

IONEER USA Corp.

Rhyolite Ridge Lithium-Boron Project

Definitive Feasibility Study (DFS) Report

Section 1

Executive Summary

TABLE OF CONTENTS (METRIC UNIT VERSION)

1.0 Executive Summary	2
1.1 Rhyolite Ridge Project – Highlights	2
1.2 Project Background	11
1.3 Scope of Study	11
1.4 Key Project Data	14
1.5 Technical Summary	15
1.6 Project Costs	37
1.7 Financial Analysis – Details	46
1.8 Permits and Approvals	49
1.9 HSEC and Sustainable Development	51
1.10 Project Execution Plan	53
1.11 Operational Readiness	56
1.12 Market Analysis and Marketing – Details	61
1.13 Site Photos	65

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1.0 EXECUTIVE SUMMARY

1.1 RHYOLITE RIDGE PROJECT – HIGHLIGHTS

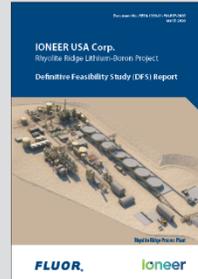
The Rhyolite Ridge Project is a greenfield large-scale, lithium-boron project being developed on federal lands in southern Nevada in the United States. The project is located approximately halfway between Reno and Las Vegas, Nevada, and is easily accessible via state and country roads.

The Rhyolite Ridge Project is the only one of its type known globally. Rhyolite Ridge's unique mineralogical characteristics support low-cost processing of its ore into high-grade lithium and boric acid products using sulphuric acid leaching.

With the definitive feasibility study (DFS) successfully completed, the Rhyolite Ridge Project has been robustly developed on a stand-alone basis and demonstrates a strong business case as follows:

- ▶ The project will be a large, long-life, low-cost operation and will play an important role in providing two critical materials (lithium and boron) essential for a sustainable future. Lithium demand is expected to increase by more than 20% year on year, driven by electrification of transportation and renewable energy storage.
- ▶ The project has a robust business case including after-tax NPV₈ of US\$1.265 billion and healthy unlevered, after-tax rate of return (20.8% IRR).
- ▶ The project's location is in Nevada, United States, consistently rated as one of the world's most favorable and stable mining jurisdictions.
- ▶ Co-production of lithium and boron products at Rhyolite Ridge will reduce overall revenue volatility and allow IONEER to produce lithium carbonate and lithium hydroxide at the bottom of the lithium cost curve (US\$2,510 per metric ton on a lithium carbonate equivalent [LCE] basis).
- ▶ The project will mine 2.5 million metric tons per year of ore over 26 years to produce the following annual averages:
 - 22,340 metric tons of lithium carbonate (99% purity) (years 1 to 3)
 - 21,951 metric tons of lithium hydroxide (99.5% purity) (year 4 onward)
 - 174,378 metric tons of boric acid (life of quarry)
- ▶ The lithium and boron **Mineral Resource** is estimated at 146.5 million metric tons (Mt) and was completed by Golder Associates and its independent Competent Person in compliance with the JORC code, with potential expansion opportunities. The Mineral Resource is inclusive of the Ore Reserve.
- ▶ The lithium and boron **Ore Reserve** is estimated at 60.2 million metric tons (Mt) and was completed by Golder Associates and its independent Competent Person in compliance with the JORC code, with potential expansion opportunities.
- ▶ The DFS mine plan is based on mining 64 million metric tons of ore over 26 years.
- ▶ The Rhyolite Ridge ore will be processed by vat acid leaching, impurity removal, evaporation, and crystallization, involving a flowsheet developed for this project using known and commercially proven

Rhyolite Ridge Definitive Feasibility Study (DFS) Facts



- ▶ NPV₈ of US\$1.265 billion
- ▶ IRR of 20.8%
- ▶ Production cost at bottom of lithium carbonate cost curve
- ▶ Mineral Resource of 146.5 million tons and Ore Reserve of 60 million tons
- ▶ 63 million ton mine plan of 26 years

- ▶ Extensive process bench-scale test work and pilot plant program
- ▶ DFS completed over 18 months
- ▶ AACEI Class 3 capital and operating cost estimates delivered
- ▶ 30% engineering complete
- ▶ 1,600 DFS deliverables produced
- ▶ Environmental baseline studies completed

Measurements in metric tons.

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equipment and technology. The flowsheet development has been supported by extensive test work and pilot plant programs.

- ▶ The project will be an environmentally friendly operation with green power production, low-water usage, low emissions, and a modest surface footprint with no tailings dam.
- ▶ Substantial market support for the project has already been achieved through a 105,000 metric tons per annum binding offtake agreement with one of the largest users and distributors to the boron industry, which represents over 50% of Rhyolite Ridge's expected annual boric acid production.
- ▶ Rhyolite Ridge will become the first greenfield site in the United States to use automated haul trucks in the initial operation after numerous international projects have demonstrated favorable results using automated haul trucks. This has been shown to provide operating and capital costs advantages in addition to minimizing safety incidents.
- ▶ The DFS has been successfully completed to international mining project standards by IONEER and Tier 1 EPCM companies Fluor and SNC-Lavalin. AACEI Class 3 operating and capital cost estimates ($\pm 15\%$) were produced, with engineering design at 30% complete.
- ▶ The project is following critical risk mitigation strategies including the following:
 - Initial production of technical-grade lithium carbonate. This will allow the plant to reach steady-state operations, making the change to production of battery-grade lithium hydroxide in year 4 a lower risk and manageable task.
 - Completion of the binding offtake agreement for over 50% of the boric acid produced assures early entry to the market.
 - Development of a project risk register using Fluor's proven risk identification and mitigation methods for execution of the project.

IONEER Limited (IONEER) (ASX:INR) has 100% ownership of the project and is solely focused on developing the Rhyolite Ridge Project. The core mission of IONEER is to responsibly and profitably provide the materials necessary for a sustainable planet.

1.1.1 CONCLUSION AND RECOMMENDATION

The definitive feasibility study (DFS) has been completed by Fluor, a Tier 1 EPCM company, and represents a major, positive step forward in the development of the project. The DFS has achieved its objectives and advanced the level of certainty of the project, including metallurgical processes, mineral resource and reserve statements, mine plan, environmental and permitting requirements, operating and capital cost estimates, and execution planning.

The demonstrated economics of the project and the low-cost, long-life, and strategic nature of the asset should allow Rhyolite Ridge to attract favorable debt finance and value-added strategic partner(s). It is therefore recommended that the project continue into the execution engineering stage, and funding of US\$785 million be obtained and approved for the implementation of the project.

1.1.2 COMMERCIAL CASE – SUMMARY

The Rhyolite Ridge DFS has demonstrated strong project economics as summarized in Figure 1-1 below. The project's commercial strength is made possible by having significant lithium and boron revenue streams.

The economics of the project were evaluated using a real (non-escalated), after-tax discounted cash flow (DCF) model on a 100% project equity basis (unlevered). Production, revenues, operating costs, capital costs, and tax were considered in the financial model.

This financial analysis covers the period from DFS completion, and cash flows are reported in 1Q 2020 real U.S. dollars without allowance for escalation or currency fluctuation.

Economic Summary – Rhyolite Ridge Project

Item	Description
IRR (internal rate of return, unlevered)	20.8%
NPV (net present value) (8% real)	US\$1.265 billion
Revenue	US\$10.7 billion
EBITDA	US\$ 7.3 billion
EBITDA margin	68.14%
After-tax CF	US\$4.9 billion
Mine life	26 years

Figure 1-1. Project Economic Summary.

Over the 26-year mine life, the project will generate a revenue of US\$10.7 billion based on annual average production of:

- ▶ 20,588 metric tons of lithium carbonate (99% purity)
- ▶ 174,378 metric tons of boric acid (99.9% purity)

From year 4, the technical-grade lithium carbonate volumes will be converted into lithium hydroxide, producing an average of:

- ▶ 21,951 metric tons of lithium hydroxide (99.5% purity) per annum in years 4 to 26

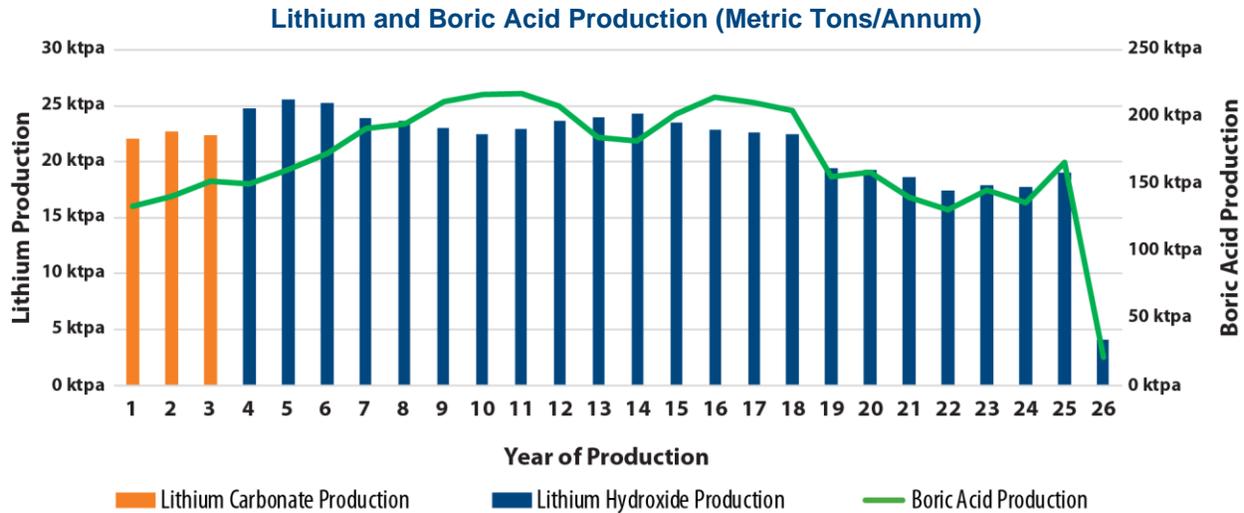
Gradual and predictable grade variation across the deposit means lithium production will be significantly higher and boron lower during the first 6 years of production as shown below in Figure 1-2. Annual productions rates during the first 6 years will be:

- ▶ 22,340 metric tons of lithium carbonate (99% purity) in years 1 to 3
- ▶ 25,171 metric tons of lithium hydroxide (99.5% purity) in years 4 to 6
- ▶ 151,691 metric tons of boric acid (99.9% purity)

IONEER will expand the plant for the conversion of lithium carbonate into lithium hydroxide at year 4 to take advantage of the following opportunities:

- ▶ Initial production of technical-grade lithium carbonate lowers operational risk in the start-up phase and establishes IONEER in the lithium supply market.
- ▶ Production of battery-grade lithium hydroxide in year 4 coincides with its market growth (expected to overtake lithium carbonate demand after 2021).
- ▶ Rhyolite Ridge production capabilities exploited in the long term:
 - Technical-grade lithium carbonate is ideally suited for conversion to lithium hydroxide.
 - The sulphuric acid plant is expected to generate excess steam and power during the conversion process, providing the potential to export power to the electrical grid.
 - Calcium carbonate formed during lithium hydroxide production will be recycled and used in the impurity-removal process within the main plant, thus reducing reagent costs.

The production advantages of the onsite lithium hydroxide circuit will result in a lower capital cost per ton of lithium hydroxide, and a substantially lower net operating cost to convert lithium carbonate to hydroxide compared to industry norms. The lithium hydroxide circuit has not been developed to the same level of completion as all other circuits in the overall operation, due to its construction commencing in production year 3. Cost estimates for the lithium hydroxide circuit were developed by IONEER based on industry expenditures, and are incorporated into the project's DFS financial model as operating and sustaining capital costs.

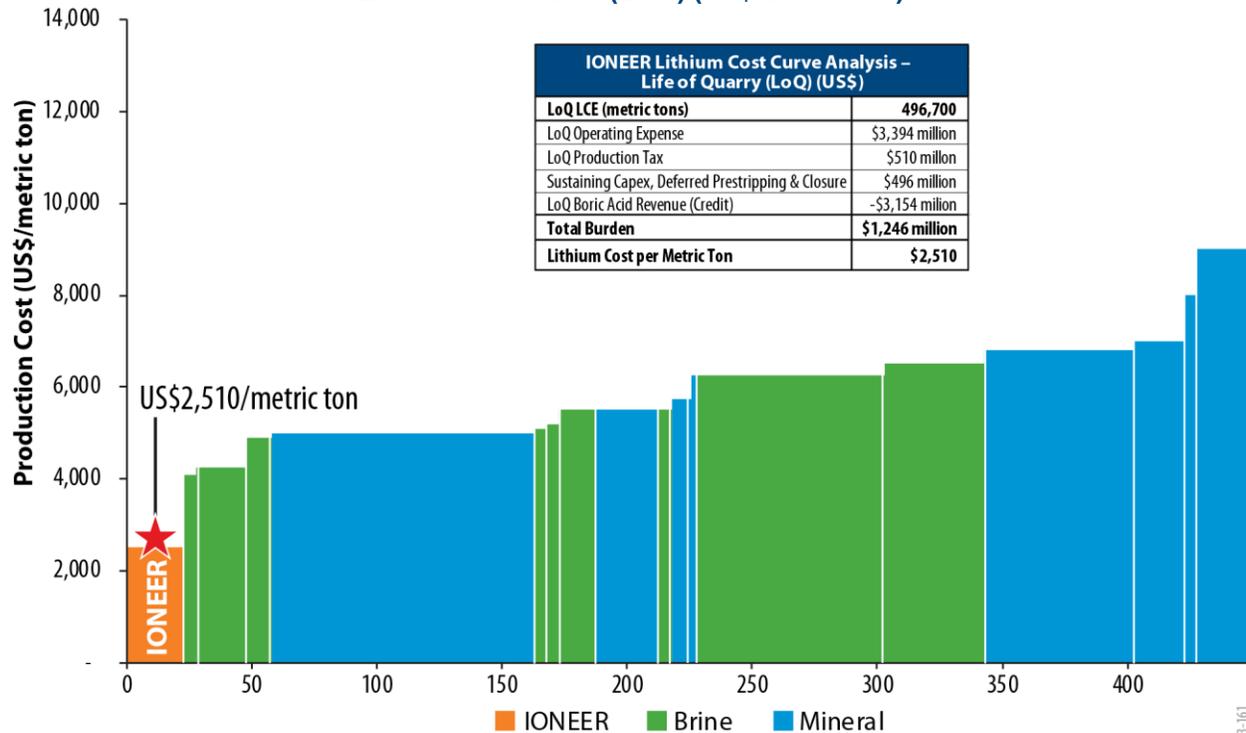


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Figure 1-2. Lithium and Boric Acid Production. Units in ktpa (thousands of metric tons per annum).

The lithium carbonate equivalent (LCE) cost curve in Figure 1-3 below shows Rhyolite Ridge as the lowest cost producer globally. This is made possible by the substantial and stable boric acid revenue stream that is applied as a credit against operating costs. The credit has been calculated using an average life-of-quarry boric acid price of \$710 per metric ton. All-in sustaining cash costs of US\$2,510/metric ton is the average cost per ton to produce battery-grade lithium hydroxide. It includes the cost to produce technical-grade lithium carbonate and its conversion into lithium hydroxide (as there are no lithium hydroxide conversion costs incurred in the first 3 years when only lithium carbonate is produced).

Lithium Cost Curve (2019) (US\$/Metric Ton)



Cumulative Lithium Carbonate Production (ktpa)

Source: Roskill 2019 lithium cost curve and IONEER DFS data. Assumption for IONEER calculation: (1) Average life-of-quarry boric acid price of US\$710/metric ton, and (2) technical-grade lithium carbonate in years 1 through 3; lithium hydroxide in years through end-of-quarry life. Units are in U.S. dollars and metric tons.

Figure 1-3. Lithium Carbonate Cost Curve (2019). Showing IONEER at bottom of cost curve.

The project’s stable and sizable boric acid revenue stream reduces overall revenue volatility and will allow IONEER to produce lithium product at the bottom of the lithium cost curve. The long-term stable price of boric acid provides a balance to volatile lithium pricing as shown below in Figure 1-4. Lithium demand has a high growth profile but prices have been highly volatile in recent periods, while boric acid has experienced remarkably stable pricing over many decades.

As a result, Rhyolite Ridge is expected to remain profitable throughout the project's life cycle with excellent margins.

Historical Price Volatility

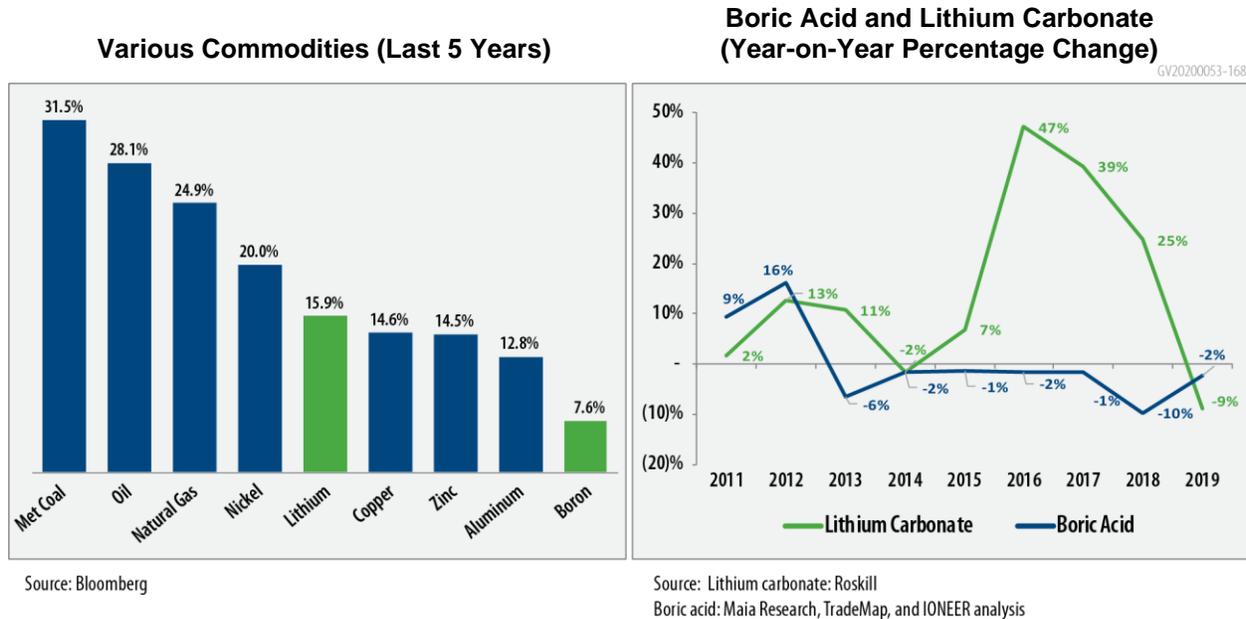


Figure 1-4. Historical Price Volatility of Commodities including Boric Acid and Lithium Carbonate.

IONEER recently executed a 5-year, 105,000 metric tons per annum binding offtake with one of the largest internal users and major distributors to the boron industry, definitively confirming that IONEER is capable of being a high-quality and cost-competitive producer in the global boron market.

1.1.3 RESOURCE, RESERVE, AND MINING – SUMMARY

The estimate for the Mineral Resource (146 million metric tons) and Ore Reserve (60 million metric tons) for the Rhyolite Ridge deposit is summarized below in Figure 1-5. Over 40% of the Mineral Resource has been converted into Ore Reserve, with 48% of the Ore Reserve classified as Proved Ore, the highest possible category.

The DFS mine plan envisages 64 million metric tons of ore being mined and processed over 26 years at an average annual rate of 2.5 million metric tons per year.

A substantial extension to the 26-year mine life is likely based on the following:

- ▶ 83 million metric tons of Mineral Resource is not included in the DFS mine plan.
- ▶ The ore body is open in three direction – south, east, and north.
- ▶ The southern-most drill hole returned the highest-grade lithium-boron intersection on the project to date: 18.5 meters of 2,364 ppm (parts per million) lithium and 13,044 ppm boron (true thickness).

The Rhyolite Ridge lithium-boron ore zone is increasing in grade and shallowing to the south. This means that the delineation of additional ore to the south (outside of the current Mineral Resource) is likely and would be expected to have a significant positive impact on project economics – due to the potential for higher grades, lower strip ratios, earlier ability to backfill the quarry (thereby reducing overburden haul distances), and extending the mine life.

Access to the southern extension of the deposit for drilling was not possible during the previous drilling campaign due to statutory limits on surface disturbance during the exploration phase. This area is scheduled for drilling once the necessary permits are in place, expected in 2Q 2021.

Mineral Resource and Reserve Estimate – Rhyolite Ridge Project			
	Metric Tons (Million)	Lithium (ppm)	Boron (ppm)
Mineral Resource (Jan. 2020)			
Measured	39.0	1,700	14,550
Indicated	88.9	1,550	14,150
Inferred	19.5	1,600	13,800
Total	146.5	1,600	14,200
Ore Reserve (March 2020)			
Proved Ore Reserve	29.0	1,899	16,271
Probable Ore Reserve	31.3	1,702	14,629
Total Proved & Probable	60.2	1,797	15,418

ppm = parts per million

Figure 1-5. Summary of Ridge Lithium-Boron Mineral Resource and Ore Reserve.

1.1.4 PROCESS FLOWSHEET – SUMMARY

During the DFS, thousands of hours of bench and pilot plant test work related to the project's process flowsheet were conducted at the following locations:

- ▶ Kemetco Research (Vancouver, Canada)
- ▶ Kappes, Cassiday & Assoc. (KCA) (Reno, U.S.)
- ▶ Veolia (Illinois, U.S.)
- ▶ FLSmidth (various locations)

Based on these efforts, the project's engineering team (led by Fluor) designed the project's processing facilities using known and commercially proven technology to accommodate the unique Rhyolite Ridge ore. The test work produced a clear understanding of the processing chemistry, sequences, and understanding of the set points for optimal operations, and allowed IONEER to produce a complete mass balance based upon bench scale and pilot-level verification. This work was used as the basis to develop the plant's engineering, cost estimates, and production forecasts in the DFS.

The Rhyolite Ridge process is expected to produce quality products at an overall recovery of 85% for lithium carbonate, 95% for the lithium hydroxide circuit, and 79% for boric acid (Figure 1-6), excellent yields for these products, particularly lithium.

Product	Recovery Rate	Annual Production
Lithium carbonate	85%	22,340 metric tons of lithium carbonate (99% purity) – years 1 to 3
Lithium hydroxide	95% ¹	21,951 metric tons of lithium hydroxide (99.5% purity) – from years 4 to 26 (conversion of lithium carbonate)
Boric acid	79%	174,378 metric tons of boric acid (99.9% purity)

¹ 95% relates to recovery from lithium carbonate feedstock, resulting in ultimate lithium hydroxide recovery of 80%.

Figure 1-6. Rhyolite Ridge Production Recoveries for Lithium and Boric Acid.

The Rhyolite Ridge process plant general layout is shown below in Figure 1-7 and consists of the main unit operations described below:

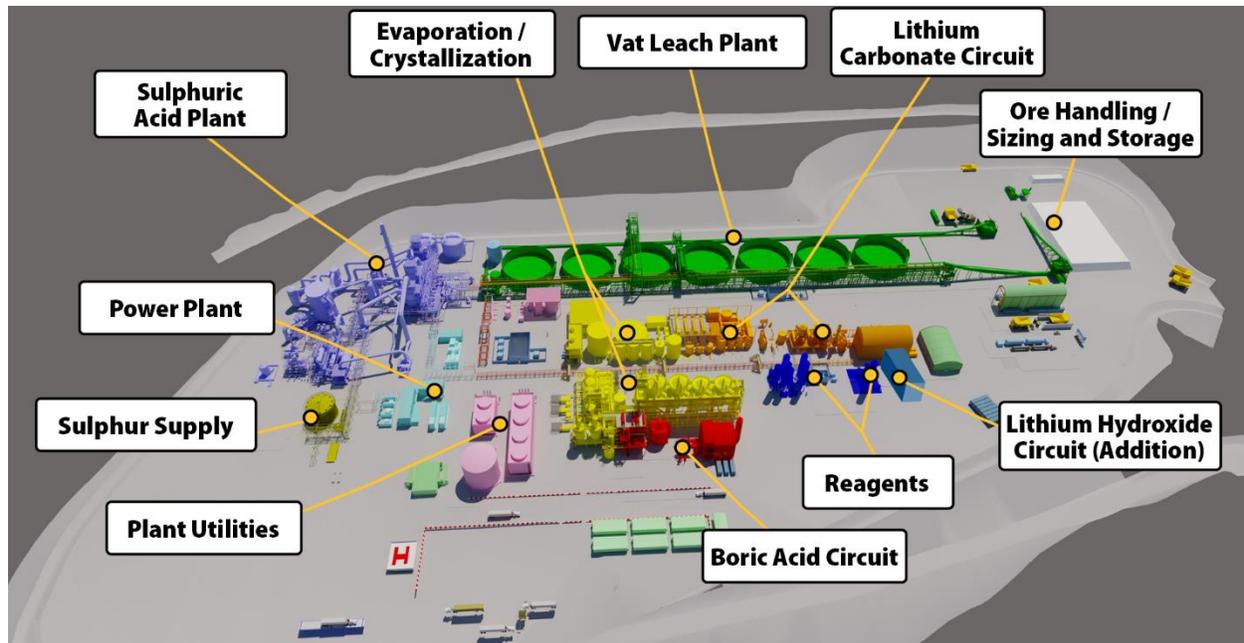


Figure 1-7. Ore Processing Facilities and Sulphuric Acid Plant – General Layout.

1. **Ore sizing.** Blended ore is transported by belt conveyor to the primary and secondary sizers where the coarse ore particles are crushed to less than 20 mm. The crushed ore is conveyed and stacked directly into the leaching vats. A unique property of the Rhyolite Ridge ore is that large particles are readily leachable and do not require expensive size reduction and milling to achieve high lithium and boron extraction rates.
2. **Vat leaching.** The vat leaching process uses a series of 7 vats where crushed ore is sequentially leached for 3 days with diluted sulphuric acid. The vats operate in a counter-current configuration, made possible by the unique Rhyolite Ridge ore particles remaining largely intact and free-draining during the leach process. Counter-current leaching minimizes the overall leaching time and acid consumption. The spent ore undergoes a displacement wash to remove valuable interstitial lithium and boron in solution. The spent ore is free draining, allowing the vat to be emptied of solution and produces a residue material that is suitable for dry stacking. High lithium and boron recoveries in leaching are consistently achieved at low to moderate temperatures (60°C) and moderate free-acidity levels.
3. **Boric acid circuit.** Crystallization of boric acid is achieved by cooling the vat leach solution (referred to as PLS – pregnant leach solution). Since the PLS is close to saturation in boric acid, the cooling effect in the crystallizer produces boric acid crystals. The boric acid crystals are separated using centrifuges and then undergo a second-stage recrystallization for purification. Most of the boric acid is recovered with minimal contamination from sulphate salts.
4. **Evaporation and crystallization circuit.** The main evaporation and crystallization circuit is designed to concentrate lithium and remove sulphate salts and other impurities. The solution (mother liquor) from the boric acid crystallization undergoes impurity removal of aluminum and other elements, and is then pumped to a 4-stage evaporator circuit to remove 70% contained water and concentrate the lithium. Crystals of sulphate salts and boric acid are produced, the latter being recovered by flotation and recycled to the boric acid crystallization circuit. Sulphate salts are sent to the spent ore storage facility. Water vapor from the evaporators is condensed and reused throughout the process.
This evaporation and crystallization process is critical to the concentration of the lithium to a high-level suitable for the lithium carbonate circuit. This process replaces evaporation ponds required in brine operations.
5. **Lithium carbonate circuit.** The lithium carbonate circuit is designed to produce technical-grade lithium carbonate from the lithium brine mother liquor. The first step is to remove the remaining magnesium from solution by precipitation with lime slurry. Lithium carbonate is then precipitated from

the magnesium free mother liquor using soda ash. The precipitated lithium carbonate is filtered, washed, and dried.

For the first 3 years, lithium carbonate will be sold as technical-grade product (99% purity). From year 4 onward, lithium carbonate will be converted into lithium hydroxide (99.5%) as described below.

