NOTICE TO READER
September 17, 2021

The attached "NI 43-101 Technical Report Lithium Resource Estimate for the EXSHAW WEST PROPERTY, SOUTH-CENTRAL ALBERTA, CANADA", which was originally filed on June 15, 2018, has been amended to clarify certain portions of the report. There were no changes to the report's conclusions, recommendations, calculations or numerical values. There are no material changes to the report. Examples of some non-material changes include clarifications in Section 12 and in Qualified Person statements.

NI 43-101 TECHNICAL REPORT

LITHIUM RESOURCE ESTIMATE

for the

EXSHAW WEST PROPERTY

SOUTH-CENTRAL ALBERTA, CANADA

Prepared for

E3 METALS CORP

Prepared by:

Gordon MacMillan, P.Geol, QP, Fluid Domains Inc.

Grahame Binks, MAusIMM, QP (Metallurgy), formerly of Sedgman Canada Limited

Report Date:
June 15, 2018
Effective Date:
June 4, 2018
Amended Date:
September 17, 2021

Important Notice Regarding Forward-Looking Information

This report contains forward-looking statements or forward-looking information under applicable Canadian securities laws (hereinafter collectively referred to as "**forward-looking statements**") concerning E3 Metals Corp.'s properties, operations and other matters. These statements relate to analyses and other information that are based on forecasts of future results, estimates of amounts not yet determinable and assumptions of the applicable author(s). Statements concerning estimates of mineral resources may also be deemed to constitute forward-looking statements to the extent that they involve estimates of the mineralization that will be encountered if the property is developed. Any statements that express or involve discussions with respect to predictions, expectations, beliefs, plans, projections, objectives, assumptions or future events or performance (often, but not always, using words or phrases such as "expects" or "does not expect", "is expected", "anticipates" or "does not anticipate", "plans", "estimates" or "intends", or stating that certain actions, events or results "may", "could", "would", "might" or "will" be taken, occur or be achieved) are not statements of historical fact and may be forward-looking statements.

All forward-looking statements are inherently uncertain and subject to a variety of assumptions, risks and uncertainties, including the speculative nature of mineral exploration and development, reliance on emerging technology not yet proven in high-volume commercial applications, fluctuating commodity prices, results of current and future testing, competitive risks and the availability of financing, as described in more detail in our recent securities filings available at www.sedar.com. Should one or more of these risks and uncertainties materialize, or should underlying assumptions prove incorrect, actual results may vary materially from those described in forward-looking statements. Forward-looking statements are made based on the writer's beliefs, estimates and opinions on the date the statements are made and neither the authors hereof nor E3 Metals Corp. will undertake any obligation to update forward-looking statements if these beliefs, estimates and opinions or other circumstances should change, other than as required by applicable laws. Investors are cautioned against attributing undue certainty to, or placing undue reliance on, forward-looking statements.

Table of Contents

List of Figures

List of Tables

1 Summary

E3 Metals Corp (TSXV: ETMC | FSE: OU7A | OTC: EEMMF) is a public lithium exploration company with a head office located in Calgary, Alberta. Gordon MacMillan, P.Geol QP, was retained by E3 Metals Corp to prepare a technical report on the inferred resource on the Alberta Petro-Lithium Project leases in conformity with National Instrument 43-101 (NI 43-101) standards. Grahame Binks, MAusIMM QP (Metallurgy), was also retained by E3 Metals Corp to prepare the technical report contained with Section 13: Mineral Processing and Metallurgical Testing. Other contributors include Maxime Claprood, Ph.D, P.Eng. and Phil Esslinger, P.Geol.

