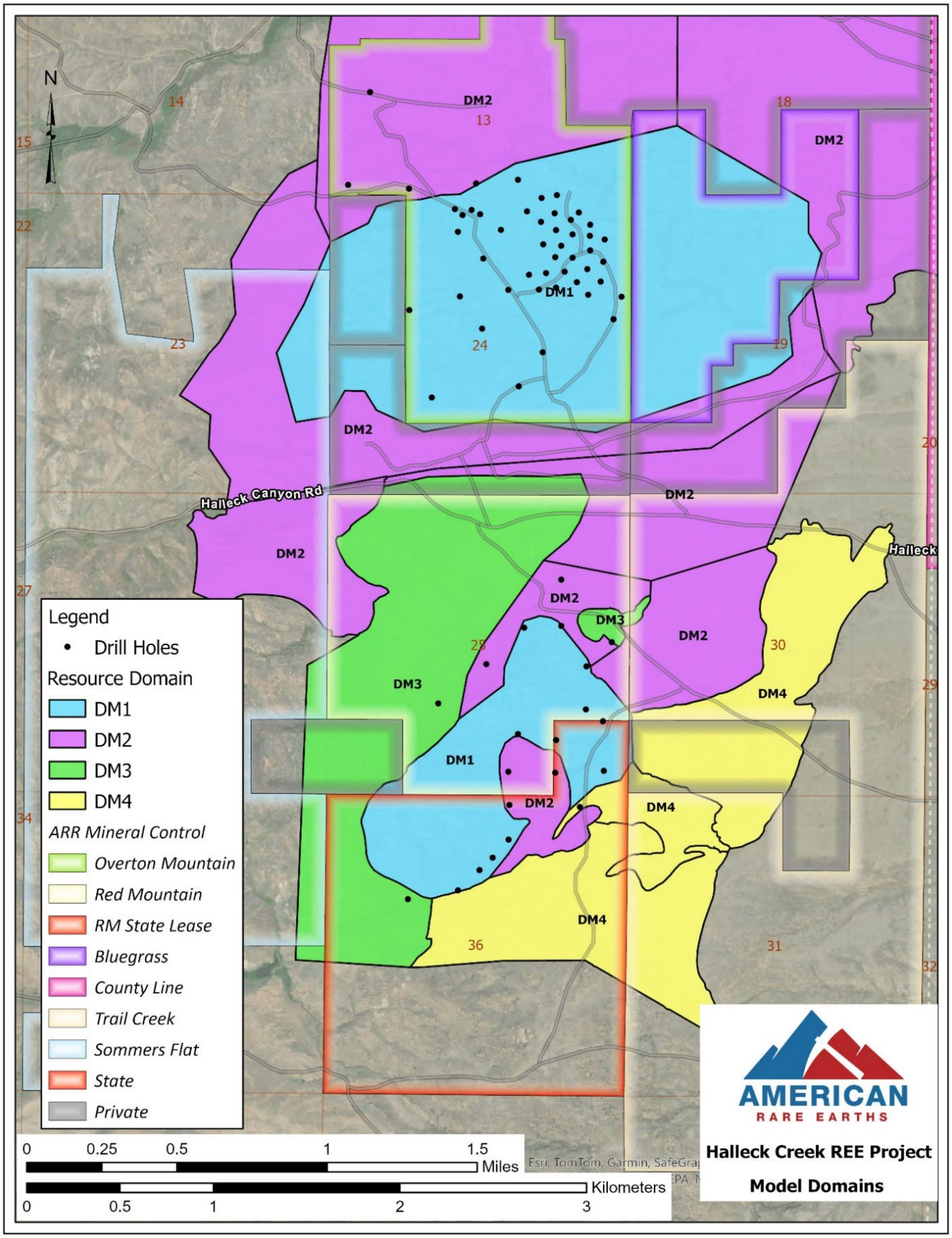
ARR interpreted lithological units and modeling domains within the drill hole data. The modeling domains were the primary geological units modeled by Odessa.

The primary modeling domains consist of the following.

- QAL – Quaternary alluvium
- DM1 – Higher grade CQM and BHS
- DM2 – Lower grade CQM, BHS, and FM
- DM3 – non-grade ERGB
- DM4 – low grade Sybille

Odessa Resources created a geological resource model using the Leapfrog Edge geological modeling tools, developed by Seequent, a subsidiary of Bentley Systems. Odessa modeled the geologic domains (Figure 10-1) and established resource boundary limits based on variography of TREO.

Figure 10-1: Modeled Geological Domains



ARR 2024

10.3 Density Assignment

A fixed SG of 2.70 was used for all domains based on hydrostatic testwork.

10.4 Exploratory Data Analysis

Figure 10-2 shows histograms log probability charts of the TREO grade data at Halleck Creek. A clear bi-modal distribution of TREO occurs with the data. The higher-grade peak is correlated with the DM1 modeling domain, which corresponds to the clinopyroxene-rich quartz monzonite rock type that contains the highest concentration of allanite. The lower grade peak is correlated with the DM2 modeling domain which corresponds to the biotite–hornblende quartz syenite rock type that contains less allanite but remains consistent in drill hole data.

Odessa compiled TREO grade information for the geological domains, lithological units, and discrete rock types. The boxplot for geological domains is shown in .

Figure 10-2: Histograms and Log Probability Charts

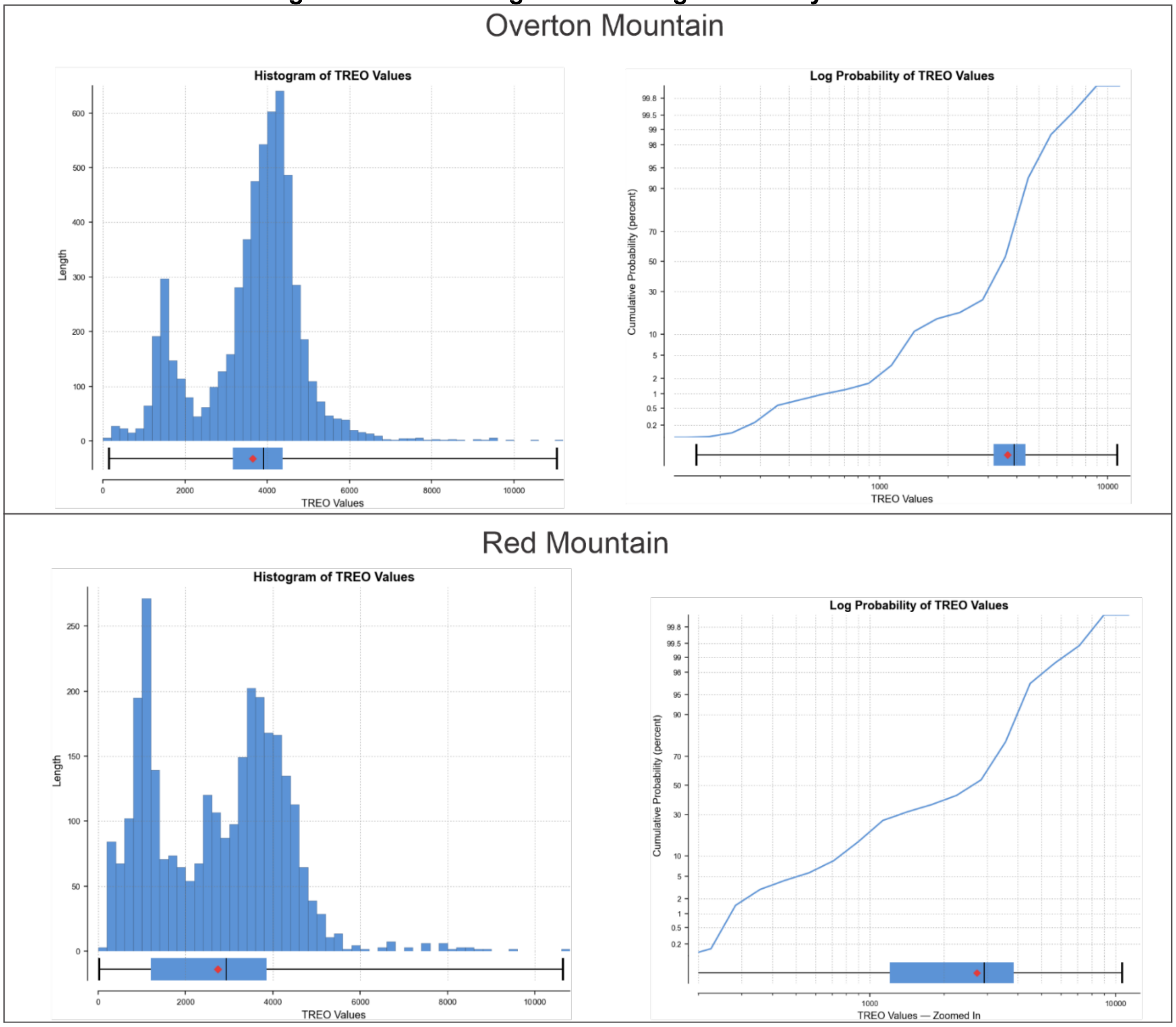


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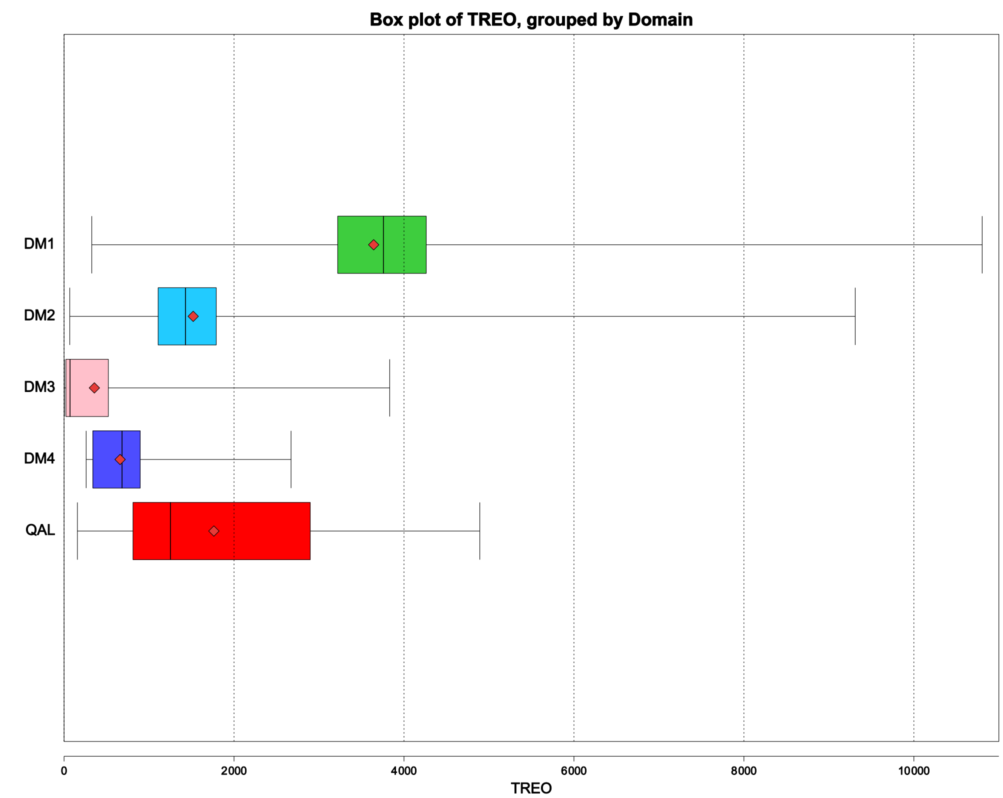
Figure 10-3: Boxplot of TREE for Geological Domains



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10.5 Grade Capping / Outlier Restrictions

Grades were capped as shown in Table 10-1

Table 10-1: Grade Restrictions

General				Value clipping			Discretization		
Interpolant Name	Domain	Numeric Values	Domained Estimation Name	Lower bound	Upper bound	Estimate Type	X	Y	Z
OM indicated	OM	TREO	TREO	157	5500	Kr	5	5	2
OM inferred	OM	TREO	TREO	157	5500	Kr	5	5	2
RM indicated	RM	TREO	TREO	8	9956	Kr	5	5	2
RM inferred	RM	TREO	TREO	8	9956	Kr	5	5	2

10.6 Composites

Grades intervals were composited by Odessa to 1.5 m (5 ft) which is the dominant sampling interval Figure 10-4. Odessa stated, there is no material difference between the composited and uncomposited samples statistics Figure 10-5.

Figure 10-4: Histogram of Assay Sample Interval Length

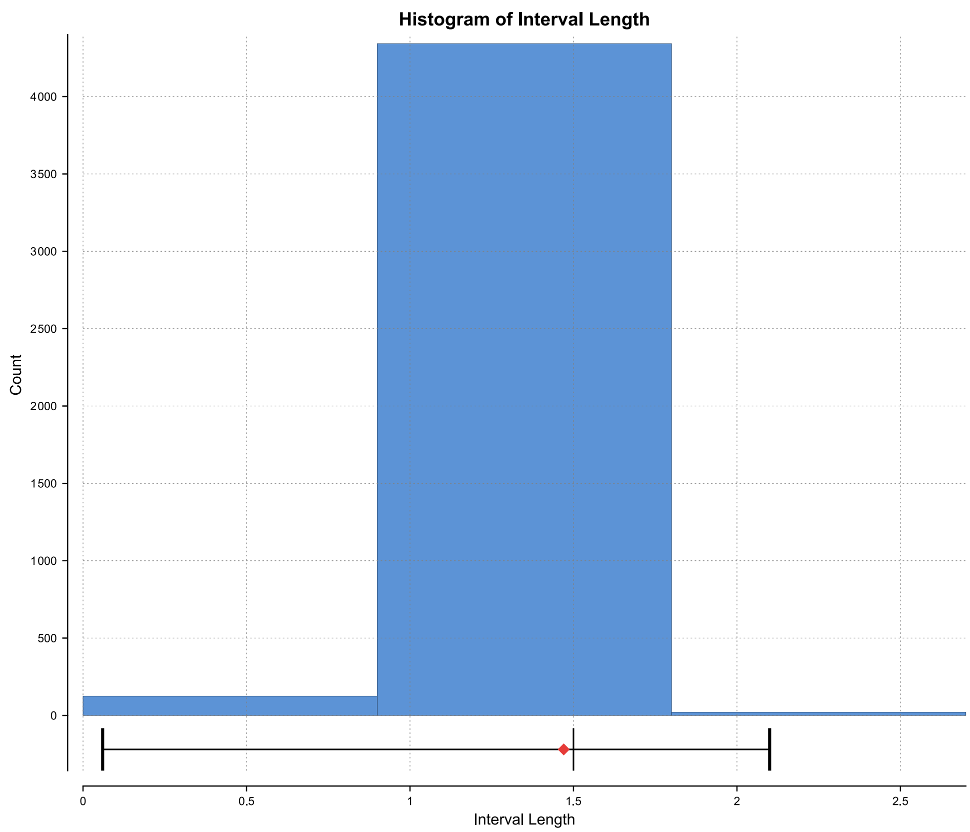

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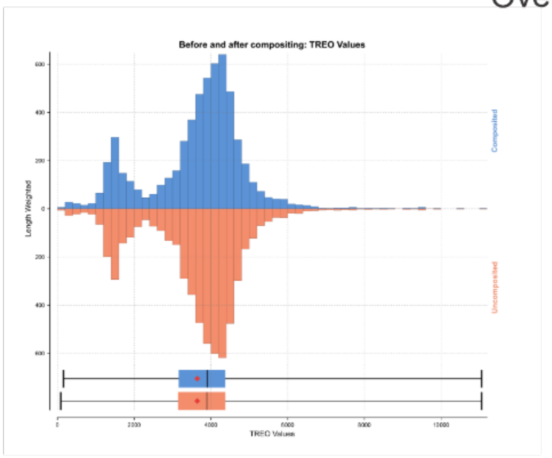
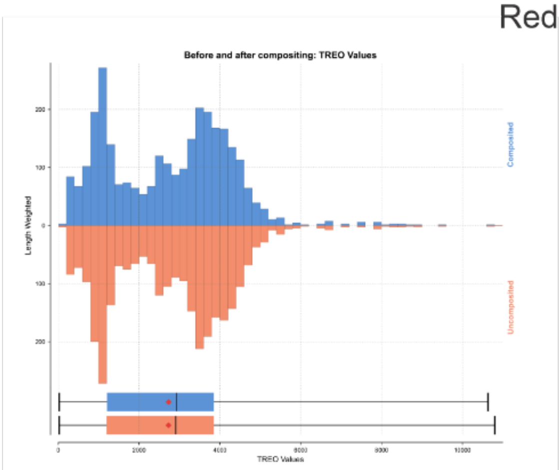
Figure 10-5: Sample Compositing Statistical Summary (TREO)

Overton Mountain



	Composited	Uncomposited
Count	3,847	3,957
Length	5,760.4	5,758.0
Mean	3,646.39	3,646.57
SD	1,255.07	1,268.27
CV	0.344194	0.347797
Variance	1.57519e+06	1.6085e+06
Minimum	157	89
Q1	3,160.87	3,148
Q2	3,907	3,898
Q3	4,380	4,381
Maximum	11,054	11,054

Red Mountain



	Composited	Uncomposited
Count	1,959	2,008
Length	2,935.5	2,933.2
Mean	2,731.42	2,730.81
SD	1,506.59	1,516.03
CV	0.551576	0.555156
Variance	2.2698e+06	2.29834e+06
Minimum	21	21
Q1	1,207	1,200
Q2	2,925	2,909
Q3	3,851.81	3,852
Maximum	10,636	10,804

Odessa 2024

10.7 Variography

Using Leapfrog Edge, Odessa performed detailed variography for the Halleck Creek assay data to determine resource boundary limits, and to provide input parameters for grade interpolation. Figure 10-6 shows an example of the variogram analysis for TREO. Table 10-2 shows the variogram parameters for TREO.

The variography results showed a resource boundary based on 90% of sill range of approximately 280 m is applicable at Overton Mountain, and approximately 445 m at Red Mountain. Figure 10-7 illustrates the resource boundaries.

Figure 10-6: Variography of TREO for Overton Mountain and Red Mountain Resource Areas

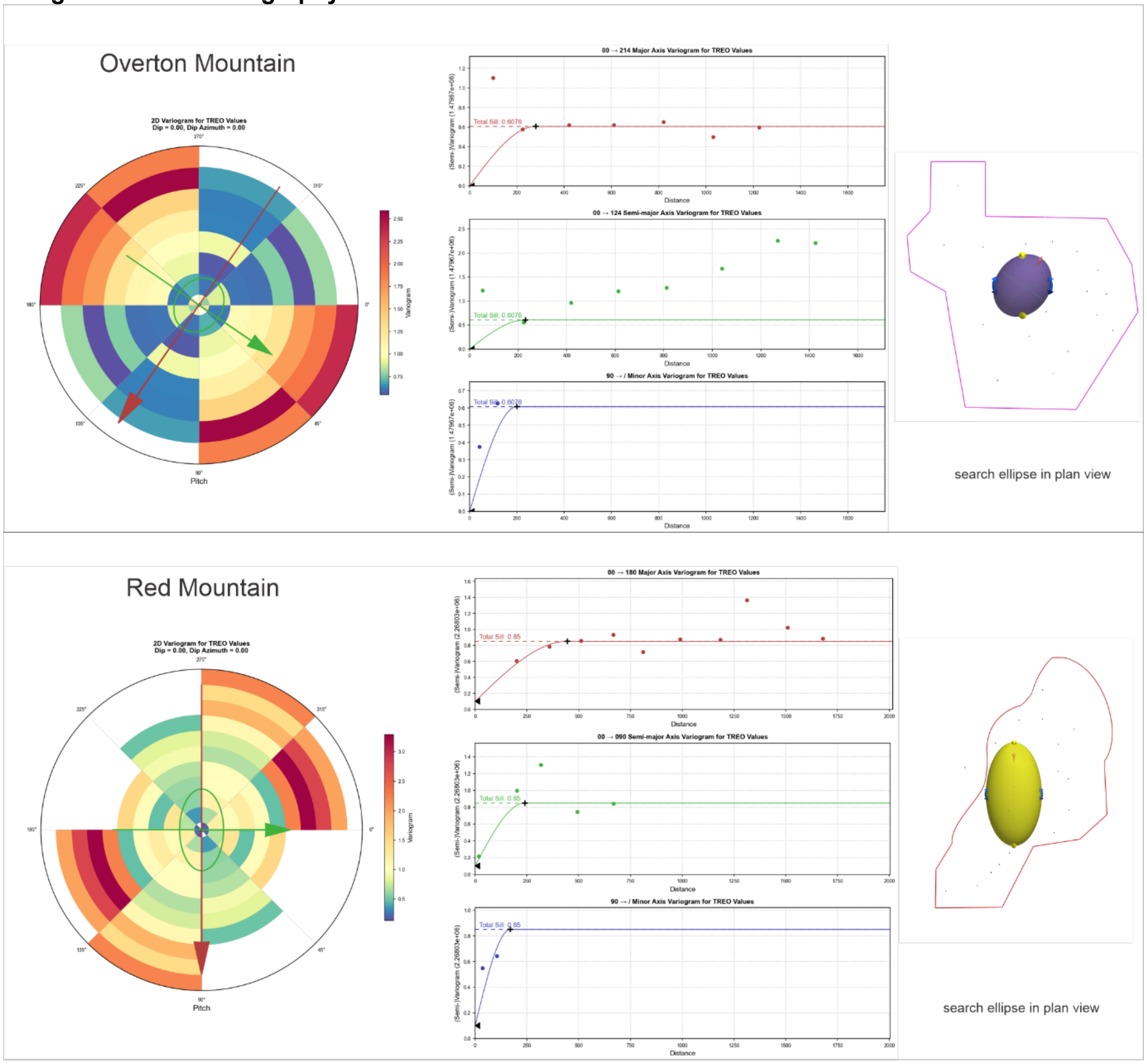


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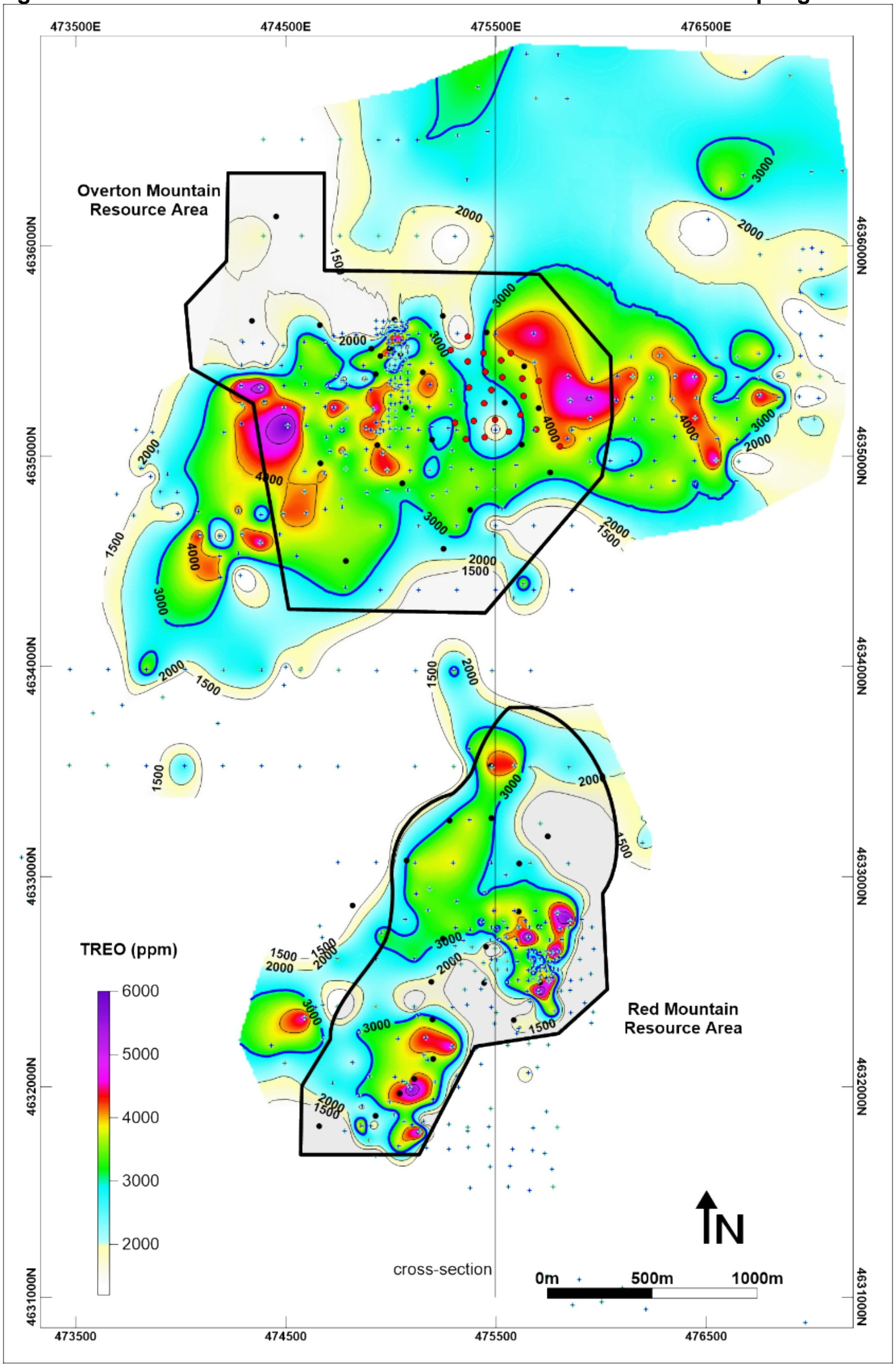
Table 10-2: Variogram Parameters

General	Direction			Structure 1					
Variogram Name	Dip	Dip Azimuth	Pitch	Normalized Nugget	Normalized sill	Structure	Major	Semi-major	Minor
OM	0	0	124	0	0.6	Spherical	280	230	200
RM	0	0	90	0.1	0.8	Spherical	445	240	170

Figure 10-7: Plan View of Resource Extents with Geochemical Sampling Results



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10.8 Estimation / Interpolation Methods

Odessa modeled grade for each of the rare earth parameters listed in Section 10.1. Odessa stated, "Grade estimation was carried [out] using an Ordinary Kriging (OK) interpolant. Kriging is a method of interpolating estimates for unknown points between measured data. Instead of the inverse distance and nearest neighbor estimates, covariances and a Gaussian process are used to produce the prediction. The interpolant profile developed for TREO was applied to the individual rare earth assemblages and individual minerals." The Leapfrog estimation parameters defined for block modeling are shown Table 10-3.

Table 10-3: Search Parameters

General			Ellipsoid Ranges			Ellipsoid Directions			Number of Samples		Outlier Restrictions
Interpolant Name	**Domain**	**Numeric Values**	**Max.**	**Inter.**	**Min.**	**Dip**	**Dip Azimuth**	**Pitch**	**Min.**	**Max.**	**Method**
TREO OM Pass 1	OM	TREO	150	150	75	0	0	90	5	15	None
TREO OM Pass 2	OM	TREO	300	300	75	0	0	90	5	15	None
TREO RM Pass 1	RM	TREO	150	150	120	0	0	90	5	15	None
TREO RM Pass 2	RM	TREO	300	300	120	0	0	90	5	15	None

10.9 Validation

"Several estimation runs were carried out on the Overton Mountain Indicated resource to check for any variance between estimated grades and the input data.

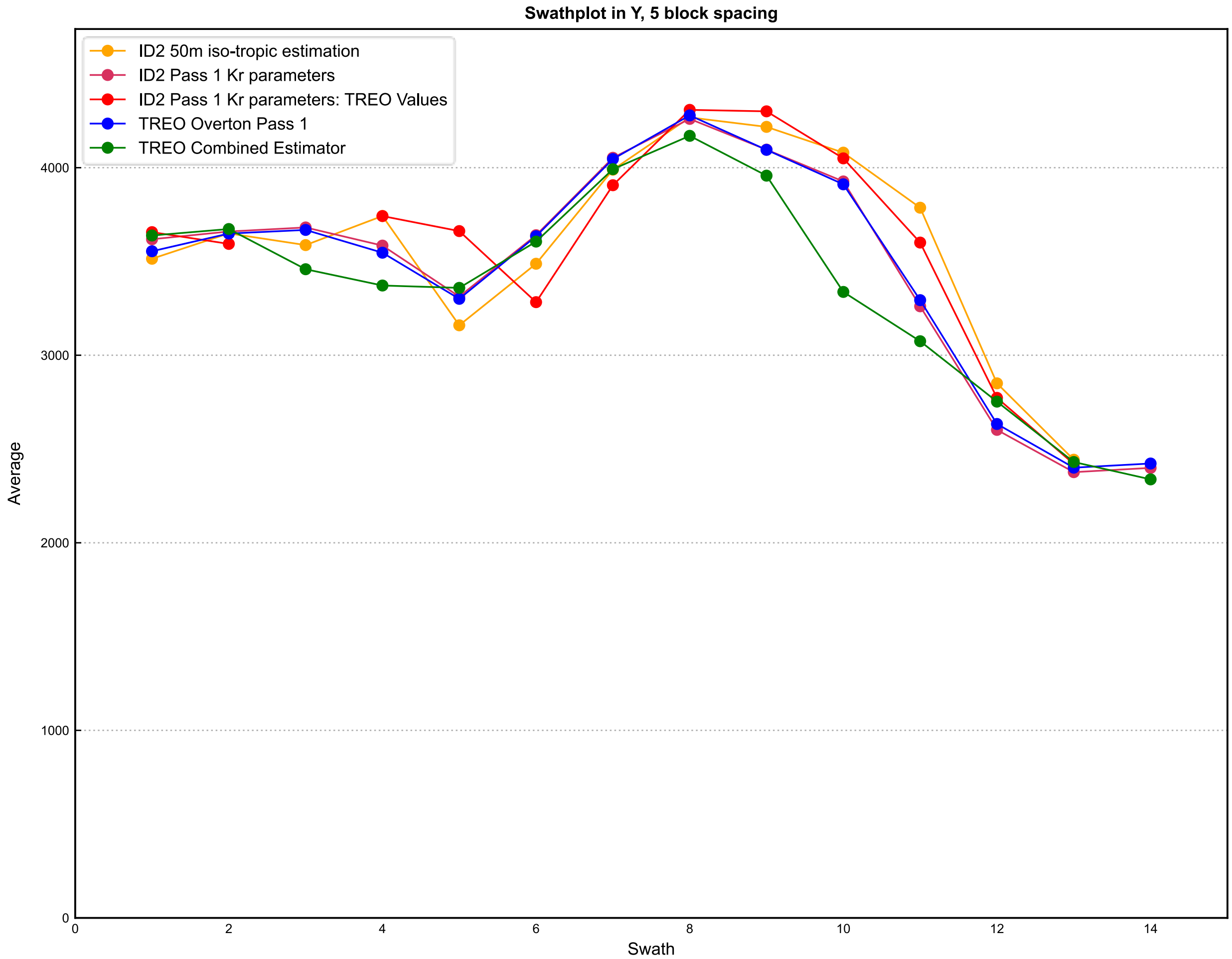
The additional estimators comprised of the following.