- 6. **Sulphuric acid plant.** A 3,500 metric tons per day (tpd) sulphuric acid plant will produce commercial-grade (98.5%) sulphuric acid for vat leaching the ore; steam to drive the evaporation and crystallization steps; and electricity to drive the entire process. The plant will generate 35 MW of electricity – sufficient to run the entire facility and will be separate from the Nevada state power grid. The selection of the technology for the large sulphuric acid plant is based on a proven operating design and specialty technology provider (MECS-DuPont). The acid plant is a double conversion-double absorption system that has proven to be reliable and predictable. It includes a tail gas scrubber system that results in an ultra-low emissions plant (12 ppm SO₂ and 15 ppm NO_x).
- 7. **Lithium hydroxide circuit (addition).** The Rhyolite Ridge process flowsheet demonstrates a strong synergy for the installation of an onsite lithium hydroxide circuit. Installation of the circuit is planned for year 3, allowing the main plant to be operating smoothly before the addition. The conversion of Rhyolite Ridge technical-grade lithium carbonate to battery-grade lithium hydroxide will be achieved by the liming method.

Overall, IONEER’s lithium and boron products will be produced using an energy-neutral process with zero carbon dioxide (CO₂) emissions from electricity generation, resulting in a process plant with low emissions of greenhouse gases and minimal hazardous air pollutants.

Water usage associated with IONEER’s mineral extraction process is a fraction of that of other lithium producers that utilize a more conventional brine extraction and solar evaporation methodology. IONEER’s design is directed toward recycling water, to the extent possible, which further reduces make-up water demands.

Low-energy consumption, substantially reduced water needs, and relatively small surface footprint make Rhyolite Ridge a sustainable, environmentally sensitive operation.

1.1.5 OPERATING AND CAPITAL COSTS – SUMMARY

The operating cost estimate (Opex) for the Rhyolite Ridge Project is consistent with a Class 3 AACEI estimate, reflecting an accuracy range between ±15%. Fluor and Golder developed the operating cost estimates for the process plant and quarry, respectively. Annual operating costs are shown below in Figure 1-8, averaging a total of US\$51 per metric ton for the life of the quarry.

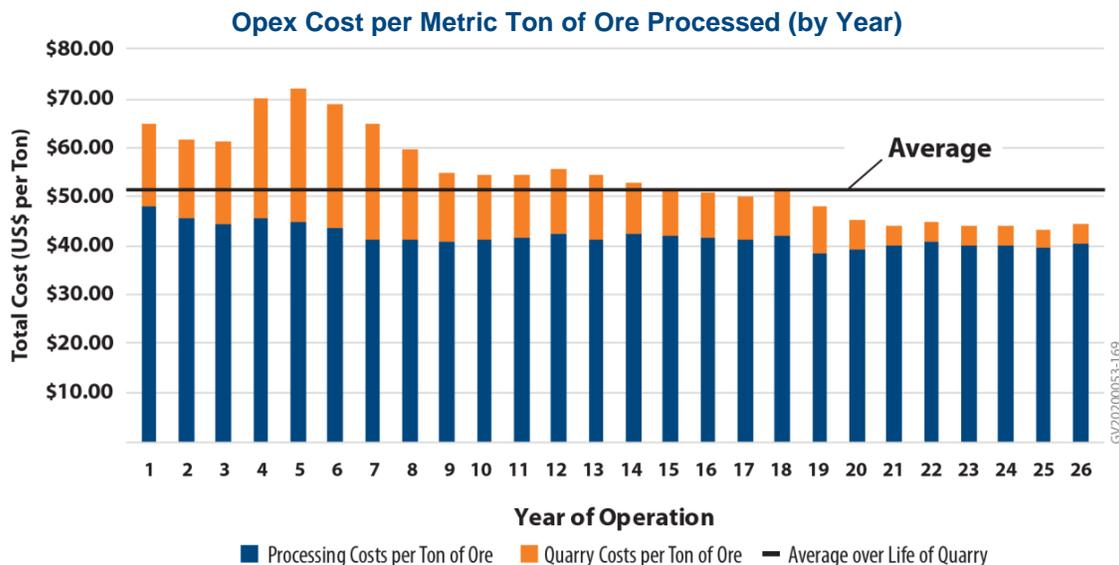


Figure 1-8. Opex Cost per Metric Ton of Ore Processed (by Year).

In addition, an ACEI Class 3 capital cost estimate (±15%) was also produced for the project. The capital cost estimate was completed to international mining project standards by EPCM companies Fluor and SNC-Lavalin, based on market pricing and 30% engineering completion.

The initial capital cost estimate (Capex) for the DFS business case is US\$785 million. A contingency analysis using Monte Carlo simulation yielded a contingency of 8%.

Capex increased from the PFS estimate of US\$599 million to the DFS estimate of US\$785 million due to changes in both scope and growth in cost. The change in Capex is illustrated in the following financial waterfall below in Figure 1-9.

Details on project costs are provided in Section 1.6 (Project Costs).

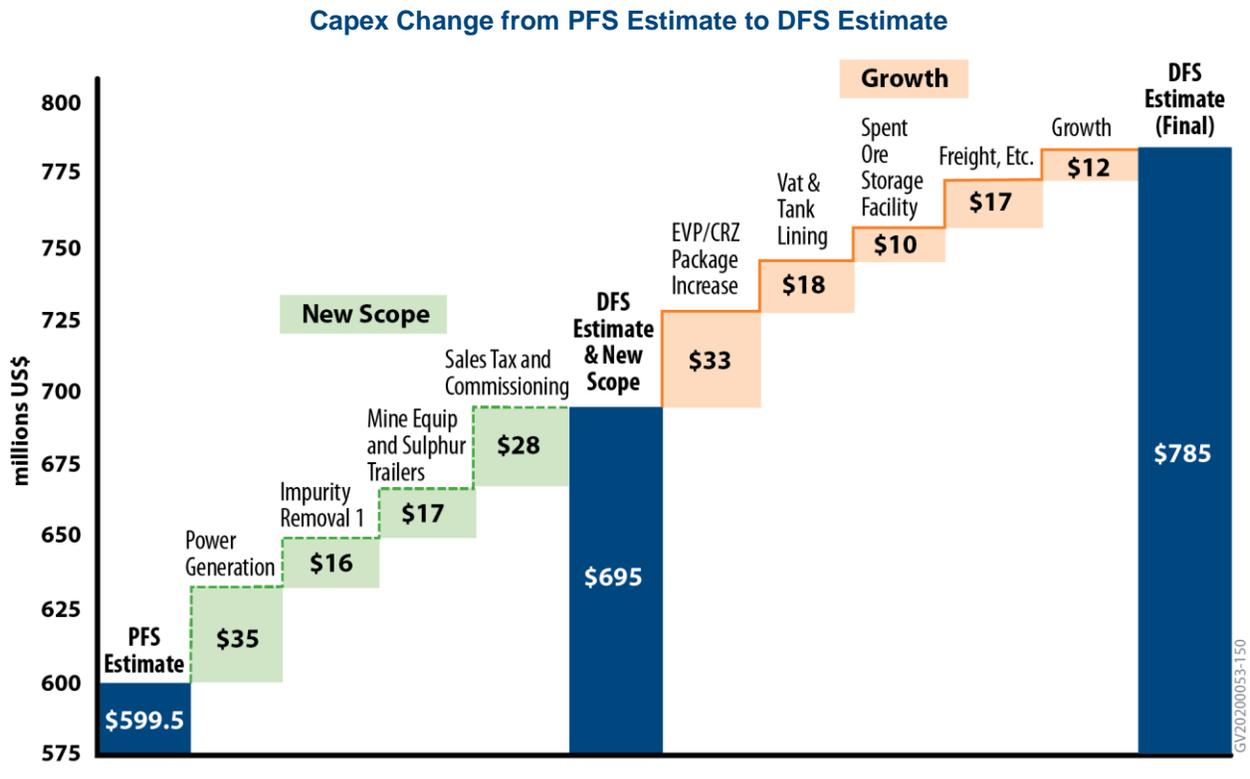


Figure 1-9. Capex Financial Waterfall – Rhyolite Ridge Project PFS to DFS.

1.1.6 PROJECT SCHEDULE – SUMMARY

The project schedule has a total duration of 41 months from commencement of the EPCM phase to final completion, with first product shipment in 2Q 2023. The construction phase of the schedule from site mobilization to first production is 25 months. Major project milestones are summarized below in Figure 1-10.

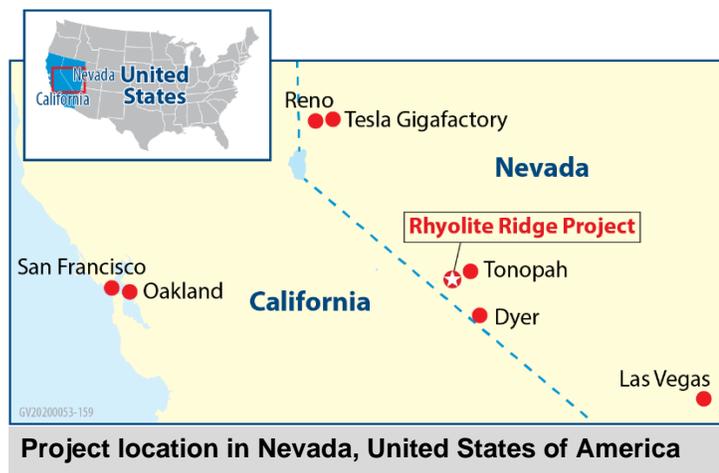
Details on the project schedule are provided in Section 1.10 (Project Execution Plan). The project schedule is subject to change and contingent on final investment decision.



Figure 1-10. Summary Project Schedule.

1.2 PROJECT BACKGROUND

The project area is located in the west-central portion of Nevada’s Esmeralda County on public land administered by the U.S. Department of Interior’s Bureau of Land Management (BLM) within the Silver Peak Range. Rhyolite Ridge is approximately 20 kilometers northeast from Dyer, Nevada (nearest town); 104 kilometers southwest of Tonopah, Nevada (closest city); 346 kilometers from Reno (third largest city in Nevada); and 410 kilometers from Las Vegas (largest city in Nevada) (all driving distances). Surface elevations at the project site range from 1,687 to 1,832 meters above sea level.



IONEER Limited of Australia is the parent company to both IONEER USA Corp. and IONEER Minerals Corp., collectively referred to as IONEER. The operator of the Rhyolite Ridge Project is IONEER USA Corp., a Nevada (U.S.) company. Title to the Rhyolite Ridge mining claims are held by IONEER Minerals Corp. and IONEER USA Corp., which together own 263 unpatented mining claims comprising the project area. An unpatented mining claim grants to the claimant (IONEER) the right to explore, develop, extract, and sell locatable minerals on the federal lands within the claim.

Several previous drilling and exploration projects have occurred at or near the Rhyolite Ridge Project site, with the earliest known boron exploration beginning in the 1890s. Most recently, exploration drilling programs targeting lithium-boron mineralization have been implemented by American Lithium Minerals (ALM) in 2010-2012 and IONEER in 2016-2019, the results of which support the current mineral resource and reserve statement.

IONEER secured ownership of the Rhyolite Ridge Project in 2016. IONEER completed the Rhyolite Ridge prefeasibility study (PFS) in October 2018 before advancing to the DFS phase now completed.

1.3 SCOPE OF STUDY

Fluor Enterprises Inc. (Fluor) was contracted by IONEER to complete the feasibility stage of the Rhyolite Ridge Project that included engineering, geology (JORC Mineral Resource), mining (JORC Mineral Reserve), cost estimating, scheduling, procurement, contracting, execution planning, and other services to further the evaluation of the project. The purpose of this definitive feasibility study (DFS) is to support the project’s business case and determine the project’s economic viability and whether it should advance to project execution as a fully funded project. Fluor is an independent Tier 1 project development

company with an extensive history of successfully planning and executing large-scale mining projects in the western U.S. and globally.

The scope of the study included:

- ▶ Developing reserve-level geological and block models and mine designs (JORC compliant)
- ▶ Developing the mine plan
- ▶ Optimizing the process flow sheet and advancing the metallurgical performance model
- ▶ Updating the financial model including updated risk analysis and mitigation strategies
- ▶ Finalizing and confirming a single go-forward option
- ▶ Developing engineering completion to a 30% level or better
- ▶ Developing AACEI Class 3 (±15%) Opex and Capex estimates
- ▶ Completing project execution plans and schedule for implementing the project
- ▶ Develop workforce plan and competitive labor cost position
- ▶ Providing performance testing and acceptance plans for turnover of the facilities

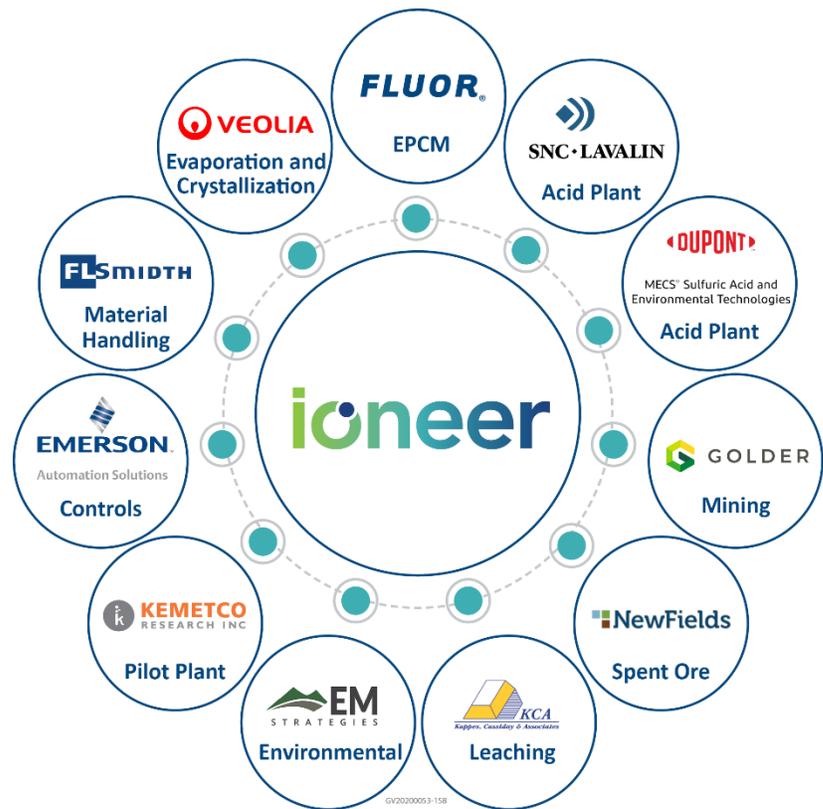
The DFS work has achieved these objectives and advanced the level of certainty for all aspects of the project. Extensive work has been completed related to metallurgical processes, mineral resource and reserve estimates, mine plan, environmental and permitting requirements, capital and operating costs, and detailed execution planning. Support of these technical requirements was achieved by carrying out mineral resource modeling, mining plans, trade-off studies, bench and pilot plant work, value engineering, permitting activities, development of engineering (30%) to support the AACEI Class 3 operating and capital cost estimates, and development of a detailed Project Execution Plan.

The DFS was carried out over 18 months by a large multi-disciplinary team of engineers and research scientists, resulting in a 5,000-page DFS report. The process flowsheet is now well-documented due to extensive test work, thousands of hours of scientific study, and a robust pilot plant program. Key facts of the extensive DFS effort completed were shown previously.

The results of the DFS technical work are reflected in the AACEI Class 3 (±15%) operating and capital cost estimates and financial analysis that form the basis for the next phase of the project.

In support of IONEER, the principle participants for the work performed during the DFS are shown at the right and their roles described in Figure 1-11 below. These are well-respected and highly qualified companies with a longstanding history of successfully delivering mining projects, including lithium and boron developments.

DFS Project Participants



DFS Participants	DFS Responsibilities
Fluor	Main DFS contractor responsible for engineering; Capex, Opex, and sustaining capital estimates; Project Execution Plan; EPCM schedule; and DFS report production. Future EPCM contractor.
SNC-Lavalin	Engineering and procurement services for the sulphuric acid plant and power plant.
MECS-DuPont Clean Technologies	Sulphuric acid plant technology provider.
Golder Associates	Evaluation of mine geology and corresponding resource and reserve estimates; preparation of mine plan; overburden storage facility design; and material take-offs for Capex and sustaining estimates.
EM Strategies, NewFields, and Trinity	Environmental permitting oversight and permit application preparation (involving specialist consultants for geotechnical, hydrogeological, hydrology, and baseline environmental studies work).
Kemetco Ltd.	Bench and pilot plant work related to boric acid and lithium carbonate circuits and aluminum removal circuit.
Kappes, Cassiday & Assoc. (KCA)	Baseline metallurgical test work for vat leaching.
FLSmidth	Material reduction, drying, and filtration test work.
Veolia	Evaporation, crystallization, centrifuge, and lithium hydroxide test work.
EnviroMINE and NewFields	Mine geotechnical report; and process plant and SOSF geotechnical report.
Emerson	Assisted with control systems architecture and budgetary pricing; recommended control systems partner for the project.
IONEER	Responsible for overall project management, lithium hydroxide circuit costs, sustaining capital estimate, and marketing studies.

Figure 1-11. DFS Project Participants.

1.3.1 DFS STUDY OUTCOMES

Positive results achieved for the Rhyolite Ridge DFS are as follows:

- ▶ Mineral resource development has been completed and reflects increased ore reserves (tons and grade) than previously reported in 2018.
- ▶ Quarry plans have been developed to minimize the disturbance footprint and quarrying high-grade ore first.
- ▶ Extensive trade-off studies have been completed and optimizations implemented for the mining and processing facilities.
- ▶ Value engineering based on zero-base design has been implemented, resulting in significant cost savings throughout the project.
- ▶ Process engineering is in an advanced stage of development ready for commercialization, supported by extensive test work and pilot plant programs.
- ▶ Engineering has been completed to a DFS level to support the estimate and permitting requirements.
- ▶ AACEI Class 3 operating and capital cost estimates have been completed and are well-supported by DFS engineering, material take-offs, and vendor pricing of major equipment.
- ▶ Long lead items and critical project works have been identified to maintain the overall project schedule and preserve the project business objectives.
- ▶ An integrated project risk register was developed with mitigation strategies.
- ▶ Fully integrated project execution plans have been developed for the detailed engineering, procurement, and construction phases, supported by a resource-loaded project schedule.
- ▶ Workforce plan was developed with recruiting/hiring timing and competitive pay, benefit, and recruiting projections.
- ▶ Operational readiness planning has been completed, ready for implementation during the execution phase.

1.3.2 DFS DELIVERABLES

The project produced 1,604 deliverables during the DFS as detailed below in Figure 1-12. Selected deliverables were advanced to the issued for construction (IFC) stage as required for the state of Nevada’s Water Pollution Control Permit (WPCP) (one of the major permits required to construct, operate, and close a mining facility).

DFS Project Deliverables			
	Issued for DFS	Issued for Construction	Total
Site Plans	13	2	15
PFDs – Process/Utilities	94	–	94
DFPs & P&IDs – Process/Utilities	280	–	280
Material Selection Diagrams (MSDs)	56	–	56
Single Line Diagrams – Electrical	18	–	18
2D Drawings	127	59	186
3D Models	2	3	5
Sketches (All Discipline)	54	–	54
Design Criteria (Multi-Discipline)	48	9	57
Datasheets	236	–	236
Mechanical/Electrical Equipment Lists	12	–	12
Civil Documents	13	15	28
Mechanical Documents	203	–	203
Electrical Documents	108	–	108
Piping Documents	99	1	100
Structural Documents	14	7	21
Construction Documents	5	–	5
Health & Safety Documents	3	–	3
Environmental Documents	11	11	22
Project Management Documents	36	14	50
Trade-Off Studies	49	2	49
Totals	1,481	123	1,604

Figure 1-12. Summary of DFS Deliverables – Rhyolite Ridge Project.

1.4 KEY PROJECT DATA

Key project data is summarized in Figure 1-13, demonstrating the favorable economics of the Rhyolite Ridge Project. Details on the project’s scope of the facilities are provided below in Section 1.5 (Technical Summary).

Key Project Data Summary

Item	Description
Project Ownership	IONEER Limited (100% ownership and operator)
Site Location (Driving Distance)	Located in Esmeralda County, Nevada, United States (U.S.): <ul style="list-style-type: none"> ▶ 20 kilometers northeast from Dyer (nearest town) ▶ 104 kilometers southwest of Tonopah (closest city) ▶ 346 kilometers southeast of Reno (third largest city in state) ▶ 326 kilometers southeast of Tesla Gigafactory, Nevada ▶ 410 kilometers northwest of Las Vegas (largest city in state)
Elevation	1,687 to 1,832 meters above sea level
Resource Model	▶ Mineral Resource: 146.5 million metric tons: <ul style="list-style-type: none"> – Measured: 39.0 million metric tons – Indicated: 88.0 million metric tons – Inferred: 19.5 million metric tons

Item	Description
Resource Model (continued)	<ul style="list-style-type: none"> ▶ Ore Reserve: 60.2 million metric tons: <ul style="list-style-type: none"> - Proved Ore Reserve: 29.0 metric tons - Probable Ore Reserve: 31.5 million metric tons
Mining	<ul style="list-style-type: none"> ▶ Total mining operations: 25.24 years (rounded off to 26 calendar years): <ul style="list-style-type: none"> - Stage 1 starter quarry: years 1 to 4.5 - Stage 2 (greater quarry): years 4 to 26 ▶ Total tons moved (life of quarry): 511 million metric tons (dry) ▶ Total ore moved (life of quarry): 64 million metric tons ▶ Ore to plant: 2.5 million metric tons per year ▶ Strip ratio: 7:1
Plant	<ul style="list-style-type: none"> ▶ Ore treatment rate: 7,121 tpd (metric tons per day) ▶ Plant main operations <ul style="list-style-type: none"> - Crushing and vat leaching plant - Boric acid production plant - Evaporation and sulphate removal - Lithium carbonate circuit and production - Lithium hydroxide plant and production (year 4) - Sulphuric acid plant (3,502 tpd) (rounded off to 3,500 tpd) - Spent ore storage facility
Production	<ul style="list-style-type: none"> ▶ Annual average, life of quarry: <ul style="list-style-type: none"> - Lithium carbonate (99% purity): 20,588 tpa (metric tons per annum) - Lithium hydroxide (99.5%): 21,951 tpa (conversion of lithium carbonate in years 4 to 26) - Boric acid: 174,378 tpa (life of quarry) ▶ Annual average, first 6 years: <ul style="list-style-type: none"> - Lithium carbonate (99%): 22,340 tpa (years 1 to 3) - Lithium hydroxide (99.5%): 25,171 tpa (years 4 to 6) (conversion of lithium carbonate) - Boric acid: 151,691 tpa (years 1 to 6) ▶ Recovery rates: <ul style="list-style-type: none"> - Lithium carbonate recovery: 85% - Lithium hydroxide recovery (lithium carbonate feed): 95% - Boron recovery: 79%
Power Supply	<ul style="list-style-type: none"> ▶ 35.2 MW onsite steam power generator (STG) (sometimes rounded off to 35 MW) ▶ 6 MW back-up diesel power (provides power to essential systems should the STG be down)
Operations Water Demand (monthly average, entire project)	<ul style="list-style-type: none"> ▶ 500 cubic meters per hour average water consumption ▶ Sourced from onsite well field and quarry pit dewatering
Investment Costs (USD, Nominal Terms)	<ul style="list-style-type: none"> ▶ Initial investment: \$785 million ▶ Sustaining capital: \$274 (stay-in-business cost for life of quarry)
Operating Cost (USD)	<ul style="list-style-type: none"> ▶ Annual average life of quarry: \$129 million
Economics	<ul style="list-style-type: none"> ▶ IRR (internal rate of return): 20.8% ▶ NPV (net present value) (8% real): \$1.265 billion

Figure 1-13. Key Project Data.

1.5 TECHNICAL SUMMARY

The purpose of the DFS was to improve and develop the level of understanding and accuracy for all aspects of the project and comprehensively present the findings in the form of a DFS report supported by extensive project-specific documentation. This section addresses the technical and engineering aspects of the DFS.

The 2018 PFS documentation provided the starting point and initial recommendations for work to be performed during the DFS. A significant body of work has been completed during the DFS that addressed PFS recommendations. As the DFS developed, additional technical requirements were identified to achieve an overall level of completion expected of a DFS.

1.5.1 GEOLOGY AND MINERALOGY

Rhyolite Ridge is a geologically unique lithium-boron deposit that occurs within lacustrine sedimentary rocks of the South Basin, peripheral to the Silver Peak Caldera. The South Basin within the project boundaries measures 6 kilometers by 2 kilometers and covers an area of 800 hectares.

Regional geology. The Rhyolite Ridge Project site is situated in the Silver Peak Range, part of the larger geo-physiographic Basin and Range Province of western Nevada. Horst and graben normal faulting is the dominant characteristic of the Basin and Range Province, which is believed to have occurred in conjunction with large-scale deformation due to lateral shear stress. This is evidenced in the disruption of large-scale topographic features throughout the area. The project area sits within the Walker Lane Fault System, a northwest trending belt of right-lateral strike slip faults.



High-grade lithium-boron (searlesite) mineralization in an outcrop at the South Basin of Rhyolite Ridge.

The regional geology is characterized by relatively young Tertiary volcanic rocks thought to be extruded from the Silver Peak Caldera, which date to approximately 6.1 million to 4.8 million years old. The northern edge of the Silver Peak Caldera is exposed approximately 3 kilometers to the south of the South Basin area and is roughly 6 kilometers by 13 kilometers in size. The Tertiary rocks are characterized by a series of interlayered sedimentary and volcanic rocks, which were deposited throughout west-central Nevada. These rocks unconformably overlie folded and faulted metasedimentary basement rocks that range from the Precambrian through Paleozoic periods.

The northern edge of the Silver Peak Caldera is exposed approximately 3 kilometers to the south of the South Basin area and is roughly 6 kilometers by 13 kilometers in size. The Tertiary rocks are characterized by a series of interlayered sedimentary and volcanic rocks, which were deposited throughout west-central Nevada. These rocks unconformably overlie folded and faulted metasedimentary basement rocks that range from the Precambrian through Paleozoic periods.

Local geology. Rhyolite Ridge is one of only two major lithium-boron deposits globally and the only known deposit associated with the boron mineral searlesite. This mineralization style is different to the brine and pegmatite deposits that are the source of nearly all the lithium produced today.

The lacustrine (lake) beds that host the mineralization lie within the Cave Spring Formation and overlie the 6-million-year-old Rhyolite Ridge Tuff and Argentite Canyon volcanic rocks. The lacustrine section that measures up to 457 meters thick is composed of three members, divided by marker beds of “gritstone” comprised of airfall debris with abundant pumice lapilli. The middle member, which is bounded top and bottom by distinctive gritstones, is dominantly marl, composing nearly 60 meters of section, and bears anomalous lithium in its upper half. About 18 meters of this section contains high concentrations of boron – contained in the sodium borosilicate mineral, searlesite (up to 30,000 parts per million [ppm] boron) – as well as lithium in mixed illite-smectite layers (about 1,500 to 2,500 ppm lithium). This marl is composed of very fine grained, intimately mingled searlesite, smectite, illite, potassium feldspar, and carbonate. The searlesite zone is capped by about 12 meters of smectite-rich marl with relatively high lithium values (commonly 2,000 to 2,500 ppm). The grade and thickness of this middle member are laterally uniform and continuous over a distance of at least 3 kilometers north to south.

The stratigraphic column for the South Basin is shown below in Figure 1-14 and is summarized as follows:

- ▶ **Alluvium:** 21-meter overburden layer to be prestripped.
- ▶ **Cave Springs Formation:** The Cave Spring Formation hosts the ore zones of interest for the project (shaded green in Figure 1-14), designated as follows:

- **M5** – 13-meter-thick **lithium claystone** layer to be removed and separately stockpiled for possible future processing.
- **B5** – 18-meter-thick **upper ore zone of high-grade lithium-boron ore** making up most of the ore planned for extraction.
- **L6** – 40-meter-thick **lower ore zone of lower-grade lithium-boron ore zone**.

► **Rhyolite Ridge Volcanics:** Underlying sedimentary and volcanic rocks of the Silver Peak Formation.