The Alberta Petro-Lithium Project (oil and gas related formation brines) consists of 76 Metallic and Industrial Mineral Permits that overlie the Leduc Reservoir in Southern Alberta (Figure 1). All permits are held 100% by 1975293 Alberta Ltd (Alberta Co), a wholly owned subsidiary of E3 Metals Corp. The property in its entirety contains 596,269 hectares (Ha) and is subdivided into 5 Sub-Project areas: Clearwater, Rocky, Exshaw, Drumheller and Sunbreaker. The Inferred Resource Estimate in this report refers to a specific permit area referred to as the Exshaw West Resource Area (EWRA; Figure 1).

The EWRA is located in the southwestern part of the Western Canada Sedimentary Basin (WCSB). In this area, the Upper Devonian (Frasnian) sediments of the Woodbend Group were deposited in a shallow inland sea bounded by the emergent Peace River Arch to the North West and the West Alberta Ridge to the south-west creating a barrier between the sea and the open ancestral Pacific to the west (Potma, et al. 2001). It is here that the flooded carbonate platform of the Cooking Lake provided structural highs and a favorable environment for the prolific reefal buildups of the Leduc formation. The Exshaw area covers a portion of the Wimborne-Bashaw complex just east of the Meadowbrook-Rimbey Leduc trend. The Duvernay and Ireton basinal shales and carbonate muds conformably encase and overlay the Leduc buildups creating traps for hydrocarbon pools and form the aquitard for the Leduc and Cooking lake aquifer system.

The Leduc limestone deposits are partially to completely replaced by dolomite, a process that enhanced the porosity and permeability of the reservoir. Current data suggests that the Cooking lake remains predominantly limestone. The main oil, gas and Li-brine mineralization accumulations in E3 Metals' properties occur in dolomitized reefs of Devonian Leduc age at true vertical depths greater than 1,400 meters in the subsurface. Many of the wells in this area in their early history started out at hundreds to thousands of barrels per day of petroleum products and required little active pumping to extract. However, at present most of the wells produce excessive amounts of formation water in comparison to petroleum products. Formation water production in the EWRA averaged approximately 1,400 m^3/day over the last 5 years (GeoSCOUT^{TM}).

E3 Metals' exploration activities consisted of brine sampling from existing oil production wells. Samples were collected from existing Leduc Formation producing oil and gas wells by field technicians contracted from Maxxam Analytics in Red Deer, Alberta. All wells producing solely from the Leduc Formation, without any additional concurrent zone production (commingling from other formations), were earmarked for sampling, and were accessed based on availability. Oil and gas operators generally cycle wells, so several field programs were completed to collect samples. Samples were either collected directly at the wellhead, or at test separators, by Maxxam employees wearing self-breathing apparatuses due to the presence of H_2S (hydrogen sulfide) gas. A documented sampling procedure ensured that samples were collected, sealed and labeled to avoid contamination and tampering. Proper chain of custody measures were in place.

Laboratory analyses consisted of a round robin of a synthetic Li-standard, created by the University of Alberta, which was sent to 5 laboratories. Based on the accuracy of the results and logistical considerations, AGAT and Maxxam laboratories were chosen as the Project labs. AGAT and Maxxam were selected as the primary and check labs respectively, based on the merits of their respective precisions in the NI 43-101 Technical Report Lithium Resource Estimate for the Central Clearwater Property, South-Central Alberta, Canada (Spanjers 2017).

Four aquifers (Leduc Reef Margin, Leduc Platform Interior, Clive Channel Area, and Cooking Lake Interior) and 14 hydrostratigraphic subdivisions (Joffre, Wood River, Malmo, Duhamel, New Norway, Bashaw, Nevis, Mikwan, Three Hills Creek, North Lagoon, South Lagoon, Clive, Clive Channel, and Cooking Lake Platform) were defined for the resource model. The aquifers and their properties were determined by facies geometry, well logs, core, well drill stem test data and isopach maps.

The inferred resource estimate was developed in three stages: 3-D modeling to calculate the volume of the reservoir, an evaluation of the reservoir properties to estimate the volume of producible brine and the potential to recover the brine, and variography using simple kriging to assess lithium concentration distribution.