- Inverse Distance Squared (ID2) using the same estimation parameters as the kriged model.
- Inverse Distance Squared (ID2) using an iso-tropic 50 m search ellipse.

These validation runs, together with the kriged estimator, were compared against the raw composite data in a north-south (Y) swath plot across the model area (Figure 10-8).

The data indicates that the kriged estimator has done a reasonable job in estimating a global resource grade with no systematic bias towards overestimating the grades. The smoothing effect of the kriging interpolant is consistent with both the inherent nature of the kriging process and the large search ellipses used."

Figure 10-8: Swath Plot in Y Axis



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10.10 Confidence Classification of Mineral Resource Estimate

10.10.1 Mineral Resource Confidence Classification

Odessa reviewed resource classification categories for the Halleck Creek Project. Odessa stated, "The resource is classified as either measured, indicated or inferred. Subject to the application of 'modifying factors' the measured plus indicated component of the resource may allow for a formal evaluation of its economics with the potential to be converted to a Probable Ore Reserve. Therefore, a high degree of conservatism has been adopted as the underlying premise of the resource classification and, in particular, the indicated component. The limits to the resource classification are shown in Figure 10-9 and Figure 10-10. The QP for this section considers the above classification strategy and methodology to be appropriate and reasonable for this style of mineralization.

The classification at Halleck Creek is based on the following key attributes.

- Geological continuity between drillholes.
    - Mineralization is controlled by batholith-scale fractionation. Hence, both empirical observations and statistical analysis confirm a very high degree of continuity with the respective rock masses at Overton Mountain and Red Mountain.
    - This is supported by variography.

- Drill spacing and drill density.
    - The drill pattern is mostly irregular with drill spacing of approximately 200m.
    - At Overton Mountain an area has been infilled on a systematic grid spacing of approximately 90m. This spacing is considered to be adequate to support a measured classification.

Figure 10-9: Resource Extent and Resource Classification Categories

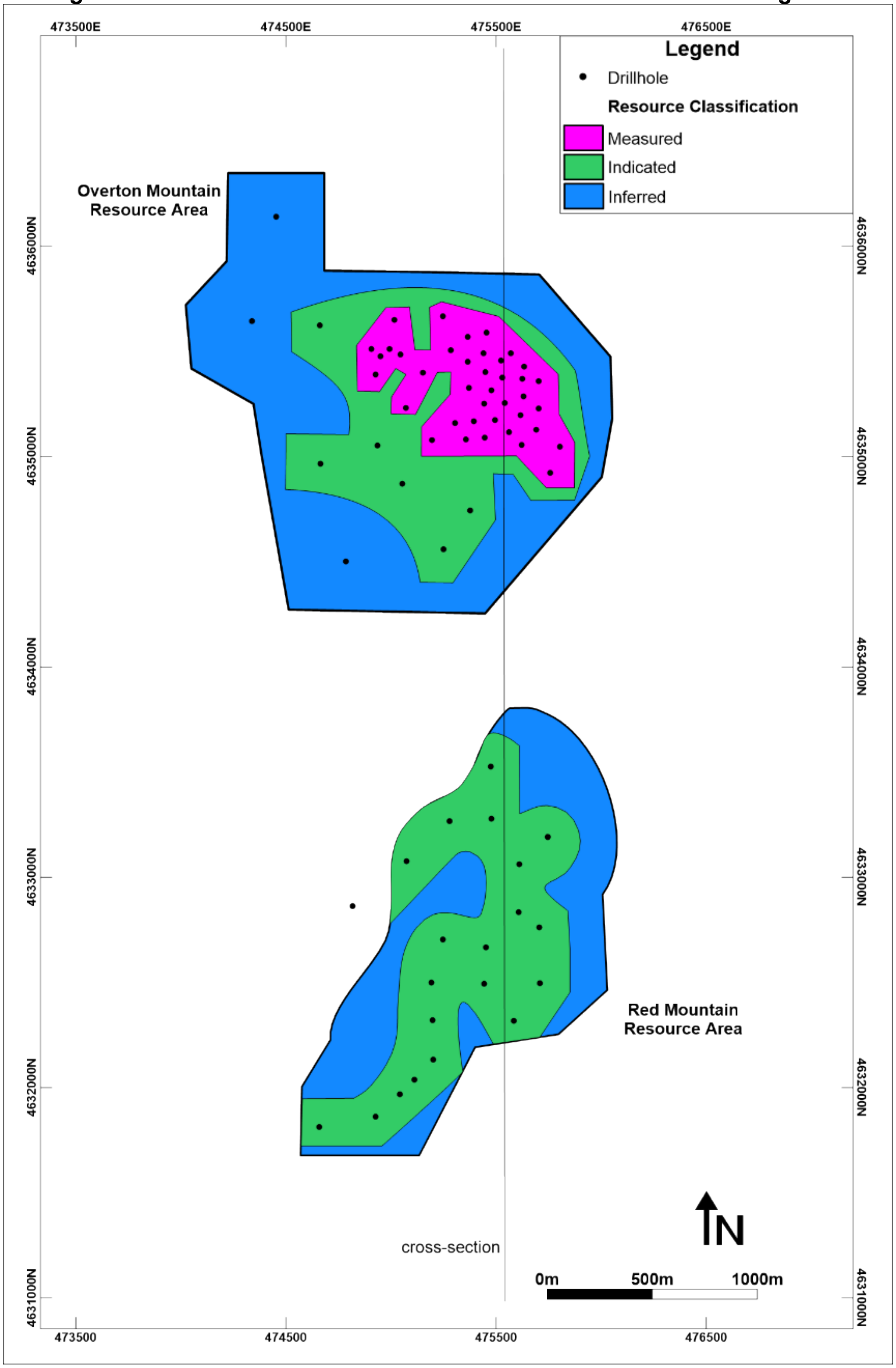

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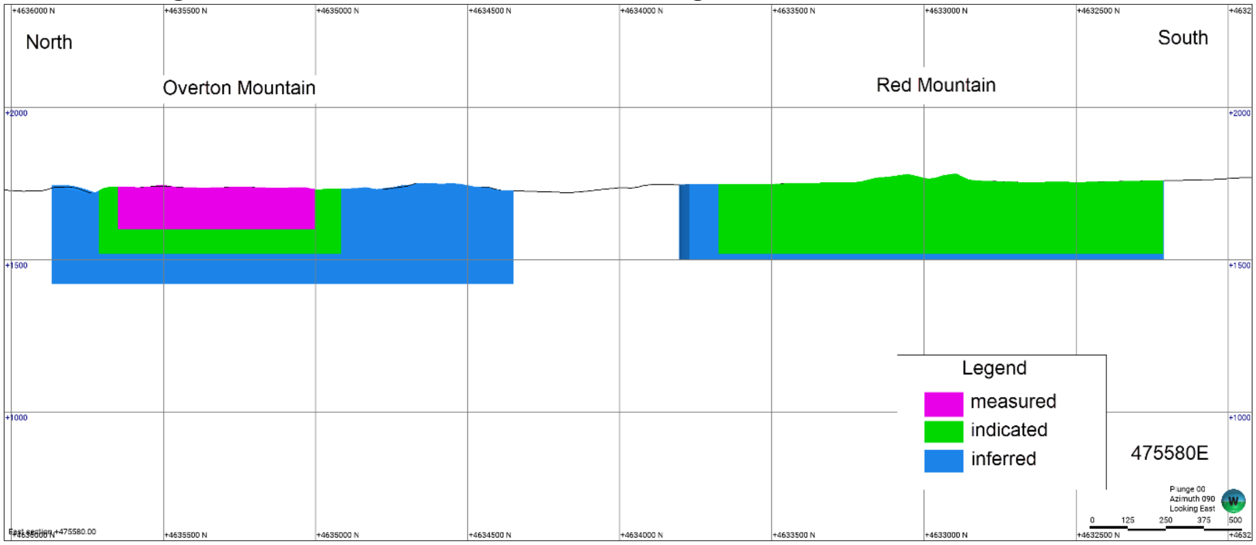
Figure 10-10: Cross-Section View Showing Resource Classification Limits



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10.10.2 Uncertainties Considered During Confidence Classification

Uncertainties regarding sampling and drilling methods, data processing and handling, geological modelling, and estimation were incorporated into the classifications assigned. The level of uncertainty is reflected in the assignment of the measured, indicated and inferred categories to the resource blocks.

10.11 Reasonable Prospects of Economic Extraction

10.11.1 Input Assumptions

Following input assumptions were applied to determine reasonable prospects for economic extraction.

- Resource material is at surface and can be mined with conventional open pit mining equipment.
- Uncontrolled minerals were excluded from resource estimates.
- NSR calculations determined that a cut-off grade of 1,000 ppm TREO provides ample economically viable material to be included in reasonable prospects for economic extraction.

10.12 Cut-Off

Stantec developed net smelter return (NSR) calculations based on recovering oxides of NdPr, La, Dy, Tb, and SEG (mixed samarium, europium, and gadolinium). The NSR calculated shows an economic cut-off grade of 1,000 ppm TREO for in situ resource estimates within proposed resource limits. This cut-off provides the basis of a reasonable expectation of economic extraction at Halleck Creek.

10.13 Mineral Resource Statement

Table 10-4 summarizes estimated global in situ resources at Halleck Creek by resource area and category using a TREO cut-off of 1,000 ppm. These in situ resource estimates have not been optimized within any open pit designs. The total estimated in situ resource at Halleck Creek is 2.34 Gt with an average TREO grade of 3,195 ppm (0.32%), and an average Magnet Rare Earth Oxide (MREO) grade of 774 ppm (0.08%). MREO comprises approximately 24% of TREO.

The total in situ measured and indicated resources at Halleck Creek are 1.4 Gt with an average TREO grade of 3,295 ppm (0.33%), and an average Magnet Rare Earth Oxide (MREO) grade of 798 ppm (0.08%).

It should be clearly noted that Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability. There is no certainty that all or any part of the Mineral Resource will be converted into a Mineral Reserve. Areas where ARR does not control mineral resources have been excluded from resource estimates.

Table 10-5 summarizes resource estimates by mineral owner. Private unleased material is not included in the estimate. Approximately 0.42 Gt of material at an average TREO grade of 3,349 ppm exists within Wyoming state mineral leases. ARR is focusing the next phases of development on resources within state mineral leases. Approximately 1.9 Gt of material at an average TREO grade of 3,161 ppm exists within federal unpatented lode claims.

Table 10-4: Estimated Rare Earth Resources at Halleck Creek (1,000 ppm TREO Cut-off)

Classification	Tonnage	*Grade*				*Contained Material*			
		TREO	LREO	HREO	MREO	TREO	LREO	HREO	MREO
	t	ppm	ppm	ppm	ppm	t	t	t	t
Measured	206,716,068	3,720	3,352	370	904	769,018	692,935	76,550	186,836
Indicated	1,210,173,301	3,223	2,838	349	780	3,899,931	3,434,947	422,124	943,421
Meas + Ind	**1,416,889,369**	**3,295**	**2,913**	**352**	**798**	**4,668,949**	**4,127,881**	**498,674**	**1,130,257**
Inferred	924,698,618	3,041	2,696	339	737	2,812,121	2,493,178	313,187	681,138
Total	**2,341,587,986**	**3,195**	**2,828**	**347**	**774**	**7,481,070**	**6,621,059**	**811,861**	**1,811,395**
Rounded	**2,342,000,000**	**3,195**	**2,828**	**347**	**774**	**7,481,000**	**6,621,000**	**812,000**	**1,811,000**

Table 10-5: Resource Estimates by Mineral Owner (1,000 ppm TREO Cut-off)

Mineral Owner	Classification	Tonnage	*Grade*				*Contained Material*			
			TREO	LREO	HREO	MREO	TREO	LREO	HREO	MREO
		t	Ppm	ppm	ppm	ppm	t	t	t	t
Federal	Measured	206,716,068	3,720	3,352	370	904	769,018	692,935	76,550	186,836
	Indicated	922,262,707	3,178	2,795	350	765	2,930,865	2,577,823	322,616	705,345
	Inferred	792,842,071	2,996	2,655	339	723	2,375,564	2,105,182	268,441	573,145
	Total	**1,921,820,846**	**3,161**	**2,797**	**347**	**762**	**6,075,447**	**5,375,939**	**667,607**	**1,465,326**
State	Indicated	287,910,594	3,366	2,977	346	827	969,066	857,124	99,507	238,076
	Inferred	131,856,546	3,311	2,943	339	819	436,557	387,996	44,746	107,993
	Total	**419,767,140**	**3,349**	**2,966**	**344**	**824**	**1,405,623**	**1,245,120**	**144,253**	**346,069**
Total	Measured	206,716,068	3,720	3,352	370	904	769,018	692,935	76,550	186,836
	Indicated	1,210,173,301	3,223	2,838	349	780	3,899,931	3,434,947	422,124	943,421
	Inferred	924,698,618	3,041	2,696	339	737	2,812,121	2,493,178	313,187	681,138
	Total	**2,341,587,986**	**3,195**	**2,828**	**347**	**774**	**7,481,070**	**6,621,059**	**811,861**	**1,811,395**

10.14 Factors That May Affect the Mineral Resource Estimate

Factors which may affect the mineral resource estimates include the following.

- Metal price and exchange rate assumptions.
- Changes to the assumptions used to generate cut-off grades.
- Changes in local interpretations of mineralization geometry and continuity of mineralized zones.
- Changes to geological and mineralization shape.
- Changes to geological and grade continuity assumptions.
- Density and domain assignments.
- Changes to geotechnical, mining, and metallurgical recovery assumptions.
- Changes to the input and design parameter assumptions that pertain to mining assumptions used to constrain the estimates.
- Assumptions as to the continued ability to access the site, complete proposed exploration programs, and maintain the social license to operate.

11.0 MINERAL RESERVE ESTIMATES

There are no mineral reserves to report in this scoping study.

12.0 MINING METHODS

Mining evaluations were performed in both the Cowboy State Mine and Overton Mountain Resource areas. Each area will be mined using surface mining methods, utilizing trucks and shovels to extract material on 6 m benches. Mineralization is extensive at Cowboy State Mine and results in a low strip ratio (SR) of 0.03. Any material below the calculated cut-off grade would be stored at an on-site Waste Rock Storage Facility (WRSF), with the majority of the material being sent to the associated processing facilities. Because mineralization extends to the surface, underground mining methods were not considered, given that ore selectivity is not a concern and associated higher mining costs would not be justified.

12.1 Design Criteria

This section forms the basis for the Project for both the Cowboy State Mine and Overton Mountain Resource areas.

12.1.1 Mineral Inventory Incorporated in Mine Design

An updated block model (*HC_BM_8Jan2024)* was provided by Odessa and validated and modified by Stantec to incorporate additional mining considerations.

Stantec normalized the Odessa block model to contain equal blocks with dimensions of 10 m x 10 m x 10 m, representing the selective mining unit (SMU) for the anticipated equipment and importation into Geovia's Whittle software for pit shell generation.

The regularized block model, *HC_BM_8Jan2024_reg_10_10_1029Jan2024.bmf*, includes measured (Overton Mountain only), indicated, and inferred material. The mineral inventory sensitivity based on a NSR value for Cowboy State Mine is summarized in Table 12-1 and Overton Mountain is summarized in Table 12-2.

Table 12-1: Cowboy State Mine Mineral Inventory (Indicated and Inferred material)

Cutoff ($/t)	Tonnes	NSR ($/t)	TREO (ppm)	HREO (ppm)	MAGREO (ppm)
0.00	1,334,010,600	47.40	2,231	263	626
5.00	1,126,539,900	56.13	2,641	311	741
15.00	1,113,292,013	56.67	2,662	313	749
25.00	1,031,131,688	59.52	2,801	323	790
29.28	993,522,713	60.75	2,862	328	808
35.00	935,754,525	62.50	2,964	336	838
50.00	720,040,388	68.36	3,269	356	929
75.00	211,080,938	83.48	3,987	411	1,151
100.00	7,571,475	129.79	5,662	681	2,045

Table 12-2: Overton Mountain Mineral Inventory (Measured, Indicated and Inferred material)

Cutoff ($/t)	Tonnes	NSR ($/t)	TREO (ppm)	HREO (ppm)	MAGREO (ppm)
-	2,002,418,550	44.38	2,326	250	529
5.00	1,445,438,250	61.48	3,223	346	733
15.00	1,444,620,150	61.51	3,224	346	733
25.00	1,395,459,900	62.89	3,308	351	754
29.28	1,336,664,700	64.44	3,399	355	777
35.00	1,191,743,888	68.37	3,636	366	832
50.00	1,014,295,500	73.20	3,934	377	892
75.00	406,614,938	82.88	4,427	410	989
100.00	9,428,400	109.41	5,175	506	1,293

12.1.2 Pit Design Criteria

Geotechnical guidance is not available at this time, as sufficient data has not yet been collected. While additional data will be collected to better understand the in-situ material and hydrogeological conditions and their impacts on pit design and operational safety, the preliminary data that has been collected shows that the material is competent, hard, and generally homogeneous. Given these assumptions, Stantec utilized industry standard design parameters appropriate for this rare earth mineralization.

Pit designs incorporate toe, crest, and ramp strings every 6 m. The design targeted modeled ore while considering Life of Mine (LOM) production targets, land boundaries, and potential mining impacts on public perception.

Following are the general design parameters for pit design.

- Height between catch benches 6 m
- Bench Face Angle 70°
- Berm Width 2.9 m
- Total Road Allowance 18.5 m
- Maximum Ramp Grade 10%
- Minimum Operating Width 30 m

12.2 Mine Design

12.2.1 Open Pit Optimization

The ultimate open pit design used industry accepted open pit optimization software, Geovia Whittle 2022 Refresh 2 version 4.8.5300.2. The methodology applied within Whittle, known as a Value Model, assumes the value for each mining block and then evaluates the costs of mining and processing to determine whether it will mine a bench before mining the one below, thus producing pit shells based on varying bench depths. This differs from the typical approach, where Whittle produces nested pit shells evaluating the revenue of each block by varying the price, known as revenue factors. With the value model, the maximum pit will be the equivalent of a revenue factor one pit shell.

Model attributes, mine design, and economic criteria used for the pit optimization of the Cowboy State Mine and Overton Mountain resource are summarized in Table 12-3.

Table 12-3: Pit Optimization Design Criteria

Parameter	Unit	Cowboy State Mine and Overton Mountain							
Revenue, Smelting and Refining		**La**	**Pr**	**Nd**	**Sm**	**Eu**	**Gd**	**Tb**	**Dy**
Price	USD	$2.00	$91.00	$91.00	$10.00	$10.00	$10.00	$1,500.00	$400.00
Recovery	%	68.63%	63.86%	63.86%	70.11%	70.11%	70.11%	70.22%	66.49%
Refining Price Factor	%	0%							
Treatment Charges	USD	$0.00							
Refining Costs	USD	$0.00							
Shipping Costs	USD	$0.00							
Transportation Concentrate Losses	%	0%							
Recovery and Dilution									
External Mining Dilution	%	0%							
Mining Recovery	%	100%							
Geotechnical									
Slope ISA	deg	50							
OPEX									
Milling Cost	USD	$26.43							
Surface Mining Cost	USD	$3.95							
Site G&A	USD	$0.00							
Total OPEX Cost	USD	$29.28							

The geological interpretation considers nearly all the material mined to be mineralized and, therefore, does not anticipate material dilution on the ore and waste contact. This results in 100% mine recovery of ore, which is appropriate at a scoping level of study. Shipping costs are zero, as metal is payable as Freight on Demand (FOB). General and Administrative costs are included in the mining and processing operating costs.

12.2.1.1 WHITTLE RESULTS ANALYSIS

Due to the nature of using a Value Model within Whittle, the results generated indicate the maximum pit and do not allow for interim phase identification. Various scenarios were initially evaluated to confirm reported resource values and identify any permitting and land boundary sensitivities. The results showed that the entire resource was economically viable, even considering the mining of unmineralized areas to extract the ore at depth based on the mining factors (pit slopes, ramp widths, etc.).

Bench by bench evaluations were performed looking at both the NSR / Block Values and overall element grades. In almost all cases, the material by bench is very homogeneous, with the Block Value and grades staying consistent with depth, while remaining above the calculated cut-off grade. This aligns with the conclusion that the modeled, mineralized areas are all economic and barring any unmodeled limitations, should be mined.

12.2.2 Design Strategy and Considerations

Whittle shells representing the ultimate or final pit shells confirmed that the mineral resource is economic given current mining and processing unit cost assumptions. Those assumptions were based on annual production rates determined by ARR after performing a market analysis for the contained metals. While higher production rates were initially considered (10.0 Mtpa, 7.0 Mtpa, and 5.0 Mtpa), an annual production rate of 3.0 Mtpa, targeting a 30-year mine life was selected for initial mine design and scheduling. Later, a 20-year mine life was chosen for the Final Mine Design and scheduling due to favorable economics.

Preliminary mine designs and sequencing mines the Cowboy State Mine property first, with the belief that permits on state lands will be obtained before permits on federal lands. As a result, mine production in this study has targeted 20 years of mining from within the Cowboy State Mine property. Subsequent stages of mining, not considered in the cash flow, but supported in the mineral resources of the Project will complete mining at Cowboy State Mine and then transfer to the start of mining at Overton Mountain, well ahead of when federal permits are thought to be available.

The shift to mine only within the Cowboy State Mine occurred after confirming that the desired production targets could be sustained solely from Cowboy State Mine.. By focusing all operations within Cowboy State Mine, operating and capital expenditures would be reduced.

Mineralized areas bordering federal land boundaries at Cowboy State Mine were given a 20-m offset to minimize the potential for land disturbance outside of state lands. Within the Overton Mountain area, a 150-m offset was applied to the Bluegrass Creek centerline and a 250-m offset to private land boundaries to minimize potential impacts to the creek and adjacent landowners.

12.2.3 Pit Design

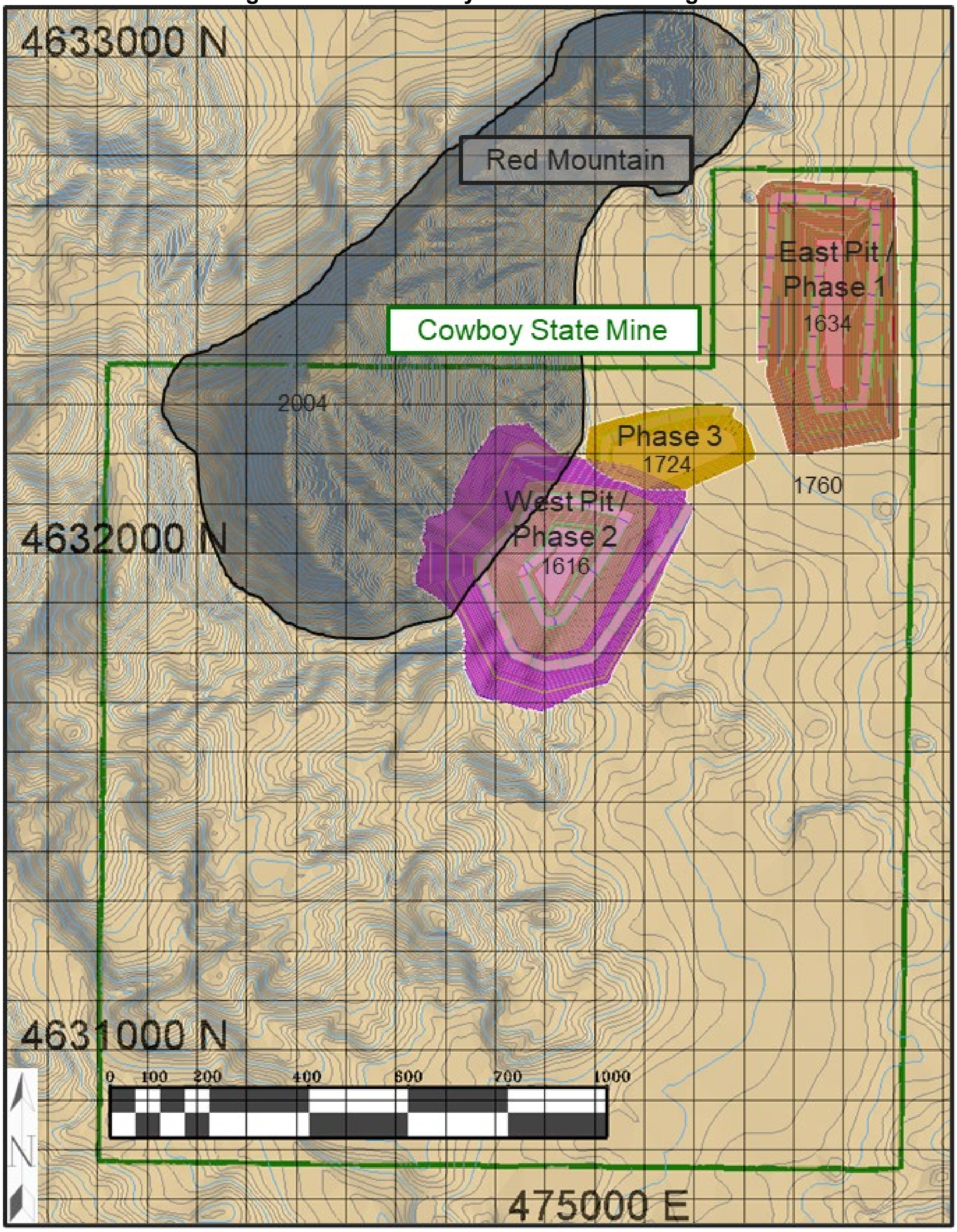
The following sections discuss each pit and phase design in detail.

12.2.3.1 COWBOY STATE MINE PIT DESIGN

The Cowboy State Mine is denoted by Red Mountain, which straddles state and federal lands. The mountain itself has been identified as mineral-rich, with mineralization extending slightly beyond the toe of the mountain. The mineral resource available at Cowboy State Mine is significantly larger than required for the 20-year mine life at 3.0 Mtpa that this study is based on. Therefore, the pit design targeted higher grades in the mineral resource while minimizing mining of Red Mountain to minimize potential environmental and social impacts on the Project.

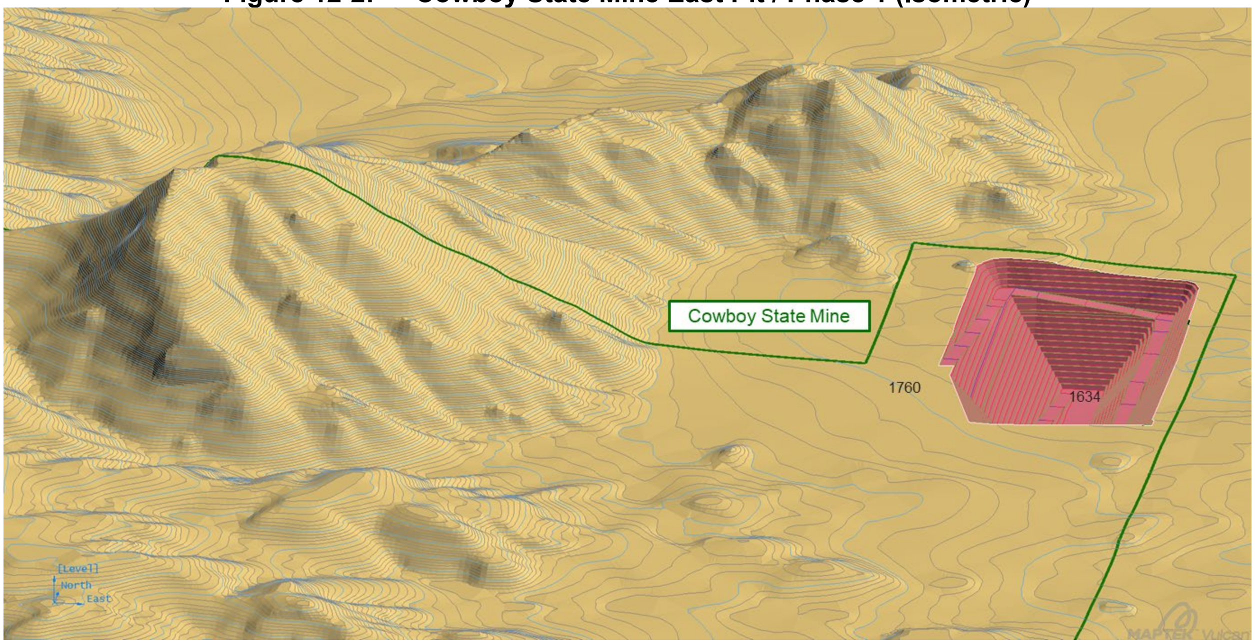
The Cowboy State Mine and associated LOM plan are comprised of three mining areas. The first area / pit is located in the northeastern corner of the property or East; the second is in the southwest or West and mines a portion of Red Mountain; and the third area is located between the East and West and is generally lower grade. The Cowboy State Mine and the considered mining areas, in relation to Red Mountain are shown in Figure 12-1.

Figure 12-1: Cowboy State Mine Pit Designs



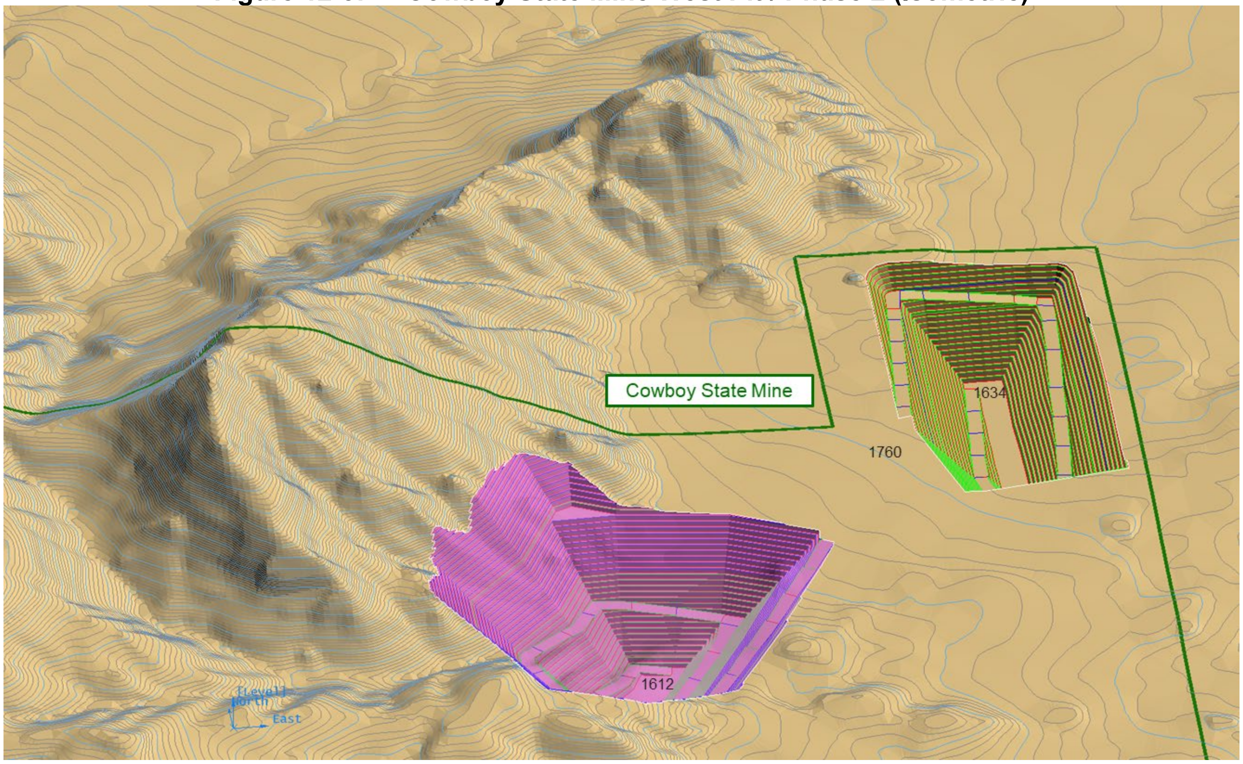
The pit to the East or East Pit / Phase 1 establishes the final pit ramp for the 1,754 bench, descending at 10% in a clockwise direction, reaching an elevation of 1,634 masl. The East Pit does not mine any portion of Red Mountain and takes place on relatively flat terrain, which will aid in achieving production targets during the pre-production / ramp-up periods during the early stages of mine development. Refer to Figure 12-2.