Project Stratigraphic Column					
Formation	Geological Model Unit Name	Average Thickness (m)	Minimum Thickness (m)	Maximum Thickness (m)	Lithology Description
Alluvium	Q1	21	2	61	Sand through cobble sized clasts, isolated boulder size clasts of Rhyolite Ridge Volcanic rocks and other nearby volcanic units
Cave Springs Formation	S3	70	3	235	Mixed lacustrine sediments (claystone, marl, siltstone, and thin sandstone)
	G4	6	1	24	Coarse gritstone (immature volcanoclastic wacke)
	M4	12	6	30	Carbonate rich, with interbedded marl
	G5	3	1	12	Coarse gritstone
	M5	13	3	94	Carbonate-clay rich marl, high-grade lithium, low- to moderate-grade boron
	B5	19	6	40	Marl, high-grade boron, moderate-grade lithium (main ore zone)
	S5	21	3	43	Siltstone-claystone, barren of lithium and boron
	G6	9	1	43	Coarse gritstone
	L6	40	3	107	Marl, siltstone-claystone, laterally discontinuous low-high-grade lithium and boron mineralized horizons within a larger low-grade to barren sequence
	Lsi	30	3	64	Silicified siltstone-claystone
G7	17	2	52	Coarse gritstone, diamictite, grading into tuff	
Rhyolite Ridge Volcanics	Tlv	N/A	0	>30	Latite flows and breccia, believed to be Argentite Canyon formation
	Tbx	43	6	168	Quartz-feldspar lithic tuff containing minor biotite, phenocrystic-rich lithic tuff, and massive lithic breccia, volcanic lava flows, and welded tuff

Figure 1-14. Project Stratigraphic Column (Mineralized Units Shaded Green).

The exploration and drilling information supporting the mineral resource model stems from work performed by IONEER in 2016-2019. Approximately 112 drill holes totaling 24,385 meters have been drilled, testing approximately one third of the total area of the South Basin, and were integrated into the geological model. The resource remains open in three directions for potential quarry expansion.

Future exploration drilling in the South Basin will initially target the extensions of high-grade ore to the south, where it is expected to be increasingly shallow with positive impact on the mine plan. The northern limits of the deposit could be mined subject to additional drilling and the success of environmental management plans.

1.5.2 MINERAL RESOURCES

The current mineral resource estimates for Rhyolite Ridge are based on the mineral resource model dated January 20, 2020, applicable to the South Basin. The total lithium-boron **Mineral Resource** for Rhyolite Ridge is estimated at 146.5 million metric tons as defined in Figure 1-15 below.

Mineral Resource Estimate – Rhyolite Ridge South Basin (2020)

Group	Classification	Metric Tons (Mt)	Li Grade (ppm)	B Grade (ppm)	Li ₂ CO ₃ (wt. %)	H ₃ BO ₃ (wt. %)	Li ₂ CO ₃ (kt)	H ₃ BO ₃ (kt)
Upper Zone B5 Unit	Measured	26.0	1,900	18,050	1.0	10.3	260	2,670
	Indicated	41.0	1,750	17,250	0.9	9.9	380	4,070
	Inferred	8.5	1,950	15,000	1.0	8.6	90	710
	Total	75.5	1,800	17,300	1.0	9.9	720	7,450
Upper Zone M5 Unit	Measured	0.5	2,450	5,450	1.3	3.1	10	20
	Indicated	2.0	1,600	6,550	0.9	3.8	20	70
	Inferred	0.0	0	0	0.0	0.0	0	0
	Total	2.5	1,800	6,300	1.0	3.6	20	80
Upper Zone Total	Measured	26.5	1,900	17,800	1.0	10.2	270	2,680
	Indicated	43.0	1,750	16,850	0.9	9.6	390	4,130
	Inferred	8.5	1,950	15,000	1.0	8.6	90	710
	Total	77.5	1,800	16,950	1.0	9.7	750	7,530
Lower Zone L6 Unit	Measured	12.5	1,350	7,700	0.7	4.4	90	560
	Indicated	45.0	1,400	11,600	0.7	6.6	330	2,980
	Inferred	11.0	1,350	12,900	0.7	7.4	80	820
	Total	68.5	1,350	11,100	0.7	6.3	500	4,360
Total (All Zones)	Measured	39.0	1,700	14,550	0.9	8.3	360	3,240
	Indicated	88.0	1,550	14,150	0.8	8.1	730	7,110
	Inferred	19.5	1,600	13,800	0.9	7.9	170	1,530
	Grand Total	146.5	1,600	14,200	0.9	8.1	1,250	11,890

Mineral Resource Notes:

1. Mt = million metric tons; Li = lithium; B = boron; ppm = parts per million; Li₂CO₃ = lithium carbonate; H₃BO₃ = boric acid; kt = thousand metric tons.
2. Totals may differ due to rounding, Mineral Resources reported on a dry in-situ basis. Lithium is converted to lithium carbonate (Li₂CO₃) using a conversion factor of 5.322 and boron is converted to boric acid (H₃BO₃) using a conversion factor of 5.718.
3. The Statement of Estimates of Mineral Resources has been compiled by Mr. Jerry DeWolfe, who is a full-time employee of Golder Associates (Golder) and a Professional Geologist (P.Geo.) with the Association of Professional Engineers and Geoscientists of Alberta (APEGA), a "Recognized Professional Organization" included in a list promulgated by ASX from time to time. Mr. DeWolfe has sufficient experience that is relevant to the style of mineralization and type of deposit under consideration and to the activity that he has undertaken to qualify as a Competent Person as defined in the JORC Code (2012).
4. Mineral Resources are reported in accordance with the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (Joint Ore Reserves Committee Code – JORC 2012 Edition).

Figure 1-15. Summary of Lithium-Boron Mineral Resource Estimate. 5,000 ppm boron cut-off grade for South Basin of Rhyolite Ridge, effective January 20, 2020.

1.5.3 OVERALL SITE PLAN

The overall site plan for the Rhyolite Ridge Project is shown below in Figure 1-16. The compact project site extends from the mine quarry in the west to the processing facilities and spent ore storage facility (SOSF) in the east. The most suitable site for the processing facilities was identified on a gently sloping plateau approximately 2.9 kilometers northwest from the quarry and 1.6 kilometers north of the spent ore storage facility.

The project is easily accessed from the cities of Reno and Las Vegas and the ports of California. The primary point of entry for vehicles transporting goods, supplies, and equipment during the project's construction and operations phases will be from Nevada State Highway 264.

Overall Site Plan – Rhyolite Ridge Project

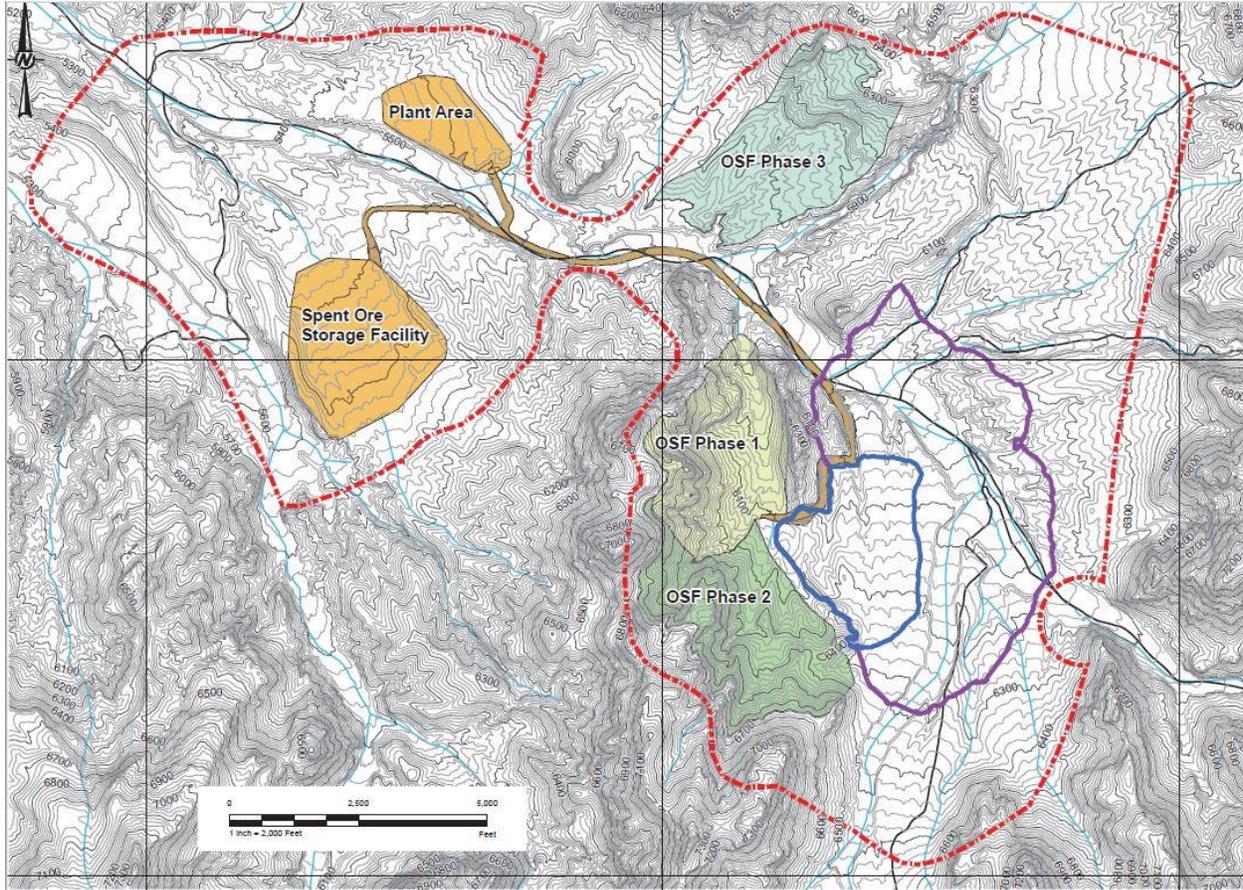


Figure 1-16. Overall Site Plan.

1.5.4 QUARRY MINE PLAN

Development of the Rhyolite Ridge quarry will occur in two stages:

- ▶ **Quarry Stage 1 – Starter Pit.** An initial starter pit will be developed in the southwestern part of the ore body to supply ore for the first 4.5 years of the project. In this area, lithium grades are 15% higher than the average grade for the deposit and the ore is more exposed at surface.
- ▶ **Quarry Stage 2.** Development of the greater pit will start once the environmental permits for this development have been granted. The Stage 2 pit design will facilitate a larger mining area to be maintained, aiding the efficiency of the operation for another 21 years (there will be an overlap of Stage 1 and Stage 2 ore mined during years 4 and 5). Stage 2 will involve expansion to the south and east. Finally, mining will progress to the north of the deposit. The Stage 2 pit requires prestripping to begin in year 4.

Thus, the anticipated mine life, when fully developed, is expected to be at least 26 calendar years. The pit development stages are shown in Figure 1-17 (with the three overburden storage facility [OSF] phases shown and described below).

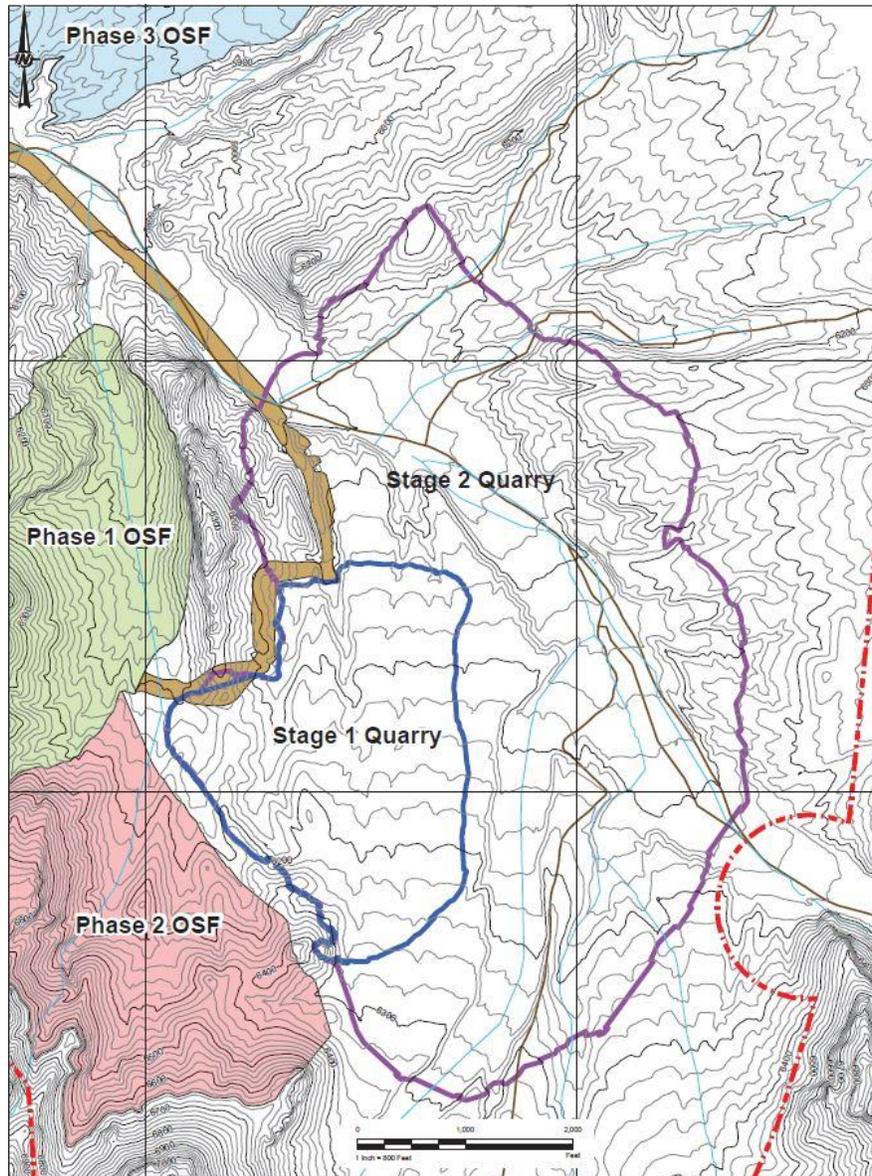


Figure 1-17. Pit Development Stage 1 (Starter Pit) and Stage 2.

The pit designs were completed based on the selected optimized pit shell, providing practical engineered pits and cutbacks for mining.

The mining operations will consist of a conventional drill-and-blast, load-and-haul operation. Ore will be trucked from the mine quarry to the nearby ore processing stockpile over a new heavy haul road. The ore will be reclaimed by a loader and fed to the crushing plant.

The open-pit mining operations are scheduled nominally for 350 days per year. It was assumed that 15 days per year will be lost due to unscheduled delays such as weather conditions. The open-pit equipment will operate 24 hours a day in two 12-hour working shifts.

The key parameters for the corresponding mine plan and mine schedule are as follows:

- ▶ Minimize initial overburden prestripping
- ▶ Minimize mine disturbance area during the first 3 years (through starter pit operations)
- ▶ Target mining of higher grade lithium ore at the beginning of the project
- ▶ Achieve 2.5 million metric tons per annum ore production
- ▶ Maintain high-grade ore feed to the plant during the initial phases of the mine life

IONEER will capitalize on current mining advances to enhance project performance including:

- ▶ **Haul Truck Automation.** IONEER will become the first greenfield site in the United States to use automated haul trucks in the initial operation. This has shown to have several advantages in operating and capital costs in addition to minimizing safety incidents.
- ▶ **Mining Selectivity.** To minimize the effects of loss and dilution in the mining operation, an accurate geologic model, high-precision GPS (global positioning system), competent operators, and a fleet management system (FMS) will be used. Specifically, an integrated, GPS-guided bucket system, such as Caterpillar’s (CAT) MineStar Terrain package, will allow excavator and wheel loader operators to know in real time what type of material is being loaded.

Ore fed to the process plant annually is shown in Figure 1-18, and lithium and boron ore grades by year are shown in Figure 1-19.

Mine Plan: Annual Ore Feed to Process Plant (Metric Tons)

Description	Total/ Average	Production Year												
		-1	1	2	3	4	5	6	7	8	9	10	11	12
ROM OB/IB/UB and Non-Economic Material														
Total Metric Tons (000s tons, dry basis)	447,730	1,814	19,667	19,582	19,599	34,554	34,470	34,410	34,311	27,263	27,217	27,241	27,235	27,261
ROM Ore														
Total ROM Ore Metric Tons (000s tons, dry basis)	63,800	–	2,286	2,371	2,355	2,359	2,443	2,503	2,602	2,619	2,666	2,642	2,647	2,621
Average Specific Gravity (tons/BCY, dry basis)	1.67	–	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Boric Acid (H ₃ BO ₃) (%)	8.77%	–	7.41%	7.56%	8.21%	8.07%	8.38%	8.77%	9.34%	9.46%	10.08%	10.41%	10.42%	10.09%
Lithium Carbonate (Li ₂ CO ₃) (%)	0.96%	–	1.14%	1.13%	1.12%	1.15%	1.15%	1.11%	1.01%	0.99%	0.95%	0.93%	0.95%	0.99%
Boron (ppm)	15,326	–	12,960	13,210	14,357	14,108	14,644	15,332	16,325	16,532	17,632	18,206	18,212	17,636
Lithium (ppm)	1,809	–	2,140	2,121	2,106	2,158	2,152	2,077	1,891	1,858	1,780	1,749	1,781	1,859
Strip Ratio	7.02		8.6	8.26	8.32	14.65	14.11	13.75	13.19	10.41	10.21	10.31	10.29	10.4

Description	Total/ Average	Production Year													
		13	14	15	16	17	18	19	20	21	22	23	24	25	26
ROM OB/IB/UB and Non-Economic Material															
Total Metric Tons (000s tons, dry basis)	447,730	27,289	12,360	12,318	12,302	12,333	12,369	11,312	3,208	2,133	1,678	1,499	1,944	2,095	254
ROM Ore															
Total ROM Ore Metric Tons (000s tons, dry basis)	63,800	2,593	2,581	2,623	2,639	2,607	2,572	2,599	2,538	2,498	2,404	2,470	2,459	2,578	524
Average Specific Gravity (tons/BCY, dry basis)	1.67	1.65	1.65	1.65	1.65	1.65	1.65	1.69	1.74	1.71	1.73	1.73	1.74	1.71	1.78
Boric Acid (H ₃ BO ₃) (%)	8.77%	9.05%	8.95%	9.78%	10.33%	10.28%	10.13%	7.59%	7.95%	7.13%	6.90%	7.47%	7.02%	8.19%	5.04%
Lithium Carbonate (Li ₂ CO ₃) (%)	0.96%	1.01%	1.03%	0.98%	0.95%	0.95%	0.96%	0.82%	0.83%	0.82%	0.80%	0.79%	0.79%	0.81%	0.86%
Boron (ppm)	15,326	15,817	15,654	17,091	18,067	17,967	17,706	13,274	13,902	12,471	12,072	13,069	12,281	14,324	8,809
Lithium (ppm)	1,809	1,904	1,938	1,845	1,783	1,786	1,795	1,539	1,563	1,531	1,494	1,493	1,482	1,515	1,617
Strip Ratio	7.02	10.52	4.79	4.7	4.66	4.73	4.81	4.35	1.26	0.85	0.7	0.61	0.79	0.81	0.49

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Figure 1-18. Mine Plan: Annual Ore Feed to Process Plant. Ore Totals in Metric Tons.

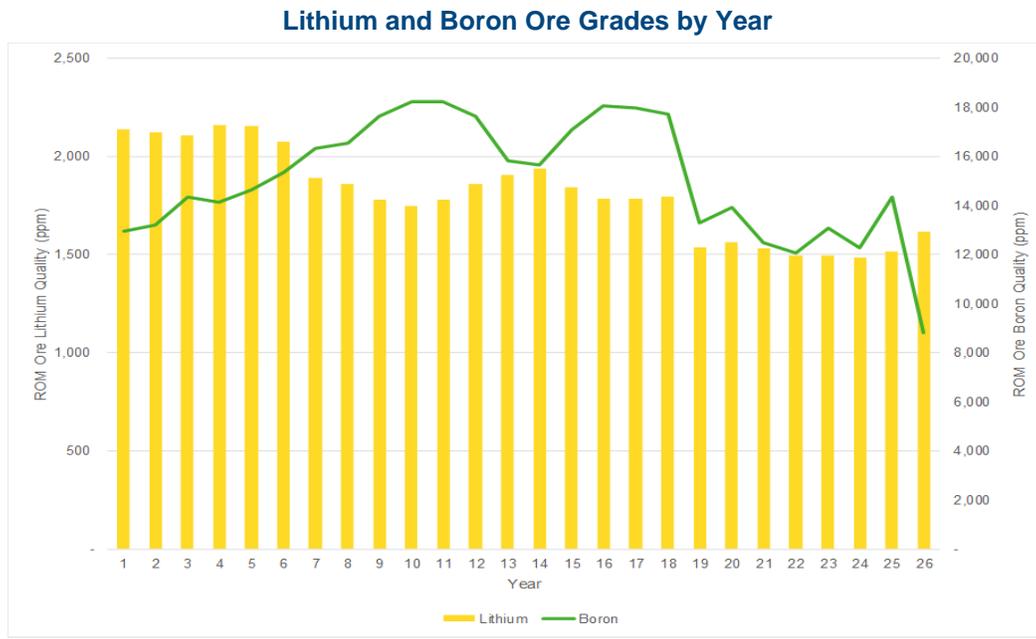


Figure 1-19. Lithium and Boron Ore Grades by Year.

Stage 1 and Stage 2 will allow for 26 calendar years of mine life with 64 million metric tons (Mt) of ore mined. Of the ore mined, 60 Mt is from the Ore Reserve shown below in Figure 1-20, with the balance coming from the Mineral Resource. The 64 Mt mine plan represents 44% of the total Mineral Resource (146 Mt).

A substantial extension to the 26-year mine life is likely for the following reasons:

- ▶ 83 Mt of Mineral Resource is not included in the DFS mine plan.
- ▶ Ore body is open in three directions – south, east, and north.
- ▶ Southern-most drill hole returned the highest-grade lithium-boron intersection on the project to date: 18.5 meters of 2,364 ppm (parts per million) lithium and 13,044 ppm boron (true thickness).

The Rhyolite Ridge lithium-boron ore zone is increasing in grade and shallowing to the south, meaning the delineation of additional ore to the south, outside of the current Mineral Resource, is likely and would be expected to have a significant positive impact on the mine plan and project economics. Access to the southern extension of the deposit for drilling was not possible during the previous drilling campaign due to statutory limits on surface disturbance during the exploration phase. This area is scheduled for drilling once the necessary permits are in place, expected in 2Q 2021.

Ore Reserve Estimate – Rhyolite Ridge South Basin (March 2020)

Description	Stage1 Pit	Stage 2 Pit	Total
Proved Ore Reserve			
Metric Tons ('000s)	10,900	18,100	29,000
Lithium Carbonate Grade (%)	1.09	0.96	1.01
Boric Acid Grade (%)	8.54	9.77	9.31
Lithium Grade (ppm)	2,052	1,806	1,899
Boron Grade (ppm)	14,927	17,082	16,271
Probable Ore Reserve			
Metric Tons ('000s)	0	31,300	31,300
Lithium Carbonate Grade (%)	1.08	0.91	0.91
Boric Acid Grade (%)	8.06	8.37	8.37
Lithium Grade (ppm)	2,022	1,702	1,702
Boron Grade (ppm)	14,100	14,629	14,629

Description	Stage1 Pit	Stage 2 Pit	Total
Total Proved and Probable Ore Reserves			
Metric Tons ('000s)	10,900	49,300	60,200
Lithium Carbonate Grade (%)	1.09	0.93	0.96
Boric Acid Grade (%)	8.54	8.88	8.82
Lithium Grade (ppm)	2,052	1,740	1,797
Boron Grade (ppm)	14,927	15,527	15,418

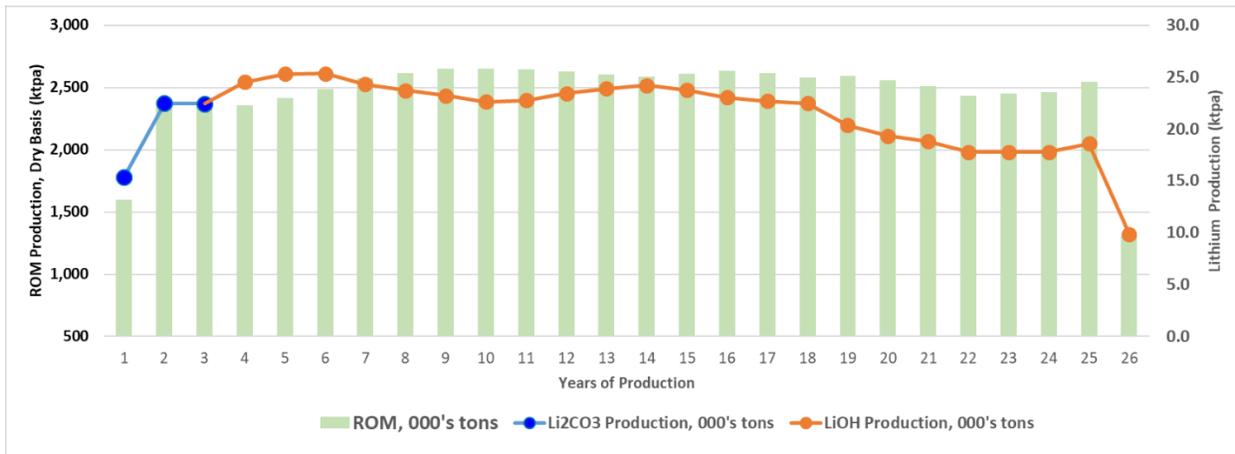
ppm = parts per million

Figure 1-20. Rhyolite Ridge Project Estimated Lithium-Boron Ore Reserves.

1.5.5 PRODUCTION PLAN

The production plan considers an initial ramp-up time frame of 1 year to reach 100% throughput while the plant availability is designed for 94% availability during the 26-year life of quarry. The plant production plan for lithium is shown in Figure 1-21 and for boric acid in Figure 1-22 below.

Plant Production Plan – Lithium Carbonate and Lithium Hydroxide (Metric Tons/Year)



Note: LiC03 = lithium carbonate; LiOH = lithium hydroxide

Figure 1-21. Production Plan – Lithium Carbonate and Lithium Hydroxide. Units in thousands of metric tons/annum (ktpa).

Plant Production Plan – Boric Acid (Metric Tons/Year)

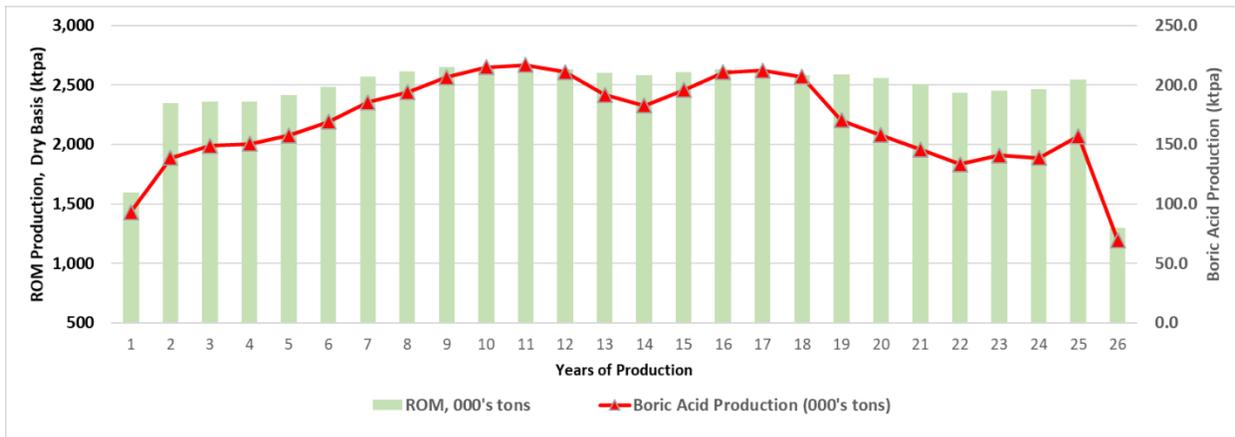


Figure 1-22. Production Plan – Boric Acid. Units in thousands of metric tons/annum (ktpa).

1.5.6 METALLURGICAL TECHNOLOGY AND PILOT PLANT

Over the 18-month DFS effort, a series of in-depth metallurgical test work and pilot plant programs were performed that optimized the project's process flowsheet. The process was customized to the metallurgical and chemical characteristics of each unit operation of the Rhyolite Ridge facilities. This extensive effort has resulted in achieving a high level of confidence in the process flowsheet and reducing process risk and uncertainty. The major unit operations of the Rhyolite Ridge flowsheet have been operated at pilot plant scale.

The Rhyolite Ridge lithium-boron-bearing ore is unique, and no reference installations exist for processing this type of ore. Thus, advanced scientific investigative and confirmatory test work was required to fully optimize recovery rates of lithium carbonate and boric acid to be produced.