Geostatistical software was used to determine the variography of 30 points and assess the manner in which Li concentrations vary spatially. Simple kriging of data points in the EWRA area predicted the lithium concentration distribution. The mean Li concentration of the EWRA was 75 mg/L.

An optimized production well network design, the schedule of production from the well networks and the dispersion of low-concentration lithium injected water have not yet been determined. For the purposes of estimating the inferred lithium resource mass, a 50% production factor has been applied to the total mass of lithium that could be produced. The selection of a 50% production factor is considered conservative as it represents the proportion of lithium that would be produced at the time the advective front arrives at the production well. Prior to that time, the lithium concentrations will decrease from 100% formation water as the relative proportion of injected water increases. The production factor may increase as more detailed studies are completed.

The mineral resource estimate for the EWRA is 19.5 billion m^3 at an average grade of 75 mg/L, which equates to 3,900,000 tonnes of lithium carbonate equivalent (LCE). This resource estimate is classified as inferred due to the geological evidence being sufficient to imply but not verify geological, grade or quality continuity. It is reasonably expected that the majority of the Inferred Mineral Resource Estimate could be upgraded to Indicated Mineral Reserves with continued exploration. Production well networks with rates of up to 20,000 m^3/d and life spans of up to 44 years are expected before the injected water reaches the production well.

The characterization used a significant amount of existing data from existing oil and gas production activity but relatively few Li-brine analyses. Additional well samples are needed, where possible, to confirm brine chemistry through time and build the larger dataset. The cost of collecting and analyzing additional samples is estimated at $50,000. The existing samples from wellhead and separators do not give a vertical profile of the sampled wells or the Li-brines within each of the identified aquifers. Vertical profile sampling of Li concentrations within the reservoir at one or more locations is recommended at an estimated cost of $200,000 each. The available permeability measurements are representative of a scale of meters to 10s of meters. Further investigation of the reservoir permeability would be beneficial to the development of modifying factors. This work, and the upgrading of the resource to measured and indicated has an estimated cost of $1,000,000.

Metallurgical testing was completed by the University of Alberta (U of A) and independently reviewed by Grahame Binks, formerly of Sedgman Canada Limited, an international leader in mineral processing. The testing focused on E3 Metals' "Concentration step", which involves a unique ion exchange technology to process low grade Alberta brine to produce a higher-grade lithium concentrate solution with low impurity levels. This step also results in a reduction of brine liquid volume. Six bench scale metallurgical tests were conducted using ion exchange technology on lithium enriched Leduc Formation water (raw brine) from the Exshaw West Project Area. The testing produced a lithium (Li) concentrate of up to 1,206 milligrams per liter (mg/L) and a concentration factor of 16 times. The process was also successful in removing up to 99% of the critical metal impurities while demonstrating lithium recoveries as high as 81%. The entire concentration process was achieved in less than 3 hours.

Further development of the ion exchange chemistry is required to achieve optimized results which include; lithium recoveries greater than 95%, greater than 20 times lithium concentration with continued greater than 99% removal of critical impurities removal. The ion-exchange chemistry will also be manufactured into a porous resin material that will be robust enough to be re-used in repetitive sorption/desorption cycles. This material will be tested in a continuous flow ion exchange column at the laboratory scale. E3 Metals will also be initiating test work through the University of Alberta and external experts to test electrolysis technology that would produce lithium hydroxide from the concentrated lithium solution produced from ion exchange step. This testing will further refine the Company's direct brine extraction flowsheet. The cost to complete additional lithium extraction test work is estimated at $700,000.

2 Introduction

E3 Metals Corp (TSXV: ETMC | FSE: OU7A | OTC: EEMMF) is a publicly listed lithium exploration company with head offices in Calgary, AB. ETMC is listed on the TSX Venture Exchange (TSXV: ETMC), the Frankfurt Stock Exchange (OU7A) and OTC Market Exchange (EEMMF).