Figure 12-2: Cowboy State Mine East Pit / Phase 1 (Isometric)



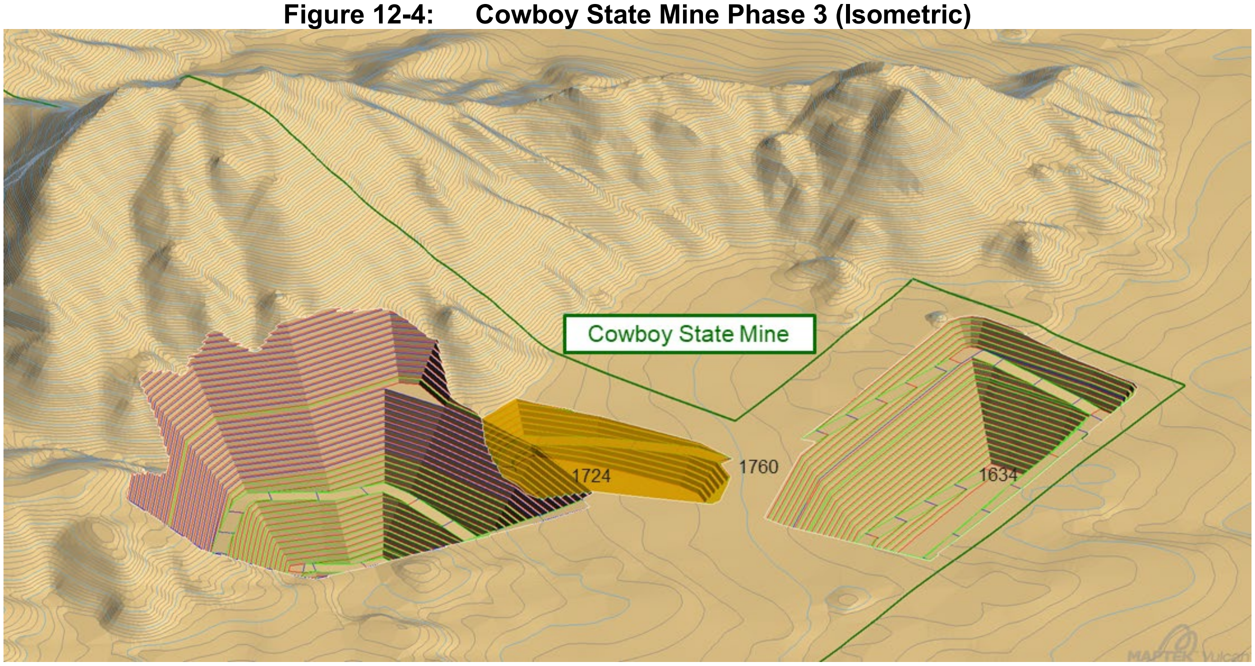
The pit to the west or West Pit / Phase 2 starts midway up Red Mountain at the 1,850 elevation. It uses internal ramps / accesses until it expands beyond the toe of Red Mountain, establishing the final pit ramp at the 1,760 bench, descending clockwise at 10% to reach its ultimate elevation of 1,612 masl. Although each pit / phase can be mined independently, Phase 2 is scheduled to commence after the beginning of Phase 1 but before it's completion; this is to allow time for the procurement of trucks for the later stages of the LOM while balancing equipment requirements and ensuring steady mine production during the initial mining activities and the upper benches of Phase 2. Refer to Figure 12-3.

Figure 12-3: Cowboy State Mine West Pit / Phase 2 (Isometric)



The third phase / pit to be mined within the Cowboy State Mine is located between Phases 1 and 2. While this area can also be mined independently, it is mined after Phases 1 and 2 due to overall lower grades. Phase 3 establishes its pit ramp at the 1,760 bench and descends counterclockwise at 10% until reaching the 1,724 elevation, providing sufficient material to satisfy LOM production targets. Refer to Figure 12-4.

Figure 12-4: Cowboy State Mine Phase 3 (Isometric)

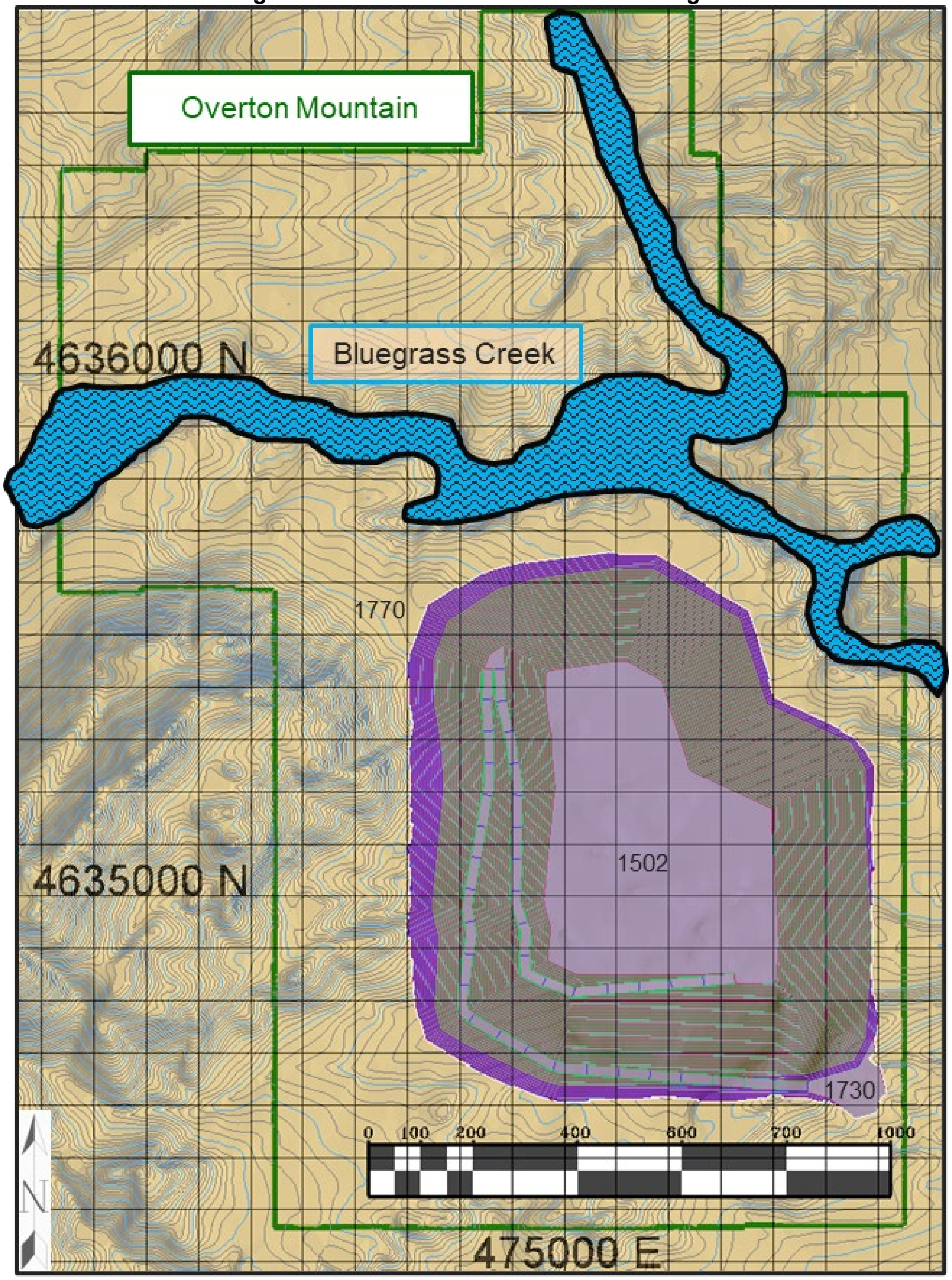


12.2.3.2 OVERTON MOUNTAIN PIT DESIGN

The Overton Mountain property is adjacent to privately owned lands along the western and southern boundaries, with the Bluegrass Creek running through the northeastern corner of the property. When considering access limitations, it was determined that the pit should be limited to the area south of Bluegrass Creek.

Overton Mountain pit designs establish the final ramp system at the 1,730 elevation and descends to the 1,502 elevation. Drill data within the pit drops from 30 holes to less than 15 by the 1,634 elevation, and less than 5 below the 1,600, with only 1 below the 1,586. Below the current pit bottom, little mineralized material is modeled due to lack of drilling. Given the geometry of the pit, the potential to descend further exists if additional mineralization is encountered. Refer to Figure 12-5.

Figure 12-5: Overton Mountain Pit Design



12.2.4 Final Pit Inventories

Final Pit inventories and contained metals by classification are shown in Table 12-4. Only mineral inventories within the Cowboy State Mine were scheduled and costed for the LOM plan as explained in *Section 12.2.2 – Design Strategy and Considerations*.

Table 12-4: Mining Mineral Inventories

Area	Class	t	In-Place Kg (millions)					Grade (g/t)				
			LA2O3	NDPR	SEG	TB4O7	DY2O3	LA2O3	NDPR	SEG	TB4O7	DY2O3
Cowboy State Mine	Measured	-	-	-	-	-	-	-	-	-	-	-
	Indicated	52	39	45	10	1	2	760	877	200	10	47
	Inferred	11	7	9	2	0	0	706	818	185	9	43
	default	2	-	-	-	-	-	-	-	-	-	-
Overton Mountain	Measured	122	101	112	23	1	5	832	918	188	9	44
	Indicated	163	129	141	30	1	7	796	867	183	8	43
	Inferred	30	22	24	5	0	1	742	793	166	8	40
	default	1	-	-	-	-	-	-	-	-	-	-

Area	t	In-Place Kg (millions)					Grade (g/t)				
		LA2O3	NDPR	SEG	TB4O7	DY2O3	LA2O3	NDPR	SEG	TB4O7	DY2O3
Cowboy State Mine Total	64	47	54	12	1	3	728	841	192	10	45
Overton Mountain Total	315	253	277	58	3	14	803	878	183	9	43
Grand Total	**380**	**300**	**331**	**70**	**3**	**16**	**790**	**871**	**184**	**9**	**43**

Approximately 83% of the LOM (20-year) production in the Cowboy State Mine is in the Indicated Mineral Resource category and 17% is in the Inferred Mineral Resource Category. The inferred mineral resource is not the determining factor in determining the viability of the Halleck Creek Rare Earths Project.

12.2.5 Operating Philosophy

This study evaluated a typical owner-operated drill / load / haul operation with contractor blasting as well as fully contractor-run operation. Other than associated infrastructure and capital requirements, each case considered equal production rates and schedules, providing 3.0 Mtpa. The material mined is considered primarily ore, with the majority of material reporting directly to a processing facility. Any unmineralized material or material below cut-off reports to the WRSF. The steady state production rate drove the selection of equipment, its size, and other mining and design parameters for a 6 m bench height.

12.2.6 Mine Equipment Requirements

A fully contractor-run operation was selected as the desired method of operation as the reduction in capital versus increased operating costs provided favorable economics. While the equipment below will not be purchased, it was used to model and schedule LOM production as it is believed that the contractor would use a similar mining fleet.

Loading equipment will include two front end loaders (with 6.9 m^3 and 5.7 m^3 buckets) loading 25 m^3 haul trucks. The larger loader will be allocated to the pit, while the smaller loader will assist mining operations and stockpile and clean up needs at the primary crusher. The initial truck fleet will require three trucks and will increase to five over the LOM. Additional mining equipment will consist of three production / blasthole drills and additional support and ancillary equipment such as a rubber tire dozer, grader, water truck, and others. Table 12-5 summarizes the mining equipment requirements for the Project by as the pit's develop, resulting in an increase in truck requirements as the distance to the bottom of the pit increases.

Table 12-5: Mining Equipment List

Major Equipment List	Year (-)1–6	Year 7–9	Year 10–20
Front End Loader 6.9 m^3	1	1	1
Front End Loader 5.7 m^3	1	1	1
Off Highway Truck – Initial Fleet – 25.2 m^3 / 48.6 t	3	4	5
Rotary Drill 11.5 cm	3	3	3
Rubber Tire Rig CAT 844H	1	1	1
Bulldozer 63/85 (KW/hp)	1	1	1
Grader 115 (KW)	1	1	1
Water Truck 9500 (liter)	1	1	1
Ancillary Equipment List	**Year (-)1–6**	**Year 7–9**	**Year 10–20**
Service Truck 6800 (kg GVW)	1	1	1
Pickup Truck ½ (ton)	5	5	5
Telehandler 5.8 m	1	1	1

12.2.7 Time Model and Haulage

Straight line time model metrics, with the structure shown below in Table 12-6 and the corresponding definitions and criteria shown below, were applied to the major equipment to estimate when it may need to have major maintenance performed or when to consider the purchase of additional equipment.

Haulage requirements within various regions of each mining area were calculated using the centroid of the respective mining area considering the haulage route and operational hours available based on equipment availability and utilization.

Table 12-6: Time Model Structure

	Total Available Hours		
Availability	Available Hours		Maintenance
Use of Availability	Operational Hours	Standby	Maintenance

The following time model definitions were applied.

- Total Available Hours
  - Hours in a calendar year.
- Available Hours
  - Total available hours less maintenance hours per piece of equipment.
- Operational Hours
  - Available hours less standby time – used for life of equipment and costing purposes.

On this basis, the target equipment availability and use of availability were defined for each of the major equipment units.

Table 12-7: Time Model Metrics for Major Equipment

Major Equipment List	Model/Capacity	Units	Life (hrs)	Avail	UofA	Hrs
Front End Loader	6.9	m^3	49,000	85%	85%	8.7
Front End Loader	5.7	m^3	49,000	85%	85%	8.7
Off Highway Truck	25.2	m^3	60,000	85%	85%	8.7
Rotary Drill	11.5	cm	49,000	85%	68%	6.9
Rubber Tire Rig	CAT 844H		56,000	80%	70%	6.7
Bulldozer	63/85	KW/hp	35,000	80%	50%	4.8
Grader	115	KW	49,000	80%	55%	5.3
Water Truck	9,500	liter	60,000	80%	70%	6.7

12.3 Operating Cycles

The following sections discuss the various operating cycles.

12.3.1 Ore Mining

Prior to mining, ore control drilling will be performed using the production / blasthole rigs. This information will be used to delineate between ore and waste for short-term mine planning.

Whenever possible, mined ore will be delivered directly to the primary crusher to avoid unnecessary rehandling. When the mined ore tonnage exceeds the operating capacity of the crusher, the ore will be placed in stockpiles for later feeding.

12.3.2 Waste Mining

Mined rock grading below the cut-off grade is classified as waste material and mined with the primary mining fleet as described in the above sections.

12.3.3 Loading

Loading units were sized from the Mining Cost Handbook based on the targeted annual production and include two front-end loaders. The first with a bucket capacity of 6.9 m^3 is to be used as the primary loading unit in the pit and the smaller unit, with a capacity of 5.7 m^3, to assist in the pit and with processing operations as needed. The loaders were paired with a fleet of off-highway trucks with a 25.2 m^3 bed, requiring four to five passes per load.

12.3.4 Hauling

Haul trucks were sized based on Stantec's mining experience and the number of units from the haulage study discussed in Section 12.5.3. These trucks have an adjusted payload factor or 48 t, equivalent to 25.2 m^3 matching both front-end loaders and requiring four to five passes. Haul roads were designed at a width of 18.5 m for two-lane roads.

A haulage study was performed evaluating the truck requirements at various stages of each pit within the LOM to determine the trucks required to meet production target for each period. Pits were then scheduled with consideration given to fleet requirements and production.

12.3.5 Drilling

The blasthole drills consist of a fleet of three rotary drills, capable of drilling a 11.5 cm diameter blasthole. Drilling will be done on 6-m benches. The typical drill pattern will be 3.3-m spacing and 2.9-m burden. The subdrill was estimated to be 0.9 m on a 6-m bench (15%). Drill patterns will be continuously evaluated to minimize potential dilution and damage on pit walls, control fragmentation, maximize equipment productivity, and reduce the overall cost of drilling and blasting.

12.3.6 Blasting

Blasting will utilize an emulsion / ANFO blend as the bulk explosive product. A 70/30% emulsion / ANFO blend by weight will be applied and used for wet holes with dry holes assuming a 50/50% blend.

The blast pattern designs, hole diameter, and explosives column heights result in an average estimated powder factor of 0.36 kg/t for both ore and waste. Bulk explosives will be provided by an explosives contractor who will be responsible for loading and blasting each pattern.

12.3.7 Support

Support equipment is used for various tasks such as quantity of primary equipment to service, managing waste dumps, roads, and clean-up within mining areas. The quantity of support equipment required is based on the size and scale of the operation and Stantec's mining experience. No capital has been allocated for the fully run contractor operation. Table 12-8 summarizes the support equipment required that would be purchased in an owner operated scenario.

Table 12-8: Ancillary Equipment

Ancillary Equipment List	Year (-)1–6	Year 7–9	Year 10–34
Service Truck 6800 (kg GVW)	1	1	1
Pickup Truck ½ (ton)	5	5	5
Telehandler 5.8 (m)	1	1	1

12.4 Production Schedule

12.4.1 Mine Production Criteria

The criteria used to develop the LOM schedule is listed below.

- Utilize a tiered production schedule before achieving full production rates.
- Schedule full production at 3.0 Mt of ore per annum.
- Schedule material bench by bench on an annual basis.
- Limit production and mine operations to the Cowboy State Mine property.
- Target a 20-year LOM considering pre-production and end of life production rates.
- Limit production to 12 benches per phase per year or 1 bench per month.

12.4.2 Net Smelter Return

Given the variability in metallurgical recoveries and commodity values of the targeted REEs, an NSR was used during the optimization and for phases evaluations of the open pit design. The NSR is a USD per tonne value of the in-situ material based on the concentration of recovered rare earth elements from the metallurgical process minus downstream cost and penalties. While the NSR was used during the pit optimization and for phase evaluation, reported economics provide a detailed breakdown for each element and associated costs.

Due to the onsite processing and separation facility assumption discussed in *Section 9.0 – Mineral Processing and Metallurgical Testing*, the only downstream costs and penalties included in the NSR calculation are the metallurgical recoveries provided in of each REE product and the Wyoming State Royalty Tax of 2.5% of gross revenue. Also Included in are the commodity pricing, provided by ARR, used in the NSR calculation. Costs such as transportation of a concentrate and refining / separation charges do not apply.

Table 12-9: REE Product Recoveries and Commodity Price Assumptions

Product	REE	Recovery (%)	Commodity Price (USD/kg)
La	La	68.63	2.00
NdPr	Pr	63.8	91.00
	Nd		
SEG	Sm	70.11	10.00
	Eu		
	Gd		
TB	Tb	70.22	1500.00
Dy	Dy	66.49	400.00

The following NSR calculation in Equation 1 was used to calculate the NSR value for each block in the block model.

Equation 1: NSR Calculation

$$La(ppm) * La\ Recovery\ (\%) * \left(\frac{La\ Price}{1{,}000}\right)$$

$$+$$

$$Nd + Pr\ (ppm) * NdPr\ Recovery\ (\%) * \left(\frac{NdPr\ Price}{1{,}000}\right)$$

$$+$$

$$Sm + Eu + Gd\ (ppm) * SEG\ Recovery\ (\%) * \left(\frac{SEG\ Price}{1{,}000}\right)$$

$$+$$

$$Nd + Pr\ (ppm) * NdPr\ Recovery\ (\%) * \left(\frac{NdPr\ Price}{1{,}000}\right)$$

$$+$$

$$Sm + Eu + \mathrm{Gd}(ppm) * SEG\ Recovery\ (\%) * \left(\frac{SEG\ Price}{1{,}000}\right)$$

$$=$$

$$Total\ Value\ (USD/tonne)$$

$$Total\ Value\ (USD/tonne) * (1 - WY\ State\ Royalty\ \%) = NSR\ (USD/tonne)$$

12.4.3 Surface Mining Cutoff

Cutoff inputs were based on data provided by ARR and InfoMine Mine Cost Handbook (2022) for a 3.0 Mtpa operation. Table 12-10 contains the costs used for the break-even cutoff for the Project.

Table 12-10: Costs and Break-Even Cutoff

Milling*	$26.43	$/tonne
Surface Mining*	$3.95	$/tonne
Site G&A	$0.00	$/tonne
Break-Even Cutoff Value (COV)	$30.38	$/tonne

* Site G&A included in Milling and Mining costs

12.4.4 Preproduction Development

Process facilities are estimated to require three years to construct, initializing the preproduction schedule denoted as Year (-) 2. Mining facilities and associated infrastructure are estimated to take less than one year of construction and be completed in Year (-) 1

Infrastructure planned for this scoping study report includes the following.

- Access road.
- Fresh water well.
- Powerline.
- A Process plant, split between the mine site and Wheatland, WY.
- Buildings for administration / technical services, warehouse, dry / change room and maintenance.
- Temporary waste rock depository and tailings storage.

Equipment is scheduled to be purchased in Year (-1) and available in Year 0 to support prestripping and ramping-up mine production to a total of 2.25 Mtpa of ore in Year 0, before achieving steady state mine production of 3.0 Mtpa in Years 1 to 20.

12.4.5 Production Schedule

Table 12-11 through 12-13 provide a summary of the total ore and waste quantities, including contained and recovered rare earths mined by year for the 20-year LOM.

Table 12-11: Cowboy State Mine LOM and Pre-Production Totals

	LOM Total
Total Ore Mt Mined	62.35
Total Waste Mt Mined	1.92
Total Mt Mined	64.26
Cumulative Mtonnes	64.26
Contained Rare Earths (MKg)	
LA2O3 (MKg)	46.80
NdPr / didy (MKg)	53.99
SEG (MKg)	12.33
Tb (MKg)	0.63
Dy (MKg)	2.90
Recovered Rare Earths (MKg)	
LA2O3 (MKg)	32.12
NdPr / didy (MKg)	34.48
SEG (MKg)	8.64
Tb (MKg)	0.44
Dy (MKg)	1.93

LOM Year	-2	-1	0
Total Ore Mt Mined	-	-	2.25
Total Waste Mt Mined	-	-	0.21
Total Mt Mined	-	-	2.46
Cumulative Mt	-	-	2.46
Contained Rare Earths (MKg)			
LA2O3 (MKg)	-	-	1.46
NdPr / Didy (MKg)	-	-	1.74
SEG (MKg)	-	-	0.42
Tb (MKg)	-	-	0.02
Dy (MKg)	-	-	0.10
Recovered Rare Earths (MKg)			
LA2O3 (MKg)	-	-	1.00
NdPr / didy (MKg)	-	-	1.11
SEG (MKg)	-	-	0.29
Tb (MKg)	-	-	0.02
Dy (MKg)	-	-	0.07

Table 12-12: Cowboy State Mine Production (Years 1–10)

	Production	Production	Production	Production	Production	Production	Production	Production	Production	Production
LOM Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Total Ore Mt Mined	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Total Waste Mt Mined	0.07	0.01	-	0.01	0.02	0.01	0.02	0.10	0.23	0.33
Total Mt Mined	**3.07**	**3.01**	**3.00**	**3.01**	**3.02**	**3.01**	**3.02**	**3.10**	**3.23**	**3.33**
Cumulative Mt	**5.54**	**8.55**	**11.55**	**14.56**	**17.58**	**20.59**	**23.61**	**26.71**	**29.94**	**33.27**
Contained Rare Earths (MKg)										
LA2O3 (MKg)	2.19	2.31	2.37	2.43	2.23	2.20	1.69	2.05	2.30	2.30
NdPr / didy (MKg)	2.61	2.74	2.80	2.85	2.62	2.58	2.10	2.44	2.69	2.66
SEG (MKg)	0.62	0.65	0.66	0.67	0.61	0.61	0.54	0.56	0.59	0.58
Tb (MKg)	0.03	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Dy (MKg)	0.15	0.15	0.16	0.16	0.15	0.14	0.14	0.14	0.13	0.13
Recovered Rare Earths (MKg)										
LA2O3 (MKg)	1.50	1.58	1.63	1.67	1.53	1.51	1.16	1.41	1.58	1.58
NdPr / didy (MKg)	1.66	1.75	1.79	1.82	1.67	1.65	1.34	1.56	1.72	1.70
SEG (MKg)	0.43	0.45	0.46	0.47	0.43	0.43	0.38	0.40	0.42	0.40
Tb (MKg)	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02
Dy (MKg)	0.10	0.10	0.10	0.11	0.10	0.10	0.10	0.09	0.09	0.09

Table 12-13: Cowboy State Mine Production (Years 11–20 / LOM)

	Production	Production	Production	Production	Production	Production	Production	Production	Production	Production
LOM Year	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Total Ore Mt Mined	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.10**
Total Waste Mt Mined	0.32	0.21	0.07	0.01	-	-	-	-	-	0.29
Total Mt Mined	**3.32**	**3.21**	**3.07**	**3.01**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.38**
Cumulative Mt	**36.59**	**39.80**	**42.87**	**45.88**	**48.88**	**51.88**	**54.88**	**57.88**	**60.88**	**64.26**
Contained Rare Earths (MKg)										
LA2O3 (MKg)	2.32	2.34	2.39	2.45	2.46	2.45	2.35	2.32	2.53	1.65
NdPr / didy (MKg)	2.67	2.70	2.73	2.78	2.75	2.70	2.57	2.62	2.79	1.86
SEG (MKg)	0.59	0.59	0.60	0.61	0.61	0.61	0.59	0.58	0.62	0.42
Tb (MKg)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02
Dy (MKg)	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.13	0.14	0.09
Recovered Rare Earths (MKg)										
LA2O3 (MKg)	1.59	1.61	1.64	1.68	1.69	1.68	1.61	1.59	1.74	1.13
NdPr / didy (MKg)	1.71	1.72	1.74	1.77	1.75	1.72	1.64	1.67	1.78	1.19
SEG (MKg)	0.41	0.41	0.42	0.43	0.43	0.43	0.42	0.41	0.43	0.29
Tb (MKg)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
Dy (MKg)	0.09	0.09	0.09	0.10	0.10	0.10	0.09	0.09	0.09	0.06

12.4.6 Open Pit Development

The following paragraphs describe the ramping up and phasing of pit development at Halleck Creek.

In Year 0, mining commences at Cowboy State Mine within the East Pit / Phase 1 to sustain process facilities with sufficient ore during the preproduction / ramp-up period. Given its generally shallow sloping topography, the targeted mining area is ideal for targeted production rates during the ramp-up period. It provides short haulage routes for all mined material and allows for additional haul truck requirements to be deferred until later in the LOM. Production demands anticipate a ramp of 2.25 Mtpa in Year 0. Three benches are scheduled to be mined, beginning with the 1,754 bench, establishing the final ramp along the pit's western side, descending clockwise at 10%.

In Years 1–3, mining activities will continue within Phase 1 at the targeted annual production rate of 3.0 Mtpa. Less than 4% of the material mined is anticipated to be below cut-off and will be placed within the WRSF to the south of the pit.

In Years 4–9, development of the West Pit / Phase 2 will commence, balancing production and resources between the upper limits of Phase 2 with a maximum bench elevation of 1,850 and Phase 1. Production from Phase 1 does not exceed a bench advancement rate of three benches per annum, while Phase 2 does exceed this rate when mining above and below the 1,800 and 1,700 elevations due to the size of each bench and targeted production rates. Mining within Phase 1 concludes in Year 9 at an elevation of 1,634. While mining at lower elevations of Phase 2 requires fewer trucks than at the top and should be considered when mining in tandem with Phase 1 to balance truck requirements, mining within Phase 2 will primarily mine in a top-down fashion, starting at the higher elevations and above the toe of Red Mountain. All mining accesses above the pit entrance, established at the 1,760 bench, are internal and designed to be mined.

In Years 10–20, mining will be focused in the western pit and will begin by establishing the ramp for the 1,760 bench, descending clockwise at 10% until the final elevation of 1,616 is achieved in Year 20. Due to pit geometries generating smaller benches and production targets, Phase 2 mines from nine different benches in Year 19. The remaining production for Year 20 is then supplied by Phase 3, which similar to the end of Phase 2 sees a higher bench advancement rate of eight benches per annum.

12.5 Operations

The mine will operate on a 12-hour schedule, working a 5-day week, Monday through Friday, with the ability to work Saturday as needed.

12.6 Maintenance

With a fully contractor-run operation, it is anticipated that any maintenance required would be the contractor's responsibility and would also be contracted and performed on site.

In an owner-operated scenario, mine maintenance for all open pit equipment will be completed by site personnel using facilities on site. Maintenance frequency and scheduling is a function of equipment hours and number of units on site. Maintenance efforts will focus on preventative maintenance to maintain planned efficiencies. Due to the estimated mine life, no major equipment rebuilds or replacements are anticipated; however, should they be required, it is anticipated they would be performed on site by contractors.

12.7 Organization, Staffing and Contracting Strategy

The mine labor detailed in this section is limited to those people directly associated with open pit mine operations (refer to Table 12-4). Explosive handling and delivery were excluded as a blasting contractor will be used for loading of blastholes. In both owner and contractor run scenarios, salaried labor requirements would not change, while in the contractor only scenario hourly personnel would be the responsibility of the contractor.

Table 12-14: Cowboy State Mine Labor Requirements

Job Title	# Personnel
Mine Manager	1
Mine Superintendent	1
Foreman	2
Mine Engineer	1
Surveyor	1
Geologist	1
Environmental Tech	1
Accountant	1
Clerk	1
Secretary	1
Warehouseman	1
Total	**12**
Job Title	**# Personnel**
Drillers	
Loader Operators	
Truck Drivers	
Equipment Operators	
Mechanics / Electricians	
Laborers / Maintenance	
Total	**0**

Table 12-15 shows the positions included within the milling operating cost.