Areas of focus during the DFS process optimization were as follows:

- ▶ Achieve high recoveries of boron and lithium through leaching
- ▶ Economically process the leach solution to remove impurities while minimizing losses of boron and lithium
- ▶ Produce high-quality, market-desirable lithium carbonate and boric acid materials



Figure 1-23. Second-stage boric acid crystallizer (top) at IONEER pilot plant in Vancouver.

To facilitate this work, a pilot plant was built at Kemetco Research in Vancouver, Canada (Figure 1-23), where over 27 metric tons of ore was processed and an extensive program of metallurgical test work was completed. A multi-faceted team of Kemetco Research scientists and technicians – working alongside Fluor process engineers, IONEER's internal processing experts, and key vendor support (including Veolia and FLSmidth) – constructed and continuously operated the major processing unit operations, including vat leaching, boric acid crystallization, and evaporation/crystallization removal of sulphate salts to produce a lithium-rich brine that was processed to produce lithium carbonate.

The pilot plant included the following operations:

- ▶ **Vat leaching.** Testing of leachability of ores of varying grade within the ore body; composite ore sample tests; and a full height vat leach test. This work established the metallurgical parameters for vat leach recovery, acid consumption, permeability, wash efficiency, and composition of the resultant leach solution for downstream processing. Ore was vat leached at Kemetco to produce PLS for downstream pilot plant processing.
- ▶ **Boric acid circuit.** Pilot plant crystallization of boric acid from the vat leach solution. Boric acid was redissolved and recrystallized to produce high-purity boric acid.
- ▶ **Impurity removal.** Bench-scale impurity removal of aluminum and acid before the evaporation and crystallization circuit.
- ▶ **Evaporation and crystallization.** Bench-scale test work to identify and quantify the optimum parameters for the evaporation and crystallization circuit.

► **Lithium carbonate circuit.** Pilot plant operation of impurity removal using lime precipitation of magnesium and other insoluble metal hydroxides prior to being fed to lithium carbonate precipitation. Pilot production of lithium carbonate was achieved by precipitation with sodium carbonate followed by washing and oven drying.

This test work produced a clear understanding of the processing chemistry, sequences, understanding of the set points for optimal operations, and allowed Fluor to produce a complete mass balance based upon pilot-level verification. This work was used as the basis to develop the plant design, cost estimates, and production forecasts in the DFS.

Ultimately, the projected overall recoveries for lithium and boron for the life of quarry were improved during the process optimization (Figure 1-24). This reflects the cumulative recovery for the unit processes that span from vat leaching to product production described below.

Product	Recovery Rate	Annual Production
Lithium carbonate	85%	22,340 metric tons of lithium carbonate (99% purity) – years 1 to 3
Lithium hydroxide	95% ¹	21,951 metric tons of lithium hydroxide (99.5% purity) – from years 4 to 26 (conversion of lithium carbonate)
Boric acid	79%	174,378 metric tons of boric acid (99.9% purity)

¹ 95% relates to recovery from lithium carbonate feedstock, resulting in ultimate lithium hydroxide recovery of 80%.

Figure 1-24. Rhyolite Ridge Production Recoveries for Lithium and Boric Acid.

1.5.7 ORE PROCESSING FACILITIES

Based on the thousands of hours of bench and pilot plant test work, the project's engineering team designed the processing facilities using known and commercially proven technology to accommodate the unique Rhyolite Ridge mineral deposit.

The processing plant facilities involve the following three main steps described in more detail below:

1. Ore crushing and vat leaching

- Run-of-quarry lithium and boron ore is crushed and then fed to the vat leach circuit.
- The vat leach circuit uses diluted sulphuric acid to leach the boron and lithium from the ore into a solution called pregnant leach solution (PLS).

2. Boric acid circuit/crystallization and evaporation

- Crystallization of boric acid is achieved by cooling the vat leach PLS solution. Boric acid is redissolved and crystallized to produce crystals for drying and then packaging, ready for sale to market.
- Solution exiting the boric acid crystallization circuit undergoes impurity removal, evaporation, and crystallization to produce a lithium-rich brine suitable for further treatment.

3. Lithium carbonate circuit

- Lithium carbonate circuit treats the lithium-rich brine firstly using a bulk impurity-removal step, followed by the production of lithium carbonate.
- Lithium is precipitated from the solution as technical-grade lithium carbonate.

Figure 1-25 shows the general layout of the ore processing facilities and sulphuric acid plant.

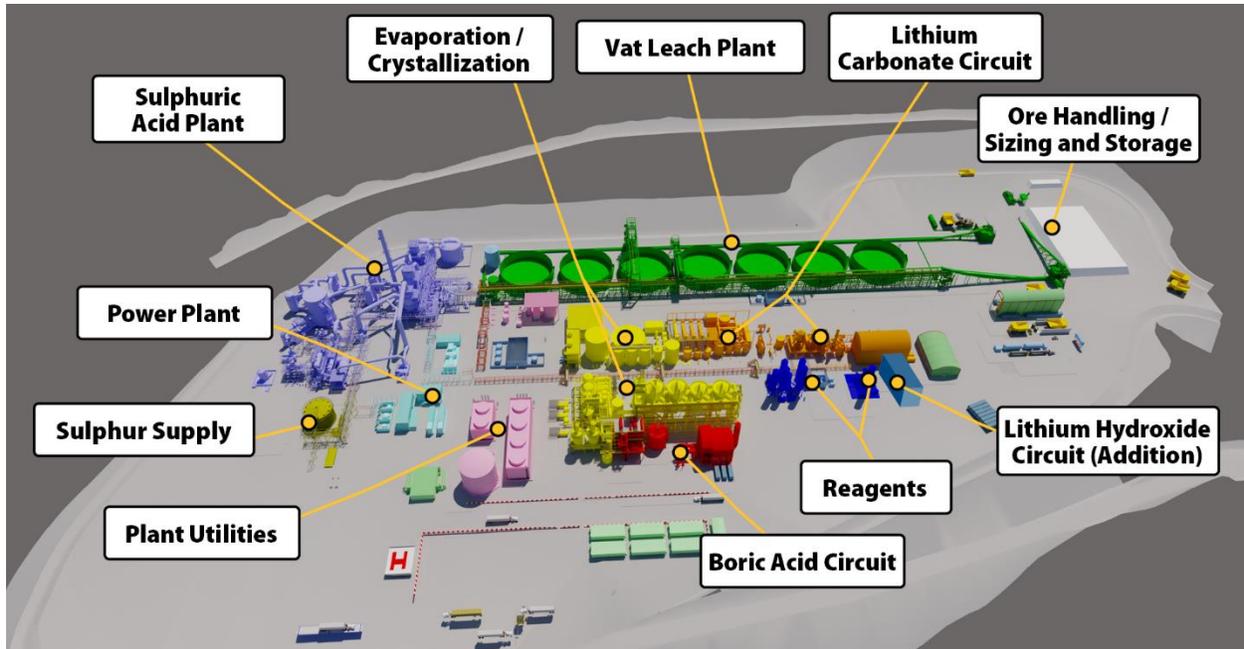


Figure 1-25. Ore Processing Facilities and Sulphuric Acid Plant – General Layout.

The processing of Rhyolite Ridge ore is summarized in the high-level flowsheet in Figure 1-26 and is described as follows:

- **Ore crushing.** Lithium-boron bearing ore is trucked from the quarry and placed in stockpiles. Blended ore is transported by belt conveyor to the primary and secondary sizers where the coarse ore particles are crushed to less than 25 millimeters (mm) (a P₁₀₀ of 20 mm). The crushed ore is conveyed and stacked directly into the leaching vats. A unique property of the Rhyolite Ridge ore is that large particles are readily leachable and do not require expensive size reduction and milling to achieve high lithium and boron extraction rates.

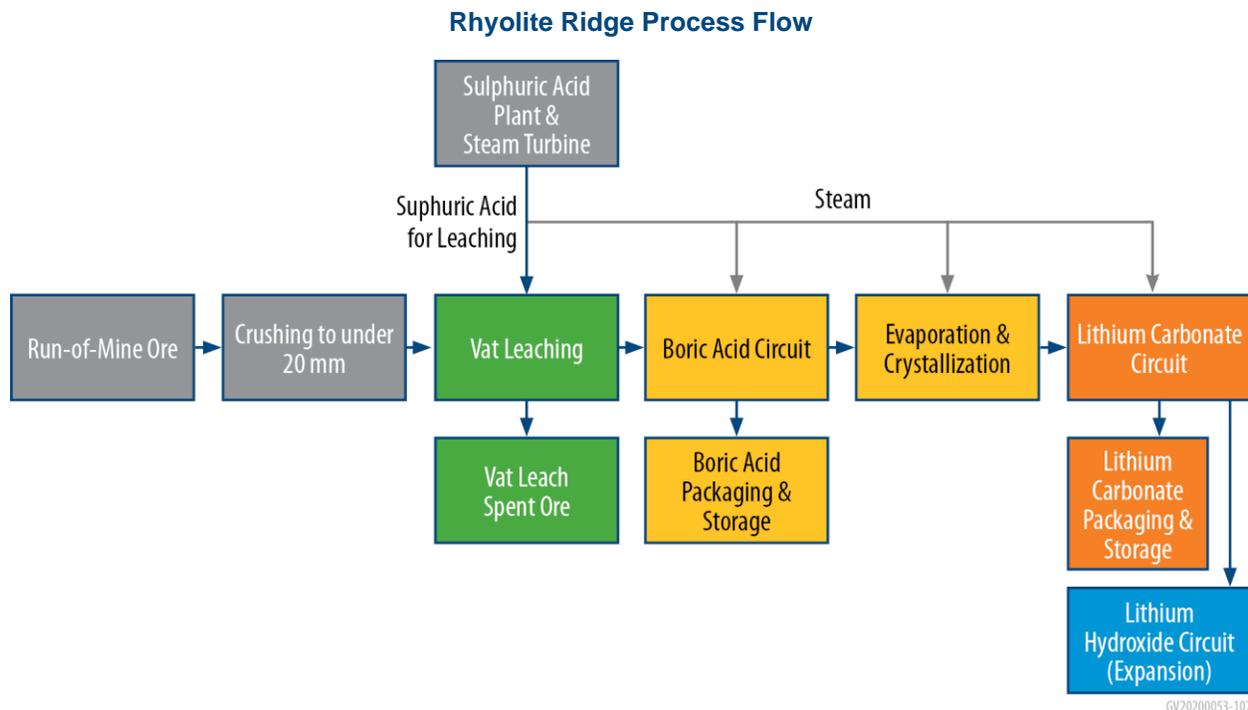
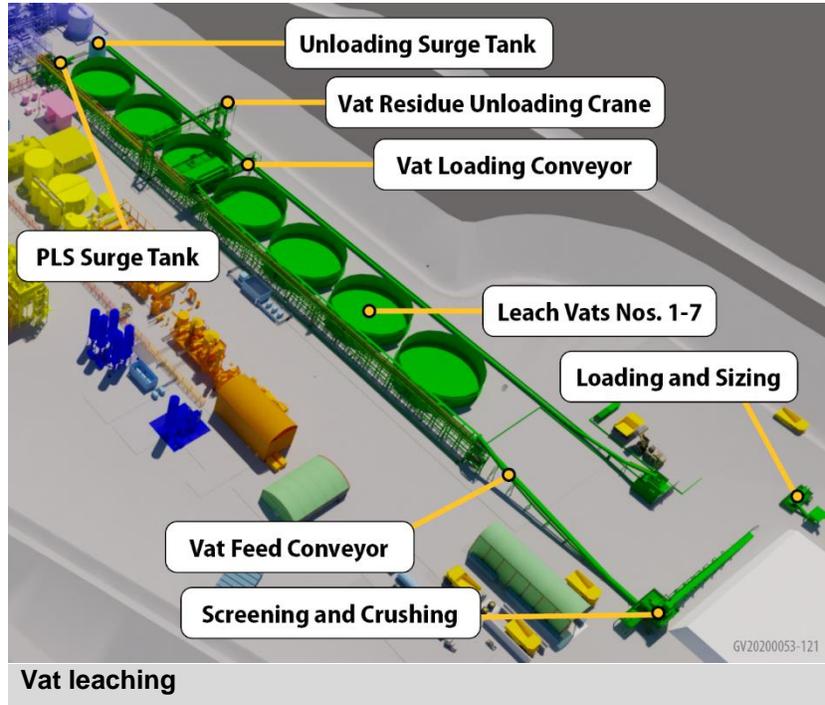


Figure 1-26. High-Level Process Flow Diagram.

▶ **Vat leaching.** The vat leaching process uses a series of 7 vats where crushed ore is sequentially leached for 3 days with diluted sulphuric acid. Each vat has a 38-meter internal diameter and is 7.5 meters tall. Both the boron and lithium minerals are readily soluble during sulphuric acid leaching. The resulting solution known as pregnant leach solution (PLS) contains lithium sulphate and boric acid at close to saturation. The PLS also includes gangue impurities requiring removal downstream, including aluminum, magnesium, sodium, and potassium sulphate.



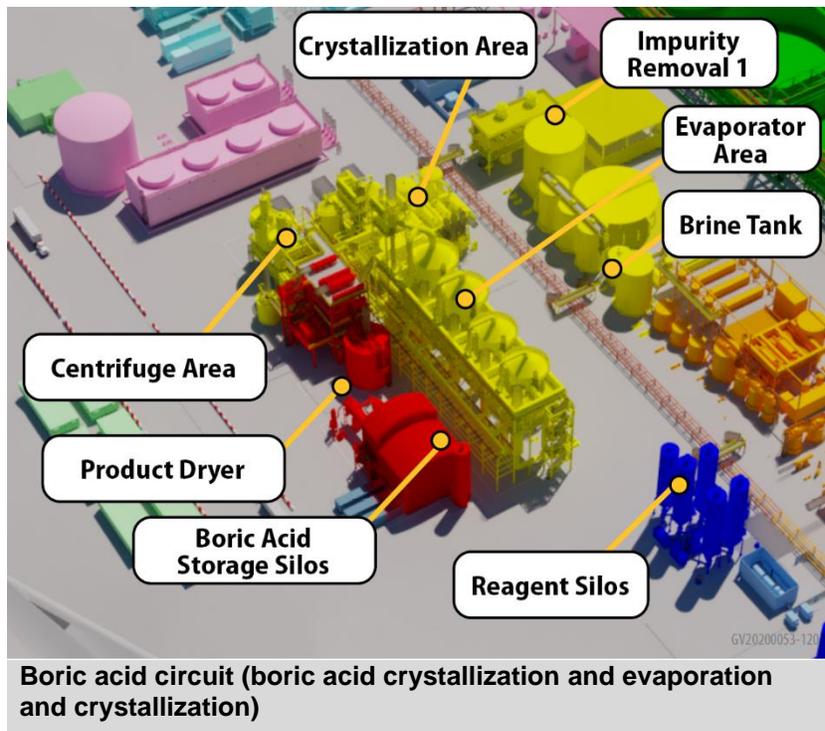
Vat leaching

The spent ore undergoes a displacement wash to remove valuable interstitial lithium and boron in solution. The spent ore is free-draining, allowing the vat to be emptied of solution leaving behind a material that is suitable for dry stacking, thus it is easily removed from the vats by an overhead crane grab. Thereafter, the spent ore is loaded onto trucks and transported to the SOSF for dry stacking, meaning there is no need for a conventional tailings dam.

▶ **Boric acid circuit.** The next stage involves pumping the PLS from the vats to the boric acid circuit. This circuit involves the discrete unit operations of (1) boric acid crystallization and (2) evaporation and crystallization to concentrate lithium, as follows:

– **Boric acid crystallization.**

Crystallization of boric acid is well-understood and achieved by cooling the PLS, using a standard industrial designed crystallizer system. Since the PLS is close to saturation in boric acid, the cooling effect in the crystallizer produces primary solid boric acid. The boric acid crystals are separated using centrifuges and then undergo a second-stage recrystallization for purification. After drying and packaging, the high-purity boric acid is ready for market.



Boric acid circuit (boric acid crystallization and evaporation and crystallization)

- **Evaporation and crystallization.** In the next step, a separate evaporation and crystallization circuit is designed to concentrate lithium and remove sulphate (magnesium) salts. The solution (mother liquor) from the boric acid crystallization undergoes impurity removal of aluminum and other elements, and thereafter the mother liquor is pumped to a 4-stage evaporator circuit to remove approximately 70% contained water and concentrate the lithium. Crystals of sulphate salts and boric acid are produced, the latter being recovered by flotation and recycled to the boric acid crystallization circuit. Water vapor from the evaporators is condensed and reused throughout the process. This aids in maximizing the efficient use of water.

Solution from the last evaporator enters a multi-stage crystallization circuit to remove sulphates salts and boric acid. During this process, additional water is removed within the magnesium sulphate crystal structure. This is the final step in lithium concentration to produce a lithium brine mother liquor before entering the lithium carbonate circuit.

In all cases, centrifuges are used to separate the sulphate salts from the evaporator or crystallizers.

This evaporation and crystallization process is critical to the concentration of the lithium to a high-level suitable for the lithium carbonate circuit. This process replaces evaporation ponds required in brine operations.

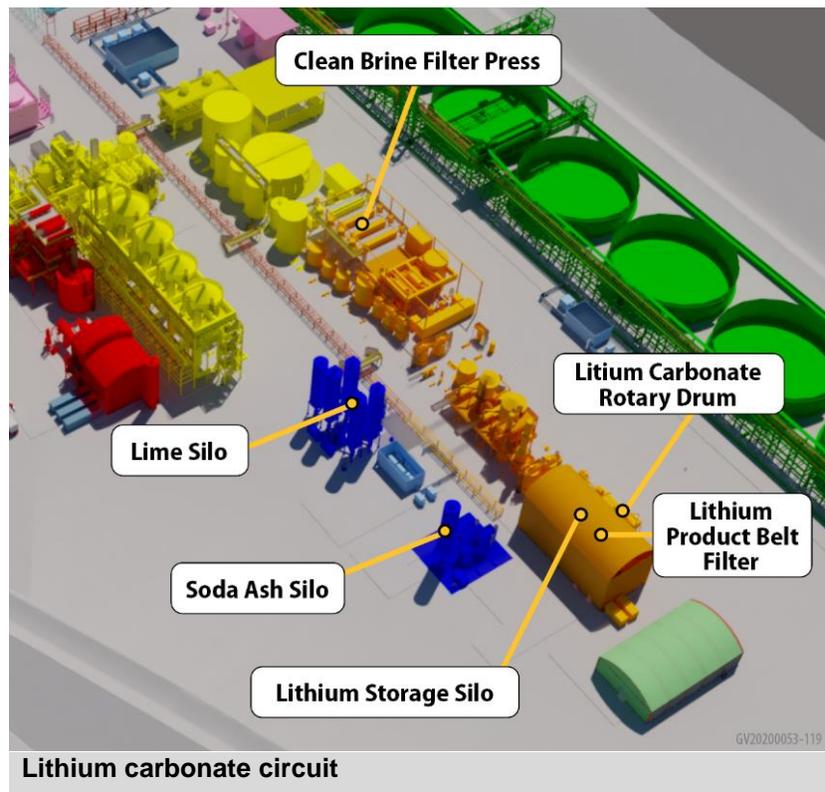
▶ **Lithium carbonate circuit.**

In the final stage, the lithium carbonate circuit is designed to produce technical-grade lithium carbonate from the lithium brine mother liquor. The first step is to remove the remaining magnesium from solution by precipitation with lime slurry.

Lithium carbonate is then precipitated from the magnesium-free mother liquor using soda ash. Ultimately, the precipitated lithium carbonate is filtered, washed, and dried to produce a market-ready product.

1.5.8 LITHIUM HYDROXIDE CIRCUIT (ADDITION)

In year 3, the Rhyolite Ridge Project will install a lithium hydroxide circuit within the process plant boundary to be operational in year 4.



Lithium carbonate circuit

As stated previously, the conversion of the technical-grade lithium carbonate to lithium hydroxide at the site by the liming method takes advantage of the following project opportunities:

- ▶ Initial production of technical-grade lithium carbonate lowers operational risk in the start-up phase and establishes IONEER in the lithium supply market.
- ▶ Production of battery-grade lithium hydroxide in year 4 coincides with its market growth (expected to overtake lithium carbonate demand after 2021).
- ▶ Rhyolite Ridge production capabilities exploited in the long term:
 - Technical-grade lithium carbonate is ideally suited for conversion to lithium hydroxide.
 - The sulphuric acid plant is expected to generate excess steam and power during the conversion process, providing the potential to export power to the electrical grid.

- Calcium carbonate formed during lithium hydroxide production will be recycled and used in the impurity-removal process within the main plant, thus reducing reagent costs.

Lithium hydroxide is the second largest chemical produced by the lithium industry and shows highest recent growth rate of all lithium products. This trend is expected to continue due to the growth in high-nickel battery cathode materials for the automotive and energy storage markets. The key advantages of lithium hydroxide battery cathodes include better power density (more battery capacity and more range) and longer life cycle. Demand for battery-grade lithium hydroxide is expected to overtake that of battery-grade lithium carbonate in 2021.

Veolia, a world-leading lithium processing technology group, conducted DFS test work on this future circuit and successfully produced battery-grade lithium hydroxide from Rhyolite Ridge technical-grade lithium carbonate. This activity confirmed that refining of the Rhyolite Ridge lithium carbonate to battery-grade lithium hydroxide is technically and commercially feasible through a liming route, using standard commercial processes.

Using HPD® evaporation and crystallization technology, Veolia simulated at bench scale the following steps to produce battery-grade lithium hydroxide from technical-grade lithium carbonate (as illustrated below in Figure 1-27):

- ▶ The initial step in conversion to lithium hydroxide is to react the lithium carbonate with slaked lime to produce a raw solution of lithium hydroxide.
- ▶ Removal of impurities using ion exchange from the raw lithium hydroxide solution purifies the solution, so it is suitable to produce primary lithium hydroxide monohydrate crystals by evaporation and crystallization.
- ▶ The final product of lithium hydroxide monohydrate is produced by redissolving the primary product and recrystallization, followed by vacuum drying to produce a high-purity lithium hydroxide monohydrate powder for sale.

Elemental analysis showed that the lithium hydroxide produced met or exceeded the common specifications for battery-grade lithium hydroxide (>56.5% lithium hydroxide) and had low levels of impurities. The lithium hydroxide monohydrate crystals produced were large crystals that exhibited excellent dewatering ability.

Process Flowsheet for Producing Battery-Grade Lithium Hydroxide Monohydrate

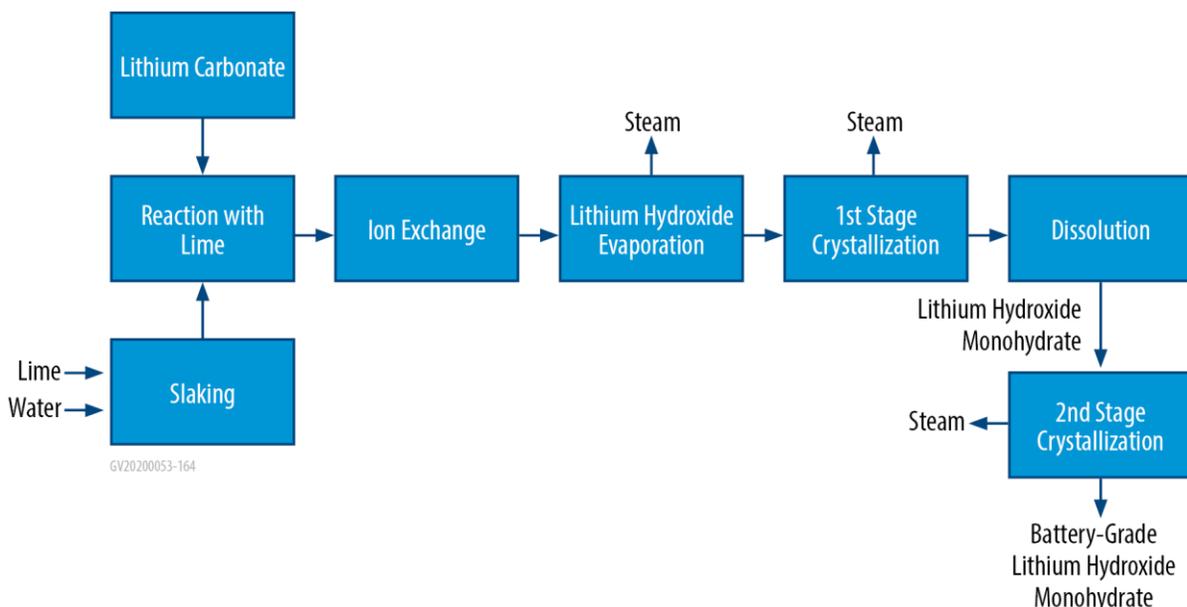


Figure 1-27. Process Flowsheet for Producing Lithium Hydroxide Monohydrate from Lithium Carbonate Feed.

In summary, the evolution of the project’s flowsheet has been significant, and proven at pilot plant scale. This provides confidence that the Rhyolite Ridge Project will provide high recovery rates and become a major, low-cost, and long-term supplier of both lithium and boron.

1.5.9 PROCESS OPTIMIZATION – DETAILS

While the Rhyolite Ridge individual process operations are commercially available with respect to equipment types and equipment sizes, the process flowsheet has been sequenced to exploit the unique mineralogy and chemistry of the Rhyolite Ridge ore that is different to traditional brine- or spodumene-based lithium production.

Due to the unique characteristics of the Rhyolite Ridge ore, challenges occurred during the testing program. These challenges were overcome through detailed analysis of results, root cause analysis, and test work. Ultimately, the underlying chemistry for each challenge was sufficiently understood, and all major issues were resolved.

To document the evolution of the process development, Rhyolite Ridge faced and resolved the following challenges coming out of the initial pilot plant run:

- ▶ Difficult crystal/liquor separation characteristics of crystal salts and poor wash efficiencies related to solid/liquor separations
- ▶ Unacceptable losses of lithium and boron due to physical crystal salt solid/liquor separation (high-value liquor) characteristics
- ▶ Formation of undesirable lithium double salts

The main areas of metallurgical testing completed during the DFS and the outcomes of the test program are thus summarized below in Figure 1-28.