2.1 Terms of Reference

Gordon MacMillan, P.Geol QP, was retained by E3 Metals Corp to prepare a technical report on the inferred resource on the Alberta Petro-Lithium Project leases in conformity with National Instrument 43--101 (NI 43-101) standards. Maxime Claprood, Ph.D, P.Eng. and Phil Esslinger, P.Geol. also contributed to Section 14 of the technical report. Dr. Claprood contributed to the variography of geologic surfaces and lithium concentrations. Mr. Esslinger analyzed drill stem test data to derive estimates of permeability. Mr. MacMillan takes responsibility for these contributions as the QP.

Grahame Binks, MAusIMM QP (Metallurgy), was also retained by E3 Metals Corp to prepare the technical report contained with Section 13: Mineral Processing and Metallurgical Testing. This report has been prepared and is to be used by E3 Metals Corp. for the purpose of supporting the TSX Venture Exchange regulatory requirements and/or financing.

2.2 Sources of Data

The report is based upon information and data collected by E3 Metals Corp, and data collected, compiled and validated by the authors. Mineral rights and land ownership information was provided by E3 Metals Corp. The majority of the information contained within the report was derived from the following:

- E3 Metals Corp-supplied exploration maps, logs, laboratory analyses, third-party reports and field test data;
- Original bench tests on collected brine samples;
- Oil and gas data compiled by the Government of Alberta; and
- Published literature (see Section 27 for references).

Sources of information are listed in Section 27 and are acknowledged where referenced in the report text.

2.3 Site Visit

A site visit during field sampling was performed by Gordon MacMillan on March 23, 2018. See Section 12 of this report for a description of the site visit.

The geoscience data utilized in the report was not sourced by E3 Metals and is instead sourced from the Alberta Energy Regulator database, collected from decades of oilfield development by various operators. Sampling data utilized in this report was addressed in the site visit by Gordon MacMillan (above).

3 Reliance on Other Experts

No other experts were used in the preparation of this report.

4 Property Description and Location

4.1 Location

The E3 Metals Corp Alberta Petro-Lithium project is located in south-central Alberta between Edmonton to the north and Calgary to the south (Figure 1). The project overlies the Leduc Reef, an oil producer and source of lithium brines.