Table 12-15: Salary Personnel Requirements – Process

Job Title	# Personnel
Plant Manager	1
Operations Mgr.	1
Operations Supervisor	5
Maintenance Manager	1
Operations Supervisor	5
Maintenance Engineer	2
Maintenance Planner	2
Project Engineer	2
Process Engineer	4
Warehouseman	1
Clerks	4
Accountants	2
HR Manager	1
HR Specialist	1
Total	**32**

12.8 Exclusions

The following are exclusions from this report as they are beyond the level of a scoping study.

- Detailed Waste Rock Storage Facility (WRSF) design.
- Detailed Tailings Storage Facility (TSF) design.
- Associated reclamation designs and costs.

13.0 PROCESSING AND RECOVERY METHODS

13.1 Process Summary

Conceptually, comminution and concentration would occur at the proposed mine site. Then conceptual extraction, impurity removal, and oxide separation would occur closer to a city or town. The proposed Halleck Creek rare earth processing components consists of the following components.

- Comminution Circuit where run-of-mine ore is crushed to less than 1.0 mm using HPGR.
- Concentration Circuit which concentrates the TREO content of the ore ten times (10X) using Density Separation and WHIMS.
- Extraction Circuit where the REE are leached from the solid ore and placed into solution using dilute sulfuric acid. Cerium is rejected in this step by converting Ce^{3+} to Ce^{4+} by calcining the ore prior to leaching.
- Impurity Removal Circuit which removes Fe, Th, Al, and U, using a partial neutralization precipitation and Ion Exchange (IX).
- Separation and Finishing Circuit where Solvent Extraction (SX) is used to separate the REE's into the following finished products:
  - Lanthanum (La) Carbonate
  - Neodymium (Nd)/Praseodymium (Pr) Oxide also referred to as "Didy" Oxide
  - Samarium (Sm), Europium (Eu), Gadolinium (Gd) mixed oxide concentrate also referred to as "SEG" concentrate.
  - Terbium Oxide (Tb)
  - Dysprosium Oxide (Dy)
- Associated plant infrastructure (wastewater treatment plant, tailings storage facility, etc.)

13.2 Preliminary Design Basis

13.2.1 Plant Design Basis

The preliminary Plant Design Basis presents key design parameters to be used as input for the next stages of project development.

13.2.1.1 PRODUCTION CAPACITY

- **Comminution** – The Comminution circuit would be designed to process 3.0 Mtpa on a dry basis, or 9,132 metric tonnes per day (tpd) assuming a 90% uptime (329 days per year) of ROM ore.
- **Concentration** – The Concentration circuit would be designed to match the Comminution Plant and process 3.0 Mtpa of ore on a dry basis, or 9,132 tpd assuming a 90% uptime (329 days per year) of crushed ore.
- **Extraction** – The Extraction circuit would be designed to process 231,945 tpa on a dry basis or 705 tpd on a dry basis assuming a 90% uptime (329 days per year) of concentrate.

- **Impurity Removal** – The Impurity Removal circuit would be designed to match output of the Extraction circuit, or 243 gpm of Pregnant Leach Solution (PLS).
- **Separation and Finishing** – The Separation and Finishing circuit would be designed to match the output of the Impurity Removal plant of 276 gpm of Uranium Removal discharge.

13.2.1.2 PRODUCT SPECIFICATIONS

- **Comminution** – The Comminution circuit would produce a crushed ore product with 100% passing 1 mm and a P_{80} of 500 microns. Fines less than 150 microns should be minimized.
- **Concentration** – The pre-concentrate product produced in the Concentration Plant would have an estimated average TREO concentration of 3.5% TREO (35,000 ppm TREO) and less than 15% moisture content, with a production rate of 705 tpd on a dry basis.
- **Extraction** – The PLS produced in the Extraction circuit will have an REO (TREO minus Ce) concentration of at least 8.3 g /L and a Free Acid of less than 3 g/L, with a production rate of 243 gpm.
- **Impurity Removal** – The Uranium Removal discharge will have an REO concentration of at least 7.2 g TREO/L and the majority of Fe, Th, Al, and U removed. Further testing and modeling is needed to properly define the impurity limits as they relate to impurity deportment and optimization.
- **Separation and Finishing** – Separation and Finishing will produce the following five finished products for sale.
  - Lanthanum (La) in the form of lanthanum carbonate or hydroxide – 1,486 tpa on a TREO basis
  - Neodymium / Praseodymium (Nd/Pr) Oxide (didy Oxide) – 1,529 tpa
  - SEG Oxide Concentrate – 383 tpa on a TREO basis
  - Terbium (Tb) Oxide – 17 tpa
  - Dysprosium (Dy) Oxide – 91 tpa

The product specifications will be developed in upcoming design work using computer simulations and laboratory testing.

13.2.1.3 PROCESS DESIGN BASIS

Comminution Feedstock or ROM Ore head analysis for Halleck Creek is shown below in Table 13-1.

Table 13-1: Halleck Creek Composite Head Analysis

Rare Earth Oxide, ppm	Value	Gangue, %	Value
Y_2O_3	221	SiO_2	61.8
La_2O_3	751	Fe_{tot}	5.11
CeO_2	1583	FeO	5.20
Pr_6O_{11}	189	Al_2O_3	15.9
Nd_2O_3	644	P_2O_5	0.072
SEGs	187	CaO	2.87
HREOs	105	K_2O	6.03
CREOs	887	Na_2O	4.24
TREO+Y	3668	TiO_2	0.50

The TREO distribution in the ore of Halleck Creek is shown below in Table 13-2.

Table 13-2: REE Distribution in Feed

TREO distribution	Feed +Y, %
La	20.55%
Ce	43.37%
didy	22.72%
SEG	5.18%
Tb	0.23%
Dy	1.30%
Y	6.64%
	100%

13.2.1.4 OPERATING FACTOR OR UPTIME

General operating factors are as follows.

- Operating Factor = Operating time x Capacity Utilization where:
  - Operating-time: number of operating hours per year.
  - Capacity Utilization: average annual percentage of design capacity achieved when operating.

Operating time incorporates both planned and unplanned maintenance and hours lost when the process chemistry deviates from its design.

Capacity utilization accounts for lower than nameplate production during ramp-up and ramp-down around shut-downs and limitations on one area caused by dependency on adjacent areas.

An Operating Factor of 90%, or the equivalent of 329 days of operation per year was assumed for all areas of the plant. Further refinement will occur in the next stages of design.

The Operating Factor is equivalent to the annual production of saleable product divided by the theoretical annual production of the plant operating at its design rate for 7,896 hours per annum.

13.2.1.5 STORAGE CAPACITIES

- Comminution – ROM (ore) will be stockpiled in outdoor impoundments designed to de-couple mining operations from the Comminution circuit. These stockpiles will accommodate planned and unplanned downtime. The exact size and location of these stockpiles will be designed in upcoming engineering and design studies.
- Concentration, Extraction, Impurity Removal, Separation and Finishing – The balance of plant will contain numerous points of surge storage in the form of tankage and solid impoundments. The surge storage will serve to accommodate transportation delays, planned and unplanned downtime as well as batch operations within an otherwise continuous operation. The exact size and location of these items will be designed in upcoming engineering and design studies.

13.2.1.6 CONTROL AND AUTOMATION

All areas of a conceptual processing plant will be semi-automated. Equipment and stream flows would be automated and primarily controlled from a control room. Local controls would also be installed where required. Laboratory technicians would manually perform chemical analyses such as rare earth product element distribution and tailings elemental distribution.

13.2.1.7 RADIONUCLIDES

Two radionuclide elements (thorium and uranium) and associated daughter products are present in Halleck Creek mine mineralization at low levels. The combined concentration of these two radionuclides is approximately 68 ppm in ROM ore.

Further simulation and laboratory testing in future engineering studies is needed to determine the deportment and concentration of the radionuclides within the proposed process and products. The impurity removal plant is designed to remove both Th and U via a precipitation reaction followed by filtration and ion exchange to remove and precipitate, respectively.

The radionuclide content reporting to the rare earth carbonate concentrate is currently estimated at levels below 0.001%. Further testing will be required to evaluate the exact concentration in radionuclides. This concentration is not expected to exceed 0.001%. The current beneficiation methods will result in a low radionuclide level that meet the current regulatory guidelines. Additional testwork is needed to determine radionuclide levels in tailings disposal material.

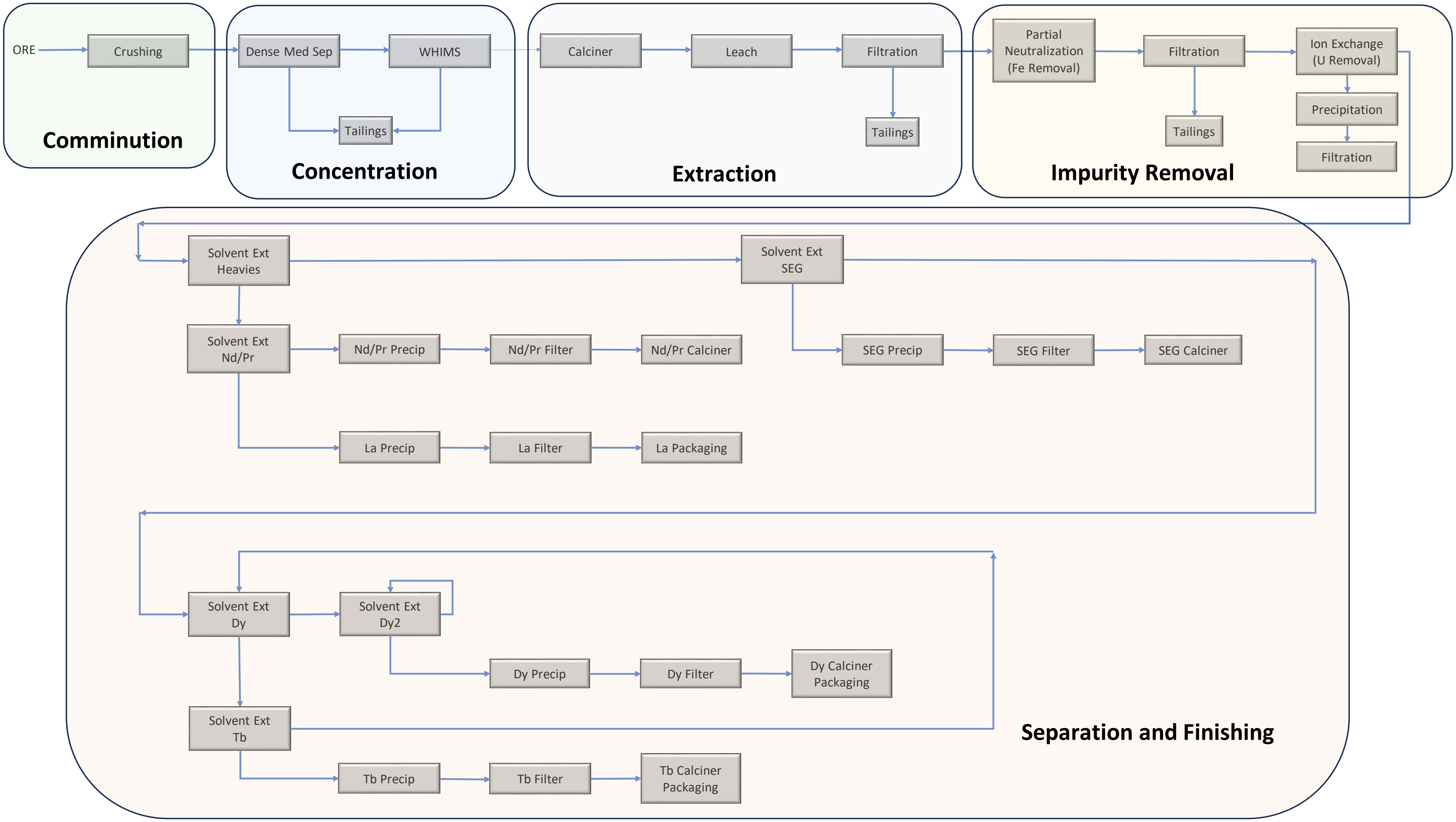
13.3 Process Description

The test work and design conducted by Wood was summarized in two documents, *Document No. 206139-0000-DC00-RPT-0001 – Halleck Creek Rare Earths Project, Preliminary Testwork Interpretation*, December 2023; and *Document No. 206076-0000-BA00-RPT-0002 – Halleck Creek Rare Earths Project, Desktop Study, Acid Tank Leach Option*, December 2023.

In addition to the test work conducted under the supervision of Wood, tests were conducted by Dr. Rick Honaker of the University of Kentucky (UK) to investigate the impacts of DMS prior to magnetic separation (WHIMS).

Using the results of this test work, Kelton Smith compiled the preliminary flowsheet Figure 13-1.

Figure 13-1: Preliminary Flowsheet



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13.3.1 Comminution

The comminution testing results show the Halleck Creek ore is amenable and well suited for a SAG Ball mill crushing operation and should be considered the design baseline. However, due to the importance of minimization of fines in downstream processing (DMS/WHIMS), it is recommended to conduct HPGR grinding tests and evaluate the particle size distribution. HPGR units are known to provide less fines and there are operating cost and capital cost benefits as compared to a SAG / Ball mill combination.

13.3.2 Concentration

13.3.2.1 DENSE MEDIUM SEPARATION AND MAGNETIC SEPARATION

The light gangue material can be floated using dense liquids or spiral separators at ~2.7 SG and sent to tailings. This separation alone removes 77% of the ore mass. Secondary separation using higher density, ~3.5 SG, cyclones would increase separation. Undersize material (defined as less than 150 microns) would be sent through WHIMS. The mineral separation flowsheet outlined by the University of Kentucky (Figure 13-1) shows that only 7% of the ore mass might sent forward for further processing and the concentration of TREO is improved by a factor of 11 (3,309 ppm TREO in the ore, 35,000 ppm TREO in the DMS/WHIMS product). This is accomplished with only a 16% yield loss of TREO in DMS. The overall TREO recovery for DMS/WHIMS Is 78%.

13.3.3 Extraction

13.3.3.1 CALCINATION

A proposed calcination step carried out in a direct-fired rotary calciner has been added to allow oxidation of the cerium (3+) to cerium (4+), rendering it nearly insoluble in the downstream leaching steps. The insolubility will result in a great majority of the cerium remaining in the leach residue, which will be disposed of as tailings. The equipment can be a rotary direct-fired calciner or a Multiple Hearth Furnace (aka Herreshoff Roaster) with a product temperature of ~600 °C.

The current market and sales price for cerium does not support the cost of equipment and raw material costs that are necessary to manufacture it.

Calcination of the rare earth bearing mineral allanite will occur via the following simplified equation.

Equation 2: Calcination of Allanite

$$(REE,Ca)_2\ (Al,Fe^{3+})_3\ (SiO4)_3\ (OH) \rightarrow REE2O_3\ (s) + CeO_2\ (s)$$

In the above reaction, REE is a rare earth element in the 3+ valence state or Yttrium present in the pre-concentrate. Cerium will be present as a 4+ valence state after calcination.

13.3.3.2 LEACHING

A leaching step is proposed to leach the rare earth elements from the calcined pre-concentrate material using sulfuric acid. Leaching would be carried out in stirred tank reactors in a gravity cascade arrangement with a scrubbing system to remove and neutralize any acid fumes from the tanks. Heating is applied through direct steam injection since additional water is to be added to bring the % solids to the 25–30% range.

Preliminary leach testing performed by Wood showed that sulfuric acid tank leaching would be a preferred option due to recovery, ease of processing, limited corrosion, and material of construction simplicity, relative to acid baking. The previous testing found optimal performance at 25% solids, 250 kg of sulfuric per mt of solids feed, 90 °C operating temperature, and 6 hr of residence time. Using the data from the Wood testing, a rare earth recovery of 85% was assumed. The Wood test data also showed a greatly reduced recovery for the heavy rare earths. Additional testwork is needed to determine if this is an anomaly and to find methods to increase recovery of heavy rare earth elements.

Water washing of the leach residue filter cake is needed to maximize REE recovery as well as remove any residual acid wetting the filter cake. The cake wash liquor will be recycled back to the leach tanks which will account for a portion of the necessary water in the leach. Even with the recycling of the filter cake wash there is 3.8% REO loss not counting the Ce in the cake.

Additional testwork is needed to optimize leaching and washing circuits. The general leaching reaction equations for primary component are:

Equation 3: Rare Earth Oxides

$$REE2O_3\ (s) + 3H_2SO_4\ (Aq) \rightarrow REE_2(SO_4)_3\ (Aq) + 3H_2O(l) + CeO_2\ (s)$$

In the above reaction, REE is a rare earth element or Yttrium present in the pre-concentrate. Cerium oxide is insoluble in the leach reaction thus rejecting cerium to the tailings.

Equation 4: Iron and Aluminum

Iron (III) Oxide (Fe_2O_3), Aluminum Oxide (Al_2O_3)

$$M_2O_3\ (s) + 3H_2SO_4\ (l) \rightarrow 2M_3+ + 3(SO_4^{-2})$$

In the equation above, M represents both Fe and Al. Both of these metals will behave similarly in the sulfuric leach. As can be seen in Table 13-2, the leach recovery for Fe is 22% and for Al is 19% at 250 kg sulfuric/ton of ore, 90 °C and 6 hr of residence time.

Equation 5: Uranium Oxide

$$U_3O_8 + 3H_2SO_4\ (l) \rightarrow 3UO_2^{2+} + 2H_2O$$

Equation 6: Thorium Oxide

$$ThO_2 + 2H_2SO_4 \rightarrow Th(SO_4)^{2+}\ 2H_2O$$

Please note, the metallurgical testing to date has not quantified the leaching recovery with respect to uranium nor thorium. Further testing should be completed to obtain a material balance for these radionuclides in the leaching step.

13.3.4 Impurity Removal

13.3.4.1 PARTIAL NEUTRALIZATION (FE REMOVAL)

In this proposed step, the PLS would be neutralized from 3–5 g/L free sulfuric acid to a pH of approximately 3.5 using sodium hydroxide (NaOH) solution. The pH adjustment and precipitation will be carried out in a stirred tank reactor. The solids generated by the partial neutralization will be thickened in a cone bottom clarifier and filtered using a plate and frame filter press. These solids will be disposed of in the tailings impoundment.

At a pH of 3.5 the iron, thorium and possibly aluminum would precipitate and then be filtered and sent to tailings impoundment. A removal efficiency of 80% is assumed for the impurities and a 2% REO loss to the filter cake.

The deportment of aluminum needs to be studied in future testing. Metal hydroxides are notoriously slimy and difficult to filter. Filtration tests should be performed on this material to determine if filtration and/or flocculants are needed to contain aluminum.

13.3.4.2 ION EXCHANGE (U REMOVAL)

An Ion Exchange (IX) system for removal of the Fe and U would be conducted in resin packed columns that the rare earth containing solution is passed through. IX resins exist that have an affinity to Fe and U which retains these elements onto the chemically reactive site of the resin thus removing them from the solution. Once a resin bed is saturated the solution would be switched to a new packed column and the first column is taken offline to regenerate or remove the Fe and U using a salt solution or dilute sulfuric acid solution. The regen solution can be disposed of in the wastewater treatment plant or processed to precipitate the Fe and U out of the liquid and disposed of or sold as a by-product. More testing is required to study this step.

13.3.5 Separation (Solvent Extraction and Finishing)

A series of conceptual solvent extraction and finishing circuits have been outlined for inclusion in the scoping study. The following sections describe the general methods that might be used to isolate each rare earth product for Halleck Creek. It should be noted that no laboratory testwork for solvent extraction or finishing has been performed using Halleck Creek material. This testwork is currently being planned.

13.3.5.1 HEAVIES SOLVENT EXTRACTION

A conceptual heavy rare earth elements (heavies) solvent extraction (SXH) circuit consists of mixer settler counter current liquid-liquid extraction circuit. The most widely used extractant is Di-(2-ethylhexyl phosphoric acid) (DEHPA). A sister compound which has superior separation factors should be considered, 2-ethylhexyl phosphonic acid-mono-2-ethylhexyl ester (PC88A).

"Heavies load first" is the phrase to remember with rare earths and phosphoric or phosphonic acid functional groups. In SXH the heavies would load preferentially onto the organic phase which is made up of a mixture of your extractant (DEHPA or PC88A) and a diluent (kerosene). If a light REE loads onto the organic a heavier REE can displace it from the organic.

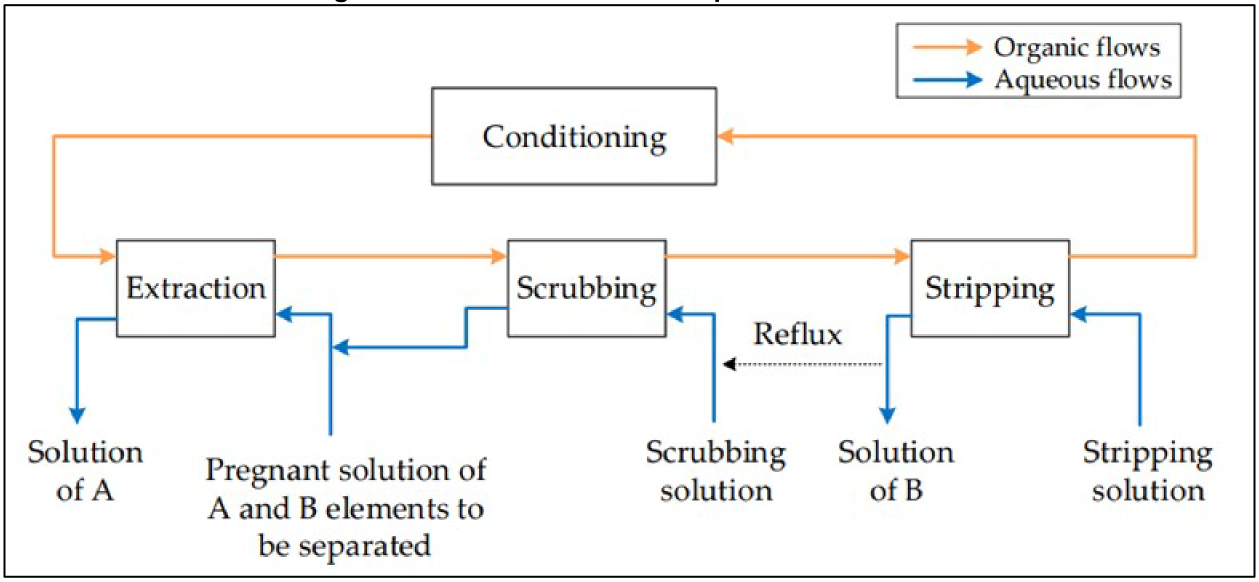
The sketches below show the major sections of a conceptual solvent extraction circuit. The feed would be introduced to the extraction section, where the target elements are loaded (transferred from the aqueous phase to the organic phase). In the extraction section, the number of potentially loaded elements is controlled by the acidity of the feed. Typically, caustic would be added to the feed just before the circuit to obtain the target acidity level. In an extraction section, it would be necessary to "over-extract," meaning some of the target elements intended to go out in the raffinate (aqueous stream product) are temporarily loaded onto the organic. The over-extraction ensures that none of the heavier molecules intended to leave the strip (organic product) are lost to the raffinate. A conceptual scrubbing section takes the elements which are intended to be in the raffinate, removes them from the organic, and returns them to the aqueous. The scrub solution is usually an acid or salt solution, but it all depends on the system and the chosen extractant. The following conceptual section is the stripping section, where an acidic strip solution would be added to remove all the elements present on the organic into the aqueous. The flow of aqueous is from right to left, and the organic is from left to right, with the organic being recycled. In some cases, the organic will need to be washed or regenerated to reset the organic so it can be used again. The feed acidity has to be tightly controlled because the more caustic added, the more that will load onto the organic. However, there is a limitation to the loading that the organic will accept, and above this level, the organic will "gel" or form fine particles that look like a gel.

The separation factor is the ratio of organic / aqueous concentration after a simple shakeout of aqueous and organic is performed in a separatory funnel in the laboratory. The lower the separation factor the more difficult the separation. The separation factor measures the separation in only one stage and therefore to overcome a low separation factor is to add stages or how many times the separation has to be performed to get the results you want. The separation factor dictates how many stages are needed in each of the sections of a solvent extraction circuit.

Due to the push and pull of a solvent extraction circuit using acid / base relationship, one of the two product streams (strip or raffinate) has to be chosen as the primary product. For instance, to achieve high purity of the strip product, the circuit will operate so that a small percentage of the strip elements will be lost to the raffinate.

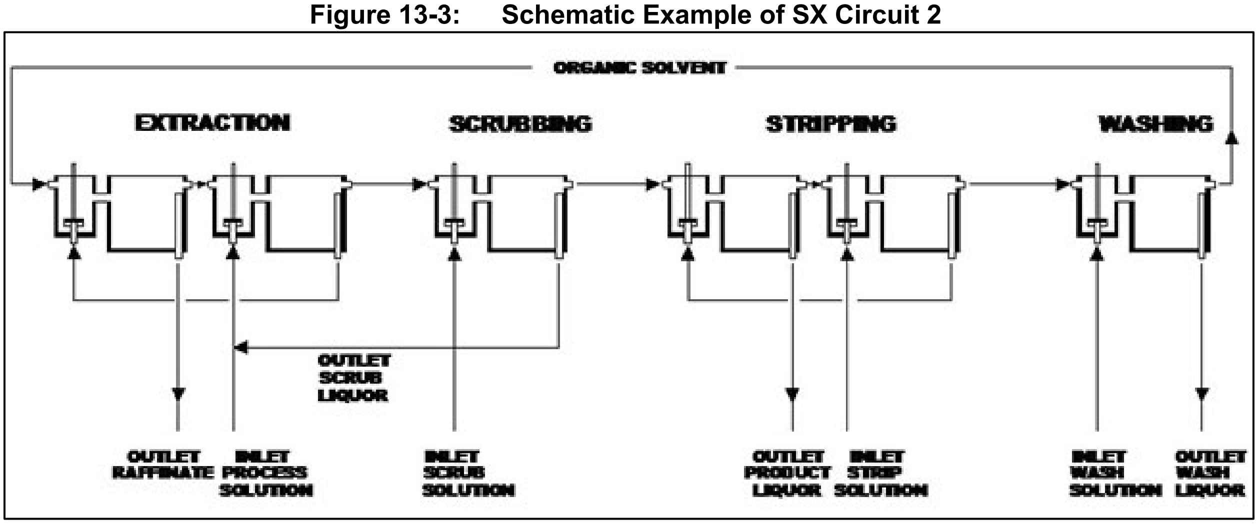
In the case of SXH, the preferred elements to load onto the organic will be samarium and larger (to the right on the periodic table), which will become the strip product. The raffinate, therefore, will be from neodymium and smaller (to the left on the periodic table).

Figure 13-2: Schematic Example of SX Circuit 1



Tetra Tech, 2024

Figure 13-3: Schematic Example of SX Circuit 2



13.3.5.2 ND/PR (DIDY) SOLVENT EXTRACTION

A conceptual solvent extraction circuit that produces La as the raffinate and Nd/Pr (didy) as the strip is referred to as SXD (D for didy). This is the largest circuit (most stages) due to the low separation factor of Nd/Pr separation factor as well as the largest vessel size (volume) and flowrate.

The acidity of the feed stream will need to be adjusted using caustic. The strip product (didy) has a much higher selling price and a higher purity requirement so didy will be the preferred product and will lose ~1-2% of the didy to the raffinate (aqueous stream La) to ensure there is no La in the didy. In fact, the catalyst manufacturers have confirmed that any trivalent (rare earth element that has a 3+ cationic charge) acts the same in the catalyst.

13.3.5.3 ND/PR (DIDY) FINISHING

The conceptual strip product (didy) is fed to a precipitation tank (two total) for oxalate precipitation on a batch-wise basis. Oxalic acid in powder form in 1-t super sacks is pneumatically fed to the precipitation tank. A batch recipe must be created based on test work to form large, easily filtered Nd/Pr oxalate particles. One method to improve solids' size and shape is the utilization of a seeding technique where the initial solids are formed quickly by a dose of oxalic, but then slowly add the remainder of the oxalic in order to grow larger crystals on top of the initial solids (seeds). A small thickener receives the solids slurry from the reactors. The thickened slurry is then fed to a horizontal vacuum belt filter, which is perfectly suited for freshwater washing to control impurity levels in the final product. The filter cake is then fed to a direct-fired rotary kiln to produce oxide. The oxide powder is fed into 1-t super sacks for shipment.

13.3.5.4 LA FINISHING

Lanthanum is used in oil refineries as a component in the fluid cracking catalyst. Conceptually, La is the raffinate product from SXD and is precipitated with either caustic to form a hydroxide or soda ash to form a carbonate, oxalic acid is not justified at this price point and the customers are accepting of the hydroxide or carbonate form and impurity levels. A continuous precipitation across two tanks with gentle agitation forms the La solid which is then pumped to a thickener where the underflow is then sent to a filter. A horizontal plate and frame filter press is best suited for this application to minimize the moisture content and minimize shipping costs since this product is normally not dried or calcined.

13.3.5.5 SEG SOLVENT EXTRACTION

The conceptual feed to the SEG (samarium, europium, gadolinium) solvent extraction (SXM for mids) is the strip solution from SXH which contains Sm and larger. The acidity of the feed stream will need to be adjusted using caustic. In this circuit, the raffinate (aqueous) is the SEG concentrate, and the strip is the Tb, Dy and larger. This conceptual circuit would be dramatically smaller than the SXD circuit because the feed came from the strip stream of SXH. When the targeted elements are loaded on the organic and the organic is stripped back to the aqueous phase this acts as a concentration step since the amount of acid in the strip solution is very small but due to the acidity it will remove all the elements from the organic.

13.3.5.6 SEG FINISHING

The conceptual raffinate from SXM is the SEG concentrate material. The conceptual raffinate is sent to a batch precipitation tank (where oxalic acid is added to the tank via a pneumatic conveyance system. The volumes are small enough that only one reactor tank should be needed given that there is ample storage tank capacity. The SEG oxalate is then sent to a small thickener where the underflow is fed to a small filter (belt filter, or drum filter or filter press) and the filter cake is fed to a direct-fired rotary calciner. The product from the calciner is then packaged in super sacks or drums and sold to a company that will further separate into the individual pure products.

13.3.5.7 DY SOLVENT EXTRACTION

The conceptual feed to the dysprosium solvent extraction circuit (SXDy) is the strip solution from SXM. The acidity of the feed stream will need to be adjusted using caustic. The conceptual raffinate stream is composed of Tb and minimal Dy losses. The strip stream is composed of Dy, Ho and larger rare earths. While few elements larger than Dy will exist in solution, they should be removed to create a high purity Dy product.. In order to remove elements larger than Dy, a second Dy solvent extraction circuit (SXDy2) is needed that takes the strip from SXD as its feed and creates a raffinate stream comprised of high purity Dy and a strip stream consisting of Ho and larger. The strip stream could be inventoried until there is a need to process further or sold as a concentrate to be further refined.

13.3.5.8 DY FINISHING

The conceptual raffinate from SXDy2 is the Dy material. The conceptual raffinate is sent to a batch precipitation tank (where oxalic acid is added to the tank via a pneumatic conveyance system. The volumes are small enough that only one reactor tank should be needed given that there is ample storage tank capacity. The Dy oxalate is then sent to a small thickener where the underflow is sent to a small filter (vac belt filter to allow for washing) and the filter cake is fed to a direct-fired rotary calciner. The product from the calciner is then packaged into drums or pails and sold.