DFS Metallurgical Testing and Results				
Test Program	Details	Outcome of Test Work	Unit Operation Impacted	By:
Sizer crushing test	Vendor test work to confirm required size reduction can be met in two stages of crushing	<ul style="list-style-type: none"> ▶ Crusher index and UCS (unconfined compressive strength) confirmed. ▶ Test work was successful by closing gap between sizer teeth in secondary stage of crushing. 	▶ Crushing	▶ FLSmidth
Leaching	Vat leach test work evaluating deposit leach response variability and full-scale leach performance	<ul style="list-style-type: none"> ▶ Ore variability leach response is consistently high for lithium and boron. ▶ Acid concentration is required to be sufficient to create fines that do not cause permeability issues. ▶ Acid addition is at the beginning of the leach cycle is critical to maintaining good leach conditions and lithium and boric acid recovery. ▶ Optimized a 3-day leach period. 	▶ Vat leach	▶ KCA
Bench-scale evaporation optimization	Bench-scale optimization of PLS evaporation and sulphate salt crystallization	<ul style="list-style-type: none"> ▶ Feed liquor adjusted to represent commercial operations composition. ▶ Crystals from both EVP1 and CRZ2 exhibited good crystal/liquor separation characteristics and low-moisture levels and low lithium losses. ▶ Defined optimum target lithium end concentrations for both EVP1 and CRZ2. ▶ Lithium double salt formation avoided by operating in the correct area of the phase diagram in EVP1. ▶ Removal of aluminum, iron, and fluoride by lime precipitation ahead of bench-scale evaporation/crystallization. ▶ Optimal boil down conditions for evaporation achieved in EVP1. ▶ Two stages of cooling implemented in CRZ 2. 	<ul style="list-style-type: none"> ▶ Evaporation (EVP1) ▶ Crystallization (CRZ2) 	<ul style="list-style-type: none"> ▶ Kemetco ▶ Veolia

DFS Metallurgical Testing and Results				
Test Program	Details	Outcome of Test Work	Unit Operation Impacted	By:
(Continued)		<ul style="list-style-type: none"> ▶ Optimized conditions for EVP1 and CRZ2 established for implementation at pilot scale. ▶ Evaporation optimization program successful. 		
Semi-integrated pilot plant	Operation of an integrated pilot plant consisting of the major unit operations of the DFS flowsheet	<ul style="list-style-type: none"> ▶ Successful production of lithium carbonate and boric acid. ▶ Feed liquor from vat leach was different from that expected during commercial operations (resolved in ensuing bench-scale evaporation optimization testing explained below). ▶ Boric acid flotation from EVP1 and CRZ2 salts proved to be readily achieved. ▶ Phase chemistry of lithium, sodium, potassium, and magnesium overlaid with test results identified desirable operations parameters. ▶ Root cause analysis undertaken to identify causes of poor crystal/liquor separation as follows (all three below resolved in ensuing bench-scale evaporation optimization testing explained below): <ul style="list-style-type: none"> – Crystals from evaporation 1 circuit (EVP1) and crystallization 2 circuit (CRZ2) CRZ2 exhibited poor crystal/liquor separation characteristics, resulting in high-moisture levels and subsequent lithium losses. – Lithium saturation occurred at below target concentrations resulting in lithium salt formation and high lithium losses. ▶ Recommendations of root cause analysis implemented in ensuing bench-scale evaporation optimization test program. ▶ A two-stage impurity-removal precipitation system using lime was successfully implemented on the CRZ2 mother liquor ahead of the lithium carbonate. ▶ Lithium carbonate was successfully produced. 	<ul style="list-style-type: none"> ▶ Vat leach ▶ Boric acid circuit ▶ Crystallization (CRZ1) ▶ CRZ2 ▶ Recrystallization (CRZ3) ▶ EVP1 ▶ Impurity removal 1 and 2 (IR1, IR2) ▶ Lithium carbonate precipitation ▶ Lithium brine evaporation (EVP2) 	<ul style="list-style-type: none"> ▶ Kemetco
Pilot-scale evaporation optimization	Optimized pilot plant operations of PLS evaporation and sulphate salt crystallization	<ul style="list-style-type: none"> ▶ Bulk impurity removal of aluminum, iron, and fluoride by lime precipitation ahead of pilot-scale evaporation/crystallization (Li/B losses unacceptably high, resolved in bench scale impurity removal as explained below). ▶ Implementation of bench-scale evaporation and optimization parameters. ▶ Crystals from EVP1 and CRZ2 exhibited good crystal/liquor separation and low-moisture contents. ▶ Achieved target lithium concentrations in EVP1 and CRZ2. ▶ Low lithium losses achieved in EVP1 and CRZ2. ▶ Results achieved were in alignment with phase diagram expectations. 	<ul style="list-style-type: none"> ▶ IR1 ▶ EVP1 ▶ CRZ2 	<ul style="list-style-type: none"> ▶ Kemetco ▶ Veolia
Pilot-scale crystal/liquor centrifuge separation	Vendor bench centrifuge test rigs for de-brining of sulphate crystals such that scale-up to industrial sizing and performance can be achieved.	<ul style="list-style-type: none"> ▶ Operated simultaneously as part of pilot-scale evaporation optimization work. ▶ Vendor centrifuges used for industrial sizing of equipment used crystal/liquor separation and wash tests. ▶ Centrifuges achieved high levels of separation, low-liquor contents, and reasonable wash efficiencies. ▶ Overall lithium losses were minimized. 	<ul style="list-style-type: none"> ▶ EVP1 ▶ CRZ2 	<ul style="list-style-type: none"> ▶ Kemetco ▶ Veolia ▶ TEMA ▶ Ferrum

DFS Metallurgical Testing and Results				
Test Program	Details	Outcome of Test Work	Unit Operation Impacted	By:
Bench-scale impurity removal	Bench-scale proof of concept and optimization testing of PLS impurity removal	<ul style="list-style-type: none"> ▶ Removal of aluminum and fluorine by an alternate process to form a crystalline sulphate of aluminum and potassium; process achieved: <ul style="list-style-type: none"> – High level of aluminum and fluorine removal to produce a feed suitable for EVP1 and CRZ2 circuits. – Low lithium and boron losses. – Good filtration and washing characteristics. 	▶ IR1	<ul style="list-style-type: none"> ▶ KCA ▶ Kemetco ▶ FLSmidth
Bench-scale flotation optimization	Bench-scale optimization of boric acid flotation	<ul style="list-style-type: none"> ▶ Bench-scale flotation of boric acid from pilot-scale evaporation optimization achieved: ▶ Good recovery of boric acid from EVP1 (3rd and 4th effect evaporators) ▶ Good recovery of boric acid from CRZ2 (2nd and 4th stage crystallizer). 	<ul style="list-style-type: none"> ▶ EVP1 ▶ CRZ2 	▶ Kemetco
Bench-scale lithium optimization	Bench-scale optimization of lithium brine cleaning	<ul style="list-style-type: none"> ▶ Removal of magnesium from lithium brine (CRZ2 product liquor) using lime precipitation was successful. ▶ Removal of calcium ahead of lithium precipitation by addition of sodium carbonate was successful. 	▶ IR2	▶ Kemetco

Figure 1-28. Rhyolite Ridge Metallurgical Testing and Results.

1.5.10 DFS FLOWSHEET SEQUENCE

The overall process block flow diagram for the DFS was updated from the test work described above to reflect the rearrangement and sequence of unit operations to achieve a viable process route. The sequence of the process flowsheet resulting from the DFS test work and pilot plant programs are detailed below in Figure 1-29. The unit operations impacted in the test work described above in Figure 1-28 correspond to the unit operations of the flow sheet sequence below.

From a technical perspective, the key modifications to the DFS flowsheet relative to the PFS are as follows:

- ▶ Optimization of PLS impurity removal (IR1) to improve performance of the downstream PLS evaporation (EVP1) and sulphate salt crystallization (CRZ2) unit operations. This option allowed the lithium brine impurity removal (IR2) precipitation cake to be recycled to PLS impurity removal (IR1), reducing lime consumption and lithium losses.
- ▶ Separation of the EVP1 and CRZ2 boric acid flotation circuits, and recycling of the boric acid flotation concentrate to boric acid crystallization (CRZ1). This is equivalent to upgrading the boric acid concentrate feed to the boric acid crystallizer (CRZ3) while dissolving the gangue sulphate salt.
- ▶ Optimizing the CRZ2 operation to a low temperature of -5°C to reduce the magnesium transferred to the lithium circuit.

Optimizing the order of the lithium brine evaporation (EVP2) and lithium carbonate precipitation unit operations, reducing the risk of lithium saturation in lithium brine evaporation.

Rhyolite Ridge Process Flowsheet Sequence and Details

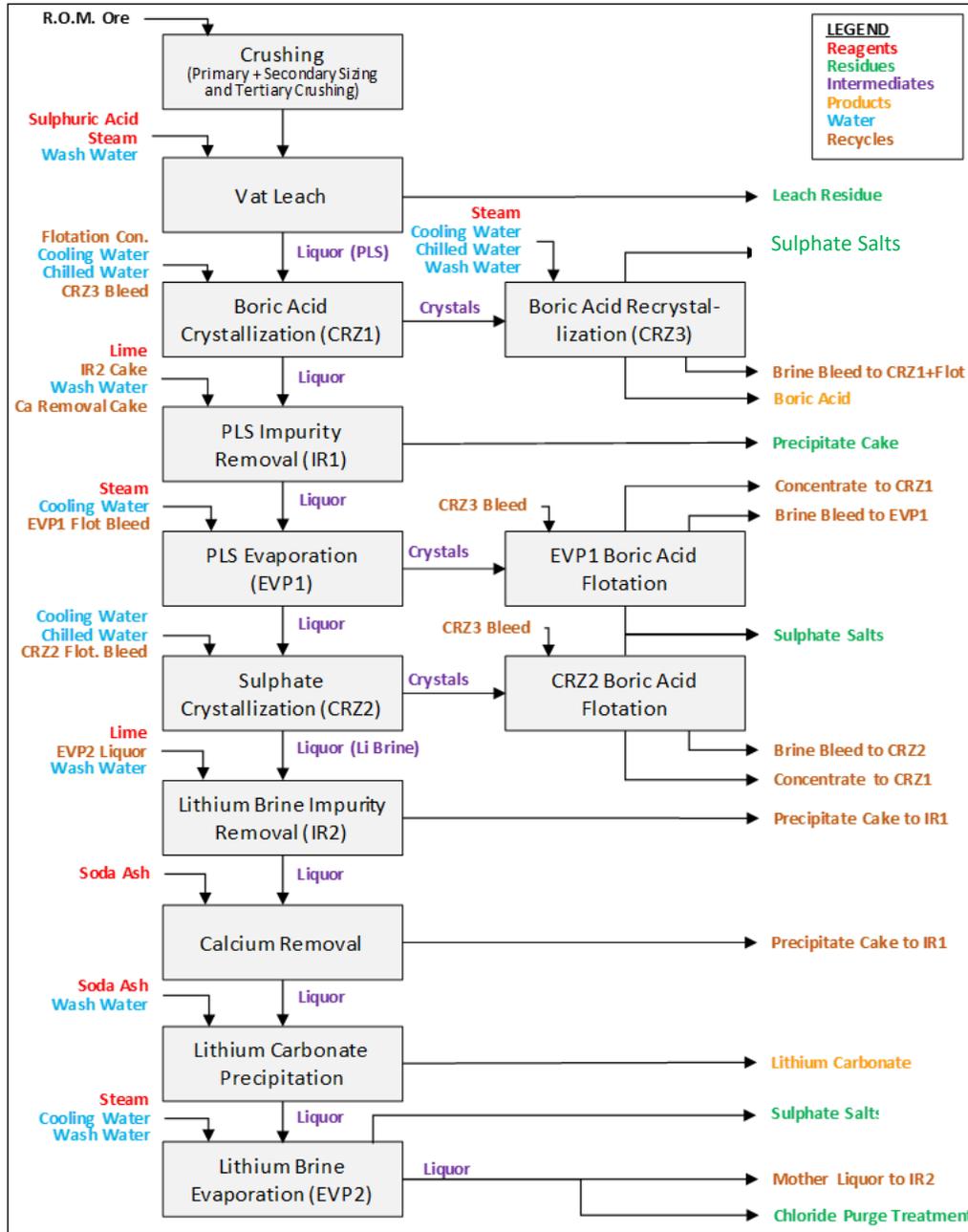


Figure 1-29. Rhyolite Ridge Process Block Flow Diagram by Sequence.

The metallurgical model developed to simulate the material and solution flow rates also addresses the chemistry occurring in the unit operations and where recycling of material or solution occurs. The sequencing of the unit operations now reflect a high level of confidence to achieve the complex Rhyolite Ridge overall recovery calculations and deliver a functional process plant to produce lithium carbonate and boric acid.

1.5.11 SULPHURIC ACID PLANT

A 3,500 metric tons per day (tpd) sulphuric acid plant (Figure 1-30) is the heart of the Rhyolite Ridge operation. The sulphuric acid plant will produce commercial-grade (98.5%) sulphuric acid for vat leaching of ore; steam to drive the evaporation and crystallization steps; and electricity to drive the entire process. The associated power plant will generate 35 MW of electricity in an island mode – sufficient to run the entire facility and will be separate from the Nevada state power grid.

The selection of the technology for the large sulphuric acid plant is based on a proven operating design and specialty technology provider (MECS-DuPont). The acid plant is a double conversion-double absorption system that has proven to be reliable and predictable. It includes a tail gas scrubber system that results in an ultra-low emissions plant (12 ppm SO₂ and 15 ppm NO_x).

As shown in the sulphuric acid plant process flow in Figure 1-31, sulphur is delivered to the site in clean molten form by tankers. Sulphur is then burned in a sulphur furnace combustion chamber with excess clean and dry air to produce sulphur dioxide (SO₂) gas, which is converted in a 4-pass converter to sulphur tri-oxide (SO₃). The SO₃ is absorbed in sulphuric acid in intermediate and final absorption towers to produce sulphuric acid, which is then stored in tanks. A tail gas scrubber is used to remove remaining SO₂ from the gas stream. The tail gas scrubber will guarantee that environmental emissions requirements are met.

The sulphuric acid produced at the plant is used in the vat leaching of the Rhyolite Ridge ore.

Medium- and low-pressure steam from the power plant is piped to the boric acid and lithium carbonate circuits to drive the evaporation and crystallization steps.

The steam power generator (STG) produces power as described in the ensuing Section 1.5.12 (Onsite Power Plant).

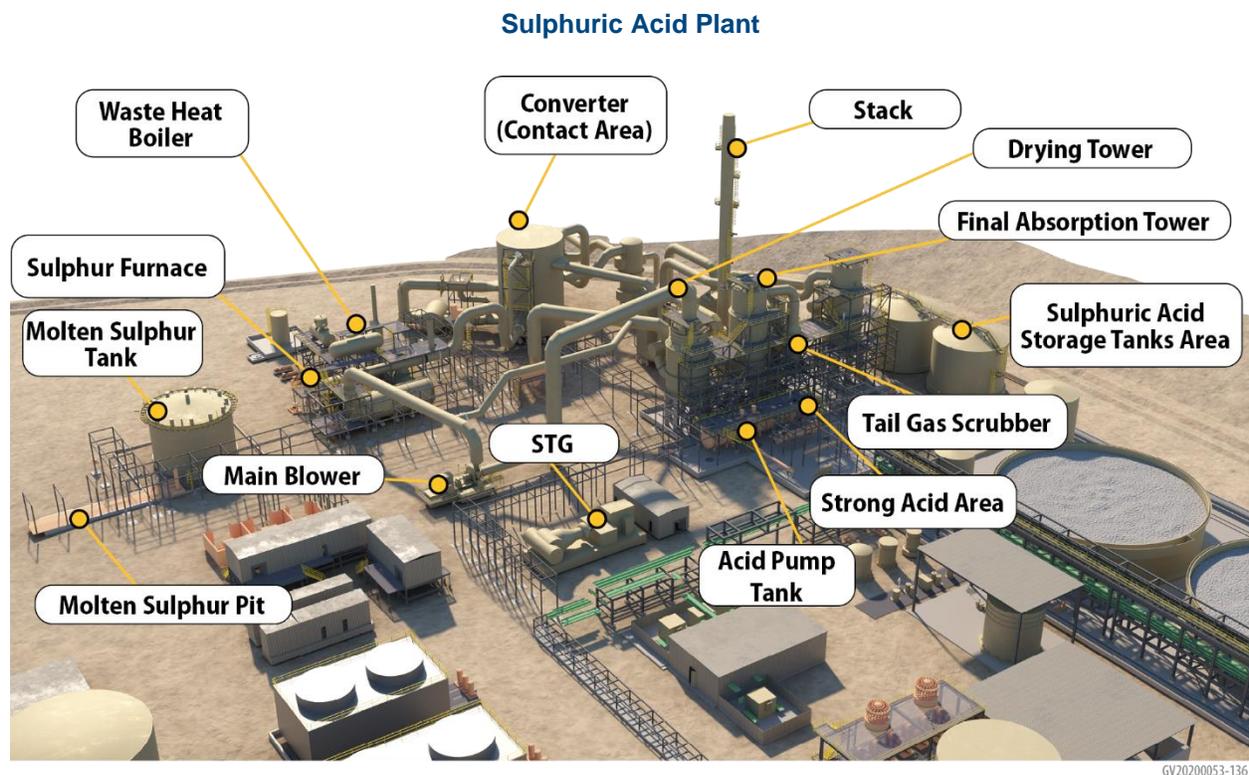


Figure 1-30. Sulphuric Acid Plant.

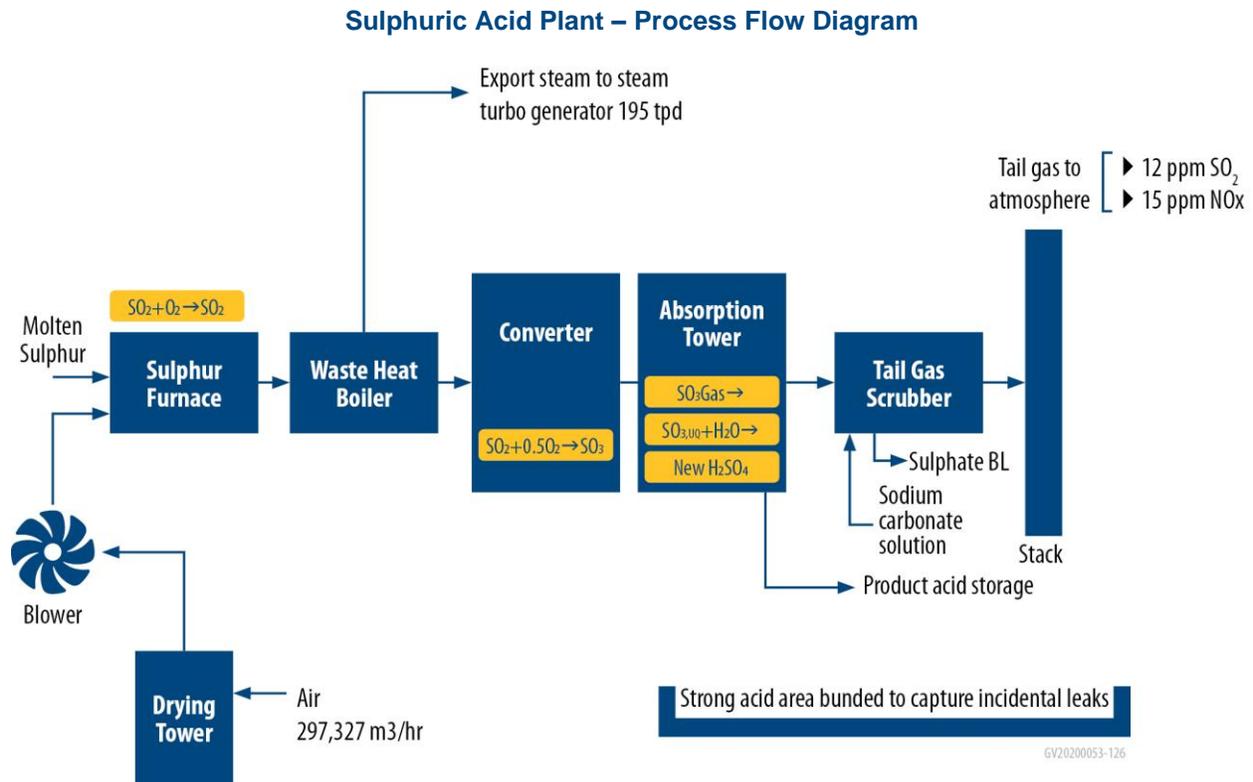


Figure 1-31. Sulphuric Acid Plant – Process Flow.

1.5.12 ONSITE POWER PLANT

The Rhyolite Ridge Project is designed to operate as an island separate from the Nevada power grid. Power will be produced onsite using a steam power generator (STG). Steam will be produced from the waste heat boiler in the sulphuric acid plant to supply the STG. A peak power generation of 35.2 MW can be realized. At full load, total power consumption for the facility is estimated to be 30.5 MW (12 MW used by the sulphuric acid plant and 18.5 MW used by the ore processing facilities).

A 13.8 kV substation near the STG will be equipped with switchgear to receive and distribute the power to the respective electrical rooms as part of the overall power distribution to the downstream plant equipment and facilities.

Various substations, transformers, and electrical switchgear will comprise the electrical distribution system, providing power at 13.8 kV, 4.16 kV, and 480 V voltage levels as required.

The power plant design also includes a separate essential power 6 MW diesel generation and distribution system, providing black-start capability and assuring power availability to essential systems, should the STG be down.

1.5.13 SPENT ORE STORAGE FACILITY

The spent ore storage facility (SOSF) is designed to be a zero-discharge facility and incorporates the necessary drainage and collection systems for a safe design. NewFields completed the detail design and issued an SOSF report and drawings ready for construction. This level of engineering completion is required by regulatory authorities and will be submitted as part of the overall permitting process.

The SOSF has been designed to store a composite consisting of leached ore from the vats plus sulphate salts generated in the evaporation and crystallization circuits. This material is suitable for dry stacking, meaning there is no need for a conventional tailings dam.

The SOSF will be constructed in two phases, with each phase storing approximately 11 metric tons of composite material (Figure 1-32). The storage capacity is based on an average dry unit weight of 1,041 kilograms per cubic meter.

An 80-mil thick, double-sided textured high-density polyethylene (HDPE) geomembrane liner will provide containment. To protect the geomembrane, and facilitate long-term drainage of the composite materials, a granular layer is specified over the geomembrane liner.

The SOSF will be located 1.6 kilometers south of the processing facilities; the material will be trucked from the processing plant and spread onto the SOSF by bulldozer.



Typical spent ore material

Spent Ore Storage Facility (SOSF) Rendering

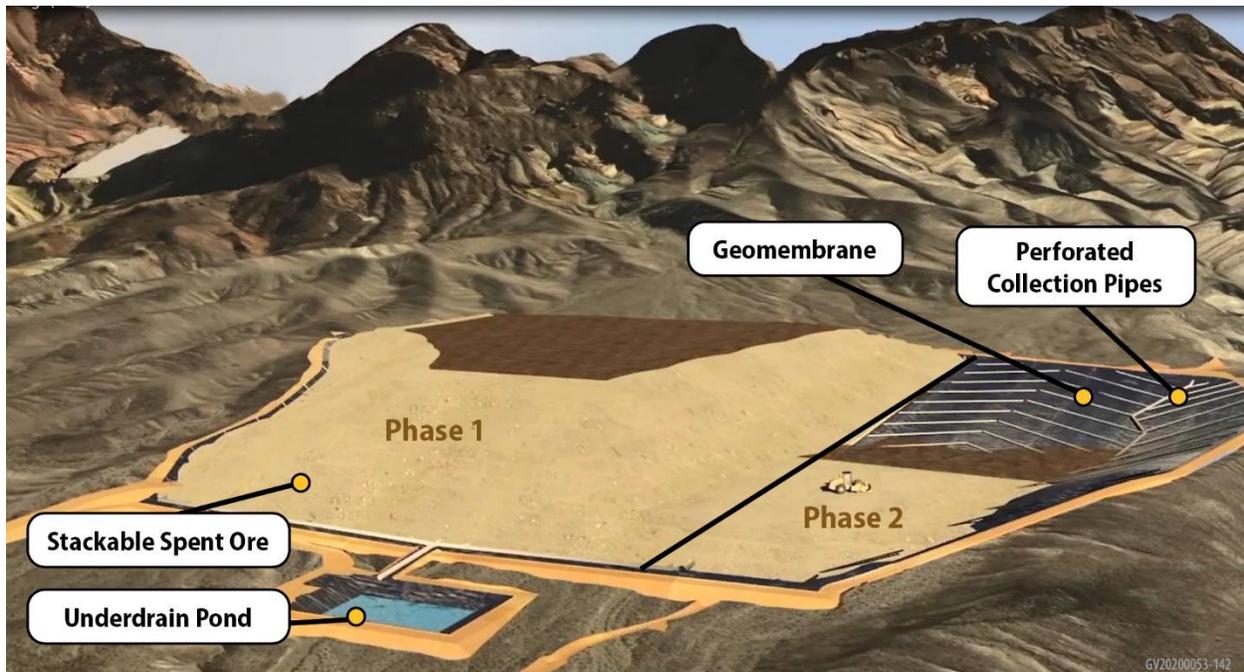


Figure 1-32. SOSF Phases and Main Components.

1.5.14 SITE ACCESS AND INFRASTRUCTURE

Site Access

The project is easily accessed from the cities of Reno and Las Vegas, as well as the ports of California.

The primary point of entry for vehicles transporting goods, supplies, and equipment during the project's construction and operations phases will be from Nevada State Highway 264. Route 264 trends north-south through the Fish Lake Valley, which then intersects with unpaved Hot Ditch and Cave Springs roads for approximately 19 kilometers. At report date, a scoping study was being finalized to allow for subsequent evaluations for alternatives and development of criteria for upgrading and/or maintaining the Hot Ditch and Cave Springs roads.

IONEER is working with Esmeralda County (Nevada) officials in developing a traffic management plan that will integrate the new access roads to the facility with the existing county roads in the area. Particular consideration will be given to make certain that the safety of all users of the county roads is not compromised through development of the project.

1.6 PROJECT COSTS

1.6.1 CAPITAL COST ESTIMATE (CAPEX)

The capital cost estimate (Capex) for the Rhyolite Ridge Project is a Class 3 AACEI estimate, reflecting an accuracy range between $\pm 15\%$. The consolidated capital estimate was produced by Fluor, incorporating engineering data and equipment pricing from Fluor and third parties including Golder, SNC-Lavalin, and NewFields. Owner's cost was provided by IONEER. The estimate reflects the project's design maturity (described below), EPCM execution strategy, and baseline project schedule.

The Capex covers the period from DFS completion to commissioning and is reported in 1Q 2020 real U.S. dollars, without allowance for escalation or currency fluctuation. The Capex cost does not include sunk cost. Figure 1-33 provides a summary of the material take-offs used in the cost estimation of the project to provide context to the estimate.

Key Quantities

Prime	Quantity
Prestripping	1.81 million metric tons
Earthworks (excludes prestripping)	621,472 m ³
Concrete (cast in place)	29,151 m ³
Structural steel	4,386 metric tons
Architectural	3,894 m ²
Platwork	58 metric tons
Tanks	3,230 metric tons
Piping in plant (excludes vat mainfolds)	64,787 meters
Instrumentation bulk materials (tubing)	4,910 meters
Electrical bulk materials (wire, cable)	332,232 meters

Figure 1-33. Material Take-Offs – Rhyolite Ridge Project.

Capex Summary. A breakdown of the Capex is shown below in Figure 1-34 (also previously presented). A contingency of 8% has been calculated using the Monte Carlo calculation methodology to achieve a P₅₀ (probability at the 50th percentile), as applied to the base estimate.

Summary of Initial Capital Cost Estimate (AAECI Class 3)

WBS	Description	Cost (US\$)*
1000	Mine	13.6 million
2000	Spent Ore Storage Facility	17.4 million
3000	Processing Facilities	256.7 million
4000	Sulphuric Acid Plant	101.6 million
5000	Power Plant	21.9 million
6000	Balance of Plant (Common)	60.8 million
Subtotal – Direct Cost		472.3 million
8000	Owner's Cost	20.1 million
9100	EPCM Services	62.6 million
9200	Field Indirect Cost	55.7 million
9200	Subcontractors Indirects	45.5 million
9700	Commissioning & Start-up	7.0 million
9700	Capital & Operational Spares	5.0 million
9800	Process Licenses	2.6 million
9800	Sales Tax	21.7 million
9800	Freight	17.9 million
9900	Contingency at P50	57.6 million
Subtotal – Indirect Cost		295.8 million
Total Direct & Indirect Cost		768.1 million
Late Changes		17.3 million
Grand Total Including Late Changes		785.4 million

*Figures rounded off

Figure 1-34. Initial Capital Summary.

As stated previously, the Capex has increased from the PFS estimate of US\$599 million to the DFS estimate of US\$785 million due to changes in both scope and growth in cost (as illustrated in the financial waterfall repeated as Figure 1-35 below).

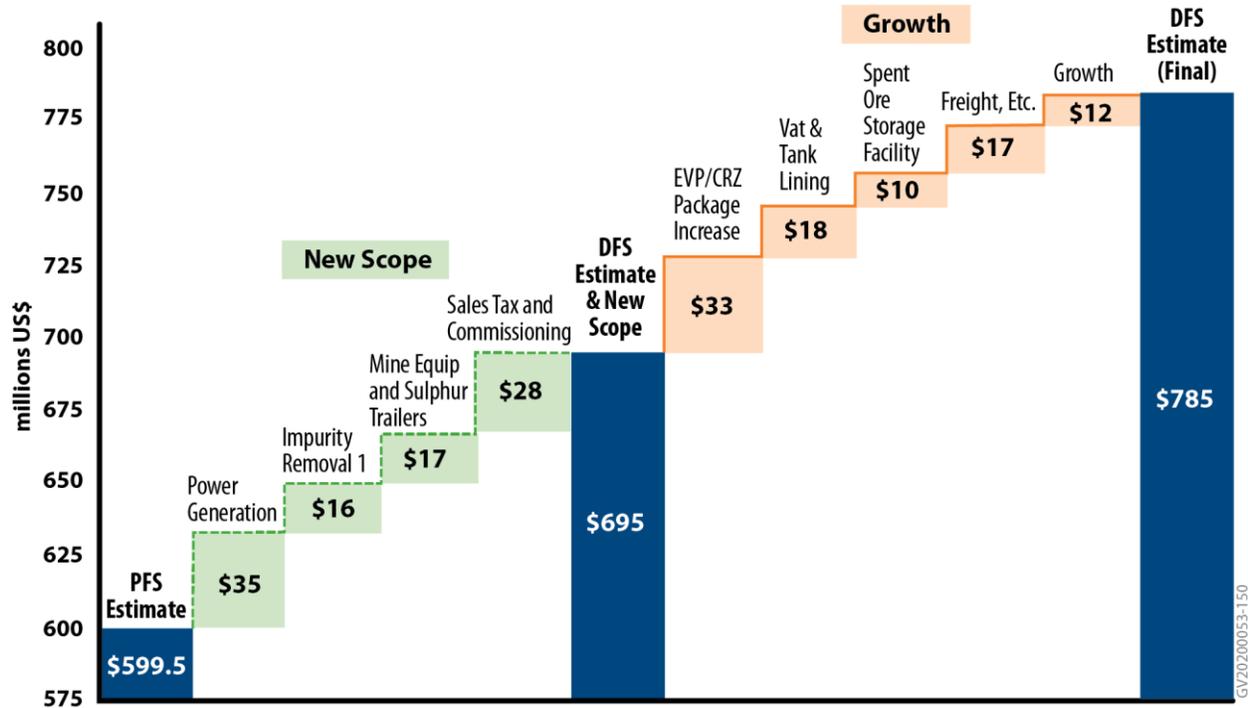
The change in Capex can be attributed to both “new scope” and “growth” as illustrated above:

► **New Scope:**

- Onsite power generation by steam power generator (STG) was added to provide self-sufficient power generation for operations at the project site (versus tying into the state power grid).
- Impurity removal circuit 1 was relocated to improved process recoveries.
- Owner purchase of mine equipment (down payment) and sulphur transportation trailers were added in a refinement to the PFS cost.
- Sales tax and commissioning support expense was added in a refinement to the PFS cost.