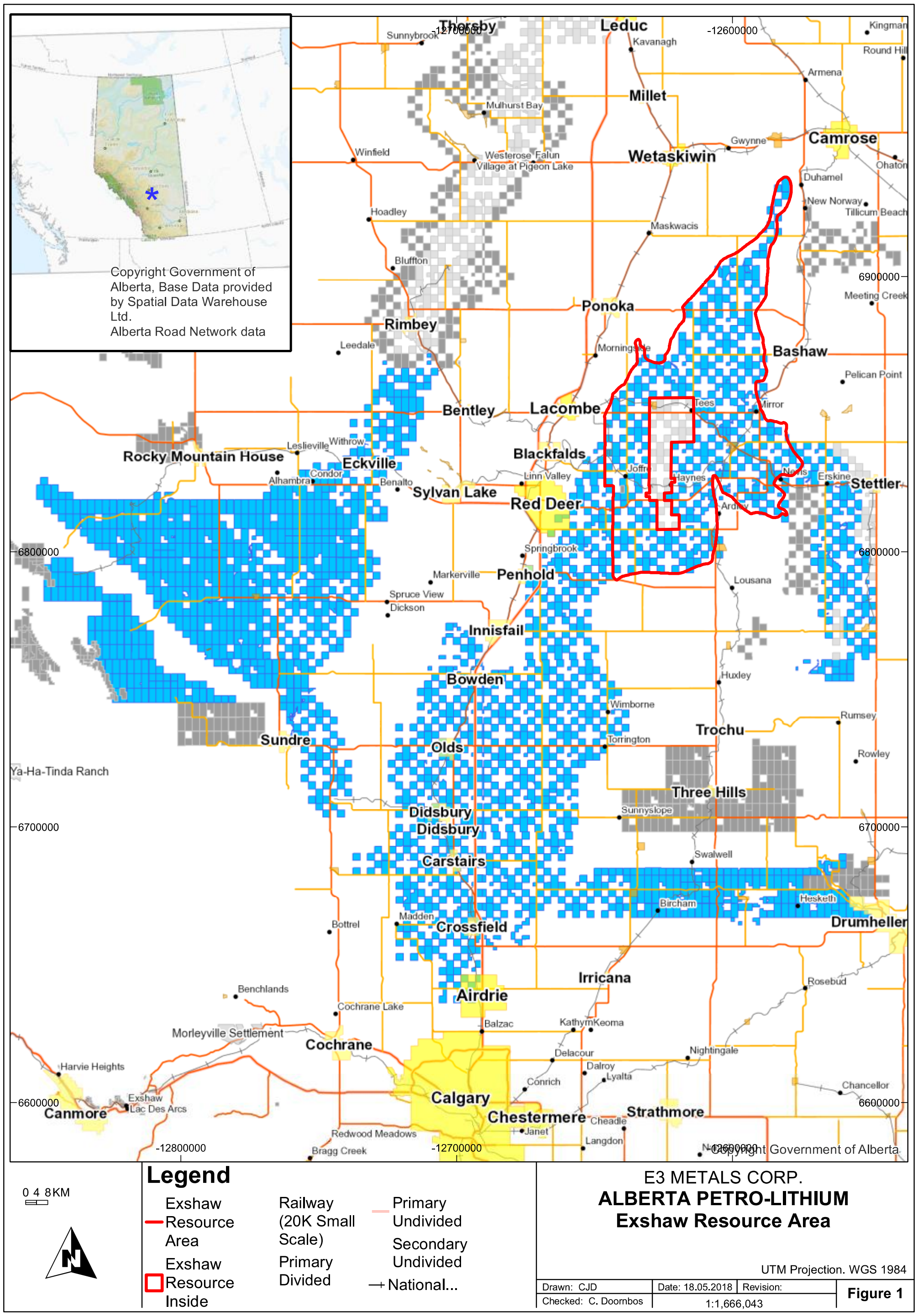


Figure 1. Location of Alberta Petro-Lithium Project in south-central Alberta. The EWRA is indicated by a red outline (E3 Metals, 2018)