13.3.5.9 TB SOLVENT EXTRACTION

The conceptual feed to the Tb Solvent Extraction (SXTb) is the raffinate solution from SXDy which contains Tb and minor Dy losses. The acidity of the feed stream will need to be adjusted using caustic. In this circuit the raffinate (aqueous) is the Tb and the strip consists of the small amount of Dy that came from SXDy raff as a yield loss. This circuit is very small due to the small amounts of materials. The strip solution is recycled back to the feed of SXDy to improve recovery.

13.3.5.10 TB FINISHING

Likke the other circuits, the conceptual raffinate from SXTb contains Tb which is sent to a batch precipitation tank where oxalic acid is added to the tank via a pneumatic conveyance system. The volumes are small enough that only one reactor tank should be needed given that there is ample storage tank capacity. The Tb oxalate is then sent to a small thickener where the underflow is sent to a small filter (vac belt filter to allow for washing) and the filter cake is fed to a direct-fired rotary calciner. The product from the calciner is then packaged into drums or pails and sold.

14.0 INFRASTRUCTURE

Local infrastructure is based out of the town of Wheatland (population 3,560), located 39 km east of the property by Wyoming State Highway 34.

The Burlington Northern Santa Fe railroad mainline runs through Wheatland, as does Interstate 25, linking the city to the entire United States. Residential power runs along County Road 720 through the Project Area. A 46 kV substation is located along Highway 34 and is approximately 3.7 km from the western side of Halleck Creek state mineral leases.

Because the Project is in the early stages of development, no infrastructure to support mining or processing has been constructed at site.

Infrastructure planned and costed for this scoping study report includes the following.

- Access road
- Fresh water well
- Powerline
- Process plant
- Buildings for administration / technical services, warehouse, dry / change room and maintenance
- Temporary waste rock depository
- Tailings Storage Facility (TSF)

Storage of tailings produced at the Halleck Creek Mill Project will be placed in an engineered, lined tailings facility, located near the mill. The TSF will be designed to meet the requirements of the Wyoming Department of Environmental Quality, Land Quality Division (WDEQ-LQD), specifically, *Chapter 3, Section 2(h)(i) – Noncoal Mine Environmental Protection Performance*.

In general, tailings will be transported to the TSF and deposited in the facility using a system of thin lifts. Additional testing is needed to characterize the dewatering and geomechanical characteristics of tailings. A tailings disposal system will be engineered from this data..

Figure 14-1 shows the conceptual layout of surface infrastructure at Halleck Creek. The access road begins from the Halleck Creek Road and trends southeasterly to the Project Site, beginning on private surface land. ARR is currently in the process of negotiating agreements with private land owners. The waste rock repository has been designed to contain all LOM waste material from mine production at the Cowboy State Mine.

Figure 14-1: Cowboy State Mine Pits and Infrastructure

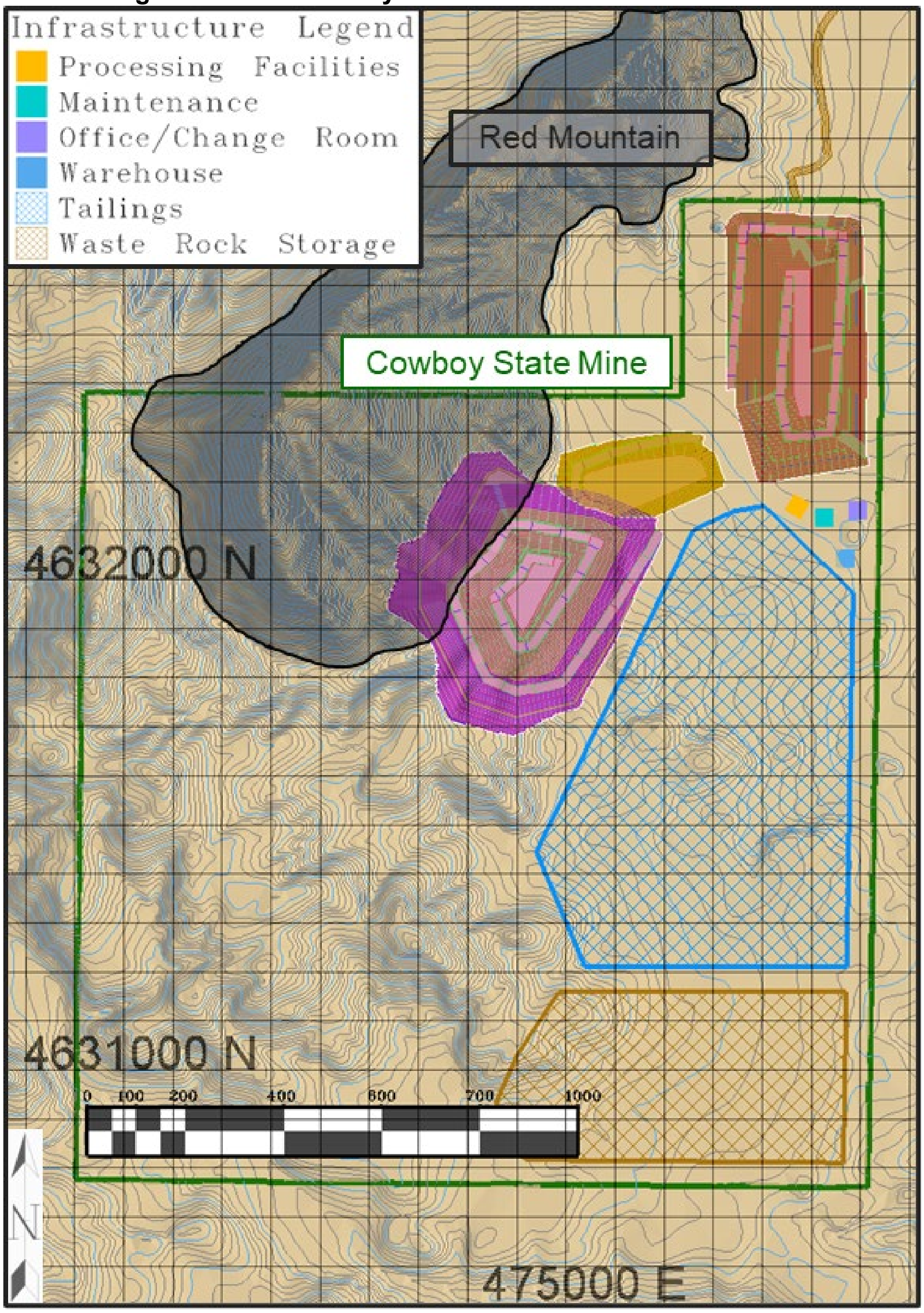
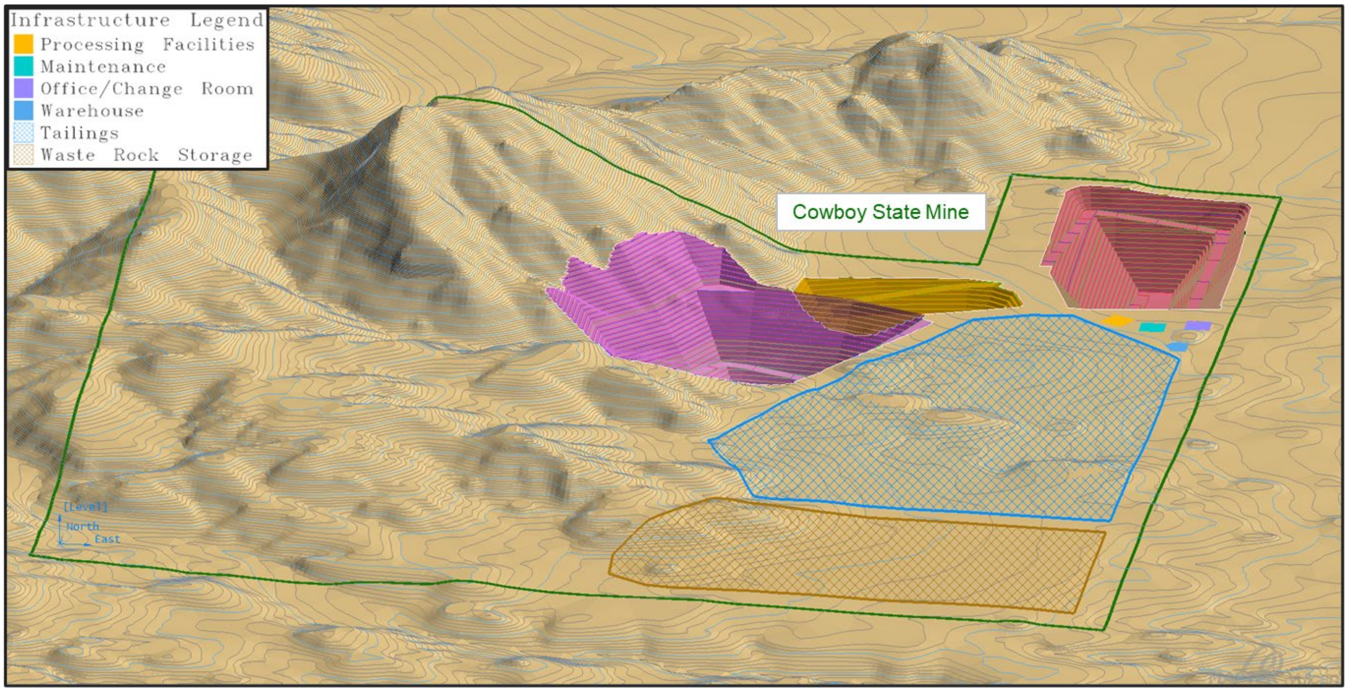


Figure 14-2: Cowboy State Mine Pits and Infrastructure



15.0 MARKET STUDIES AND CONTRACTS

Rare earth elements (REEs) comprise of 17 elements made up of the 15 Lanthanides, yttrium and scandium. They have unique properties and are essential for many high-tech products, such as smartphones, electric vehicles, wind turbines, and military equipment. REEs are used in minimal amounts but provide essential functionality in their applications. Neodymium (Nd) and Praseodymium (Pr) are the most valuable REEs in rare earth mines due to their relatively high price and large market. Rare earth mineral production is geographically constrained, with about two-thirds of global production occurring in China and another 20% in the U.S. and Australia. The processing of REEs is further constrained, with most processing occurring in China and some elements exclusively being processed in China. China recently banned the exports of some rare earth processing technologies, threatening the growth of processing facilities outside the country in the near term. China's control over production has led some countries to incentivize production in other countries, primarily Australia, Canada, and the U.S.

With a small market and geographically constrained production, prices for REEs can be volatile. Stantec relied on price expectations provided by ARR, which were based on price forecasts from multiple firms.

15.1 Supply of Neodymium and Praseodymium

The global supply of Nd and Pr is dominated by China, which accounts for about 80% of the production and 90% of the refining capacity. Most of the remaining supply comes from the Mountain Pass Mine in California and the Mount Weld Mine in Western Australia. The Mountain Pass Mine produced minimal NdPr oxide in late 2023 but is planning to ramp up the recently recommissioned NdPr oxide production plant in 2024. Previously, rare earth concentrate was shipped to China for processing. The Mount Weld mine ships its rare earth concentrate to Malaysia where it produces NdPr oxide. China has imposed export quotas, taxes on rare earths, and environmental regulations to control the market and protect its domestic industries, leading to price volatility and supply uncertainty for other countries that depend on China for rare earths.

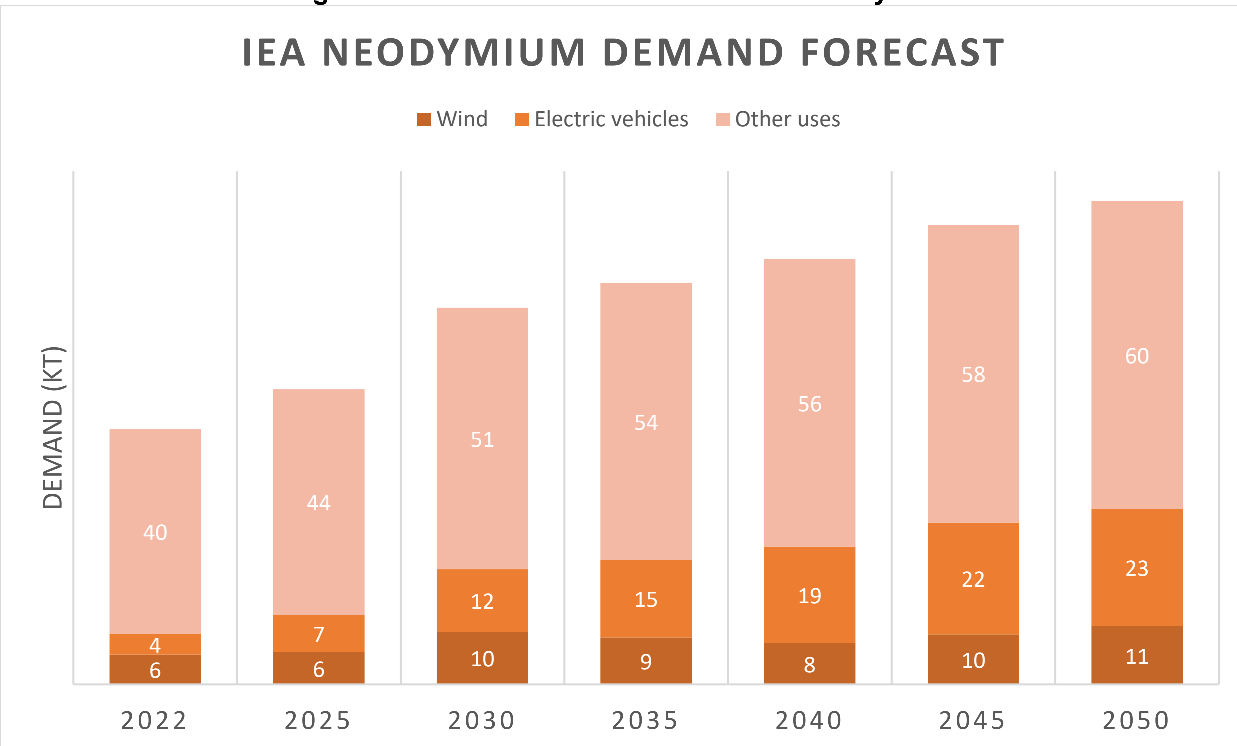
Ex-China supply is expected to increase over the next few decades, primarily due to support from countries.

15.2 Demand for Neodymium and Praseodymium

The global demand for Nd and Pr is driven by their use in permanent magnets, which are widely used in various sectors, such as renewable energy, automotive, and consumer electronics. Nd and Pr are the main components of neodymium-iron-boron (NdFeB) magnets, which are the strongest and most efficient type of permanent magnets. The demand for Nd and Pr is expected to grow as the demand for magnets increases. The IEA forecasts demand for Neodymium to nearly double over the next 25 years, based on various renewable energy targets.

Figure 15-1 below shows the forecast for demand of Neodymium.

Figure 15-1: IEA Demand Forecast for Neodymium



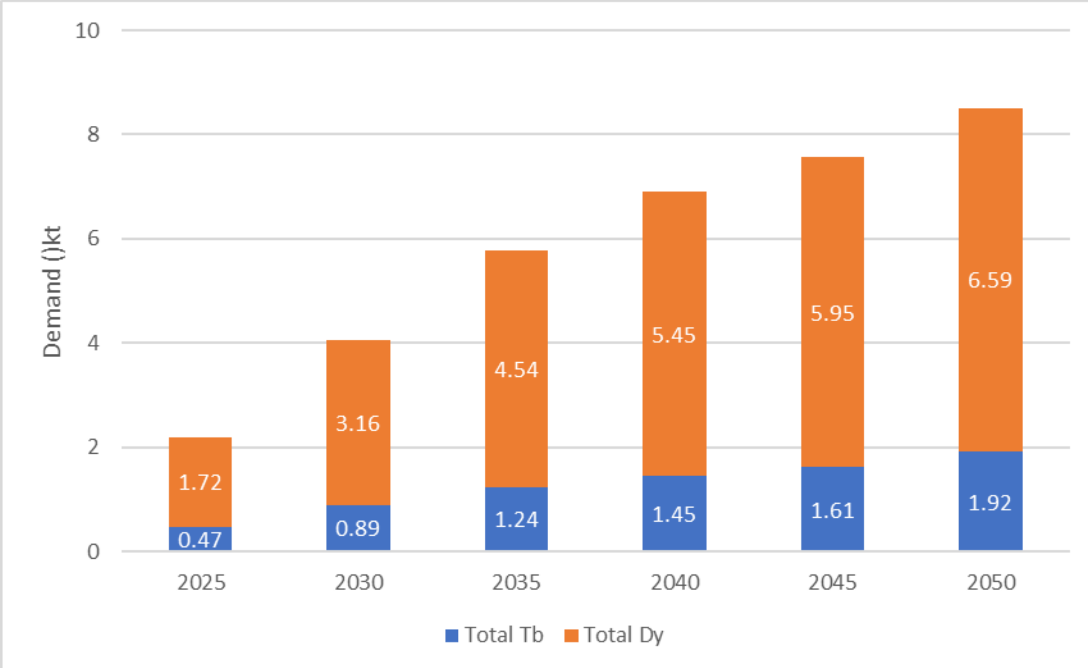
Source: IEA (2023), Critical Minerals Data Explorer, IEA, Paris https://www.iea.org/data-and-statistics/data-tools/critical-minerals-data-explorer

15.3 Market and Demand for Terbium and Dysprosium

DY and Tb occur in small, but potentially profitable amounts at Halleck Creek. Dy and Tb are important components of permanent magnets (PMs), specifically NdFeB PMs. NdFeB PMs are the optimal PMs for use in battery electric vehicles (BEVs) and hybrid vehicle (HV) motors, due to their power and size. BEV and HV motors use 1.8-5.5 kg of REEs, depending on the design. Dy and Tb are substituted into the NdFeB alloy in small amounts. PMs are negatively affected by heat, but Dy and Tb content help PMs resist changes in performance due to heat. Dy and Tb are also used in nuclear reactor control rods. Tb is also used in solid-state devices, lighting, and actuators.

Near term market forecasts show gradual price recovery for Nd and Pr into 2024. Dy and Tb prices may show stronger recovery. The REE PM sector is expected to continue to rely on China for sources of Dy and Tb in the short to medium term, as there is a worldwide shortage of HREE projects. Demand for PM REE (Nd, Pr, Dy, and Tb) is expected to grow strongly, at nearly 10%/year, to represent 45% of the market by 2033 (Figure 15-2). Dy prices are expected to drop the least and rise the most through 2033, due to lack of supply relative to expected demand. Tb, however, is relatively well supplied compared to demand, despite its scarcity. Prices for Tb are expected to follow Nd and Pr price trends, then to rise relatively slowly through 2033. Adamas Intelligence is similarly predicting an annual Dy and Tb undersupply of 1,800 t and 450 t by 2040.

Figure 15-2: IEA Demand Forecast for Terbium and Dysprosium



15.4 Rare Earth Prices

Rare earth price assumptions used in the base case scenario are derived from ARR's assessment of price expectations over the next couple of years. ARR's assessment is based on an average of spot and price forecasts from Goldman Sachs, Morgan Stanley, JPM Chase, and Canaccord Genuity. The resultant price is lower than the average price over the past two years. All prices are FOB. Pricing data from the various sources can be found in Appendix B and are summarized in the table below.

Table 15-1: Commodity Pricing Used in Report

Product	Price ($/kg)
NdPr	$90.61
Dysprosium	$400
Terbium	$1,500
SEG	$10
Lanthanum	$2

16.0 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

ARR acquired exploration drilling notices from the WDEQ-LQD for all drilling activities performed to date. ARR keeps these drilling notices current and performs timely drill site reclamation as part of all exploration programs.

ARR is developing a permitting needs assessment with local environmental consulting groups to present to each division at WDEQ to identify comprehensive environmental baseline studies needed to permit a mining operation at Halleck Creek. ARR is identifying additional regulatory stakeholders in Wyoming as part of the needs assessment.

At this stage of development, no mine closure plans have been developed as the scoping study is limited to a small portion of the resource area and assumed to have a much longer mine life. Plans are to have contemporaneous reclamation within operating expense to minimize closure costs in the future. At this stage in project development, no social impact studies have been completed.

The Company plans to engage and employ local contractors and operators throughout the Project's permitting, construction, and operation as much as possible. Specialized contractors may be required outside the immediate region. However, they will be encouraged to prioritize local employment whenever possible. At this stage, no definitive plans have been established for the Project.

It is the QP's opinion that planning for environmental baselines studies and permit planning is adequate for projects at this early stage of development.

17.0 CAPITAL AND OPERATING COSTS

17.1 Basis of Estimate

The following methodology and assumptions were used in the creation of the capital and operating cost estimates, CAPEX and OPEX, respectively.

- This study will be completed in accordance with guidelines for studies at a scoping level.
- This study assumes there are no installment payments for equipment. When a piece of equipment is required in the mine schedule, the full price of the equipment is listed in the CAPEX schedule.
- Mining equipment, infrastructure, and unit rates were obtained from 2021 Mining Cost Service Mine and Mill Equipment cost guides and escalated to 2023 costs.
- Contractor mining unit rates assumed a 20% markup from owner-operated unit rates.
- Site preparation, and ancillary infrastructure estimates provided by Stantec. Process infrastructure, tailings, associated capital, and operating costs were provided by Tetra Tech.

A contingency of 20% was applied to all initial CAPEX.

17.2 Mining Initial Capital Estimate

The capital cost estimate initially considered owner operations and accounted for all major mining, support equipment, and associated infrastructure required to operate the open pit mine during the LOM schedule. The capital cost estimate is directly related to the mine design and mine schedule. Specifically, this includes open pit mine development, auxiliary equipment, and mine services. Due to favorable economics, client preference, and the assumption that production rates would be equivalent between owner versus contractor, contractor-run operations was chosen. While the equipment mentioned in *Section 12.3.2 – Mine Equipment Requirements* was initially costed using 2021 Mine and Mill Equipment cost guide and adjusted for 2023 costs, all associated equipment capital was removed as well as the need for an on-site truck shop. Table 17-1 presents the annual initial CAPEX required in Year (-)1 before production begins during the Preproduction periods beginning in Year 0.

Table 17-1: Initial CAPEX – Mining

LOM Year			-1
Infrastructure (USD)	**Area (m2)**	**Unit Cost (USD/m2)**	**Total Cost (USD)**
Roads	9,810	$11	$105,594
Dry	238	$3,000	$714,000
Office	383	$3,600	$1,378,800
Warehouse	224	$2,363	$529,312
Water Supply System			$2,192,000
Infrastructure Total			$4,919,706
Escalation			5%
Infrastructure Escalated Total Cost			$5,423,976
Contingency (20%)			$1,084,795
Total Infrastructure Cost			$6,508,771

Process capital estimates were provided by Tetra Tech and considered infrastructure, equipment, and field costs assuming a portion of processing facilities will be located at Cowboy State Mine with the remainder located near Wheatland. The total cost was distributed over the 3-year preproduction period with 60% in Year (-)2, 25% in Year (-)1, and 15% in Year 0. CAPEX during the preproduction periods and associated totals are shown in Table 17-2 and Table 17-3.

Table 17-2: Initial CAPEX – Process Site Prep and Infrastructure

LOM Year		-2	-1	0
Infrastructure	**Total Cost (USD)**	**60%**	**25%**	**15%**
Power Line	$4,000,000	$2,400,000	$1,000,000	$600,000
Natural Gas Pipeline	$2,800,000	$1,680,000	$700,000	$420,000
On Site Infrastructure	$12,310,000	$7,386,000	$3,077,500	$1,846,500
Mobile equipment	$500,000	$300,000	$125,000	$75,000
Miscellaneous	$1,894,406	$1,136,644	$473,602	$284,161
Total Site Prep and Infrastructure	$21,504,406	$12,902,644	$5,376,102	$3,225,661

Table 17-3: Initial CAPEX – Process Totals

LOM Year		-2	-1	0
Infrastructure	**Total Cost (USD)**	**60%**	**25%**	**15%**
Total Site Prep and Infrastructure	$21,504,406	$12,902,644	$5,376,102	$3,225,661
Processing Plant	$227,458,734	$136,475,240	$56,864,684	$34,118,810
Site Wide	$4,481,337	$2,688,802	$1,120,334	$672,201
Infrastructure and Processing Plant	$68,039,697	$40,823,818	$17,009,924	$10,205,955
Mining - Permitting, Land Acq etc.	$44,813,365	$26,888,019	$11,203,341	$6,722,005
Commissioning	$6,346,864	$3,808,118	$1,586,716	$952,030
Tailings	$2,000,000	$1,200,000	$800,000	
Process Capital Total	$374,644,403	$224,786,642	$93,961,101	$55,896,660
Contingency (20%)	$74,928,881	$44,957,328	$18,792,220	$11,179,332
Total Process Capital Cost	**$449,573,283**	**$269,743,970**	**$112,753,321**	**$67,075,992**

17.3 Project Operating Cost

A unit mining cost of $3.95 per ore tonne was obtained from the Mining Cost Service Mine cost guide for an owner operation mining 3.0 Mtpa. This cost was increased 20% to $4.74 per ore tonne to account for the mark up of a mine contractor to account for profit, capital equipment, benefits, etc. for equivalent production rate.

Mine operating costs included mine supplies, labor (hourly and salary), equipment operation and miscellaneous covering all phases of drilling, blasting and haulage including equipment maintenance over the life of equipment.

A unit milling cost of $26.43 per ore tonne was estimated by Tetra Tech, and accounts for the following.

- Grinding
- Concentration
- Impurity removal
- Separation and finishing
- Infrastructure
- Product packaging
- Miscellaneous: to include salary costs, fuel (vehicles), lubricants and mobile equipment costs

Each category is composed of manpower, energy (electrical and natural gas), reagents, consumables and other processing costs.

Transportation operating cost covers trucking the concentrate by highway from Halleck Creek to the final processing facility located near Wheatland, Wyoming. It is expected that 705 t of concentrate will be trucked daily a distance of 27-mile trip (one way) to the Wheatland Wyoming processing facility where the final payable metal will be processed at a cost of $0.62 per mined ore ton. Tailings material would be hauled on the return trip and deposited in the tailings storage facility at the Halleck Creek mine site.

Process infrastructure, tailings, associated capital, and operating costs were provided by Tetra Tech. Table 17-4 presents the LOM operating cost summary.

Table 17-4: Operating Cost Summary

Description	Value
Mining OPEX (USD)	304,608,509
Milling OPEX (USD)	1,647,993,088
Transportation OPEX (USD)	38,850,000
Royalties (USD)	193,604,692
Total OPEX and Royalty (USD)	2,185,056,288

17.4 Sustaining Capital Costs

Sustaining capital costs were not applied to mining capital for rebuilds or replacements given the desire to consider fully run a contractor for mining operations.

Process capital allocated 2% of total equipment costs as capital spares with supplies and repair parts being considered within the process operating cost. The life expectancy of processing equipment is 30 yr / greater than the LOM (20 yr).

18.0 ECONOMIC ANALYSIS

An economic analysis was performed by Stantec using the assumptions presented in this report. The cash flow, being limited to Cowboy State Mine, contains Indicated and Inferred material only, as measured does not currently exist within the Cowboy State Mine. Operating costs includes state royalty, severance, ad valorem, and industrial property taxes. Net Present Value (NPV) is calculated before and after-tax, with discount rates of 8 and 10%. Table 18-1 summarizes mine production and costing assumptions, expenditures, the estimated Internal Rate of Return (IRR), NPV, free cash flow, payback periods, and taxes paid.

Table 18-1: Financial Summary – Before / After Tax

Project	Unit	Value	Capital Expenditures	Unit	Value
Phase 1 Mine Plan	yr	20+	Initial Mine Capital	USD	5,423,976
Processing Run-of-Mine (ROM)	Mtpa	3.0	Initial Processing Capital	USD	374,644,403
Total Production	Mt	64,263,399	Contingency (20%)	USD	76,013,676
Construction Period	yr	2.5	Total Initial Capital	USD	456,082,054
Operating Costs	**Unit**	**Value**	**Pricing**	**Unit**	**Value**
NdPr Oxide	USD$/kg	38.38	NdPr Oxide	USD$/kg	91.00
Tb Oxide	USD$/kg	632.56	Tb Oxide	USD$/kg	1,500.00
Dy Oxide	USD$/kg	168.68	Dy Oxide	USD$/kg	400.00
SEG Concentrate	USD$/kg	4.22	SEG Concentrate	USD$/kg	10.00
La	USD$/kg	0.84	La	USD$/kg	2.00
Total	USD$/kg	25.66	Total		60.85
Before Tax Financials	**Unit**	**Value**	**Recovery**	**Unit**	**Value**
Free Cash Flow	USD	2,081,100,045	NdPr	%	63.9%
NPV	at 8%	673,886,445	Tb	%	70.2%
NPV	at 10%	505,055,903	Dy	%	66.5%
IRR (%)	%	23	SEG	%	70.1%
Payback Period	yr	2.9	La	%	68.6%
After Tax Financial	**Unit**	**Value**	**Annual production (average)**	**Unit**	**Value**
Free Cash Flow	USD	1,845,074,127	NdPr Oxide	mt	1,529
Federal and State Taxes Paid	USD	(236,025,918)	Tb Oxide	mt	17
NPV	at 8%	582,244,832	Dy Oxide	mt	91
NPV	at 10%	429,954,875	SEG Concentrate	mt	383
IRR (%)	%	21	La Carbonate	mt	1,486
Payback Period	yr	3.1	Total	mt	3,506

The federal income tax was calculated to be 21%. The federal income tax paid is equal to 21% multiplied by the amount of taxable income remaining after paying state income taxes. Because

Wyoming has state income taxes of 0%, the federal income tax is effectively 21% of the taxable income. The total state and federal taxes paid in a given year is reduced by applicable tax credits.

Taxes applied also include the *Advanced Manufacturing Production Tax Credit, part of the Inflation Reduction Act (IRA*), better known as 45X. This production tax credit, equal to 10% of the costs incurred by the producing taxpayer, was enacted to incentivize the domestic production of, among other things, critical minerals, including rare earths. This rule was proposed by the US Treasury Department late in 2023.

The Company has applied this 10% tax credit to costs incurred during the Project's processing and separation processes, with certain exclusions. As currently written, the proposed regulation appears to exclude extracting raw minerals (mining) and costs of consumable indirect materials (chemical reagents), we have therefore not applied the 10% tax credit to these specific costs.

Industry participants have submitted comments to the proposed regulations, including comments that request modification of the proposed language to include mining costs and chemical reagent costs. However, we note that, as with any proposed regulation, these regulations will continue to change until finalized at which point the Company's ability to apply the tax credit to costs incurred during the production process may be more or less favorable than contemplated in this study.