► **Growth:**

- Growth in the evaporator/crystallization package was driven by materials of construction, equipment sizing, etc.
- Vat and tank lining growth was due to acidic process conditions.
- Additional spent ore storage facility design requirements were identified in a refinement to the PFS design.
- Growth occurred in the freight and indirect costs associated with equipment fabrication locations and installation support requirements in a refinement to the PFS cost.
- Growth was associated with remaining facilities equipment, structural, piping, and electrical installation works in a refinement to the PFS cost.



Note: Figures above include indirect costs and contingencies.

Figure 1-35. Capex Financial Waterfall – Rhyolite Ridge Project PFS to DFS.

Pricing Sources. Pricing for major equipment and materials for the project was obtained from firm bids or budgetary quotes from qualified suppliers as summarized below in Figure 1-36. The remaining associated costs came from historic pricing from Fluor and the specialist companies involved on the project.

Pricing Source	Mine Equipment	Process/Mechanical	Electrical	Instruments/Controls	Total
Firm Bid	100%	40%	0%	12%	36%
Budgetary Bid	0%	57%	87%	79%	61%
Historical/In-House	0%	3%	13%	9%	3%
Totals	100%	100%	100%	100%	100%

Figure 1-36. Equipment Pricing Source Summary.

Design Maturity and Deliverables. The DFS design maturity for each work breakdown (WBS) area to support the Capex estimate is shown below in Figure 1-37. Likewise, the quantity maturity for major scope items are shown in in Figure 1-38.

Level of Design Maturity

Level of Design Maturity		
WBS	Description	Level of Design Maturity
1000	Mine	Detailed Engineering (100%)
2000	Spent Ore Storage Facility	Detailed Engineering (100%)
3000	Processing Facilities	Basic Engineering (29%)
4000	Sulphuric Acid Plant	Basic Engineering (35%)
5000	Power Plant	Basic Engineering (35%)
6000	Balance of Plant/Common	Basic Engineering (32%)

Figure 1-37. Level of Design Maturity.

Quantity Maturity Matrix

Discipline	IFC Drawings	Eng. Drawings & MTOs	Eng. Sketches & MTOs	Estimated Quantity	Historical Data	Factored Quantity	Allowance
Civil Works – Process Area	–	100%	–	–	–	–	–
Civil Works – SOSF	100%	–	–	–	–	–	–
Civil Works – Water Management	100%	–	–	–	–	–	–
Roads	100%	–	–	–	–	–	–
Concrete	–	25%	20%	25%	20%	10%	–
Structural Steel	–	–	50%	20%	30%	–	–
Mobile Equipment	100%	–	–	–	–	–	–
Mechanical Equipment – Sulphuric Acid Plant	–	100%	–	–	–	–	–
Process Equipment	–	100%	–	–	–	–	–
Piping	–	80%	15%	5%	–	–	–
Electrical	–	50%	–	15%	–	25%	10%
Control Systems	–	50%	–	–	30%	20%	–
Architectural	–	–	70%	30%	–	–	–
Indirects	–	–	–	20%	50%	30%	–
Average Percentage	13%	54%	35%	25%	50%	30%	3%

Figure 1-38. Quantity Maturity Matrix.

Engineering was completed by various engineering companies as shown below in Figure 1-39. The deliverables from the engineers consisted of engineered material take-offs (MTOs) from each discipline, equipment sizing, and pricing in accordance with level of engineering completed and direct cost estimate basis.

Engineering and Estimate Responsibilities

Area	Engineering Responsibility	Equipment Sizing and Pricing Responsibility	Material Take-off Responsibility	Estimating Responsibility
Mine Facilities	Golder	Golder	Golder	Fluor
Ore Processing & Infrastructure	Fluor	Fluor	Fluor	Fluor
Sulphuric Acid Plant	SNC-Lavalin	SNC-Lavalin	SNC-Lavalin	Fluor
Power Plant	SNC-Lavalin	SNC-Lavalin	SNC-Lavalin	Fluor
Spent Ore Processing	NewFields	NewFields	NewFields	Fluor

Figure 1-39. Engineering and Estimate Division of Responsibility.

The project produced more than 1,600 deliverables during the DFS to support the Capex estimate as summarized below in Figure 1-40 (with details on project deliverables previously provided in Figure 1-12).

DFS Project Deliverables Summary (See Figure 1-12 for Details)	
Deliverable Type	Total
Deliverables Issued for DFS	1,481
Deliverables Issue for Construction (IFC)	123
Total	1,604

Figure 1-40. High-Level Summary of DFS Deliverables.

EPCM Project Cash Flow. The Rhyolite Ridge cash flow (Figure 1-41) was developed to align with the engineering, procurement, construction, commissioning, and start-up schedule.

The duration for the cash flow is from start of detailed design activities to final completion.

The cash flow is based on cash outlay at net 30 days for engineering services, net 45 days for major equipment vendors, and net 60 days for all field subcontractors.

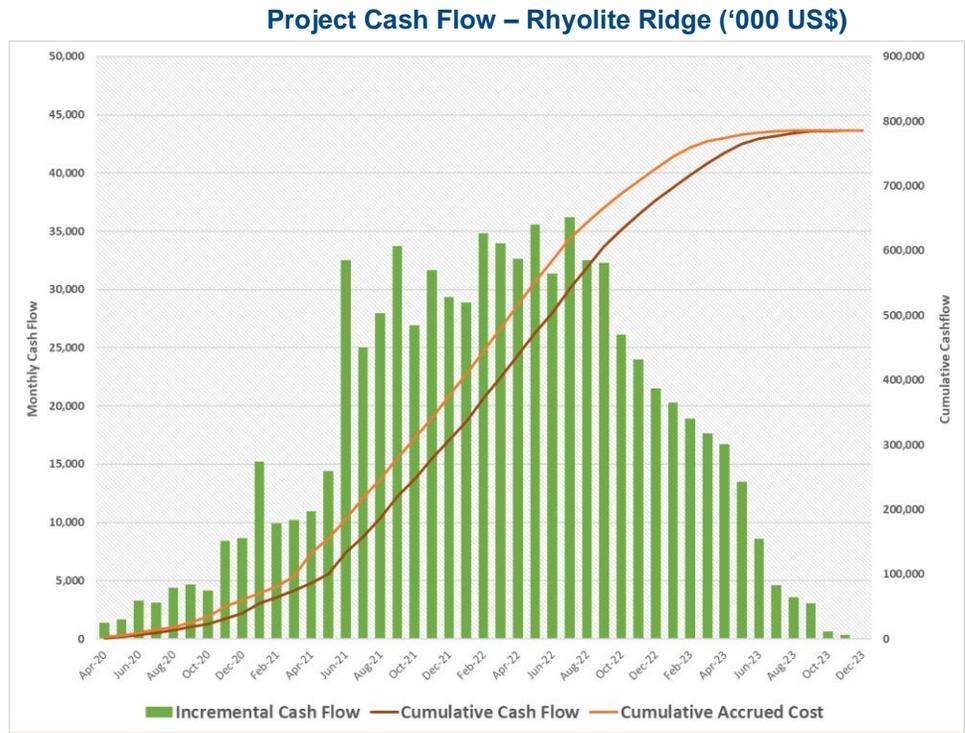


Figure 1-41. EPCM Project Cash Flow.

1.6.2 OPERATING COST ESTIMATE (OPEX) AND SUSTAINING CAPITAL

The operating cost estimate (Opex) for the Rhyolite Ridge Project is a Class 3 AACEI estimate, reflecting an accuracy range between ±15%. Fluor and Golder developed the operating cost estimates for the process plant and quarry, respectively. These were combined into one Opex model that was subsequently used to develop the financial model. The plant and quarry operations costs include the following, with the geographical delineation shown below in Figure 1-42:

- ▶ Process plant includes the cost associated with the spent ore storage facility (SOSF).
- ▶ Quarry includes the cost associated with the overburden storage facility (OSF), haul roads, and quarry stormwater diversions.

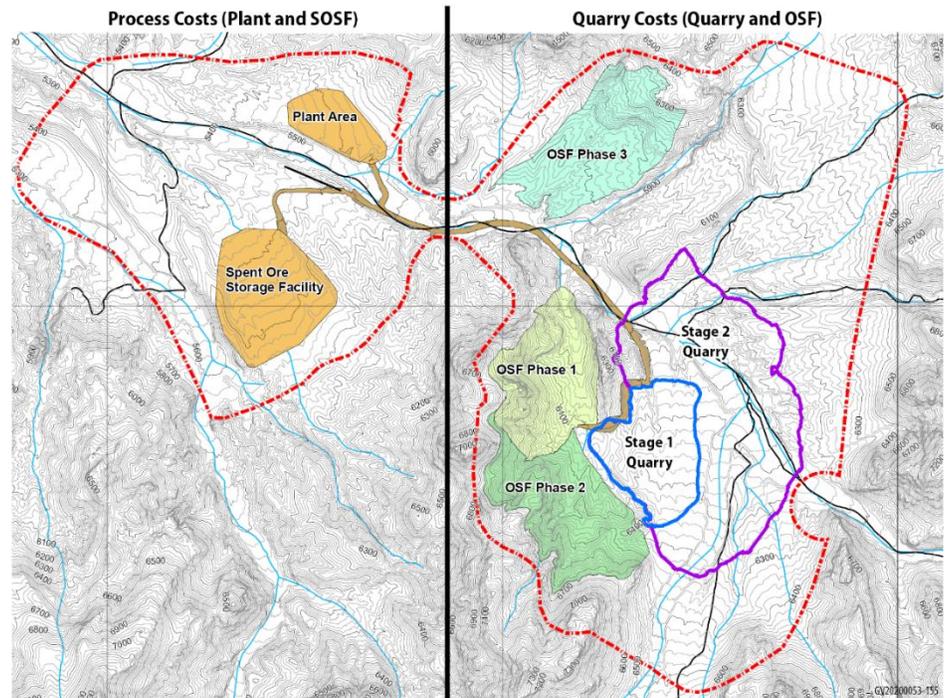


Figure 1-42. Opex Division between Process and Quarry Costs.

The budgets for these operations covered activities over the life of quarry, starting with the scheduled date for production of first product and consisting of 26 years of operations with year 26 being a partial

year. The Opex basis of estimate defines the assumptions, sources of information, and means of estimating the operating expenses for the project.

An overview of the Opex and sustaining capital costs for the Rhyolite Ridge Project are shown below in Figure 1-43 (by total 26-year cost and per-year cost), with Opex details provided below.

Opex and Sustaining Costs – Summary (26-Year Life Of Quarry)*		
	Total Cost (US\$)	Average Cost/Year (US\$)
Operating Expenditure (Opex)		
Process Plant Opex	2,668 million	105.7 million
Quarry Opex	796 million	31.5 million
Less Capitalized Prestripping	-202 million	-8 million
Total Opex	3,262 million	129.3 million
Sustaining Capital		
Sustaining Capital Total	274 million	10.5 million

*Figures rounded off

Figure 1-43. Opex and Sustaining Capital Costs Summary.

Closure costs are currently estimated at \$20 million, to be incurred over a 7-year period after the end-of-quarry life.

1.6.3 OPEX COST – DETAILS

The operating costs (process plant and quarry) for the Rhyolite Ridge Project are shown below by year in Figure 1-44, with a \$129.3 million annual Opex average. The quarry costs in years 4 through 9 vary due to the large variances in overburden excavation.

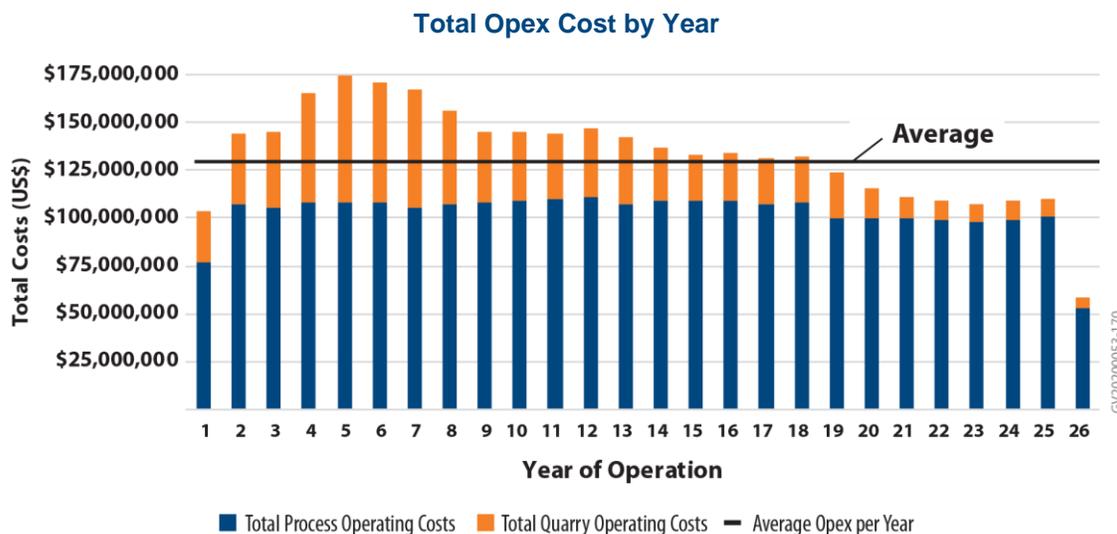


Figure 1-44. Total Operating Cost (Opex) by Year – Rhyolite Ridge Project.

The operating costs per metric ton of processed ore (US\$51.14) also show a similar variability, as shown below in Figure 1-45.

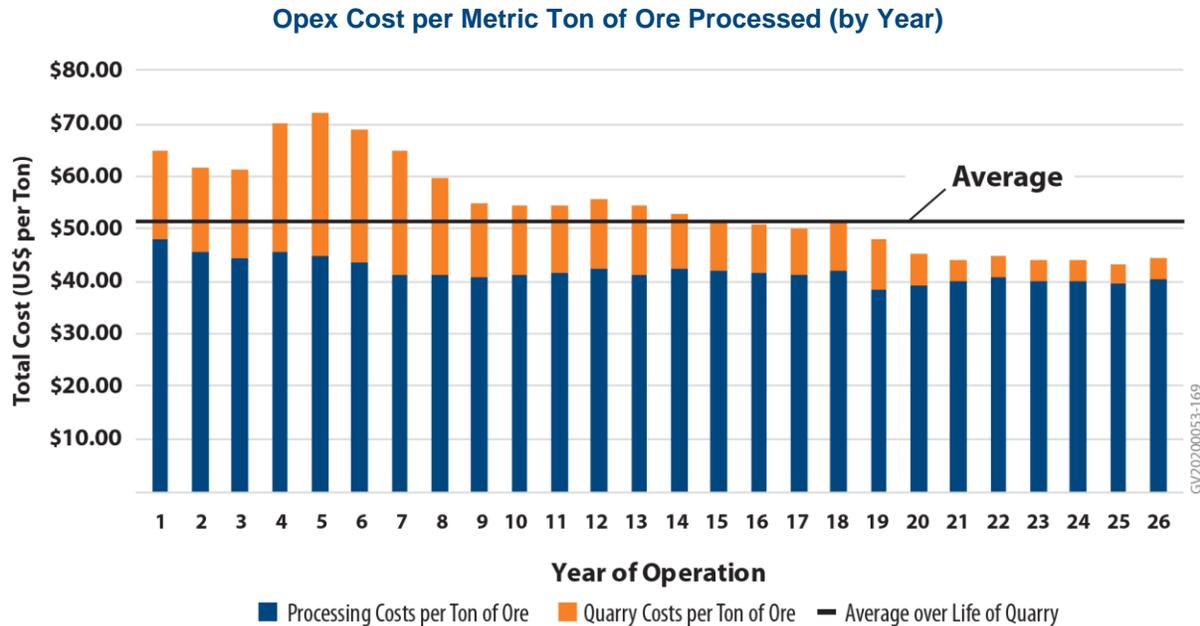


Figure 1-45. Total Cost per Metric Ton of Ore Processed.

The distribution of operating costs is shown below in Figure 1-46. Reagents such as sulphur, soda ash, and hydrated lime make up the majority of these costs; however, transport costs of these reagents exceed the material costs. The total personnel cost includes direct hire of IONEER staff, without corporate staff and outsourced services personnel.

Distribution of Costs – Operating Expense	
Category	Total Cost (US\$)*
Total Personnel Cost	832 million
Total Reagents	778 million
Total Transport (Reagents and Product)	960 million
Total Fuels	259 million
Total Other Including Equipment Leases	341 million
Other Operational Costs (Insurance, Misc. Supplies, Sales Tax, etc.)	293 million
Less Capitalized Prestripping (Transfer to Sustaining Capital)	-202 million
Total Operating Costs	3,262 million

* Figures rounded off

Figure 1-46. Distribution of Costs – Process Plant Opex.

Opex cost per metric ton has decreased from the PFS estimate of US\$59.59 to the DFS estimate of US\$51.14 per metric ton, as illustrated in the Opex financial waterfall below (Figure 1-47).

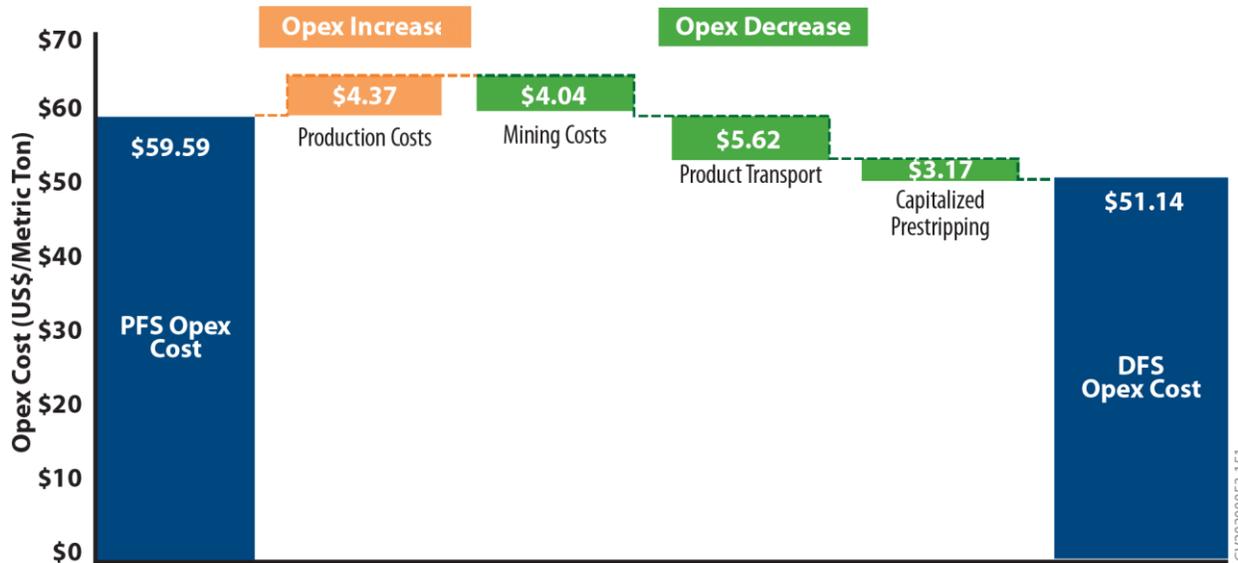


Figure 1-47. Opex Financial Waterfall – Rhyolite Ridge Project PFS to DFS.

The increases and decreases in the Opex shown in the financial waterfall above can be attributed to the following:

▶ **Opex Increase:**

- **Production operational costs.** In a refinement to the PFS Opex, the following production costs were identified and added to the DFS Opex cost:
 - Water rights that include annual charges for actual water consumption.
 - Quantities of reagents consumed by the project’s laboratories.
 - Outsourced services defined as laboratory facilities and personnel, laboratory supplies, consumables, and software.
 - Safety supplies were estimated to include special materials to support safety process and procedures at the site, such as harnesses and extraction devices.

▶ **Opex Decreases:**

- **Mining costs.** During the DFS, a trade-off study determined that a change from contractor miner to Owner-operated mining operations was more cost-effective for the life cycle of the project. Use of autonomous haul trucks also resulted in significant savings.
- **Product transportation costs.** Product transportation costs were significantly reduced due to precise quotes from established logistics providers.
- **Capitalized prestripping.** Prestripping cost was moved to sustaining capital cost in line with applicable regulatory guidance.

1.6.4 SUSTAINING CAPITAL COST

Sustaining capital totals by WBS are shown below in Figure 1-48. Closure costs are incurred after the life of quarry and thus are not tabulated in this cost category.

Sustaining capital is modeled in the financial model and includes (a) \$74 million for the addition of a lithium hydroxide circuit and (b) \$25 million for a sulphuric acid plant heat recovery system that will increase electricity production, both in year 3.

Sustaining Capital Costs		
WBS	Sustaining and Capital Projects	Total Cost* (US\$ million)
1300	Processing Mobile Equipment	9.1
1200	Mining Mobile Equipment	47.4
1100	Haul Road Expansion	1.3
1100	Stormwater Controls Expansion	7.9
2100	Spent Ore Storage Facility – Phase II	6.6
2100	Spent Ore Storage Facility – Additional Capacity	73.9
3600	Lithium Hydroxide Project Process Equipment	40.0
3600	Lithium Hydroxide Project Building and Improvements	34.0
4300	Acid Plant Heat Recovery System (HRS) Installation	25.0
4300	Catalyst Replacement	2.1
5100	STG Refurbishment	1.5
6300	Capital Updates/Building Replacements	20.0
6800	Offsite Water Supply	5.0
	Total	274.1

* Figures rounded off

Figure 1-48. Sustaining Capital Costs.

Timing for the expenditure of the above sustaining costs is included in the Opex model. Highlights of the sustaining and capital project costs are as follows:

- ▶ Heavy mobile equipment is assumed to have a life of 10 years, based upon mining industry practice, and costs for replacement reflect a 10% down payment in the sustaining capital budget. The balance of the acquisition costs are in lease payments in the Opex model. Mine operations will require additional equipment during quarry life, and those acquisitions are modeled similarly to replacements. Some equipment, such as the ambulance and fire truck, have longer service lives that are accounted in the corresponding Capex and Opex models.
- ▶ A 10-year capital refurbishment budget of US\$10 million for each period will cover periodic equipment replacement or upgrades.
- ▶ Significant changes to stormwater controls are planned for years 2 through 5 to accommodate changing topography due to quarry operations. These costs were determined using the life-of-quarry stormwater and drainage plans developed by Golder.
- ▶ The sulphuric acid plant will require a converter catalyst screening every 2 years during a scheduled shutdown to remove fines and assure proper catalyst activity. Some catalyst is replaced during this operation under sustaining capital. In addition, the steam turbine generator will be refurbished every 6 years. A heat recovery system for the acid plant is planned for year 4 of operation to increase electric energy generation and take advantage of a potential connection to a public utility grid for sale of the excess electric power.
- ▶ The SOSF will be expanded after year 3 of operation in a second phase at a cost of US\$6.7 million. OSF capacity at the mine is further expanded in year 7 and every 7 years thereafter at a cost of US\$24.6 million for each expansion.
- ▶ A project to convert lithium carbonate to lithium hydroxide is planned to be constructed in year 3 at a cost of US\$74 million. IONEER provided a lump sum price for this circuit to produce battery-grade lithium hydroxide. Capital and operating costs are reflected in the financial model after year 4. Lithium hydroxide product pricing is reflected in the financial model results. A further study is recommended during detailed design to evaluate the additional electrical, steam, and water needs compared to the current capacity. This will help further define the costs and appropriate additions to the plant system.

1.7 FINANCIAL ANALYSIS – DETAILS

The economics of the Rhyolite Ridge Project were evaluated using a real (non-escalated), after-tax discounted cash flow (DCF) model on a 100% project equity basis (unlevered). Included in the financial model are production costs, revenues, operating costs, capital costs, and taxes.

This financial analysis covers the period from DFS completion to final completion, and cash flows are reported in 1Q 2020 real U.S. dollars without allowance for escalation or currency fluctuation.

The cash flow analysis was used to estimate the economics of mining 2.5 million metric tons of ore annually to produce an average of 20,588 metric tons of lithium carbonate (years 1 to 3); 21,951 metric tons of battery-grade lithium hydroxide (years 4 to 26); and 174,378 metric tons of boric acid.

Key financial modeling assumptions are noted below in Figure 1-49 and Figure 1-50.

Commodity Price Assumptions (US\$/Metric Ton)									
Year	1	2	3	4	5	6	7	8	9
Lithium Compound (US\$/Metric Ton)	\$10,443	\$11,938	\$12,837	\$14,334	\$14,229	\$13,650	\$12,612	\$12,511	\$12,660
Year	10	11	12	13	14	15	16	17	18+
Lithium Compound (US\$/Metric Ton)	\$13,641	\$13,044	\$12,286	\$12,561	\$12,859	\$13,106	\$13,375	\$13,597	\$13,807

Life of Quarry	
Boric Acid (US\$/Metric Ton)	\$710

Note: The above prices are for technical-grade lithium carbonate in years 1 to 3 and thereafter for battery-grade lithium hydroxide, and are based on an average of Roskill and Benchmark Minerals average forecasts.

Figure 1-49. Commodity Price Assumptions (Metric Tons).

Other Key Financial Modeling Assumptions	
Item	Parameter
General	
Ore Mined	2.5 million metric tons
Lithium Carbonate Production	20,588 metric tons, average annual (years 1 to 3)
Lithium Hydroxide Production	21,951 metric tons, average annual (years 4 to 26)
Boric Acid Production	174,378 metric tons, average annual (life of quarry)
Opex US\$ per Ton	US\$51.14/metric ton
Capex – Initial	US\$785 million
Capex – Sustaining	US\$274 million
Closure	US\$20 million
Working Capital Assumptions	
Accounts Receivable Lithium Carbonate	50 days
Accounts Receivable Boric Acid	95 days
Accounts Payable	60 days

Other Key Financial Modeling Assumptions	
Item	Parameter
Tax Rates Assumed	
Federal Corporate Tax	21%
Nevada Minerals Tax	5%
Depletion Allowance	22%
Nevada Commerce Tax	0.05%
Nevada Property Tax Rate	3.02%
Assessed Book Value for Property Tax	35%
Nevada Modified Business Tax	2.00%
Nevada Sales Tax	6.85%
Other	
Diesel (US\$ per gallon)	US\$2.34 (average life of quarry)
Inflation Rate	None
Discount Rate	8% Real
Currency	U.S. dollars (US\$)

Figure 1-50. Other Financial Modeling Assumptions.

The Rhyolite Ridge DFS has demonstrated strong project economics as summarized in Figure 1-51 below. The project has a robust business case including after-tax NPV_s of US\$1.265 billion and healthy unlevered rate of return (20.8% IRR).

Economic Summary – Rhyolite Ridge Project

Item	Description
IRR (internal rate of return, unlevered)	20.8%
NPV (net present value) (8% real)	US\$1.265 billion
Revenue	US\$10.7 billion
EBITDA	US\$7.3 billion
EBITDA margin	68.14%
After-tax CF	US\$4.9 billion
Mine life	26 calendar years

Figure 1-51. Project Economic Summary.

Sensitivity analysis was performed taking into account variations in discount rate, commodity (lithium and boric acid) price and recovery rate, operating costs, capital costs, labor (Opex), and fuel cost. The project is most sensitive to lithium recovery and pricing.