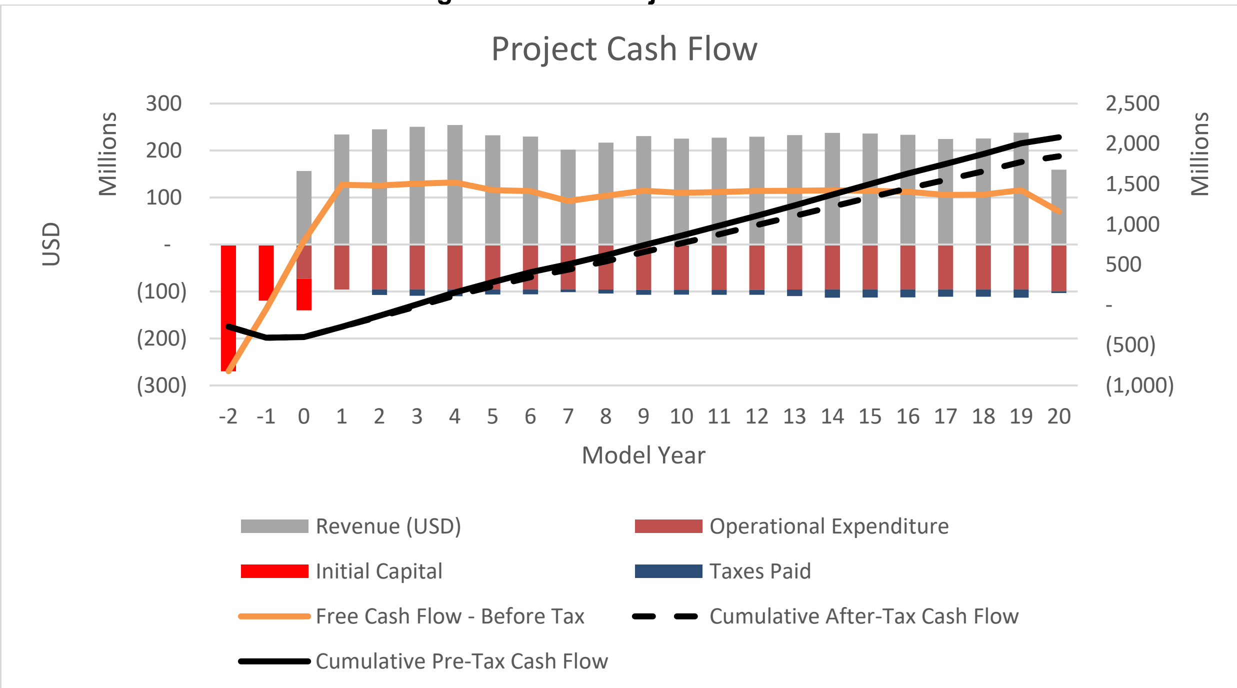
The Cowboy State Mine is subject to a 5% Wyoming State royalty on the gross revenue of the product sold. The project is also subject to a severance and the Albany County ad valorem tax, equal to 2% and 7%, respectively. The basis for these taxes is equal to the percent total production costs that are direct costs, multiplied by net proceeds. Net proceeds are equal to gross revenue less royalties. Last, an industrial property tax of 11.5% and a mill rate equal to 7.6%. The tax basis is equal to the book value of the processing plant less accumulated depreciation. The total industrial property tax paid is equal to the tax basis multiplied by the 11.5% tax and the 7.6% mill rate. Total taxes and royalties payable equal 193,710,360 over the life of the mine.

Royalties are composed of the following.

- Wyoming State Royalty (5 %) and Wyoming State Min Royalty ($0.50 per ore tonne): Is the larger value in any given year between 5% of the gross revenue and $0.50 per recoverable ton saleable.
- Wyoming Royalty Basis 1 (based on Gross Revenue).
- Wyoming Royalty Basis 2 (Ton Saleable).
- Wyoming State Royalty Option 1 (based on Gross Revenue).
- Wyoming State Royalty Option 2 (USD/ton).
- Wyoming State Royalty (USD).

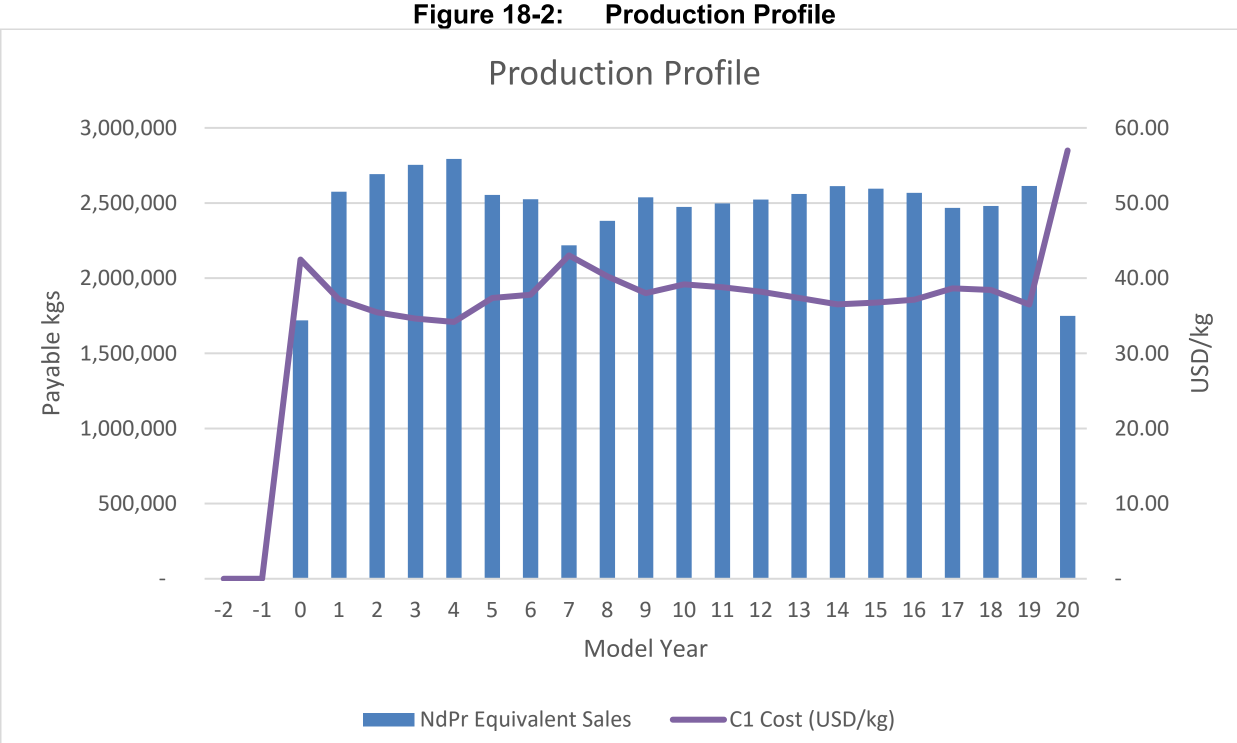
Resulting before / after-tax cash flow details for the LOM are shown in Figure 18-1.

Figure 18-1: Project Cash Flow



The mining production schedule currently being considered generates the production profile of equivalent NdPr Sales with a C1 cost as shown in Figure 18-2.

Figure 18-2: Production Profile



18.1 Alternative Scenario

Stantec completed a high-level comparison of a 6.0 Mtpa alternative production rate and compared it to the Base Case of 3.0 Mtpa to investigate the upside of the property in the case that a higher demand for rare earths is realized. A mine life of 20 yr was kept constant and supported by a design targeting the best grade within the required tonnage within the Cowboy State Mine. Processing operating and capital costs were factored for the higher production rate, while mining costs were determined from the Mine Cost Handbook for the given rate. Table 18-2 summarizes the differences between each production rate and shows, as expected, that the 6.0 Mtpa scenario has a superior NPV at all discount rates.

Table 18-2: Production Scenario Summary

LOM Mining Stats	3.0 Mtpa Base Case	6.0 Mtpa Alt. Case
Total Ore Mined (Mt)	62.3	124.5
Total Waste Mined (Mt)	1.9	2.9
Total Material Mined (Mt)	64.3	127.4
Strip Ratio	0.03	0.02
Recovered Rare Earths	**3.0 Mtpa Base Case**	**6.0 Mtpa Alt. Case**
La (Mkg)	32.1	56.7
NdPr (Mkg)	34.5	62.0
SEG (Mkg)	8.6	15.6
Tb (Mkg)	0.4	0.8
Dy (Mkg)	1.9	3.4
NdPr_Eq (Mkg)	51.9	92.5
NdPr_Eq (g/t)	832	743
LOM Cash Flow	**3.0 Mtpa Base Case**	**6.0 Mtpa Alt. Case**
Total Revenue (MUSD)	4,722	8,416
OPEX Mining (MUSD)	305	567
OPEX Milling (MUSD)	1,648	2,986
CAPEX Mining (MUSD)	7	10
CAPEX Milling (MUSD)	450	727
After Tax Metrics	**3.0 Mtpa Base Case**	**6.0 Mtpa Alt. Case**
Free Cash Flow (MUSD)	1,845	3,335
Federal & State Taxes Paid (MUSD)	236	411
NPV at 8% (MUSD)	582	1,065
NPV at 10% (MUSD)	430	795
IRR (%)	21.1%	22.3%
Payback Period	3.1 yr	3.0 yr

18.2 Sensitivities

Sensitivities to price, mining cost, processing cost and processing capital were evaluated. Ranges from 60% to 120% were evaluated for each. The after-tax cash flow sensitivities are shown in Table 18-3 and Figures 18-3 and 18-4 for the 3.0 Mtpa Base Case. The 6.0 Mtpa Alternative Case is shown in Table 18-4 and Figure 18-5 and Figure 18-6.

Table 18-3: 3.0 Mtpa Base Case – Cash Flow Sensitivities

% of Base Case Change	NdPr_Eq Price	After Tax NPV at 10%	After Tax IRR
(%)	(USD/kg)	(US$ M)	(%)
60%	54.60	070	12.0%
80%	72.80	249	16.8%
100%	91.00	430	21.1%
110%	100.10	522	23.2%
120%	109.20	615	25.3%
% of Base Case Change	**Mining Cost**	**After Tax NPV at 10%**	**After Tax IRR**
(%)	**(USD/Ore t)**	**(US$ M)**	**(%)**
60%	2.84	470	22.1%
80%	3.79	450	21.6%
100%	4.74	430	21.1%
110%	5.21	420	20.9%
120%	5.69	410	20.7%
% of Base Case Change	**Processing Cost**	**After Tax NPV at 10%**	**After Tax IRR**
(%)	**(USD/ t)**	**(US$ M)**	**(%)**
60%	15.86	615	25.5%
80%	21.15	524	23.4%
100%	26.43	430	21.1%
110%	29.08	383	20.0%
120%	31.72	337	18.9%
% of Base Case Change	**Processing Capex**	**After Tax NPV at 10%**	**After Tax IRR**
(%)	**(US $M)**	**(US$ M)**	**(%)**
60%	270	595	32.7%
80%	360	512	25.7%
100%	450	430	21.1%
110%	495	389	19.4%
120%	539	350	17.9%

Figure 18-3: 3.0 Mtpa Base Case – After-tax NPV

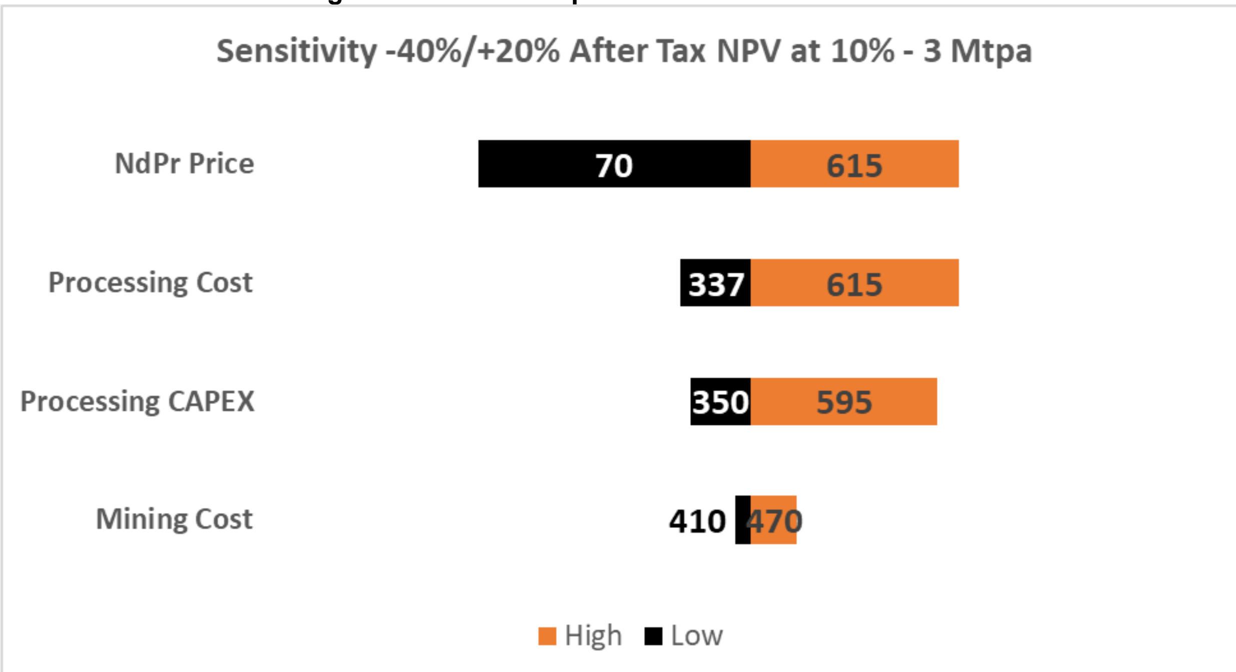


Figure 18-4: 3.0 Mtpa Base Case – After-tax IRR

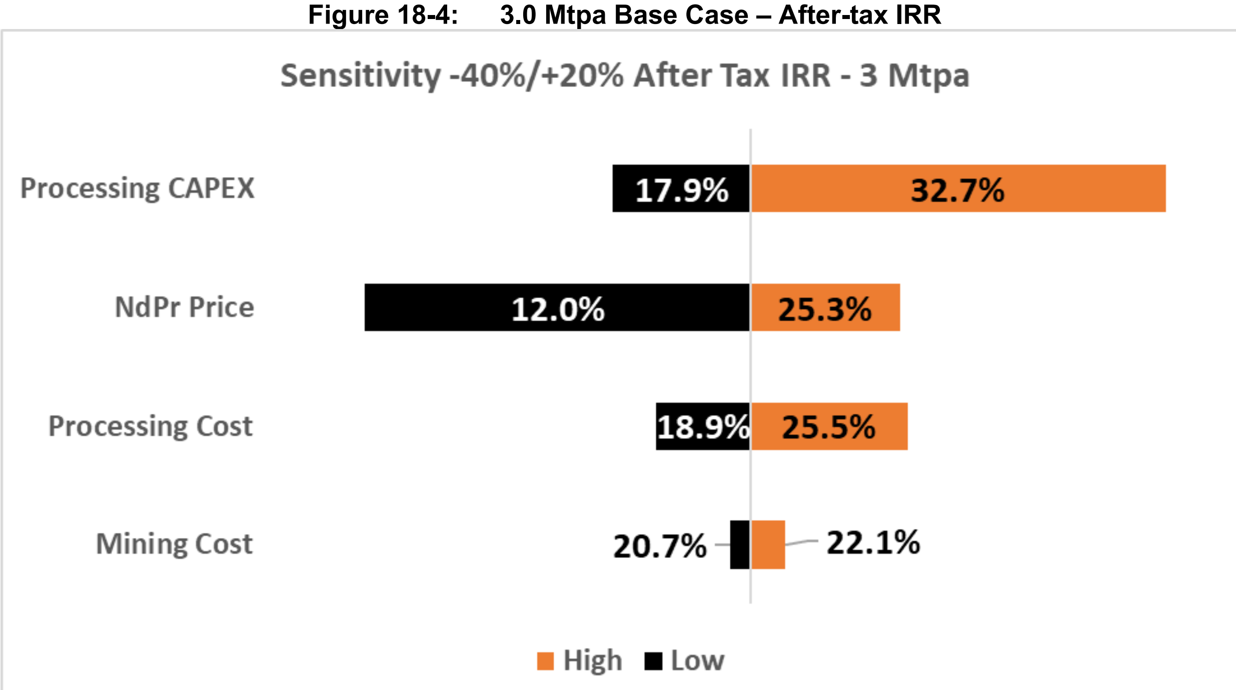


Table 18-4: 6.0 Mtpa Alternative Case – Cash Flow Sensitivities

% of Base Case Change	NdPr_Eq Price	After Tax NPV at 10%	After Tax IRR
(%)	(USD/kg)	(US$ M)	(%)
60%	54.60	152	12.64%
80%	72.80	475	17.74%
100%	91.00	795	22.3%
110%	100.10	955	24.47%
120%	109.20	1115	26.56%
% of Base Case Change	**Mining Cost**	**After Tax NPV at 10%**	**After Tax IRR**
(%)	**(USD/Ore t)**	**(US$ M)**	**(%)**
60%	2.67	866	23.3%
80%	3.56	831	22.8%
100%	4.45	795	22.3%
110%	4.90	778	22.1%
120%	5.34	760	21.8%
% of Base Case Change	**Processing Cost**	**After Tax NPV at 10%**	**After Tax IRR**
(%)	**(USD/ t)**	**(US$ M)**	**(%)**
60%	14.39	1116	26.8%
80%	19.18	957	24.6%
100%	23.98	795	22.3%
110%	26.38	713	21.1%
120%	28.78	631	19.9%
% of Base Case Change	**Processing Capex**	**After Tax NPV at 10%**	**After Tax IRR**
(%)	**(US $M)**	**(US$ M)**	**(%)**
60%	436	1047	33.7%
80%	582	921	26.9%
100%	727	795	22.3%
110%	800	732	20.6%
120%	873	669	19.0%

Figure 18-5: 6.0 Mtpa Alternative Case – After-tax NPV

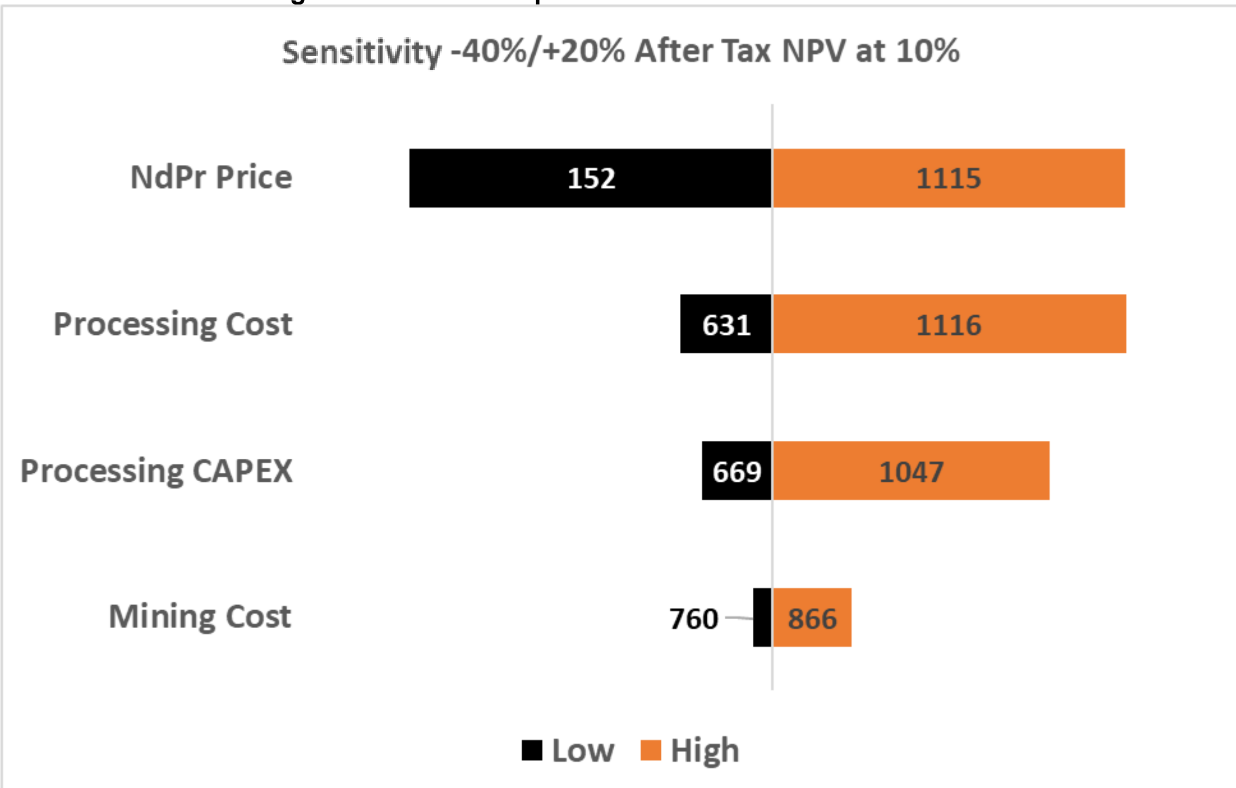
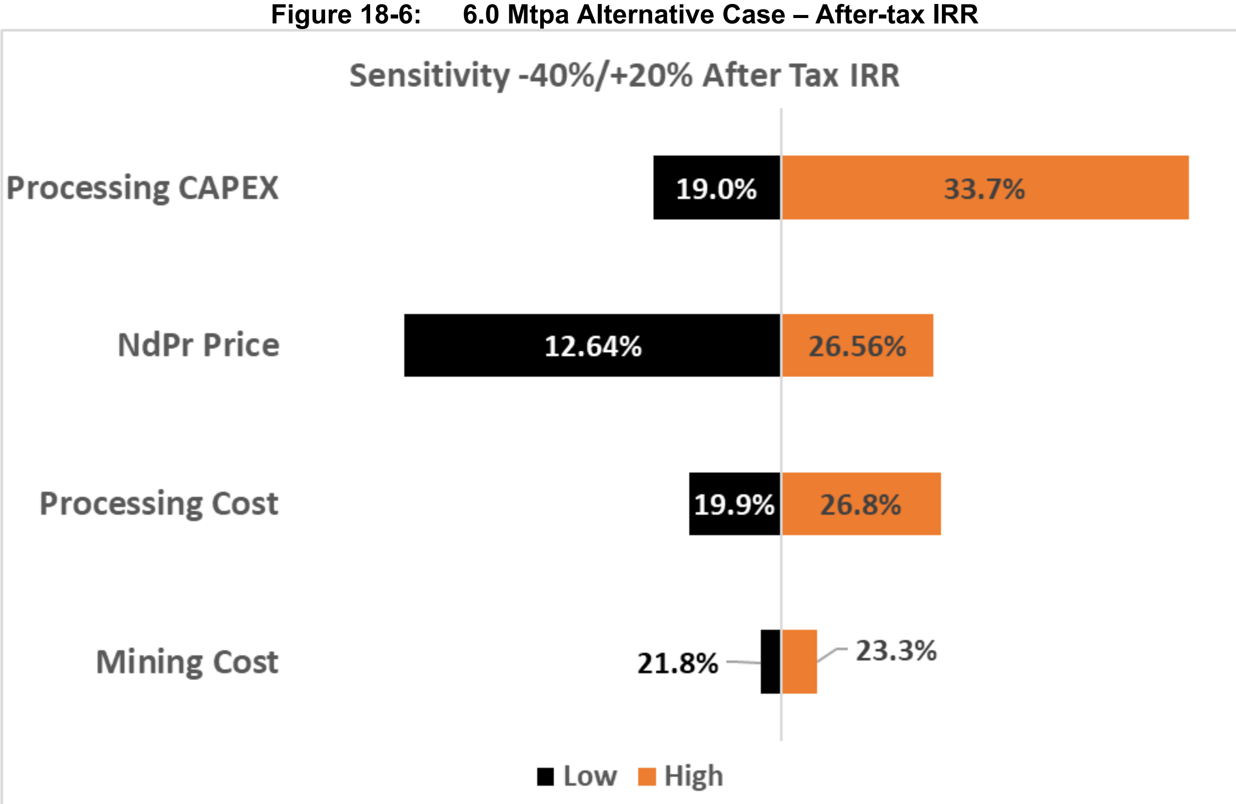


Figure 18-6: 6.0 Mtpa Alternative Case – After-tax IRR



19.0 ADJACENT PROPERTIES

At this time, there are no adjacent mining or mineral exploration projects within 10 km of the Halleck Creek Project.

20.0 OTHER RELEVANT DATA AND INFORMATION

At this time, Stantec and other contributors to this report do not know of any relevant information and data that has not been included or documented in this report.

21.0 INTERPRETATIONS AND CONCLUSIONS

Wyoming has a rich a mining history. The Powder River Basin (PRB) was the world leader in productive, cost-effective coal mining for decades. ARR can draw upon this rich institutional knowledge base and skill sets from Wyoming residents.

Cowboy State Mine resides on wholly state mineral leases controlled by ARR.

The Wyoming DEQ requires a rigorous, comprehensive, yet straight forward path to permitting for projects like Halleck Creek.

ARR federal lode claims and mineral leases throughout the Halleck Creek district provide great potential upside for future development.

Infrastructure adjacent to the Project will facilitate access and power to and from the mine.

21.1 Geology and Mineralization

The demonstrated geologic homogeneity of the deposit will provide a consistent and reliable feedstock throughout the life of the Project. The current Halleck Creek estimated measured and indicated resource is 1.42 Gt with an average TREO grade of 3,295 ppm.

Allanite is the primary rare earth bearing mineral at Halleck Creek making up approximately 1.31% of all minerals. Zircon is a secondary rare earth mineral making up approximately 0.42% of all minerals. Allanite comprises 72% of all REE bearing minerals. Zircon represents about 23% and minor occurrences of other minerals amount to about 5% of REE bearing minerals.

Mineralogical characterization shows that allanite liberates well from gangue material during crushing. Approximately 87.5% of allanite can be liberated into pure, free, and liberated classes. ARR believes the relatively large phenocrysts in the rock contribute to high allanite liberation. High liberation generally increases the ability to reject gangue material through physical separation and increases overall recovery of allanite.

ARR believes that metamictization of allanite over 1.4 billion years contributes to leachability of REE from allanite. While at low concentrations, naturally occurring Th and U have decayed over time causing allanite crystals to become amorphous (without structure).

The in situ Halleck Creek deposit is naturally low in thorium and uranium with an average concentration of approximately 68 ppm.

21.2 Metallurgical Testwork

21.2.1 Comminution

Halleck Creek material has been shown to have about average hardness when compared to other granitic type rocks. Additionally, Halleck Creek material has been shown to be less abrasive than other granitic type rocks because of a lack of quartz in host rocks. ARR believes that a less abrasive feedstock will reduce wear on grinding equipment and reduce operating costs over time.

21.2.2 Separation

Allanite and other more dense minerals can be separated from less dense minerals using commonly used gravity separation methods like spirals, gravity concentrators, or dense media. Allanite has an SG between 3.6 and 4.0. The primary gangue minerals of feldspar, syenite, and minor quartz have SG between 2.65 to 2.75. Preliminary gravity separation testwork has shown that up to 77% of gangue material can be rejected from feed material, TREO concentrations have been shown to increase by more than 10 times and with allanite recovery exceeding TREO of 3% or 30,000 ppm.

Allanite and an iron-rich amphibole, called hastingsite, are paramagnetic. This means they become magnetic in the presence of highly intense magnetic fields. Therefore, allanite can be further separated from non-magnetic gangue material in WHIMS units. Approximately 4% to 5% additional gangue material can be separated from allanite and hastingsite using WHIMS.

Therefore, ARR believes that up to 93% of all feed mass can be rejected from ROM feed using gravity separation and WHIMS with a TREO recovery of approximately 85% with a TREO concentration factor of about 11x. This large rejection of gangue material is preferred because very little non-rare earth bearing material flows into leaching and refining processes. This translates into reductions in size of processing equipment, reductions in reagent use resulting in lower capital expenses and operating expenses, respectively. Also, using the 11x TREO concentration factor the ROM grade of 3,805 ppm gets increased to approximately 41,855 ppm or 4.2% TREO.

21.2.3 Leaching

Testing performed by Wood PLC and Virginia Tech shows that rare earth elements can be readily leached from allanite using sulfuric acid using lower temperatures of about 90 °C, and relatively short residence times, between two and six hours. Leach testing shows that about 85% of TREO can be extracted using these parameters. Furthermore, the lower temperatures and shorter residence times reduces the formation of silica gels often associated with leaching silicate minerals.

As mentioned above, ARR believes that metamictization of allanite over 1.4 Ga, enhances leachability of the allanite. Therefore, high temperature caustic or acid cracking is not needed, and it might actually interfere with rare earth extraction.

21.2.4 Rare Earth Recovery Products

ARR and Tetra Tech determined that producing a mixed rare earth concentrate, or a mixed rare earth oxide does not provide saleable products. Therefore, the scoping study options to recover five rare earth products including NdPr oxide, La carbonate, Dy oxide, Tb oxide, and SEG (mixed samarium, europium, and gadolinium) oxide.

Stantec developed NSR calculations using these five products as input.

21.3 Mining Methods

Rare Earth bearing rock at Halleck Creek occur at surface over relatively large areas within the state mineral lease area called the Cowboy State Mine. Therefore, the deposit can be mined using straightforward conventional open pit mining techniques with minimal overburden and stripping. The homogeneous geology will help reduce mining costs due to minimal in-pit grade control requirements.

Components of the Cowboy State Mine including, conceptual mine facilities, separation plant, mine dumps and tailings all reside within the state lease controlled by ARR. The conceptual mining ideas include dry-stacked tailings, and eventual backfilling of open pits with gangue material collected during physical separation.

Pits within the Cowboy State Mine contains approximately 62.4 M tonnes with an average TREO of 3,805 ppm. The pits will sustain a 3.0 Mtpa ROM production rate over 20 yr. The geological resources at Halleck Creek allow for eventual expansion into other areas and extend the mine-life well beyond 20 yr.

21.4 Recovery Methods

The scoping study has comminution, and mineral separation occurring at the Cowboy State Mine. Leaching and processing will likely occur at facilities located adjacent to interstates and railroads.

Comminution will focus on the use of HPGR to minimize fines in ROM material. Separation will focus on spirals, and gravity concentrators, then using WHIMS for separation of fines.

Rare earth extraction begins with leaching rare earths into solution using sulfuric acid. The major impurities of iron, thorium will be removed from solution using partial neutralization by increasing pH and precipitating these elements as hydroxides. After filtering, Uranium will be removed using ion exchange columns, precipitation and filtration.

ARR with work closely with the Wyoming DEQ and the Nuclear Regulatory Commission to acquire proper processing and handling permits of source material occurring as by-products of processing.

Each La, NdPr, Dy, Tb, and SEG product will then be refined using iterative solvent exchange and precipitation circuits focused on each product.

21.5 Infrastructure

Infrastructure planned for the mine site reflects the simplicity and small size of the mining operation. Road access and buildings for a modest head count in hourly and salary personnel can be satisfied by prefabricated buildings or trailers.

At this point preliminary, hydrological estimates indicate sufficient water can be obtained from several wells outside the pit limits. Drilling, pumping and piping costs are based on Stantec's mining experience. Construction of road access, line power and natural gas are not expected to be difficult, nor expensive as existing infrastructure is in close proximity to the project.

21.6 Capital Cost Estimates

Mine site capital costs were limited to costs for road access, water supply, buildings, line power and natural gas as any mining equipment would be realized by the mine contractor. These costs were obtained from the Mine Cost Service (2021) and escalated to 2023.

21.7 Operating Cost Estimates

Mine operating costs, appropriate to the size and scale of the Halleck Creek operation, were obtained from the Mine Cost Service (2021) and escalated to 2023 costs and further increased 20% to reflect contractor mark-ups and profits.

21.8 Economic Analysis

An economic analysis was performed on the project using a discounted cash flow method of evaluation using industry accepted metrics of discounted rate, payback period and IRR.

22.0 RECOMMENDATIONS

ARR should perform a gap analysis of all aspects of this scoping study to begin data collection in support of environmental permitting and to revise geologic modelling, resource estimation, mine and metallurgical engineering and associated metal pricing and economics with the goal of completing a prefeasibility study within the next year or two.

The following recommendations develop in more detail the work needed to achieve an aggressive goal to supply rare earth metals to the country.

22.1 Environmental and Social Governance

It is recommended that ARR develop permitting and environmental baseline needs for assessment for the project area and compile each permitting and environmental baseline component from WDEQ guidelines. Future work should include establishing long term monitoring and data collection methods to feed into baseline environmental baseline studies and maintain programs for long term monitoring and data collection to obtain all required permits by State and Federal authorities.

Hydrologic work is an important component of the permitting and mining of the project. Work should include performing hydrological characterization of the project based on determining and drilling monitoring wells and installing the appropriate data collection devices for long term data collection.

In terms of community relations, ARR is recommended to perform a community needs assessment and develop a framework for community engagement.

22.2 Geological Exploration

22.2.1 Geologic Mapping and Sampling

It is recommended that continued geological mapping and surface sampling take place during 2024. There are remaining areas within the Red Mountain pluton under ARR control which require high resolution sampling to fully understand surface mineralization. The two high-priority areas of interest include the County Line project area and the Sommers Flat project area.

Sampling and mapping efforts in both areas will be critical to understanding deposit dimensions and resource extent. It may identify new high-grade areas that have yet to be mapped. Furthermore, these results will help guide future exploration efforts at the Halleck Creek Project.

The sampling effort will also include collecting and testing presumably REE-depleted country rock to have for comparison purposes. These samples will also more strictly define resource extent.

22.2.2 Cowboy State Mine Infill Resource Drilling

The company plans to conduct infill resource drilling at the Cowboy State Mine project area in order to produce a measured resource and to further constrain deposit dimensions. An additional eight diamond core holes and 17 RC holes are being permitted on State Land with an approximate 100 m spacing (T22N, R71W, Section 36, SESE Section 25). This includes a deep core hole (302 m) to observe mineralization at depth. The Cowboy State Mine infill campaign is planned for later summer of 2024.

The objectives of the drilling are as follows.

1. To provide additional drilling data to increase resource classification and determine measured resources at Cowboy State Mine.
2. To delineate contacts between RMP, Sybille Intrusives, and Elmer's Rock Green Belt rocks for detailed resource definition.
3. To provide core material for geotechnical and geomechanical testing at Cowboy State Mine for detailed pit stability analysis and ground control planning.
4. To provide core material for long-term environmental characterization and baseline studies.

22.3 Mining and Geotechnical Engineering

While mining is straightforward at Halleck Creek, additional modelling of the mineral resource, hydrology and geotechnical engineering will enhance and optimize the open pit parameters while allowing higher grade material to be targeted in the early years of production and reduce costs. Hydrological modelling requirements have been discussed above in Environmental and Social Governance. A geotechnical drilling and logging program will collect additional geotechnical core and which will generate geomechanical strength testing data which in turn will determine geotechnical parameters to revise mine designs, including bench heights, slope angles and catch bench width to further enhance mineral extraction while maintaining operational safety standards.

Mine engineering should include revising pit designs based on hydrological and geotechnical study results, while focusing on delivering the highest-grade mineralization based on infill drilling and a revised resource model. Sensitivity analysis should determine the optimal production rate and project costs.

22.4 Metallurgy and Recovery Recommendations

22.4.1 Comminution Testing

A large sample (~2 t) of diamond drilling core should be prepared and sent to a manufacturer of High-Pressure Grinding Roll (HPGR) equipment for testing. The output of this work will be a particle size distribution, budgetary quote from vendor with performance and wear guarantees, as well as a large sample of crushed ore for future downstream testing.

22.4.2 Concentration Testing

Primary separation testing using gravity should be performed to validate mass balance and concentration efficiency. Upfront size screening should be evaluated, and a minimum particle size cutoff established for primary and secondary separation. The preferred equipment for the primary separation is a gravity separation spiral due to its simplicity and low capital and operating cost. The first and most important separation is at a specific gravity less than 2.7 in order to remove the light gangue material which represents 77% of the whole ore mass. Additional gravity separation testing should be performed on the >2.7 specific gravity material resulting from the primary testing. The preferred equipment is again a gravity separation spiral but due to tight specific gravity differences a cut of >2.7 but <3.5 may require centrifugal gravity separators. Generation of a zircon by product should be studied during this testing.

Secondary separation should be performed on the concentrated stream from the primary testing. The equipment that has showed promise here is WHIMS, and electrostatic separation. Flotation testing on a primary WHIMS concentrate did not show any promise in previous testing but should be investigated again since the nature of the material has changed due to the gravity primary separation.

22.4.3 Extraction Testing

Calcination testing shall be conducted to find an optimal calcination temperature and to create feedstock for downstream testing. A Thermogravimetric Analysis should be performed pre-concentrate product to understand the thermal decomposition points which will aid in selecting a temperature setpoint. Calcination or roasting with sulfuric acid and/or caustic should be investigated.

Sulfuric acid tank testing shall be performed on the calcined feed, the extraction data for rare earth and impurity compounds being used to modify the calcination temperature. The testing should also look at the impacts of varying the following variables: % solids in the leach reaction, grind size, temperature, acid concentration, use of oxidation aids such as hydrogen peroxide.

The leach residue solids should be studied for thickening and filtration with cake washing efficiency testing. The leach residue solids should be characterized for tailings geotechnical parameters, material handling parameters as well as heavy metal and other hazardous waste parameters.

Testing should be performed to further understand the cause of suppressed extraction of heavy rare elements. Analyzing the zircon fraction or performing mineralogical testing of the leach residue may aid in understanding and eliminating this phenomenon.

22.4.4 Impurity Removal

Experimentation of impurity removal via a bulk partial neutralization with the variables; pH, base reagent (sodium hydroxide vs magnesia), residence time, and temperature.

Solids should be tested for thickening and filtration with cake washing efficiency testing. The solids should also be characterized for tailings geotechnical parameters, material handling parameters as well as heavy metal and other hazardous waste parameters.

Uranium and iron ion exchange removal testing should be conducted on the partial neutralization to select a preferred resin functionality, establish a mass balance for loading and elution. Analysis of the eluant and further testing to evaluate if a saleable uranium product should be investigated. Precipitation of the uranium and iron will have to be done regardless of disposition so precipitation conditions must be tested along with characterization of the solids for thickening and filtration with cake washing efficiency testing, tailings geotechnical parameters, material handling parameters as well as heavy metal and other hazardous waste parameters.

22.4.5 Separation and Finishing

The solvent extraction circuits must all be studied with initial batch shakeouts and eventual continuous testing where the quantity of feedstock allows.

In general, the following parameters must be tested to further equipment design and material balance calculations.

- Feed acidity.
- Separation coefficients for all sections (extraction, scrub and strip) from batch wise testing shakeouts, maximum loading and organic to aqueous ratio.
- Settling time testing to determine optimal extractant concentration and the chosen diluent.
- Stripping acid concentration and quantity along with strip and raff product characteristics
- The need for organic washing, regeneration or conditioning.
- The finishing circuits must be tested for all products. Variables to consider are the chosen precipitation agent and dosage, pH, temperature, residence time.
- All finished products must be studied for thickening parameters, material handling parameters, impurity profiles and physical parameters. For products requiring oxidation or drying lab testing should be performed to find the optimal calcination temperature and residence time.

22.4.6 Waste Water Treatment Characteristics

Waste water streams need to be quantified and analyzed to aid in the mass balance. If sufficient quantities of waste water effluent can be collected testing for a pH adjustment and resulting precipitation should be performed along with characterization of the solids for tailings impoundment similar to earlier tailings solids described above.

Further testing should be performed to evaluate lower leaching temperatures versus longer leaching residence time, higher % solids in the leach tank to limit the dilution of adding water, balancing the Fe and Al leach recovery with the REE leach recovery. Investigate controlling the acid dosage based on both the 250 kg of sulfuric per mt of solids but also the free acid reading in the last stage. If for some reason the ore and the supporting reactions do not consume nearly all the acid then the dosage will need to be reduced or there will be a large increase in caustic consumption that is added downstream. Literature suggests that adding ammonium sulfate or peroxide to the leach as an oxidizing agent to enhance the REE recovery, this should be tested on Halleck Creek ore.

23.0 RELIANCE ON INFORMATION PROVIDED BY THE REGISTRANT

This Technical Report has been prepared by the Stantec's QP for American Rare Earth Ltd. The information, conclusions, opinions, and estimates contained herein are based on:

- Information available to the Stantec's QP at the time of preparation of this Technical Report,
- Assumptions, conditions, and qualifications as set forth in this Technical Report, and
- Data, reports, and other information supplied by American Rare Earth Ltd. and other third-party sources.

24.0 REFERENCES

American Rare Earths, Ltd. (2023a). Technical Report of Exploration and Maiden Resource Estimates of the Halleck Creek Rare Earths Project.

American Rare Earths, Ltd. (2023b). Summary of 2023 Infill Drilling at the Halleck Creek Project Area.

Anderson, I. (1995). Petrology and Geochemisty of the Red Mountain Pluton, Laramie anorthosite complex, Wyoming. Ph.D. Thesis. University of Wyoming.

Anderson, I.C., Frost, C.D., and Frost, B.R. (2003). Petrogenesis of the Red Mountaing Pluton, Laramie anorthosite complex, Wyoming: Implications for the origin of A-type granite. Precambrian Research, 124(2-4), 243-267. doi:https://doi.org/10.1016/S0301-9268(03)00088-3

Balaram, V. (2019). Rare Earth Elements: A Review of Applications, Occurrence, Exploration, Analysis, Recycling and Environmental Impact. Geoscience Frontiers, v. 10, 1285-1303. doi:https://doi.org/10.1016/S0301-9268(03)00088-3

DCM Science Laboratory, Inc. (2019). Petrographic Analysis.

Fountain, J.C., Hodge, D.S., and Hills, A. (1981). Geochemistry and Petrogenesis of the Laramie anorthosite complex, Wyoming. Lithos, v. 14m, 113-132. doi:https://doi.org/10.1016.0021-4937(81)90049-9

Frost, B.R., Snyder, G.L., Lindsley, D.H., Scoates, J.S., and Anderson, C.I. (2021). Geologic Map of the Poe Mountain Quadrangle, Albany and Platte Counties, Wyoming. Wyoming State Geological Survey, scale 1:24,000, 1 sheet.

Frost, C.D., Frost, B.R., Lindsley, D.H., Chamberlain, K.R., Swapp, S.M., and Scoates, J.S. (2010). Geochemical and Isotopic Evidence of the Anorthositic Plutons of the Laramie Anorthosite Complex: Explainations for Variations in Silica Activity and Oxygen Fugacity of Massif Anorthosites. The Canadian Mineralogist, v. 48, 925-946. doi:10.3749/canmin.48.4.925

Geist, D.L., Frost, C.D., and Kolker, A. (1990). Sr and Nd Isotope Constraints on the Origin of the Laramie Anorthosite Complex, Wyoming. American Mineralogist, v. 75, 13-20.

King, J.K. and Harris, R.E. (1987). Rare Earth Elements and Yttrium in Wyoming. Geological Survey of Wyoming Open File Report, v. 87-8, 43.

Scoates, J.S. and Chamerlain, K.R. (2003). Geochronologic, Geochemical and Isotopic Constraints on the Origin of Monzonitic and Related Rocks in the Laramie Anorthosite Complex, Wyoming, USA. Precambrian Research, v. 124, 269-304.

Scoates, J.S., and Frost, C.D. (1996). A Strontium and Neodymium Isotopic Investigation of the Laramie Anorthosites, Wyoming, USA: Implications for Magma Chamber Processes and the

Evolytion of Magma Conduits in Proterozoic Anorthosites. Geochemica et Cosmochimica Acta, v. 60, 95-107.

SGS Canada, Inc. (2023). An Investigation into the Mineralogical Characterization of a REE Sample from the Halleck Creek Project, Wyoming, USA. Lakefield, Ontario.

Snyder, G.L., Budahn, J.R., Nealey, L.D., Bartel, A.J., and Ludwig, K.R. (1998). Geologic Map, Petrochemistry, and Geochronology of the Precambrian Rocks of Bull Camp Peak Quadrangle, Albany County, Wyoming. U.S. Geological Society Miscellaneous Investigations, Series I-2236, scale 1:24,000.

Spicuzza, M.J. (1990). High Grade Metamorphism and Partial Melting in the Bluegrass Creek Suite, Central Laramie Mountains Wyoming. [Ph.D. Thesis]: University of Wyoming. Retrieved from https://conservancy.umn.edu/handle/11299/220212

Weier, Matt. (2023). Nagrom: SMC Test Report. Perth, WA.

World Industrial Minerals. (2021). Technical Report on the Wyoming Halleck Creek Rare Earths Project. Western Rare Earths.

Appendix A
JORC Table 1

Appendix A – Halleck Creek JORC Table 1

Section 1 Sampling Techniques and Data		
(Criteria in this section apply to all succeeding sections.)		
Criteria	***JORC Code explanation***	***Commentary***
Sampling Techniques	*Nature and quality of sampling (e.g. cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as downhole gamma sondes, handheld XRF instruments, etc.). These examples should not be taken as limiting the broad meaning of sampling.*	ARR drilled 15 reverse circulation (RC) holes and eight HQ-sized diamond core holes between September and October 2023. All RC holes were 102 meters (334.65 feet) deep, with seven core holes at 80 meters (262.47 feet) and one deep core hole at 302 m (990.81 feet). RC chip samples were collected at a 1.5-meter (4.92 ft) continuous interval via rotary splitter. Rock core was divided into sample lengths of 1.5 m (4.92 feet) long and at key lithological breaks. ARR drilled 38 reverse circulation (RC) holes across the Halleck Creek Resource Claim area between October and December 2022. All holes were approximately 150 meters (492.13 feet) deep, with the exception of HC22-RM015 which went to a depth of 175.5 meters (576 feet). Chip samples were collected at 1.5-meter continuous intervals via rotary splitter. In March and April 2022, ARR drilled nine HQ-sized core holes across the Halleck Creek Resource claim area. All holes were approximately 350 ft with the exception of one hole which was terminated at 194 ft. Total drilled length of 3,008 ft (917 m). Rock core was divided into sample lengths of 5 ft (1.52 m) long and at key lithological breaks. A total of 734 surface rock samples exist in the Halleck Creek database. Surface rock samples collected by ARR are logged, photographed and located using handheld GPS units. As part of reverse circulation (RC) and diamond core exploration drilling at Halleck Creek, ARR collected XRF readings on RC chip and core samples. Elements included in XRF measurements include Lanthanum, Cerium, Neodymium, and Praseodymium. ARR collected three XRF readings on each sample, then averaged the readings. Readings are performed at 20-meter intervals down each drill hole. These values are qualitative in nature and provide only rough indications of grade.

Section 1 Sampling Techniques and Data		
(Criteria in this section apply to all succeeding sections.)		
Criteria	***JORC Code explanation***	***Commentary***
	Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.	For the April 2022 core drilling program, core recoveries and RQDs were calculated by ARR field geologists. The same was done for the Fall 2023 program with the addition of detailed geotechnical logging.
	Aspects of the determination of mineralisation that are Material to the Public Report.	The Red Mountain Pluton (RMP) of the Halleck Creek Rare Earths Project is a distinctly layered monzonitic to syenitic body which exhibits significant and widespread REE enrichment. Enrichment is dependent on allanite abundance, a sorosilicate of the epidote group. Allanite occurs in all three units of the RMP, the clinopyroxene quartz monzonite, the biotite-hornblende quartz syenite, and the fayalite monzonite, in variable abundances.
	In cases where 'industry standard' work has been done, this would be relatively simple (e.g. 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases, more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (e.g. submarine nodules) may warrant disclosure of detailed information.	Reverse circulation rock chip samples were collected at 1.5-meter continuous intervals via rotary splitter. For each interval chip samples were placed in labelled sample bags weighing between 1-2kg. A 0.5-1kg sample was collected for reserve analysis and logging. Chip samples were also placed into chip trays with 20 slots for logging and XRF analysis. Rock core samples 5 ft (1.52 m) long are fillet cut. The fillet cuts are being pulverised and sampled for 60 elements including rare earth elements using ICP-MS and industry standards. A select number of samples are additionally being assayed for whole rock geochemistry. American Assay Labs in Sparks, NV is performed the analyses for the Spring 2022 program, and ALS Laboratories in BC, Canada.
		RC chip samples were sent to ALS labs in Twin Falls, ID for preparation and forwarded on to ALS labs in Vancouver, BC for ICP-MS analysis. ALS analysis: ME-MS81. Core samples were first sent to ALS in Reno, NV, for cutting and preparation, and also sent to Vancouver, BC for the same suite of testwork.

Section 1 Sampling Techniques and Data		
(Criteria in this section apply to all succeeding sections.)		
Criteria	***JORC Code explanation***	***Commentary***
Drilling Techniques	*Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc.) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or another type, whether the core is oriented and if so, by what method, etc.).*	A Schraam T-450 reverse circulation drill rig was used to drill all 15 RC drill holes from the Fall 2023 program. A continuous rotary sample splitter was used to collect the RC samples at 1.5m intervals. Total drilled depth of 3,011.81 ft (1,530 m). Core, fall 2023: HQ, diamond tip, 5 ft (1.52 m) runs, unoriented. Total drilled depth of 2,816.60 ft (858.5 m).
Drill Sample Recovery	*Method of recording and assessing core and chip sample recoveries and results assessed.*	A continuous rotary sample splitter was used to collect the RC samples at 1.5m intervals. All drill core was visually logged, measured, and photographed by ARR geologists. Drill core was collected in lengths (runs) of 5 ft (1.52 m). Recoveries were calculated for each core run. Each rock sample was described, photographed with its location determined using handheld GPS.
	Measures are taken to maximise sample recovery and ensure the representative nature of the samples.	Reverse circulation rock chip samples were collected at 1.5-meter continuous intervals via rotary splitter. For each interval chip samples were placed in labelled sample bags weighing between 1-2kg. A 0.5-1kg sample was collected for reserve analysis and logging. Chip samples were also placed into chip trays with 20 slots for logging and XRF analysis. All core and associated samples were immediately placed in core boxes.
	Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.	Recoveries were very high in competent rock. No loss or gain of grade or grade bias related to recovery

Section 1 Sampling Techniques and Data		
(Criteria in this section apply to all succeeding sections.)		
Criteria	***JORC Code explanation***	***Commentary***
Logging	*Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.*	All RC samples were visually logged by ARR geologists from chip trays using 10x binocular microscopes. Samples at 25m intervals were photos and analysed using an Olympus Vanta handheld XRF analyser in triplicate. Lanthanum, Cerium, Neodymium, and Praseodymium were analysed via XRF. All drill core was visually logged, measured, and photographed by ARR geologists. Drill core was collected in lengths (runs) of 5 feet (1.52m). ARR geologists calculated recoveries for each core run. ARR geologists logged lithology, various types of alteration and mineralisation, fractures, fracture conditions, and RQD.
	Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc.) photography.	RC samples and logging is quantitative in nature. Chip samples are stored in secure sample trays. Chip samples were photographed and 25m intervals. Core logging is quantitative in nature. All core was photographed.
	The total length and percentage of the relevant intersections logged.	All RC samples were visually logged by ARR geologists for each 1.5-meter continuous sample. All drill core was visually logged, measured, and photographed by ARR geologists. Drill core was collected in lengths (runs) of 5 feet (1.52m). ARR geologists calculated recoveries for each core run. ARR geologists logged lithology, various types of alteration and mineralisation, fractures, fracture conditions, and RQD.

Section 1 Sampling Techniques and Data		
(Criteria in this section apply to all succeeding sections.)		
Criteria	***JORC Code explanation***	***Commentary***
Sub-sampling techniques and sample preparation	*If core, whether cut or sawn and whether quarter, half or all core taken.*	RC chip samples were not cut. Drill core was fillet cut by ALS Laboratories with approximately 1/2 of the core used for assay. The remaining core material will be kept in reserve by ALS until sent for future metallurgical testwork.
	If non-core, whether riffled, tube sampled, rotary split, etc. and whether sampled wet or dry.	Samples varied between wet and dry. The course crystalline nature of the deposit minimizes adverse effects of wet samples. Samples were rotary split during drilling and sample collection. ALS labs dried wet samples using their DRY-21 drying process.
	For all sample types, the nature, quality and appropriateness of the sample preparation technique.	RC samples were taken from pulverize splits of up to 250 g to better than 85 % passing minus 75 microns. All core samples were dry. Sample preparation: 1kg samples split to 250g for pulverising to -75 microns. Sample analysis: 0.5g charge assayed by ICP-MS technique. Both sampling methods are considered appropriate for the type of material collected and are considered industry standard.
	Quality control procedures adopted for all sub-sampling stages to maximise the representivity of samples.	ARR submitted CRM sample blanks, CRM standard REE samples from CND Labs and duplicate samples for analysis. Each CRM blank, REE standard, and duplicate were rotated into both the RC and core sampling process every 20 samples.
	Measures are taken to ensure that the sampling is representative of the in situ material collected, including, for instance, results for field duplicate/second-half sampling.	RC samples were collected using a continuous feed rotary split sampler. Fillet cuts along the entire length of all core are representative of the in-situ material.

Section 1 Sampling Techniques and Data		
(Criteria in this section apply to all succeeding sections.)		
Criteria	***JORC Code explanation***	***Commentary***
	Whether sample sizes are appropriate to the grain size of the material being sampled.	Allanite is generally well distributed across the core and the sample sizes are representative of the fine grain size of the Allanite.
Quality of assay data and laboratory tests	*The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.*	ALS uses a 5-acid digestion and 32 elements by lithium borate fusion and ICP-MS (ME-MS81). For quantitative results of all elements, including those encapsulated in resistive minerals. These assays include all rare earth elements. AAL Labs uses 5-acid digestion and 48 element analysis including REE reported in ppm using method REE-5AO48 and whole-rock geochemical XRF analysis using method X-LIB15.
	For geophysical tools, spectrometers, handheld XRF instruments, etc., the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.	Samples at 25m intervals were photographed and analysed using an Olympus Vanta handheld XRF analyser in triplicate. Lanthanum, Cerium, Neodymium, and Praseodymium were analysed. Simple average values of three XRF readings were calculated. Seven of the core holes received ATV/OTV logging as well as slim hole induction which recorded natural gamma and conductivity/resistivity. All geophysical logging was completed by Century Geophysical located in Gillette, WY. All tools were properly calibrated prior to logging.
	Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established.	For the RC drilling, ARR submitted CRM sample blanks, CRM standard REE samples from CND Labs and duplicate samples for analysis. CRM and Blank samples were inserted alternately at 20 sample intervals. The same was done for the core drilling completed Fall 2023. ALS Laboratories will additionally incorporate their own Qa/Qc procedure. For core drilling completed Spring 2022, ARR submitted CRM sample blanks, CRM standard REE samples from CND Labs and duplicate samples for analysis. Blank samples were added one for every 10 core samples, REE samples were added one for every 25 core samples, and Duplicate samples were added one per every 25 core samples. Internal laboratory blanks and standards will additionally be inserted during analysis.

Section 1 Sampling Techniques and Data		
(Criteria in this section apply to all succeeding sections.)		
Criteria	***JORC Code explanation***	***Commentary***
Verification of sampling and assaying	*The verification of significant intersections by either independent or alternative company personnel.*	RC chip samples have not yet been verified by independent personnel. Consulting company personnel have observed the assayed core samples. Company personnel sampled the entire length of each hole.
	The use of twinned holes.	No twinned holes were used.
	Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.	Data entry was performed by ARR personnel and checked by ARR geologists. All field logs were scanned and uploaded to company file servers. All photographs of the core were also uploaded to the file server daily. Drilling data will be imported into the DHDB drill hole database. All scanned documents are cross-referenced and directly available from the database. Assay data from the RC samples was imported into the database directly from electronic spreadsheets sent to ARR from ALS. Core assay data was received electronically from AAL labs. These raw data as elements reported ppm were imported into the database with no adjustments.
	Discuss any adjustment to assay data.	Assay data is stored in the database in elemental form. Reporting of oxide values are calculated in the database using the molar mass of the element and the oxide.
Location of data points	*Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.*	RC drill holes have been located using handheld GPS units. Final surveys of hole locations will be performed by professional surveyors. Drill hole location is based on GPS coordinates +/- 10 ft (3 m) accuracy.
	Specification of the grid system used.	The grid system used to compile data was NAD83 Zone 13N.
	Quality and adequacy of topographic control.	Topography control is +/- 10 ft (3 m).

Section 1 Sampling Techniques and Data		
(Criteria in this section apply to all succeeding sections.)		
Criteria	***JORC Code explanation***	***Commentary***
Data spacing and distribution	*Data spacing for reporting of Exploration Results.*	The Fall 2023 program included drill hole spacing at approximately 100 m resolution. For previous programs, holes were both randomly spaced and localised clustering of drillholes.
	Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.	Data from the Fall 2023 program will be at a high enough resolution to provide a measured resource at the Overton Mountain project area.
	Whether sample compositing has been applied.	Each sample is the result of assaying a 5 ft interval of core or 1.5 m RC interval.
Orientation of data in relation to geological structure	*Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.*	Mineralization at Halleck Creek is a function of fractional crystallization of allanite in syenitic rocks of the Red Mountain Pluton. Mineralization is not structurally controlled and exploration drilling to date does not reveal any preferential mineralization related to geologic structures. Therefore, orientation of drilling does not bias sampling.
	If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material.	Orientation of drilling does not bias sampling.
Sample security	*The measures are taken to ensure sample security.*	All RC chip samples were collected from the drill rigs and stored in a secured, locked facility. Sample pallets were shipped weekly, by bonded carrier, directly to ALS labs in Twin Falls, ID. Chains of custody were maintained at all times. All core was collected from the drill rig daily and stored in a secure, locked facility until the core was dispatched by bonded courier to ALS Laboratories. Chains of custody were maintained at all times.

Section 1 Sampling Techniques and Data		
(Criteria in this section apply to all succeeding sections.)		
Criteria	***JORC Code explanation***	***Commentary***
		All rock samples were in the direct control of company geologists until dispatched to American Assay Labs.
Audits or reviews	*The results of any audits or reviews of sampling techniques and data.*	No external audits or reviews have been conducted to date. However, sampling techniques are consistent with industry standards.

Section 2 Reporting of Exploration Results		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
Mineral tenement and land tenure status	*Type, reference name/number, location and ownership, including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.*	ARR acquired 5 unpatented federal lode claims on BLM US Federal Land totalling 71.6 acres (29 has) from Zenith Minerals, Ltd (Zenith). in 2021. 67 unpatented federal lode claims were staked by ARR that totalled 1193.3 acres (482 ha) in summer 2021. ARR staked 182 unpatented federal lode claims in March 2022 covering an area of approximately 3,088 acres (1,250 ha). ARR staked 118 unpatented federal lode claims in November 2022 covering an area of approximately 2,113 acres (855 ha). As of December 31, 2022, ARR controlled 367 unpatented federal lode claims and 4 Wyoming State mineral licenses covering 8,165 acres (3,304 ha).
	The security of the tenure held at the time of reporting and any known impediments to obtaining a licence to operate in the area.	No impediments to holding the claims exist. To maintain the claims an annual holding fee of $165/claim is payable to the BLM. To maintain the State leases minimum rental payments of $1/acre for 1-5 years; $2/acre for 6-10 years; and $3/acre if held for 10 years or longer.
Exploration done by other parties	*Acknowledgment and appraisal of exploration by other parties.*	Prior to sampling by WIM on behalf of Blackfire Minerals and Zenith there was no previous sampling by any other groups within the ARR claim and Wyoming State Lease blocks.

Section 2 Reporting of Exploration Results		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
Geology	*Deposit type, geological setting and style of mineralisation.*	The REE's occur within Allanite which occurs as a variable constituent of the Red Mountain Pluton. The occurrence can be characterised as a disseminated type rare earth deposit.
Drill hole Information	*A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes:*	For the Fall 2023 program, FTE DRILLING USA INC. of Mount Uniacke, Nova Scotia used a Schraam T-450 track mounted rig to drill 15 reverse circulation drill holes. Drill hole depths for 37 holes was 102 m. FTE also utilized an enclosed Versa-Drilling diamond core rig to drill eight HQ-sized core holes. For the Fall 2022 program, FTE DRILLING USA INC. of Mount Uniacke, Nova Scotia used a Schraam T-450 track mounted rig to drill 37 reverse circulation drill holes. Drill hole depths for 37 holes was 150m and one hole at 175.5m Authentic Drilling from Kiowa, Colorado used both a track mounted and ATV mounted core rig to drill nine HQ diameter core holes. From March to April 2022, ARR drilled nine core holes across the Halleck Creek claim area. Drill holes ranged in depth from 194 to 352.5 ft with a total drilled length of 3,008 ft (917 m).
	easting and northing of the drill hole collar *elevation or RL (Reduced Level – elevation above sea level in metres) of the drill hole collar* *dip and azimuth of the hole* *downhole length and interception depth* *Hole length.*	Drilling information from the Fall 2022 drilling campaign is presented in detail in the "Technical Report of Exploration and Maiden Resource Estimates of the Halleck Creek Rare Earths Project", March 2023. Drilling information from the Fall 2023 campaign was published in the report "Summary of 2023 Infill Drilling at the Halleck Creek Project Area", November 2023.
	If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the	No Drilling data has been excluded.

Section 2 Reporting of Exploration Results		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
	Competent Person should clearly explain why this is the case.	
Data aggregation methods	*In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (e.g. cutting of high grades) and cut-off grades are usually Material and should be stated.*	Average Grade values were cut at minimum of TREO 1,000 ppm.
	Where aggregate intercepts incorporate short lengths of high-grade results and longer lengths of low-grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.	Assays are representative of each 1.50 m, (~5 ft) sample interval.
	The assumptions used for any reporting of metal equivalent values should be clearly stated.	Metal equivalents were used in economic sensitivities.
Relationship between mineralisation widths and intercept lengths	*These relationships are particularly important in the reporting of Exploration Results.* *If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.* *If it is unknown and only the downhole lengths are reported, there should be a clear statement*	Allanite mineralization observed at Halleck Creek occurs uniformly throughout the CQM and BHS rocks of within the Red Mountain Pluton. Therefore, the geometry of mineralisation does not vary with drill hole orientation or angle within homogeneous rock types.