The average pricing shown used for the duration of the project is shown below in Figure 1-52 (prices are in real terms).

Average Pricing Used	
Product	US\$/Metric Ton
Lithium carbonate price (ex-plant)	\$11,740
Lithium hydroxide price (ex-plant)	\$13,423
Boric acid price (ex-plant)	\$710

Figure 1-52. Average Pricing Used in Financial Model.

1.7.1 NPV SENSITIVITY

Sensitivity of NPV to the discount rate is presented below in Figure 1-53.

NPV – Sensitivity to Discount Rate ('000 US\$)					
Discount Rate	12.0%	11.0%	10.0%	9.0%	8.0%
NPV (US\$ '000)	\$625,874	\$752,802	\$899,010	\$1,068,149	\$1,264,684

Figure 1-53. NPV (in thousands US\$) Sensitivity to Discount Rate.

1.7.2 IRR SENSITIVITY

The results of sensitivity analysis for IRR to Capex, Opex, and lithium and boric acid pricing and recovery are presented below in Figure 1-54.

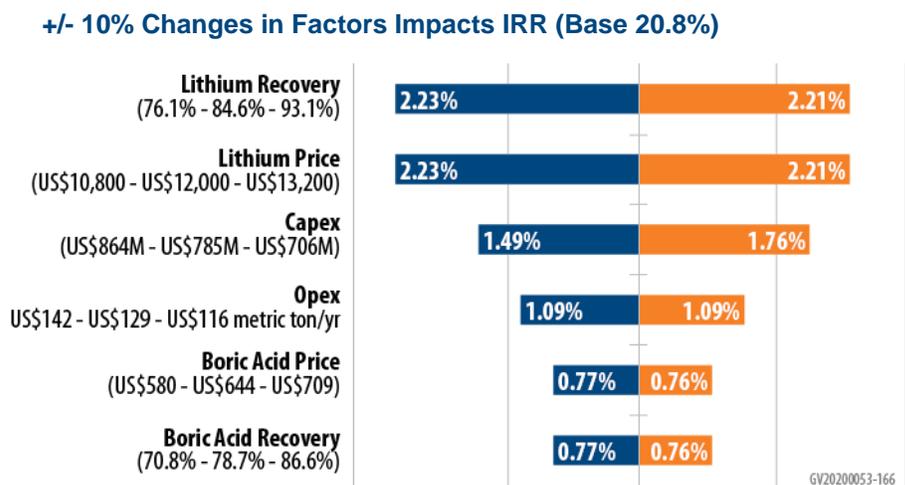


Figure 1-54. IRR Recovery and Pricing Sensitivity.

The internal rate of return of the project is highly sensitive to the lithium recovery and lithium price that are equal weighting. This equality is derived due to the linear relationship between lithium recovery in the process and sales price. The boric acid pricing/recovery relationship is also equally weighted and can be seen in the two bottom factors. Other factors that were considered:

- ▶ **Initial capital expenditures (Capex).** Due to the function and nature of discounted revenue streams, the IRR is much more sensitive to initial Capex due to these expenditures naturally occurring in the first 3 to 4 years of the project.
- ▶ **Operational expenditures (Opex).** Provides a band of +/- 1.09% range in IRR with a 10% increase. Opex through the entire 26-year project is more discounted in the later years. This accounts for the low sensitivity when compared to the previous mentioned three factors.
- ▶ **Boric acid (recovery and price).** Boric acid is a very solid revenue stream with little movement in historical pricing. While IRR does not consider historical pricing, it is worth noting due to the low rate of return sensitivity and historic stability. These two characteristics make boric acid production a very complementary revenue stream.

1.7.3 OPEX PRICING SENSITIVITY

The results of sensitivity analysis for Opex (in cost per produced metric tons) as a function of major factors are shown below in Figure 1-55. A +/- 10% band was also used to determine the sensitivity.

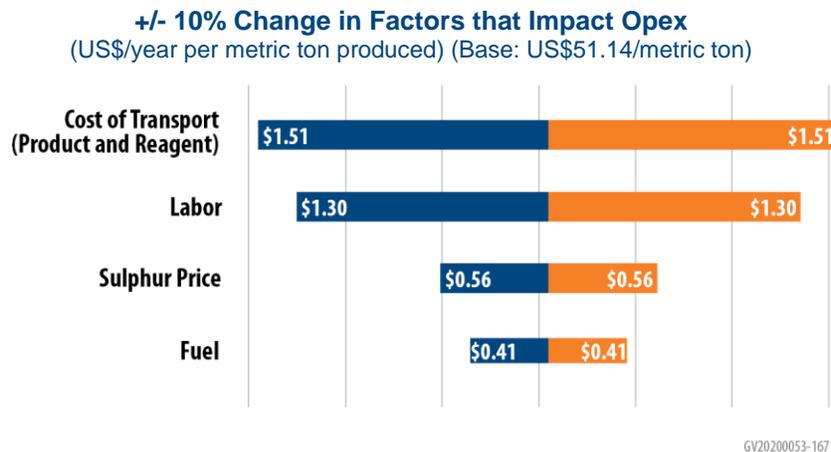


Figure 1-55. +/- 10% Change in Opex Factors Impacts IRR.

The following Opex factors are noted as follows:

- ▶ **Cost of transport (product and reagents).** This category results in 29.4% of the annual Opex expenditures. Some mitigations that IONEER has taken to mitigate this risk are purchasing sulphur trailers to transport the large amount of molten sulphur from the vendor to the process plant. This approach has reduced the cost and risk for the transportation company.
- ▶ **Labor.** Labor has a high sensitivity as well as the highest percentage contributor to the Opex at 25.5%. This is due to the number of personnel required at the process plant as well as the mine that operates three 40-hour work weeks, which contributes to the 24-hour/7-day work week schedule.
- ▶ **Sulphur pricing.** Due to the amount of sulphur required to produce the amount of sulphuric acid needed to leach the Rhyolite Ridge ore, sulphur is approximately half of the reagents cost. Reagents in general are the third largest contributor to Opex. Therefore, sulphur is roughly 11% of the annual Opex expenditures. Having a stable supply and consistent stream of sulphur in place will assist in cost control.
- ▶ **Fuel.** Fuel is approximately 7.9% of Opex. An above-ground fuel station that will service both the mine and process fleet is planned with service agreement from a fueling company. With fuel prices being volatile and dependent on a number of factors, having a stable company with proven supply lines and logistics will help mitigate any increase in costs.

1.8 PERMITS AND APPROVALS

IONEER is in the process of securing permits deemed critical to advance the overall project, particularly those required by:

- ▶ BLM (Bureau of Land Management) of the U.S. Department of Interior under 43 CFR 3809
- ▶ State of Nevada Water Pollution Control Permit (WPCP) (required to construct, operate, and close a mining facility)
- ▶ Nevada Bureau of Air Pollution Control – Air Quality Permit

The BLM permitting process will require compliance with the National Environmental Policy Act (NEPA); IONEER is actively preparing to meet these requirements. Preparation of all other permits, including state and local permits (listed in Figure 1-56), are also in progress with various applications expected to be submitted in 2Q 2020.

The NEPA requirements include the following:

- ▶ **Baseline reports.** At report date, baseline reports for applicable resources in the project area and associated field work are complete for 14 different resource areas of Rhyolite Ridge Project (e.g., air quality, biology, cultural resources, groundwater, recreation, socioeconomics, soils, and rangeland).

► **Plan of Operations.** The Plan of Operations, required by the BLM, includes measures to be implemented to prevent unnecessary or undue degradation of public lands by operations authorized under the Mining Act (1872). It describes all aspects of the project including construction, operations, reclamation, and environmental protection measures. The Plan of Operations will be submitted to the BLM in 2Q 2020. This filing will trigger the environmental review process under NEPA that is expected to follow an Environmental Impact Statement (EIS) pathway.

The NEPA process will be guided by recently implemented guidelines specified in Secretarial Order 3355 by the U.S. Department of Interior, which have been enacted to streamline the overall environmental review and permitting process. If the project is selected for evaluation under an EIS, a draft and then final EIS would be completed by a BLM-approved third-party contractor selected by IONEER. Public comment periods are required as part of the EIS process. The project schedule assumes 12 months of EIS approval cycle.

1.8.1 PERMIT REGISTER

IONEER is in the process of acquiring the necessary permits to develop a starter quarry for the initial years of operations (Stage 1). The permits required from federal, state, and Esmeralda County are summarized in Figure 1-56.

Permit Register (Stage 1 Mining, Alphabetically)	
Permit	Regulatory Agency
Above-Ground Storage Tanks Permit	State Fire Marshall
Air Quality Permit to Construct and Operate	NDEP, Bureau of Air Pollution Control
Boiler and High-Pressure Vessels Operating Permit	State of Nevada Department of Business and Industry, Division of Industrial Relations, Mechanical Compliance Section
Certificate of Public Convenience and Necessity for Power Generation	Public Utilities Commission of Nevada
Dam Safety Permit	Nevada Division of Water Resources
Energy Projects Fund ¹	Nevada Department of Wildlife
Explosives Permit	U.S. Department of Treasury, Bureau of Alcohol, Tobacco, Firearms, and Explosives
Fire and Life Safety	State Fire Marshall
Hazardous Materials Permit	State Fire Marshall
Hazardous Materials Storage Permit	Nevada Department of Public Safety, State Fire Marshall, and State Emergency Response Commission
Hazardous Waste Identification Number	U.S. Environmental Protection Agency and NDEP, Bureau of Sustainable Materials Management
Hazardous Waste Management Permit	NDEP, Bureau of Waste Management
Industrial Artificial Pond Permit	Nevada Department of Wildlife, Habitat Division
Mine Identification Number Request	Mine Safety and Health Administration (MSHA)
Notice of Commencement of Mine Operations	MSHA
Notice of Commencement of Mine Operations	Nevada Department of Business Industry, Division of Industrial Relations, Mine Safety and Training Section
Mine Plan of Operations and Record of Decision	BLM
Mine Registry	Nevada Division of Minerals
Notice of Dam Construction	Nevada Division of Water Resources
Permit to Appropriate Water	Nevada Division of Water Resources
Permit for Package Wastewater Treatment Plant ¹	NDEP, Bureau of Water Pollution Control
Public Water System Permit	NDEP, Bureau of Safe Drinking Water

Permit Register (Stage 1 Mining, Alphabetically)	
Permit	Regulatory Agency
Project Notification	Esmeralda County
Radio Communication Authorization	Federal Communications Commission (FCC)
Reclamation Permit	NDEP, BMRR
Road Maintenance Agreement	Esmeralda County Road Department
Septic System Permit ¹	Nevada Division of Public Health (Fallon)
WPCP	NDEP, BMRR

¹ Permit may not be required depending upon final project design.

Figure 1-56. Permits Register – Rhyolite Ridge Project.

1.9 HSEC AND SUSTAINABLE DEVELOPMENT

1.9.1 HEALTH, SAFETY, AND ENVIRONMENT

The project is committed to providing a safe, injury-free work site while protecting the environment and surrounding communities.

A site health, safety, environmental (HSE) and security program will be developed for the construction phase, and will meet or exceed mandatory codes, acts, and regulatory requirements of MSHA of the U.S. Department of Labor. The HSE program will include safety requirements addressing hazardous processes, hazardous materials and equipment, fire suppression equipment, safe work permit requirements, emergency procedures, safety training requirements, incident reporting, and medical services support.

The message that safety is a core value will be communicated to all levels of the project’s organization and workforce. The HSE plan will describe the project’s core values and policy for complying with all relevant HSE commitments, laws, and regulations. Training for employees will include a comprehensive overview of expectations for safe execution of work activities on the project. This training will include instructions on how all project employees, contractors, and other personnel are to perform their duties and comply with MSHA regulations.

It is the intention of IONEER to utilize the HSE culture and procedures developed during the project and transition them to the operations phase.

1.9.2 ENVIRONMENT AND SOCIAL PLANS

Key elements of the environmental and social plans are described below.

Buckwheat Protection Plan

Nine subpopulations of the Tiehm’s buckwheat (a small perennial plant and BLM-sensitive species) were mapped within the project area. Collectively, the known subpopulations, which currently represent the only known populations of the species, are distributed throughout approximately 4 hectares of the project area.

IONEER has a longstanding Tiehm’s buckwheat management and protection effort in place. IONEER is funding continuing research into Tiehm’s buckwheat at the University of Nevada, Reno (UNR), as part of its larger ongoing Tiehm’s buckwheat protection plan. UNR scientists reported an unexpectedly high and encouraging success rate growing over 1,000 seedlings in the UNR greenhouse from Tiehm’s buckwheat seeds collected from Rhyolite Ridge. This research aims to demonstrate the feasibility of propagating Tiehm’s buckwheat in the wild as UNR researchers have done with similar types of buckwheat elsewhere in Nevada.

Ongoing and proposed buckwheat mitigation efforts include:

- ▶ Seed collection and storage
- ▶ Greenhouse germination
- ▶ Research sponsorship
- ▶ Transplanting of adult populations
- ▶ Soil testing to identify preferred soil conditions
- ▶ Care and protection of existing populations
- ▶ Genetic research

IONEER's completed and ongoing efforts are documented in a buckwheat protection plan, will form part of the Plan of Operation. The protection plan aims to assure the protection and sustainability of the buckwheat population in its own habitat.

Dewatering and Depressurization

In-pit dewatering will be necessary in all stages of quarry progression to maintain a dry, stable floor, as the lower hydraulic conductivity Cave Springs formation provides a barrier to groundwater flow in the quarry.

Dewatering rates are predicted to range from 15 to 27 cubic meters per hour. A minimum of one dewatering area will be maintained at all times in the lowest area of the pit floor. This water will be pumped out of the quarry using dewatering pumps where it will be sent to the process circuit for reuse. Stormwater controls will be constructed around the perimeter of the pit, before the quarrying process begins in the respective area, to limit the quantity of water in the pit. Between production years 4 and 9, there may be two entirely separate mining areas in two separate pits, in which case two dewatering areas will be used, one for each pit.

Quarry Lake

The quarry lake mentioned above is expected to form in the quarry after dewatering ceases. For evaluating quarry lake impacts, three scenarios were simulated: a base case (expected); scenario that simulated the quarry lake refilling with a higher hydraulic conductivity; and another with a lower hydraulic conductivity. In all cases, the quarry lake is predicted to stabilize below the local, pre-mining groundwater elevation, resulting in a long-term stable hydraulic sink around the quarry.

Groundwater

Several aspects of potential impacts to groundwater are currently being evaluated by IONEER and its consultants due to development of the proposed project. Such impacts are generally associated with the following:

- ▶ Dewatering of the quarry
- ▶ Development of a groundwater supply source for processing and other project-related needs
- ▶ Development of a post-closure quarry lake/sink

A groundwater model, calibrated to site conditions and groundwater system hydraulic conditions, is being developed and will be used to assess such impacts.

Socioeconomics

Social and community impacts associated with development of the project are being considered and will be evaluated in accordance with NEPA and other federal laws. Potential impacts are generally restricted to the existing population, including changes in demographics, income, employment, local economy, public finance, housing, community facilities, and community services. Potentially affected Native American tribes and tribal organizations are being consulted during the preparation of all social plans to advise them of project aspects that may have an effect on cultural sites, resources, and traditional activities.

At this time, no known social or community issues or impacts will have a material impact on IONEER's ability to extract mineral resources. Identified socioeconomic issues (e.g., employment, payroll, services, supply purchases, and state and local tax payments) are anticipated to be positive and enhance the

lifestyles of the local citizenry. Logistical considerations such as housing and transportation are currently being evaluated and discussed by IONEER in coordination with local community members.

In terms of employment opportunities, IONEER estimates a total of 400 to 500 persons will be employed either directly through IONEER or through contractors constructing the project. This will include a mix of skilled workers, as well as management personnel. While the mine is operating, IONEER estimates an initial staff of over 200 workers evolving to a peak of approximately 290 will be employed, including a similar mix of skilled workers plus several management personnel. Numerous other jobs are expected indirectly as a result of the project, providing goods and services beyond those created through direct employment with IONEER and its contractors.

In addition, several revenue streams will likely be realized by Esmeralda County through various taxes levied directly and indirectly by federal, state, and local governments. These revenue sources include:

- ▶ Sales and use taxes
- ▶ Property taxes
- ▶ Employment wage taxes
- ▶ Fees and transfer payments
- ▶ Other taxes associated with local, regional, state, and national project-specific purchases

The majority of the tax revenue to be received by Esmeralda County, however, would be associated with a Net Proceeds of Minerals tax. Other nearby communities (e.g., Tonopah in Nye County) would also realize financial benefits from the project through increased commerce and related tax revenues.

IONEER envisions finalizing and implementing a community enhancement plan before starting construction. This plan will be developed with input from community and county management teams and other stakeholders. The plan's objective will be to identify potential preemptive development actions that IONEER would implement to address any issues resulting from an influx of construction and operations phase employees into the local communities.

Planning elements will include a focus on alleviating any impacts to schools, health and medical facilities, utilities, landfills, emergency response services (e.g., ambulance, fire), roads, law enforcement, and community welfare systems, among other factors important to local communities with respect to project development, operations, and closure. Funding for execution of the plan would ultimately be in the form of taxes paid by IONEER to county and state entities responsible for such improvements.

Roads and Transportation

Potential project impacts on local roads are being evaluated and addressed in close coordination with the Esmeralda County roads department and BLM. Delivery and transport trucks (currently estimated at approximately 75 per day) and employee vehicles will increase traffic in the project vicinity, including along the unpaved access road from Highway 264 to the project area, along public land administered by BLM.

Additionally, IONEER is in the process of completing a transportation plan to further evaluate and mitigate potential effects of increased traffic and road use in the project vicinity.

1.10 PROJECT EXECUTION PLAN

1.10.1 EPCM EXECUTION APPROACH

The Rhyolite Ridge Project has been divided into four major areas for execution purposes:

- ▶ Mine quarry including mine haul roads (Figure 1-16)
- ▶ Processing facilities (Figure 1-25)
- ▶ Sulphuric acid plant (Figure 1-30)
- ▶ Spent ore storage facility (referred to as SOSF) (Figure 1-32)

The Project Execution Plan is based on an EPCM delivery framework. A project delivery model has been developed as Figure 1-57. Project execution is based on continuing with the same companies that completed the DFS to maintain continuity and retain project knowledge.

The key elements of the Rhyolite Ridge Project management approach and delivery model are as follows:

- ▶ **IONEER project governance.** All project activities are performed in accordance with Fluor requirements and project execution plans and project procedures, with adjustments to suit IONEER's specific project needs. IONEER sets the business requirements and general guidelines, and makes strategic decisions.
- ▶ **EPCM contractor.** Fluor is the EPCM contractor responsible for management and integration of the overall program. Fluor's role is to effectively manage the program under its responsibility on behalf of the Owner's team, using the most appropriate contracting strategy for the individual scope blocks to assure the business objectives of the project are delivered.
- ▶ **Detailed engineering.** Upon completion of the DFS, engineering will proceed into execution engineering services (EES). During the initial EES phase, priority will be placed on finalization of major packages. Availability of certified vendor data will be critical to the completion of engineering drawings and avoid vendor data negatively impacting engineering's ability to complete ahead of start of construction. Hence, it is envisioned that the project will purchase the vendor data prior to committing to the fabrication release of the equipment. The FNTF of the project is expected to be 13 months after the start of engineering services (ESS).

The same engineering entities that successfully complete the feasibility study engineering will continue on the project to complete detailed design as follows:

- Mine and haul road design is by Golder (complete)
- SNC-Lavalin is responsible for the engineering and licensing of the technology for the sulphuric acid plant
- Fluor will provide engineering for the main processing facilities
- SOSF detailed engineering has been completed by NewFields

In addition, specialty companies will be engaged to provide detailed design for the following packages:

- Material handling
 - Evaporators and crystallizers package
 - Instrumentation and controls systems
- ▶ **Procurement.** The majority of the procurement will be carried out by the Fluor procurement team per the approved material responsibility matrix, with the exception of the sulphuric acid plant procurement (tagged equipment) that will be by SNC-Lavalin. The project will involve development and placement of approximately 65 home office purchase orders. A select few specialty packages (e.g., material handling) will be procured by the specialty engineering firms. Fluor will procure bulk materials.

Fabrication of equipment and materials will be released after the FNTF milestone, with exception of the following long lead packages that may require fabrication release prior to FNTF:

- Waste heat boiler
- Boiler feed water pumps
- Vat unloading crane
- Steam turbine generator
- Evaporation and crystallization
- Main blower

Implementation of proactive expediting methods (e.g., shop visits, weekly meetings, progress reporting) will make certain that engineering information is received and equipment and materials are delivered to meet schedule requirements. Supplier quality surveillance will verify that the specified level of quality is achieved through focused inspections and quality surveillance performed in accordance with the equipment's criticality rating.

Fluor will be responsible for managing a logistics service provider for prompt delivery of equipment and materials to the site.

Project Delivery Model

		Rhyolite Ridge Project			
		Sulphuric Acid Plant	Processing Plant	Spent Ore Storage Facility	Mine/Haul Roads
EP	Owner	IONEER			
	EPCM Contractor	Fluor			IONEER
	Engineering	SNC-Lavalin	Fluor	Newfields	Golder
	Procurement		Fluor		
Construction	Construction Management	Fluor			IONEER
	Civil, Earthworks & Site Preparation	Civil Package			
	Concrete	Sulphuric Acid Plant Package	Process Facilities Package		No Scope
	Structural Steel				
	Mechanical/ Equipment Setting				
	Piping/Insulation				
	Precommissioning				
	Field Erected Tanks	Field Erected Tank Package			
	EI&C & Heat Tracing	EI&C Package			
	Start-Up	Commissioning	IONEER (with Fluor Support)		
Ramp-Up/Production					
Performance Testing*					

*Performance testing of operable systems; and plant performance testing

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Figure 1-57. EPCM Project Delivery Model.

► **Construction.** Construction will last 24 months from site mobilization to mechanical completion (including precommissioning). Fluor will be the construction manager for the project and manage all aspects of the construction activities.

The main contracting approaches for the project’s construction involve a combination of (1) large vertical packages and (2) large horizontal packages as shown in the project delivery model:

- Overall horizontal civil package including site preparation and earthworks
- Two major vertical contract packages (e.g., concrete, steel, mechanical, and piping) for sulphuric acid plant and all processing facilities
- Tank and vessel horizontal package
- Electrical and instrumentation horizontal package

Fluor will team with qualified construction contractors who have significant relevant experience, supervision, and craft resources in the region.

The EPCM work will be complete after precommissioning by the contractors (managed by Fluor), achieving mechanical completion and formal transfer of care, custody, and control of the facilities to IONEER for further commissioning and production ramp-up.

- ▶ **Commissioning.** Commissioning, preliminary operations, and performance testing will be undertaken by IONEER with Fluor, contractors, and vendors serving in a program assistance role. Program assistance is defined as coordination, planning, and executing commissioning of equipment, operable systems, and performance tests. Fluor will develop a detailed precommissioning and commissioning plan for the project facilities to support the commissioning and performance testing works. Fluor's commissioning support team along with IONEER, contractors, and vendors will execute the works according to the project commissioning plan.

1.10.2 ORGANIZATION

Fluor as EPCM contractor will act for and on behalf of IONEER in the execution of the works. IONEER and Fluor management will collaborate in a one-team approach to successfully manage and execute the project. Fluor will provide considerable support to IONEER with respect to operational readiness and commissioning to facilitate a smooth start-up. Organization charts for the EPCM execution phase of the project have been completed.

1.10.3 PROJECT SCHEDULE – DETAILS

A critical path method (CPM) EPCM project schedule was developed during the DFS and takes into account the engineering, procurement, construction, commissioning, and permitting elements of the project. The detailed Level 3 schedule contains a total of over 5,000 activities.

The project schedule has a total duration of 41 months from commencement of the EPCM phase to final completion. The 41-month schedule has been developed to forecast the earliest date for completion of the project, including 4 months for commissioning, start-up, and performance testing.

The schedule duration from the start of the EPCM phase to mechanical completion is 37 months.

On completion of the DFS, the schedule reflects a partial release of engineering and procurement of critical equipment. Thereafter, when full funding for the project is realized, the full EPCM scope is released and executed.

The construction phase of the schedule from site mobilization to mechanical completion is 24 months. An EPCM summary schedule with key milestones at the top is depicted as Figure 1-58.

The project permitting is expected to follow an Environmental Impact Statement (EIS) pathway. FNTF and site mobilization will be tied to approval of the EIS by the U.S. Department of Interior's BLM. Approval is expected to take about 12 months from submission to approval. In addition to the EIS, the Water Pollution and Control Plan (WPCP) requires approval prior to site mobilization. The approval processing time for the WPCP is approximately 6 months. WPCP deliverables are planned to be updated and issued after completion of DFS to assure the WPCP remains off the critical path.

1.11 OPERATIONAL READINESS

1.11.1 OPERATIONS MISSION

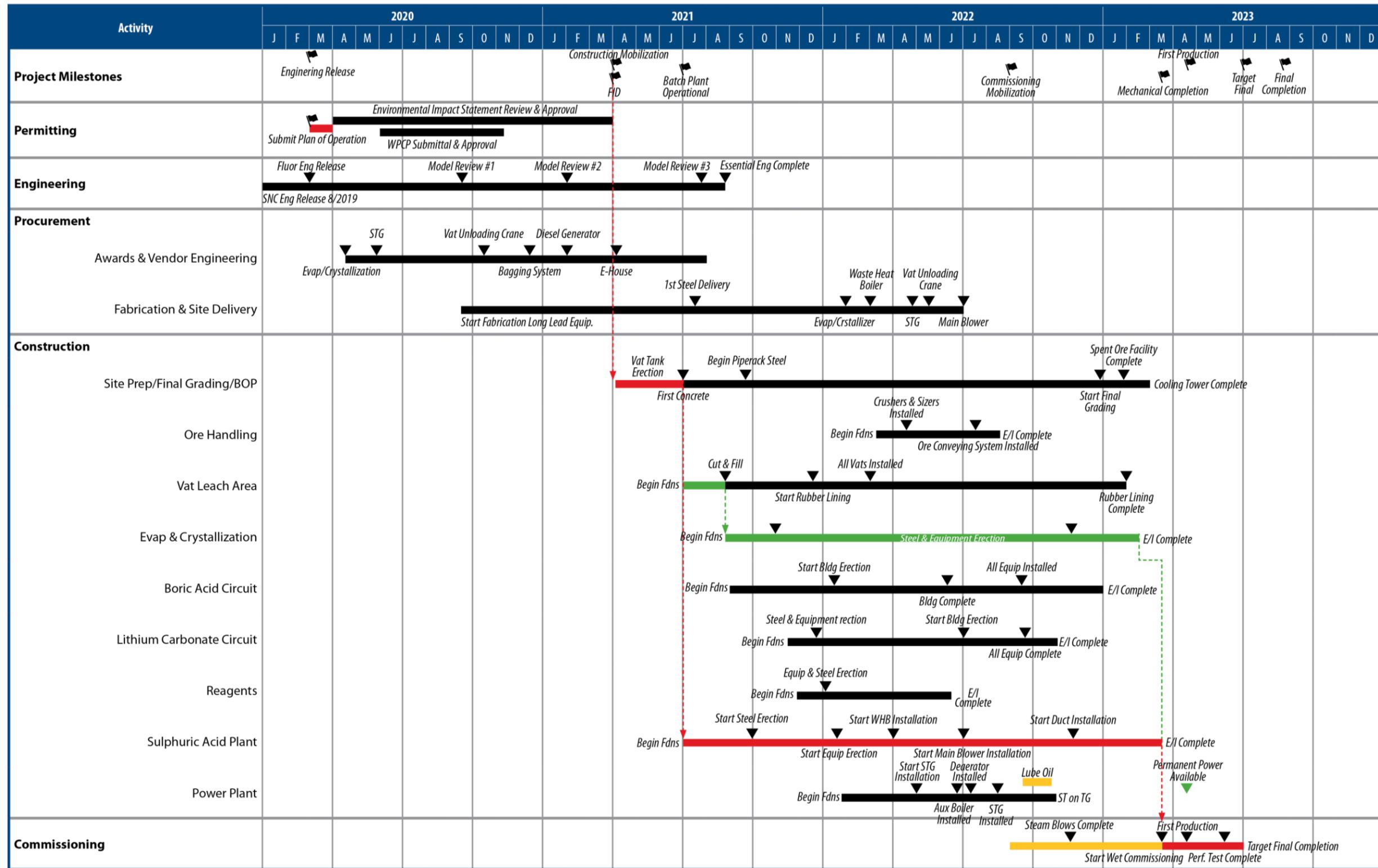
The mission of the Rhyolite Ridge operations team is to achieve the highest HSE performance possible while producing products that will meet or exceed our customers' expectations and establishing IONEER as a leader in the supply of technical-grade lithium carbonate and boric acid.