Section 2 Reporting of Exploration Results		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
	to this effect (e.g. 'down hole length, true width not known').	
Diagrams	*Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported. These should include, but not be limited to, a plan view of drill hole collar locations and appropriate sectional views.*	Location information is presented in detail in the "Technical Report of Exploration and Maiden Resource Estimates of the Halleck Creek Rare Earths Project", March 2023
Balanced reporting	*Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practised to avoid misleading reporting of Exploration Results.*	The latest exploration results reported in "Mapping and Surface Sampling Summary at the Halleck Creek Project Area: April 2022". All relevant information for this section can be found in Table 1 in the "Technical Report of Exploration and Maiden Resource Estimates of the Halleck Creek Rare Earths Project", March 2023, and in report "Summary of 2023 Infill Drilling at the Halleck Creek Project Area", November 2023.
Other substantive exploration data	*Other exploration data, if meaningful and material, should be reported, including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock*	In hand specimen this rock is a red colored, hard and dense granite with areas of localized fracturing. The rock shows significant iron staining and deep weathering. Microscopic description: In hand specimen the samples represent light colored, fairly coarse-grained granitic rock composed of visible secondary iron oxide, amphibole, opaques, clear quartz and pink to white colored feldspar. All of the specimens show moderate to strong weathering

Section 2 Reporting of Exploration Results		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
	characteristics; potential deleterious or contaminating substances.	and fracturing. Allanite content is variable from trace to 2%. Rare Earths are found within the Allanite. Historical metallurgical testing consisted of concentrating the Allanite by both gravity and magnetic separation. The current program employs sequential high gradient magnetic separation and flotation to produce a concentrate suitable for downstream rare earth elements extraction.
Further work	*The nature and scale of planned further work (e.g. tests for lateral extensions or depth extensions or large-scale step-out drilling).*	Further drilling is planned to increase the area of the project, and to increase confidence levels of resources. Geological mapping and surface sampling will also be performed to define and prioritize drilling targets.
	Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.	Additional drilling is planned in new exploration areas and to increase resource confidence levels.

Section 3 Estimation and Reporting of Mineral Resources		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
Database integrity	*Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes.*	Drill hole data header, lithologic data checked by field geologists and by visual examination on maps and drill hole striplogs. Assay and Qa/Qc data were imported into the database directly from electronic spreadsheets provide by laboratories. Histograms graphical logs were also prepared and reviewed by ARR geologists.

Section 3 Estimation and Reporting of Mineral Resources		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
	Data validation procedures used.	
Site visits	*Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* *If no site visits have been undertaken indicate why this is the case.*	Mr. Dwight Kinnes visited the Halleck Creek site numerous times in 2023 and 2024. Mr. Gordon Sobering and Mr. Mark Stacy of Stantec visited the on November 29, 2023. Mr. Alf Gillman of Odessa Resources and Mr. Kelton Smith of Tetra Tech visited the site on March 7, 2024.
Geological interpretation	*Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.* *Nature of the data used and of any assumptions made.* *The effect, if any, of alternative interpretations on Mineral Resource estimation.* *The use of geology in guiding and controlling Mineral Resource estimation.* *The factors affecting continuity both of grade and geology.*	The Halleck Creek RE deposit is contained with rocks of the Red Mountain Pluton. These rocks consist primarily of clinopyroxene quartz monzonite (CQM), and biotite hornblende syenite (BHS). These two lithologies are difficult to visually distinguish. However, the concentration of rare earth elements is observable between lithologies. Rocks of the Elmers Rock Greenstone Belt (ERGB) and the Sybille (Syb) intrusion are easily distinguishable from rocks of the RMP. These rock units are essentially barren of rare earth elements. Therefore, the confidence in discerning rocks of the RMP from is high. The extent of the RMP relative to other units was outlined into modelling domains used for resource estimates. The distribution of allanite throughout CQM and BHS rocks of the RMP is generally uniform and is not structurally controlled. Potassic alternation observed does not appear to affect the grade of allanite throughout the deposit.
Dimensions	*The extent and variability of the Mineral Resource expressed as length (along strike or*	The Halleck Creek REE project currently contains two primary resource areas: the Red Mountain area and the Overton Mountain area. Resources also extend into the Bluegrass resource area.

Section 3 Estimation and Reporting of Mineral Resources

(Criteria listed in the preceding section also apply to this section.)

Criteria	JORC Code explanation	Commentary
	otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	The Red Mountain resource area is bounded to the west by the ERGB, and to the south by the Syb. Further exploration is needed to determine the extent to the north and two the east. RC samples with TREO grades exceeding 1,500 ppm occurred at the base of 37 drill holes in the Red Mountain resource area extending down to depths of 150m with one hole extending to a depth of 175.5m. Therefore, ARR considers the Red Mountain resource area to be open at depth. The Overton Mountain resource area is bounded to the west by mineral claims, and therefore, remains open to the west. Lower grade BHS rocks occur at the northern end of Overton Mountain. Drilling data to the east and south indicate that the Overton Mountain resource area remains open across Bluegrass Creek. Like the Red Mountain drilling, RC samples at Overton Mountain contained TREO assay values exceeding 3,500 ppm to depths of 150m in 18 holes. One, 302m diamond core hole additionally exhibited grades exceeding 2,000 ppm to the bottom of the hole. Therefore, ARR considers the Overton Mountain resource area to be open at depth.
Estimation and modelling techniques	*The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used.*	Odessa Resources updated block models for Overton Mountain and Red Mountain using the Leapfrog geological modelling software. **Block Model Parameters** **Block Model Parameter** — **Value** Parent Block Size — 20m Sub-block count (i, j, k) — 4, 4, 4 Minimum block size (i, j, k) — 5m ,5m, 5m Base point (x, y, z) — 473900.00, 4631300.00, 2000.00

Section 3 Estimation and Reporting of Mineral Resources

(Criteria listed in the preceding section also apply to this section.)

Criteria	JORC Code explanation	Commentary
	The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data. *The assumptions made regarding recovery of by-products.* *Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation).* *In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.* *Any assumptions behind modelling of selective mining units.* *Any assumptions about correlation between variables.* *Description of how the geological interpretation was used to control the resource estimates.* *Discussion of basis for using or not using grade cutting or capping.*	(see tables and text below)

Boundary size (W x L x H)	2400.00, 5400.00, 600.00
Azimuth	0
Dip	0
Pitch	0
Size in Blocks	120x270x30=972,000

The block model contains attributes pertaining to resource block, resource category, grade class, geologic domain, and numerical attributes for TREO, rare earth oxides of all rare earth elements.

Geological domains focused on higher grade CQM and BHS lithologies which provided control of resource block boundaries along with variography.

General	Direction			Structure 1					
Variogram Name	**Dip**	**Dip Azimuth**	**Pitch**	**Normalized Nugget**	**Normalized sill**	**Structure**	**Major**	**Semi-major**	**Minor**
OM	0	0	124	0	0.6	Spherical	280	230	200
RM	0	0	90	0.1	0.8	Spherical	445	240	170

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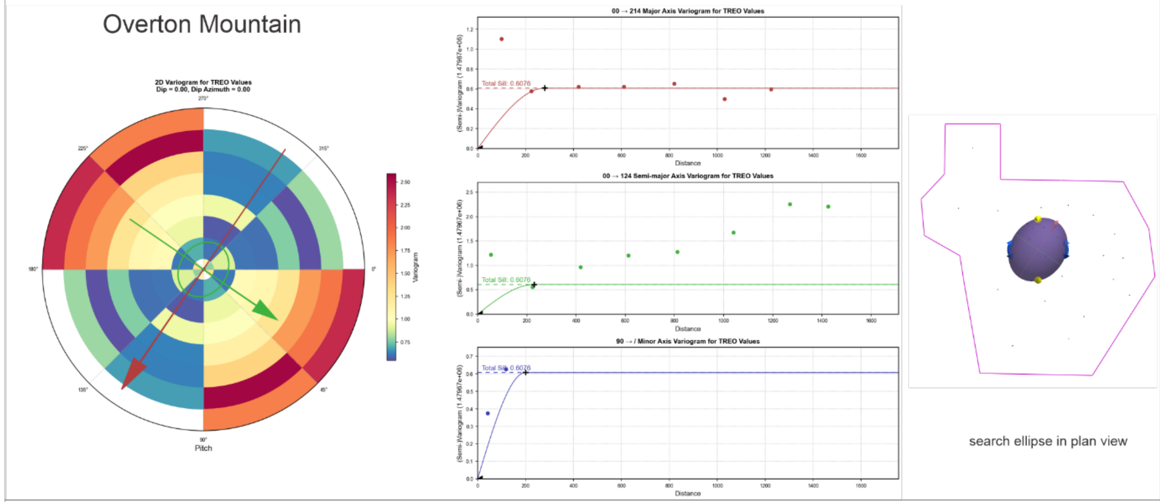
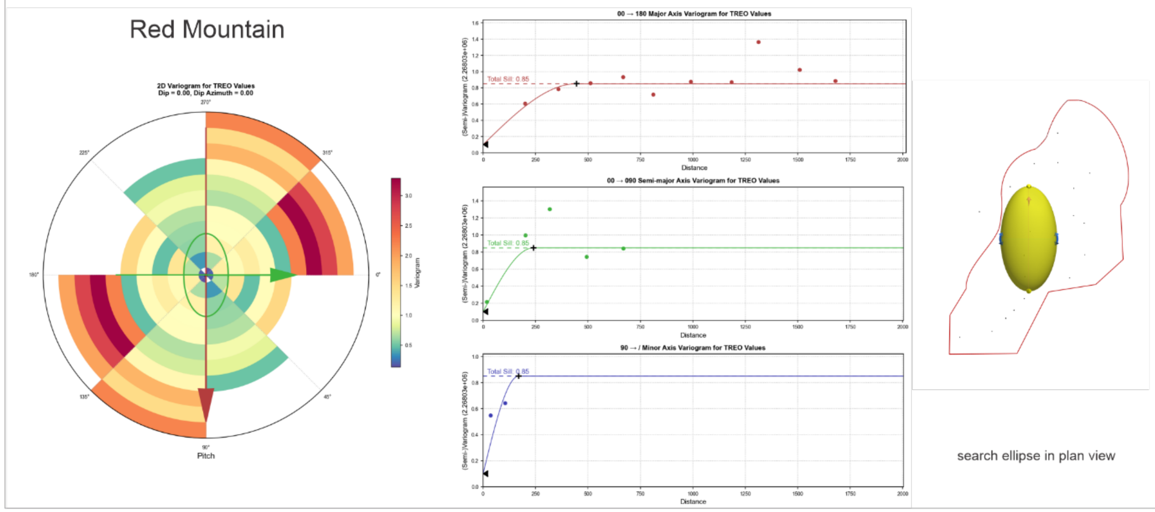
<td>The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.</td>
<td>




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Section 3 Estimation and Reporting of Mineral Resources		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
Moisture	*Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.*	Tonnages are based on in-situ, dry basis.
Cut-off parameters	*The basis of the adopted cut-off grade(s) or quality parameters applied.*	A cut-off grade of 1,000 ppm TREO was applied to reported resource estimates based on preliminary net smelter calculations performed by Stantec.
Mining factors or assumptions	*Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.*	No mine plan or design has been prepared at this stage however the shallow nature of the deposit assumes extraction by open pit mining methods.

Section 3 Estimation and Reporting of Mineral Resources

(Criteria listed in the preceding section also apply to this section.)

Criteria	JORC Code explanation	Commentary
Metallurgical factors or assumptions	*The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.*	Preliminary metallurgical testwork shows that use of dense media separation and WHIMS can potentially reject up to 93% of waste and upgrade grade by about 11 times. Additional testwork is being planned to test these processes on larger volumes of core. Direct sulphuric acid leaching shows that more than 90% of REE can be extracted from allanite. Additional testwork is being planned to test these processes on larger volumes of core.
Environmental factors or assumptions	*Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported.*	ARR is in the process of outlining environmental, social, and community impacts regarding the potential development of the project. These impacts are being included in conceptual designs of all facets of the project.

Section 3 Estimation and Reporting of Mineral Resources		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
	Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	
Bulk density	*Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples.* *The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit.* *Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.*	An average specific gravity of 2.70 represents the in-place ore material at Halleck Creek based on hydrostatic testing. Bulk density testing will be included during bulk sample collection currently being designed and permitted.
Classification	*The basis for the classification of the Mineral Resources into varying confidence categories.* *Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and*	The classification at Halleck Creek is based on the following key attributes: **Geological continuity between drill holes** • Mineralization is controlled by batholith-scale fractionation. Hence, both empirical observations and statistical analysis confirm a very high degree of continuity with the respective rock masses at Overton Mountain and Red Mountain. • This is supported by variography.

Section 3 Estimation and Reporting of Mineral Resources		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
	metal values, quality, quantity and distribution of the data). *Whether the result appropriately reflects the Competent Person's view of the deposit.*	**Drill spacing and drill density** • The drill pattern is mostly irregular with drill spacing of approximately 200m. • At Overton Mountain an area has been infilled on a systematic grid spacing of approximately 90m. This spacing is considered to be adequate to support a measured classification. The CP considers the above classification strategy and methodology to be appropriate and reasonable for this style of mineralisation.
Audits or reviews	*The results of any audits or reviews of Mineral Resource estimates.*	There have not been any audits of mineral resource estimates.
Discussion of relative accuracy/ confidence	*Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate.* *The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be*	Reported resources for Halleck Creek are in-place global estimates of tonnage and rare earth grade. The basis of classification of mineral resources was based on geostatistical analysis of variograms of rare earth elements. The resource is classified as either measured, indicated or inferred. Subject to the application of 'modifying factors' the measured plus indicated component of the resource may allow for a formal evaluation of its economics with the potential to be converted to a Probable Ore Reserve. Therefore, a high degree of conservatism has been adopted as the underlying premise of the resource classification and, in particular, the indicated component.

Section 3 Estimation and Reporting of Mineral Resources		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	***JORC Code explanation***	***Commentary***
	relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. *These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	

Section 4 Estimation and Reporting of Ore Reserves		
(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)		
Criteria	**JORC Code explanation**	**Commentary**
Mineral Resource estimate for conversion to Ore Reserves	*Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve.* *Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.*	No mineral resources have been converted to Ore reserves
Site visits	*Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* *If no site visits have been undertaken indicate why this is the case.*	Mr. Gordon Sobering, Senior Project Manager of the Halleck Creek Scoping Study representing Stantec, completed a site visit on Wednesday, 29 November 2023 with executives and geologists from ARR, including Mr. Dwight Kinnes and Mr. Donald Swartz. The visit included an inspection of the land at both Red Mountain and Overton Mountain and the project geology. Mr Kelton Smith

Section 4 Estimation and Reporting of Ore Reserves		
(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)		
Criteria	**JORC Code explanation**	**Commentary**
		of Tetra Tech and Mr. Alf Gillman of Odessa Resources, completed a site visit on March 7, 2024 with Messrs. Dwight Kinnes and Don Swartz of ARR.
Study status	*The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.* *The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.*	American Rare Earths Pty. Ltd. (ARR) has engaged Stantec Consulting Services Inc. (Stantec) to conduct a scoping study under the Australian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code or JORC) standards for the Halleck Creek Rare Earth Deposit (HCRE-D. As such, mineral resources are reported in this study and not ore reserves, as is stated for a scoping study in the JORC code.
Cut-off parameters	*The basis of the cut-off grade(s) or quality parameters applied.*	The break-even cut-off grade was calculated using mining costs ($3.95/ore tonne) determined by Stantec and milling costs ($26.43/ore tonnes) supplied by Tetratech (ARR's metallurgical consultant) and are appropriate for a mine of this size and scale. General and Administration costs are included in both costs listed above.
Mining factors or assumptions	*The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design).*	Surface mining was chosen as the method to extract the resource due to mineralization outcropping on surface and the homogeneity of the mineral grade over a large extent. In the absence of geotechnical data Stantec used reasonable bench angles, catch bench widths based on industry experience. Mining and metallurgical costs were from Stantec and Tetratech's respective cost databases for a mine and mill of this size and scale. Process recoveries were based on preliminary test work on samples of the mineralization.

Section 4 Estimation and Reporting of Ore Reserves		
(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)		
Criteria	**JORC Code explanation**	**Commentary**
	The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc. *The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.* *The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate).* *The mining dilution factors used.* *The mining recovery factors used.* *Any minimum mining widths used.* *The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion.* *The infrastructure requirements of the selected mining methods.*	Mine design work was based on Geovia's Whittle mine software package, using a block model supplied by ARR and reviewed by Stantec for adequacy at a scoping level of study. The following mine design parameters were used in the pit design: Height between catch benches 6 m Bench Face Angle 70° Berm Width 2.9 m Total Road Allowance 18.5 m Maximum Ramp Grade 10% Minimum Operating Width 30 m

Section 4 Estimation and Reporting of Ore Reserves

(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)

Criteria	JORC Code explanation	Commentary

Parameter	Unit	Red Mountain & Overton Mountain							
Revenue, Smelting & Refining		**La**	**Pr**	**Nd**	**Sm**	**Eu**	**Gd**	**Tb**	**Dy**
Price	USD	$2.00	$91.00	$91.00	$10.00	$10.00	$10.00	$1,500.00	$400.00
Recovery	%	68.63%	63.86%	63.86%	70.11%	70.11%	70.11%	70.22%	66.49%
Refining Price Factor	%	0%							
Treatment Charges	USD	$0.00							
Refining Costs	USD	$0.00							
Shipping Costs	USD	$0.00							
Transportation Concentrate Losses	%	0%							
Recovery and Dilution									
External Mining Dilution	%	0%							
Mining Recovery	%	100%							
Geotechnical									
Slope ISA	deg	50							
OPEX									
Milling Cost	USD	$26.43							
Surface Mining Cost	USD	$3.95							
Site G&A	USD	$0.00							
Total OPEX Cost	USD	$29.28							

No mining dilution was used in the mine design of this study and a mining recovery of 100 % was assumed. Based on the chosen mining equipment, a minimum mining width of 30 meters was utilized. Measured, indicated and inferred mineral resources were included in the mine design, which is appropriate at a scoping level of study. Due to the homogeneity of the mineralization, while it is not reasonable to state that all inferred resources will be converted to a more precise mineral resource category, in general it is felt that the it is reasonable to assume that the majority

Section 4 Estimation and Reporting of Ore Reserves		
(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)		
Criteria	**JORC Code explanation**	**Commentary**
		of the inferred resource will be converted to indicated or measured with additional sampling due to the size and homogeneity of the mineralized zone. Supporting mine infrastructure is discussed in the appropriate section of this paper.
Metallurgical factors or assumptions	*The metallurgical process proposed and the appropriateness of that process to the style of mineralisation.* *Whether the metallurgical process is well-tested technology or novel in nature.* *The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied.* *Any assumptions or allowances made for deleterious elements.* *The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole.*	Based on testwork to date, metallurgical recovery factors for the study as thus: La Recovered (kg) 68.6% NdPr Recovered (kg) 63.9% SEG Recovered (kg) 70.1% Tb Recovered (kg) 70.2% Dy Recovered (kg) 66.5%

Section 4 Estimation and Reporting of Ore Reserves		
(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)		
Criteria	**JORC Code explanation**	**Commentary**
	For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	
Environmental	*The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.*	ARR acquired exploration drilling notices from the Wyoming Department of Environmental Quality (WDEQ), Land Quality Division, for all drilling activities performed to date. ARR is developing a permitting needs assessment with local environmental consulting groups to present to each division at WDEQ to identify comprehensive environmental baseline studies needed to permit a mining operation at Halleck Creek. ARR is identifying additional regulatory stakeholders in Wyoming as part of the needs assessment. Factors for mine closure have been included in mining costs and financial modeling. At this stage of development, no mine closure plans have been developed. At this stage in project development, no social impact studies have been completed.
Infrastructure	*The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.*	Processing facilities will be split between the mine site and a second site near Wheatland, Wyoming. A concentrate will be produced at the mine site and trucked by highway to the second and final processing facility where saleable metals will be produced. Infrastructure consisting of roads, water supply, electrical power, natural gas and buildings to support operations at both sites is included in the economics of the project. Mining, oil and gas operations are common in Wyoming and is reasonable to expect a well trained work force will be able to be attracted to the operation during start up and life of mine operations.
Costs	*The derivation of, or assumptions made, regarding projected capital costs in the study.*	Site capital costs buildings were determined from the Mine Cost Handbook (2021) and escalated based on inflation factors to 2023 costs. Costs to erect access roads and construct the water

Section 4 Estimation and Reporting of Ore Reserves		
(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)		
Criteria	**JORC Code explanation**	**Commentary**
	The methodology used to estimate operating costs. *Allowances made for the content of deleterious elements.* *The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co- products.* *The source of exchange rates used in the study.* *Derivation of transportation charges.* *The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc.* *The allowances made for royalties payable, both Government and private.*	supply system were based on construction and drilling costs from recent similar projects Stantec has worked on. Stantec relied on price expectations provided by ARR, which were based on price forecasts from multiple firms. No exchange rates were used in this study, as all costs are in US dollars.
Revenue factors	*The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc.*	

Section 4 Estimation and Reporting of Ore Reserves		
(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)		
Criteria	**JORC Code explanation**	**Commentary**
	he derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	
Market assessment	*The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.* *A customer and competitor analysis along with the identification of likely market windows for the product.* *Price and volume forecasts and the basis for these forecasts.* *For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.*	Rare earth price assumptions used in the base case scenario are derived from ARR's assessment of price expectations over the next couple of years. ARR's assessment is based on an average of spot and price forecasts from Goldman Sachs, Morgan Stanley, JPM Chase, and Canaccord Genuity. The resultant price is lower than the average price over the past two years. All prices are FOBfob. Pricing data from the various sources can be found in Appendix BX and are summarized in the table below. **Product** / **Price ($/kg)** NdPrO / $90.61 Dysprosium / $400 Terbium / $1,500 SEG / $10 Lanthanum / $2
Economic	*The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc.* *NPV ranges and sensitivity to variations in the significant assumptions and inputs.*	The evaluation of the project assumes 100% ownership. The financial model was completed on yearly increments; NPV was determined at both pre and post-tax treatments, using the Discounted Cash Flow method of valuation using discount rates of 8%, 10% and 12%. Some costs were escalated at a rate of 5% per annum from the date of their source to 2023 costs. US Federal, Wyoming state tax and various State royalty treatments were applied to the post tax case.

Product	Price ($/kg)
NdPrO	$90.61
Dysprosium	$400
Terbium	$1,500
SEG	$10
Lanthanum	$2

Section 4 Estimation and Reporting of Ore Reserves		
(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)		
Criteria	**JORC Code explanation**	**Commentary**
		Sensitivity to the major cost drivers have been modelled, including equivalent NdPr price, Processing OPEX, Mining OPEX and Processing CAPEX
Social	*The status of agreements with key stakeholders and matters leading to social licence to operate.*	At this stage in project development, no social impact studies have been completed.
Other	*To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:* *Any identified material naturally occurring risks.* *The status of material legal agreements and marketing arrangements.* *The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third*	No Ore Reserves are reported in this scoping study, in agreement with JORC standards.

Section 4 Estimation and Reporting of Ore Reserves		
(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)		
Criteria	**JORC Code explanation**	**Commentary**
	party on which extraction of the reserve is contingent.	
Classification	*The basis for the classification of the Ore Reserves into varying confidence categories.* *Whether the result appropriately reflects the Competent Person's view of the deposit.* *The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).*	No Ore Reserves are reported in this scoping study, in agreement with JORC standards.
Audits or reviews	*The results of any audits or reviews of Ore Reserve estimates.*	Stantec performed a gap analysis of the resource model before starting any work and found the work adequate to support a scoping study.
Discussion of relative accuracy/ confidence	*Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could*	No Ore Reserves are reported in this scoping study, in agreement with JORC standards.

Section 4 Estimation and Reporting of Ore Reserves		
(Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.)		
Criteria	**JORC Code explanation**	**Commentary**
	affect the relative accuracy and confidence of the estimate. *The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.* *Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage.* *It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	

Appendix B
NdPr Prices Used in this Report

Company	*2024*	*2025*	*2026*	*2027*	*2028*
Morgan Stanley	$ 95.00	$ 28.00	$ 136.00		
JPM Chase	$ 81.34	$ 88.02	$ 92.47	$ 102.28	
Canaccord Genuity	$ 80.00	$ 125.00	$ 135.00		
Goldman Sachs	$ 77.00	$ 83.00	$ 88.00	$ 91.00	$ 94.00
Consensus	**$ 83.34**	**$ 106.01**	**$ 112.87**	**$ 96.64**	**$ 94.00**

Appendix C
Qualified Person Certifications

CERTIFICATION OF QUALIFICATIONS
J Gordon Sobering
Senior Project Manager
Stantec Consulting Services Inc.

I, JAMES GORDON SOBERING, Qualified Professional Member (QP) #4061917RM of the Society of Mining Engineers (SME), and Professional Engineer (PE) in the State of Colorado (PE# 0049491) HEREBY CERTIFY THAT:

1. I am currently employed as a Senior Project Manager with Stantec Consulting Services in Denver, Colorado USA.

2. I am a graduate of the Montana Technological University, with a B.S. degree in Mining Engineering (1990) and a BSc. in Geology from Lakehead University in Thunder Bay, Ontario, Canada (1985) and have been practicing my profession since 1985.

3. I am a registered member of the Society of Mining Engineers (SME), number #4061917RM.

4. From 1985 to present I have been actively employed in various capacities in the mining/minerals industry in numerous locations in North America.

5. I have read and reviewed the Technical Report titled “Halleck Creek Scoping Study, Technical Report” dated 08 March, 2024, and accept professional responsibility for the following Sections: 1 (Executive Summary with others), 2 (Introduction), 12 (Mining Designs and Plans), 14 (Facilities and Infrastructure), Capital Cost Estimate (with Tetra Tech), Operating Cost Estimate (with Tetra Tech), 19 (Socioeconomics/ ESG), 21 (Financial Analysis), 24 (Other Relevant Data and Information), 25 (Interpretations), 26 (Recommendations), 28 (Reliance on Information Provided by the Registrant) .

6. I have extensive experience in mine engineering, mine operations, and mineral economics for over 30 years in various capacities as an employee of mining companies and as a consultant.

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

8. I am independent of American Rare Earths, Ltd.

9. I consent to the filing of this Technical Report with any stock exchange and other regulatory authority and publication by them, including publication of this Technical Report in the public company files on their websites accessible by the public.

DATED in Lakewood, Colorado, USA this 8th day of March 2024.

/s/ James Gordon Sobering

James Gordon Sobering, SME-RM 4061917, PE (Colorado)

CERTIFICATION OF QUALIFICATIONS
Kelton Smith
Process Department Lead
Tetra Tech Inc.

I, KELTON SMITH, Qualified Professional Member (QP) #4227309RM of the Society of Mining Engineers (SME), HEREBY CERTIFY THAT:

1. I am currently employed as a process department lead with Tetra Tech Inc., with an office in Parker, Colorado USA.

2. I am a graduate of the University of Utah, with a B.S. degree in Chemical Engineering (1997), I have been practicing my profession since 1997.

3. I am a registered member of the Society of Mining Engineers (SME), number #4227309RM.

4. From 1997 to present I have been actively employed in various capacities in the mining/minerals/chemicals industry in numerous locations in North America.

5. I have contributed to the Technical Report titled "Halleck Creek Scoping Study, Technical Report" dated 08 March, 2024, and accept professional responsibility for the following for Section 9 (Metallurgy) and Section 13 (Processing and Recovery Methods) of this report.

6. I have had extensive prior involvement in working with rare earths and rare earth properties similar to Halleck Creek for the past 15 years in various capacities as an employee of mining companies and as a consultant.

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

8. I am independent of American Rare Earths, Ltd.

9. I consent to the filing of this Technical Report with any stock exchange and other regulatory authority and publication by them, including publication of this Technical Report in the public company files on their websites accessible by the public.

DATED in Parker, Colorado, USA this 12th day of March 2024.

Kelton Smith, SME-RM 4227309

CERTIFICATION OF QUALIFICATIONS
ALFRED J. GILLMAN
CONSULTING GEOLOGIST
ODESSA RESOURCES PTY LTD

I, Alfred J. Gillman, hereby certify that:

1. I am currently the Principal of the independent resource consulting firm Odessa Resources Pty Ltd (ABN 16 133 543 727) and have been engaged by American Rare Earths to undertake resource estimation work for the Halleck Creek Rare Earths Project.

2. I am a graduate of the University of Western Australia (1980) and hold a Bachelor of Science Degree with Honours in Geology and I have been practicing in my profession since 1980.

3. I am a Chartered Professional (Geology) and Fellow of The Australasian Institute of Mining and Metallurgy or the Australian Institute (AusIMM), number 107303.

4. From 1980 to present I have been actively employed in various capacities in the mining industry in numerous locations around the world.

5. I have read and understood the requirements of the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code, 2012 Edition).

6. I am a Competent Person as defined by the JORC Code 2012 Edition, having sufficient experience that is relevant to the style of mineralisation and type of deposit described in the Report, and to the activity for which I am accepting responsibility.

7. I verify that Section 10 of the Technical Report is based on and fairly and accurately reflects in the form and context in which it appears, the information in my supporting documentation relating to Mineral Resources.

8. As of the effective date of the report, to the best of my knowledge, information and belief, Section 10 of the Technical Report contains all scientific and technical information that is required to be disclosed to make the report not misleading.

9. I consent to the filing of this report with any stock exchange and other regulatory authority and publication by them, including publication of the report in the public company files on their websites accessible by the public.

Dated in Perth, Western Australia this 12th day of March 2024.

/s/ Alfred J. Gillman

Alfred J. Gillman
BSc(Hons), FAusIMM (CP Geol) 107303

CERTIFICATION OF QUALIFICATIONS
Dwight M. Kinnes, CPG, RM-SME
Chief Technical Officer
American Rare Earths, Ltd.

I, DWIGHT M. KINNES, Qualified Professional Member (QP) #4063295RM of the Society of Mining Engineers (SME), HEREBY CERTIFY THAT:

1. I am currently employed as chief technical officer with American Rare Earths, Ltd, with an office in Lakewood, CO 80401.

2. I am a graduate of Colorado State University, with a B.S. degree in Geology (1986), I have been practicing my profession since 1986.

3. I am a registered member of the Society of Mining Engineers (SME), number 4063295.

4. From 1986 to present I have been actively employed in various capacities in the mining industry in numerous locations in North America, South America, Asia, Australia, and Europe.

5. I am a contributor, with employees, of the Technical Report titled "Halleck Creek Scoping Study, Technical Report" dated March 12, 2024, and accept professional responsibility for Sections 2.0, 3.0, 4.0, 5.0, 6.0 7.0 8.0, and 16.0 of this report.

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

7. I am employed by American Rare Earths, Ltd.

8. I consent to the filing of this Technical Report with any stock exchange and other regulatory authority and publication by them, including publication of this Technical Report in the public company files on their websites accessible by the public.

DATED in Palisade, Colorado, USA this 12th day of March 2024.

/s/ Dwight M. Kinnes

Dwight M. Kinnes, CPG (4063295RM – SME)