Operations will safely, consistently, and reliably perform the following:

- ▶ Adopt a zero harm policy to personnel, community, and environment when operating the new facilities
- ▶ Quickly achieve stable operations after operational start-up and ramp-up
- ▶ Continuously improve all aspects of the mine, processing facilities, and administration functions throughout the organization

- ▶ Work together to achieve IONEER product quality requirements to achieve a low-cost operational facility

Rhyolite Ridge Summary Schedule



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Figure 1-58. Rhyolite Ridge Summary Schedule.

- ▶ Provide the timely preparation and completion of the operational readiness activities, facilitating a smooth transition through design, construction, precommissioning, commissioning, performance testing, and production ramp-up to achieve steady-state plant operations

1.11.2 OPERATIONAL READINESS PLAN

The operational readiness function of the IONEER organization will address planning, development, and implementation of all business processes that are required to prepare the organization for operations, management, and administration of the facility. To accomplish this, a strategy for each business process (e.g., operations, maintenance, supply chain, HSE) will be used to guide the creation of an organization that will effectively and efficiently complete the prestart-up work, and promptly begin commissioning, start-up, and ramp-up, and achieve steady-state production.

An EPCM project execution model has been selected; IONEER will utilize Fluor's resources to support the preparation and initial start-up of the facilities.

An operational readiness master plan and schedule will be finalized early in the EPCM phase for all the activities required to implement the business processes to achieve readiness. Among these activities are:

- ▶ Establishing the facility organization and structure with roles and responsibilities (complete)
- ▶ Determining outsourcing strategies, validating qualified service, and establishing external contract service providers for supplemental staff for the maintenance of specialized equipment (e.g., bridge cranes and centrifuges) (progressed)
- ▶ Developing and execution of the training program for operations personnel (progressed)
- ▶ Creating a comprehensive quality manual to drive conformance to the process requirements to produce products meeting specifications
- ▶ Managing the interface of material suppliers and outsourced services
- ▶ Developing storage, handling, packaging, and delivery procedures to guarantee the proper quality control, handling, labelling, storage, packaging, and delivery of product to customers

Operations personnel will be assigned activities in the operational readiness master plan and schedule for the facilities including:

- ▶ Developing standard operating procedures (SOPs)
- ▶ Participating in vendor-supplied training
- ▶ Witnessing or participating in precommissioning and wet commissioning activities

These activities will be based upon a roles and responsibilities workshop conducted with IONEER to define who will be responsible for the activities, the inputs needed to perform the activities, due dates for the activities, and a definition of the deliverable. The operational readiness schedule will include an estimation of the hours required to perform all the activities.

1.11.3 OPERATIONS ORGANIZATION AND STAFFING

Organizational charts for operations of the mine and project facilities have been developed. A Level 1 Owner operations organization chart is shown in Figure 1-59. The total staffing plan for steady-state operations over the 26-year life of quarry is provided in Figure 1-60, with peak staffing of approximately 290 in year 6.

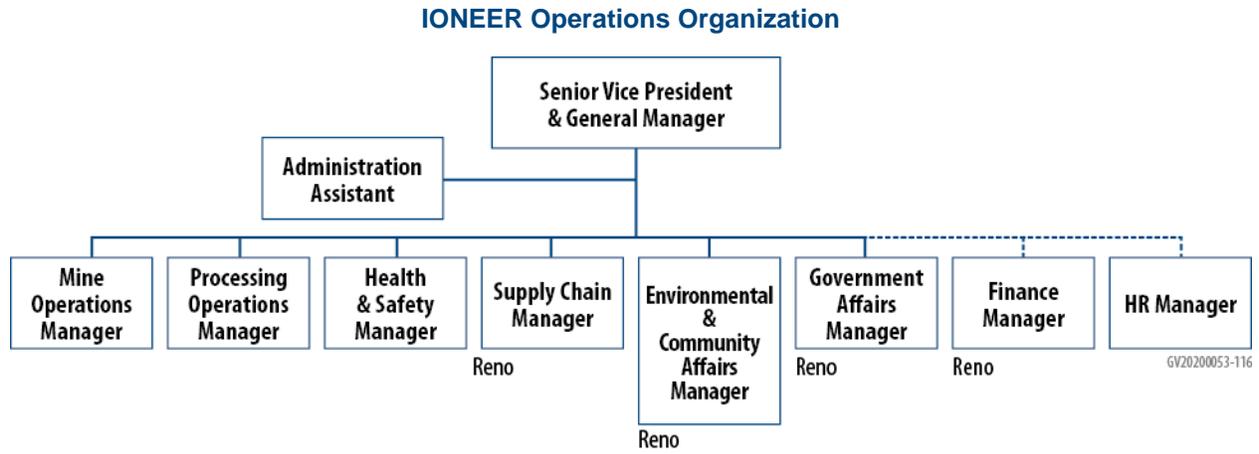


Figure 1-59. IONEER Operations Organization.

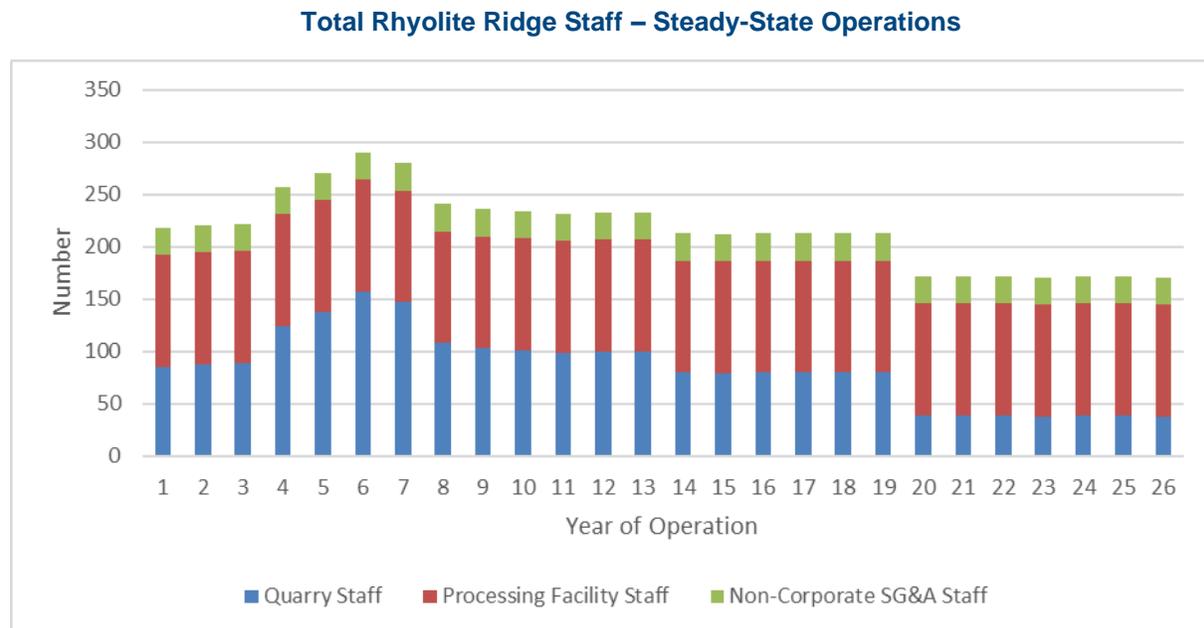


Figure 1-60. Total Rhyolite Ridge Staff – Steady-State Operations Phase.

1.11.4 MAINTENANCE PLAN

The maintenance business process will be managed and integrated with other plant business, operations, and engineering process using a computer maintenance management system. Maintenance is founded on a risk-based maintenance approach.

1.11.5 TRAINING PLAN

A training plan has been developed and responsibilities assigned to parties based on current execution and organizational structures within IONEER. Training for IONEER personnel will include the programs listed in Figure 1-61.

No.	Training Program	Trainer	Intended Trainees
1	Project orientation and safety	Fluor HSE	All personnel onsite
2	Position-specific MSHA training	IONEER HSE and MSHA trainer	Operations and maintenance (O&M) personnel
3	DCS and associated systems	DCS supplier	Board operators and instrument technicians
4	Equipment O&M	Supplier technicians	O&M personnel
5	Performance test monitoring	IONEER and Fluor	O&M personnel
6	Process and operations training	Suppliers, consultants, and IONEER supervisory staff	O&M personnel
7	Detailed operations training	IONEER supervisory staff and senior operators	Operations personnel
8	Mobile equipment operation	Equipment supplier	O&M personnel

Figure 1-61. Project Training Responsibility Matrix.

1.12 MARKET ANALYSIS AND MARKETING – DETAILS

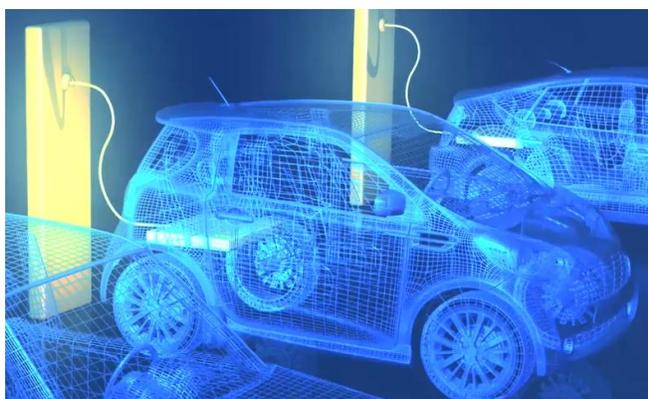
A core mission of IONEER is to develop a sustainable U.S.-based source of lithium and boric acid that can be efficiently produced and delivered to customers domestically and internationally.

Lithium is a critical raw material to enable technologies that reduce climate change. It is an irreplaceable component for batteries essential to electric vehicles and green energy storage systems that lead to emission reductions.

Boric acid is a rare, critical raw material. It is used in more than 100 unique applications, such as in powerful magnets for electric cars and wind turbines, and advanced glass for televisions, computers, handheld electronic devices, and solar panels.

Economic deposits containing borates are extremely rare and production is dominated by two major companies with over 80% of world supply. No mines in the world currently produce both borates and lithium and Rhyolite Ridge represents a unique opportunity to have a world-class, politically secure U.S. source of both critical raw materials. Global specialty glass companies like Corning and Asahi Glass purchase both raw materials for their glass operations for smart phones, computers, LCD, and OLED televisions, so it represents an opportunity to supply these companies reliability from the same source.

As Rhyolite Ridge has two critical products, the dual revenue stream reduces overall revenue volatility and will allow IONEER to produce lithium carbonate at the bottom of the lithium cost curve. As a result, the project is expected to remain profitable throughout the project’s life cycle with sustainable margins.



Lithium production at Rhyolite Ridge equates to supplying batteries for approximately 400,000 electric vehicles annually.

1.12.1 LITHIUM SUPPLY AND DEMAND

The global lithium market is expanding rapidly due to an increase in the use of lithium-ion batteries for electric vehicle and energy storage applications. In recent years, the compound annual growth rate of lithium for battery applications was over 22% and is projected by Roskill to be more than 20% per year to 2028.

According to analyst Benchmark, the demand for electric vehicles is expected to push demand for lithium-ion batteries above 400 GWh by 2025. In China, the government is pushing for all-electric battery cars and plug-in hybrids to account for at least 20% of its vehicle sales by 2025, and Benchmark predicts that electric vehicles will reach 10% of total sales globally by 2025. China already produces 55% of lithium-ion batteries globally, and its share is forecast to grow to 65%, according to Bloomberg.

Figure 1-62 below from Roskill shows the forecast for electric vehicle sales to escalate to over 25 million units by 2028, with China dominating production. Benchmark has published similar figures.

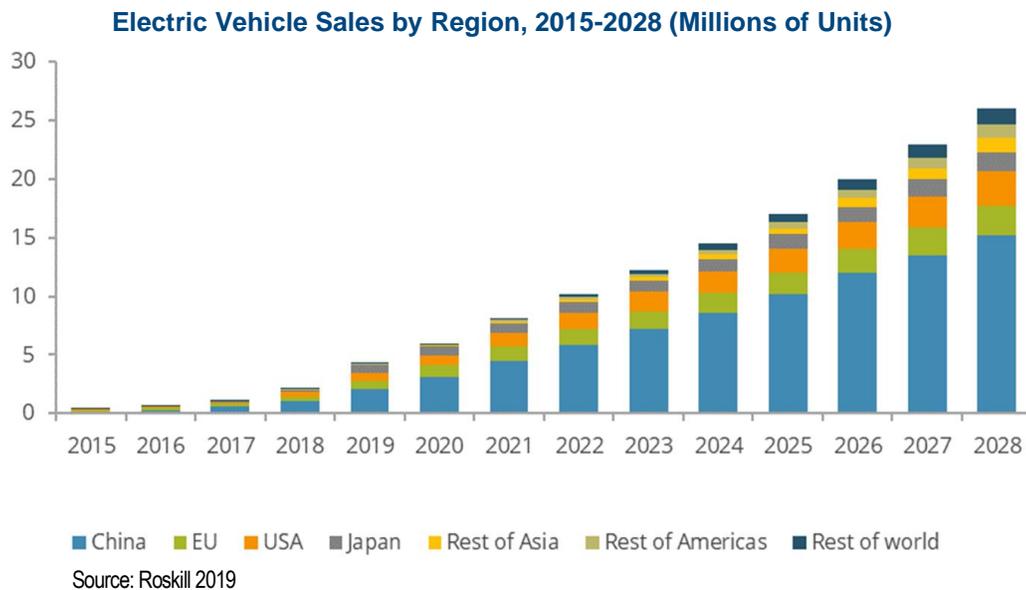


Figure 1-62. Electric Vehicle Sales by Region, 2015-2028 (millions of units).

Chile has the largest lithium reserves worldwide with an estimated 7.5 million metric tons of lithium reserves, of which 6 million tons come from Salar de Atacama, a large salt flat located in northern Chile. China is second with reserves estimated at 3.2 million metric tons. Australia has more than 2.7 million metric tons of lithium, making it the third most lithium-enriched country. Argentina is the world’s fourth most endowed country of lithium with reserves of more than 2 million metric ton. In the United States, there is a single, small lithium mine operated by Albemarle at Silver Peak in Nevada.

In 2019, 45% of global lithium consumption was in ceramics, glass, polymers, and alloys; however, growth in the technology and energy sectors in recent years has seen consumption in lithium-ion batteries grow at over 20% per year.

In mid-2019, Roskill published its prediction for lithium supply and demand (Figure 1-63) as did Benchmark in late 2019 (Figure 1-64).

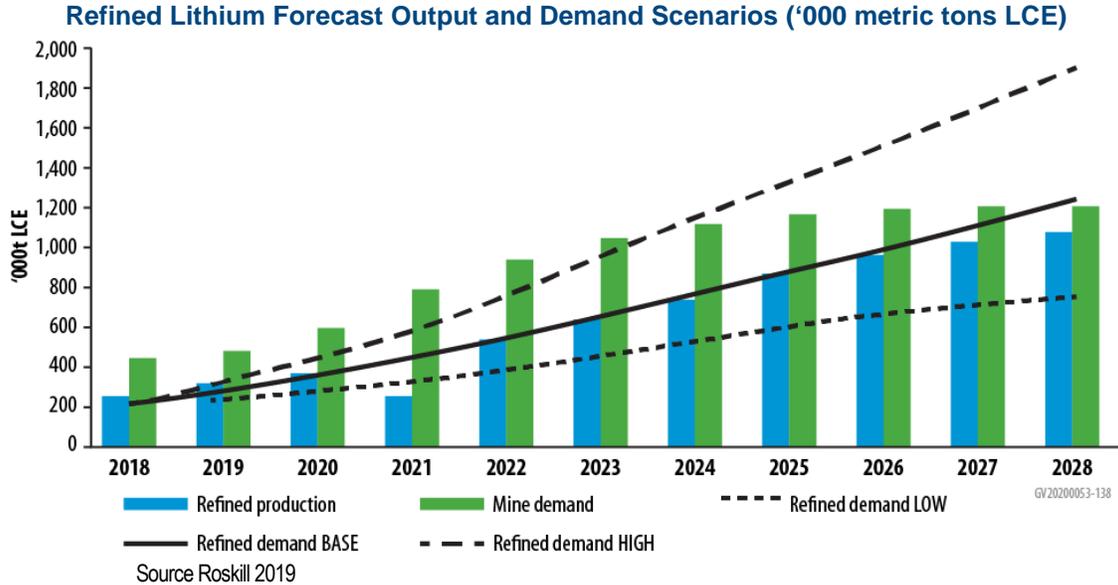
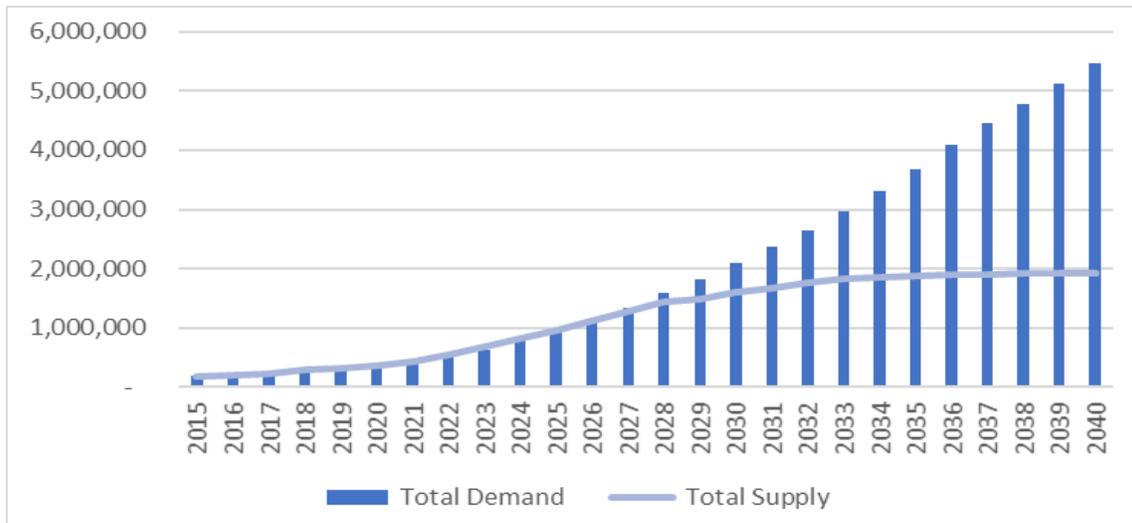


Figure 1-63. Refined Lithium Forecast Output and Demand Scenarios, 2018-2028 ('000 metric tons [t] LCE).

Lithium Market Balance (Metric Tons LCE)



Source: Benchmark 2019

Figure 1-64. Lithium Market Balance (metric tons).

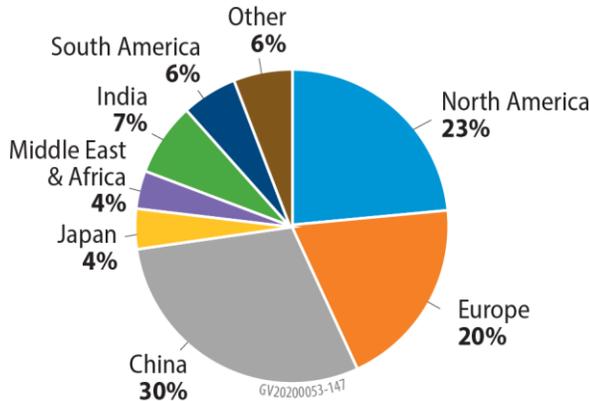
In the U.S. and Europe, there is large demand growth forecasted in key auto markets yet very little domestic supply is in the pipeline. Rhyolite Ridge will be a politically secure Western source of this critical raw material, ready to be sold directly into these global battery supply chains.

1.12.2 BORIC ACID SUPPLY AND DEMAND

Boric acid is a critical raw material and is used in more than 100 specialist applications globally. The global distribution of boric acid use is shown below in Figure 1-65, and the distribution of applications is set out in Figure 1-66. Borosilicate glass is the main end use due to its high chemical resistance and resistance to thermal shock. Other major uses include fiberglass, liquid crystal display panels (LCD used in televisions, computers, mobile phones, computer tablets, smart watches, etc.), domestic ovenware,

and laboratory glassware. Some strategic end uses are use in permanent magnets for electric motors, specialty alloys, and ceramics including armor and armor plating.

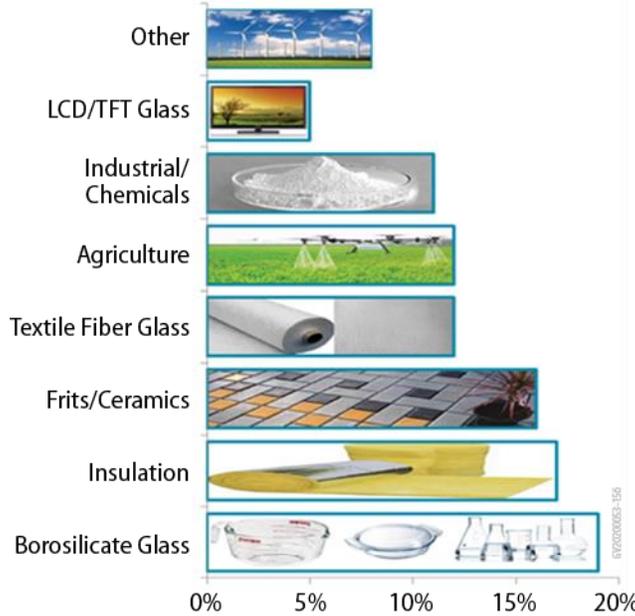
Boric Acid Market Demand – By Geographical Location



Source: IONEER and Maia Research 2020

Figure 1-65. Boric Acid End Uses (2019).

Global Borates Demand by Use



Source: Maia Research and IONEER analysis

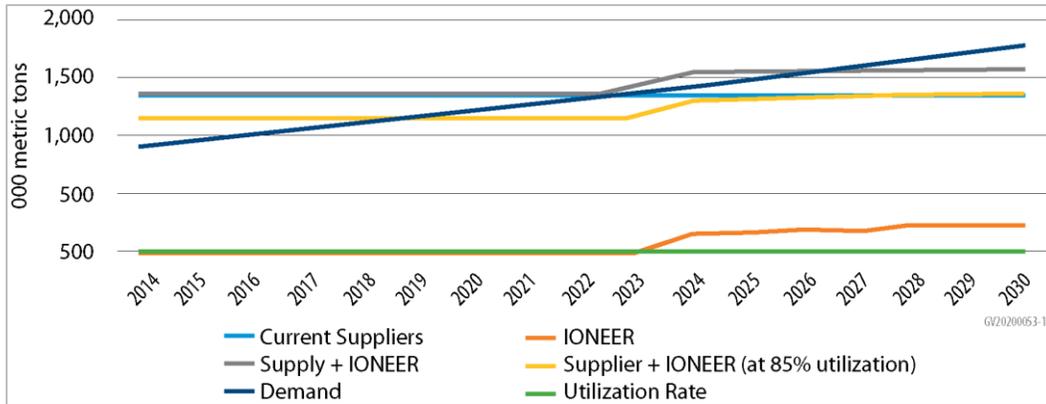
Figure 1-66. Global Borates Demand by Use.

As large-scale borate resources are very rare, there are only two major suppliers of borates and they currently have over 80% of total borate sales. One is in Turkey operated by a government company and the other in the Mojave Desert in California owned by Rio Tinto. Rio Tinto’s open cut mine was started in 1957 after pursuing underground operations for many years and the reserves are diminishing. There are no other major mines in the U.S. or elsewhere other than Turkey. Currently, there are no announcements of any large expansions of existing producers and no new large-scale mines have been announced. Rio Tinto does have an underground project in Jadar, Serbia but this project has been in the prefeasibility study stage since 2012. No recent announcements have been made on this project.

The global demand for boric acid has been consistently growing at more than 4% over the years and is projected to grow at approximately 4% each year to 2024. Based on the supply and demand modeling, it

is believed that the market will start to tighten in 2021 at >85% utilization rate of installed capacity. This is due to maintenance shutdown requirements, non-scheduled breakdowns, inefficient global distribution of supply, and other inefficiencies. Demand is expected to exceed supply by 2024 without IONEER boric acid supply. This supports the assumption that the market needs additional capacity, as shown in Figure 1-67. China will continue to be the biggest market over the forecast period, growing the fastest of the four major end use regions (over 4% annually) after growing at 5.3% annually over the past 4 years. North America is the second biggest borates market.

Boric Acid Supply and Demand (2014-2030) (IONEER Supply Included)



Source: Maia Research and INR research and analysis

Figure 1-67. Boric Acid Supply and Demand (2014-2030). IONEER supply included (thousands of metric tons).

A commercial strategy has been developed for both products together with detailed plans and tactics including developing geographic diversity of customers and diversity of end use to minimize market risk. This includes the key end uses with high growth rates like ferro boron, boron carbide, specialty glass, borosilicate glass, ceramic frits, insulation, and agriculture. For example, IONEER has signed a 105,000 metric-ton-per-year, 5-year offtake agreement with a major borate player in China (Dalian Jinma Boron Technology Group). This confirms that IONEER is capable of being quality- and cost-competitive. IONEER has been active in the marketplaces in Asia and the U.S. since 2018 promoting the project.

1.13 SITE PHOTOS

Photos of the Rhyolite Ridge site are provided below in Figure 1-68, Figure 1-69, and Figure 1-70 to provide a visualization of the site’s terrain and location of the quarry and main facilities.



Figure 1-68. Offsite on Cave Springs Road Heading Northwest to Rhyolite Ridge Site.

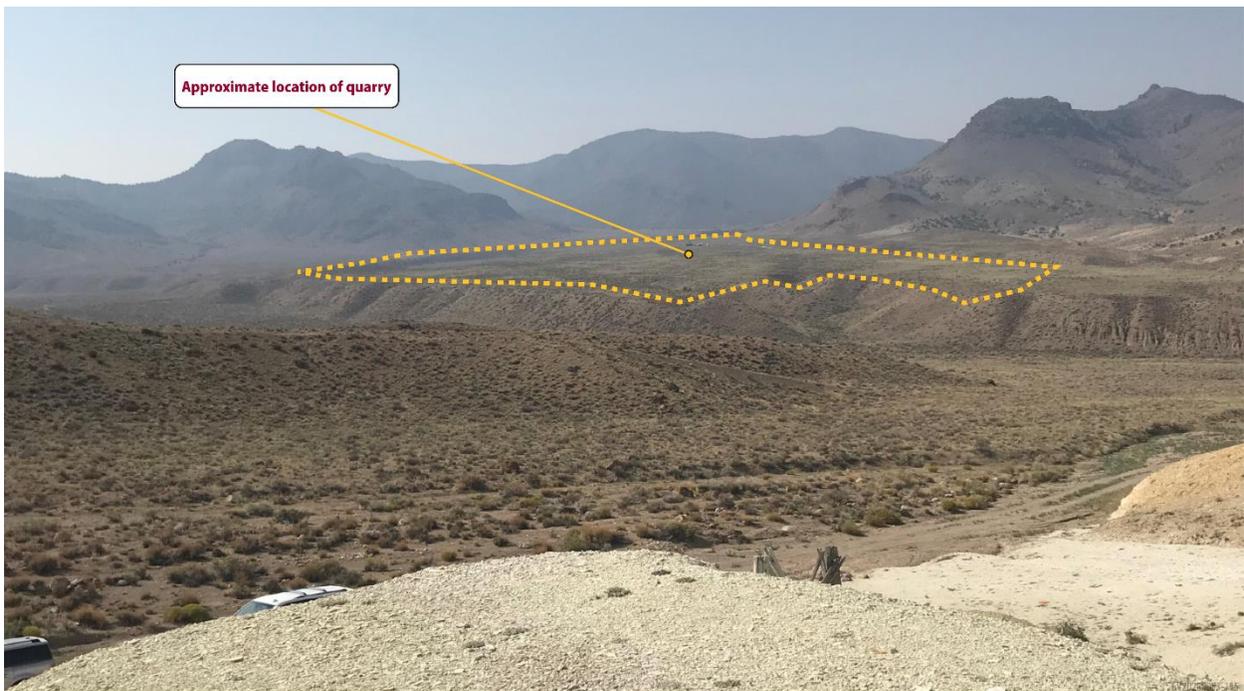


Figure 1-69. Looking South at Quarry Location.



Figure 1-70. Standing at Northeast Side of Plant Location (Looking Southwest).