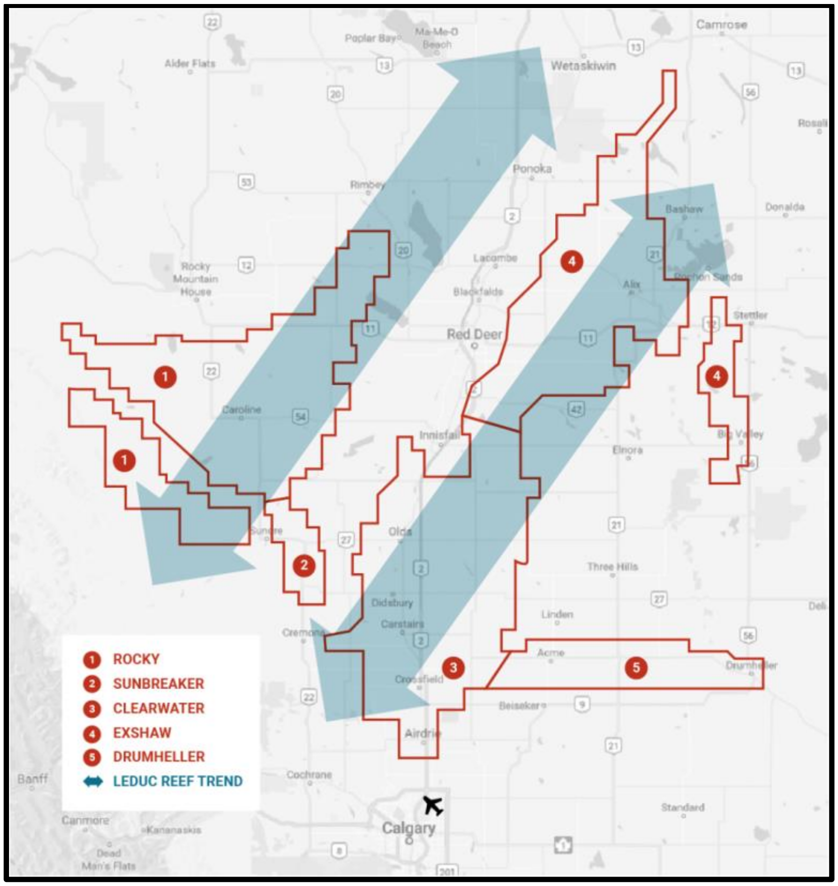
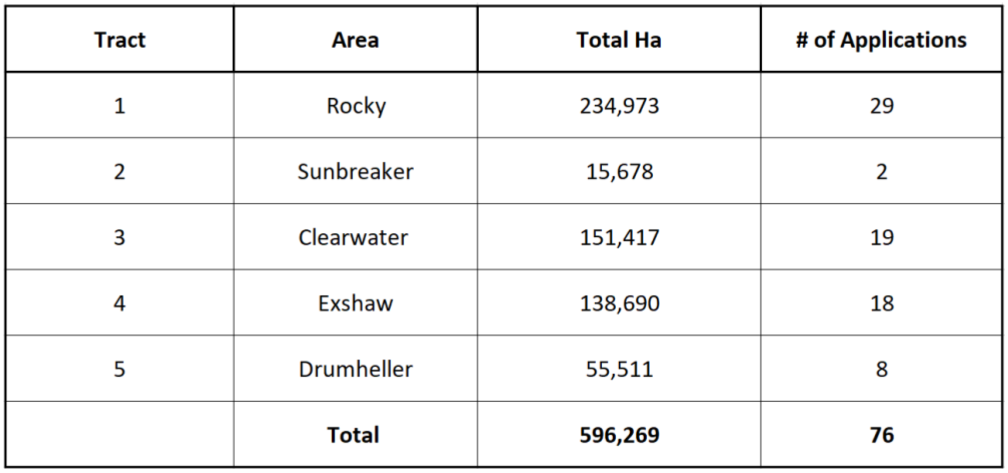


Figure 2. General trend of Leduc Reef underlying the Alberta Petro-Lithium Project lease holdings (E3 Metals, 2018)

4.2 Property Description

The Alberta Petro-Lithium Project consists of 76 Metallic and Industrial Mineral Permits (the Permit Area) that cover the Leduc Reservoir in Southern Alberta (Figure 1). All permits are held 100% by 1975293 Alberta Ltd (Alberta Co), a wholly owned subsidiary of E3 Metals Corp. The property is subdivided into 5 Sub-Project areas (Table 1) outlined on Figure 2 and the areas of the resource study are summarized in Appendix A and Appendix B. The total area of the permits is 596,269 hectares.

The Exshaw West Resource Area, a sub-area of the Tract 4 Exshaw claims in Table 1, consists of 103,843 hectares covered in 13 Metallic and Industrial Mineral (MIM) Permits. Of the 13 permits, which completely or partially intersect the EWRA boundary, 84,156 ha fall within the EWRA boundary. The claims are interspersed with privately owned (Freehold) land.



Tract	Area	Total Ha	# of Applications
1	Rocky	234,973	29
2	Sunbreaker	15,678	2
3	Clearwater	151,417	19
4	Exshaw	138,690	18
5	Drumheller	55,511	8
	Total	**596,269**	**76**

Table 1. Summary of the Alberta Petro-Lithium Project lease holdings (E3 Metals, 2018).

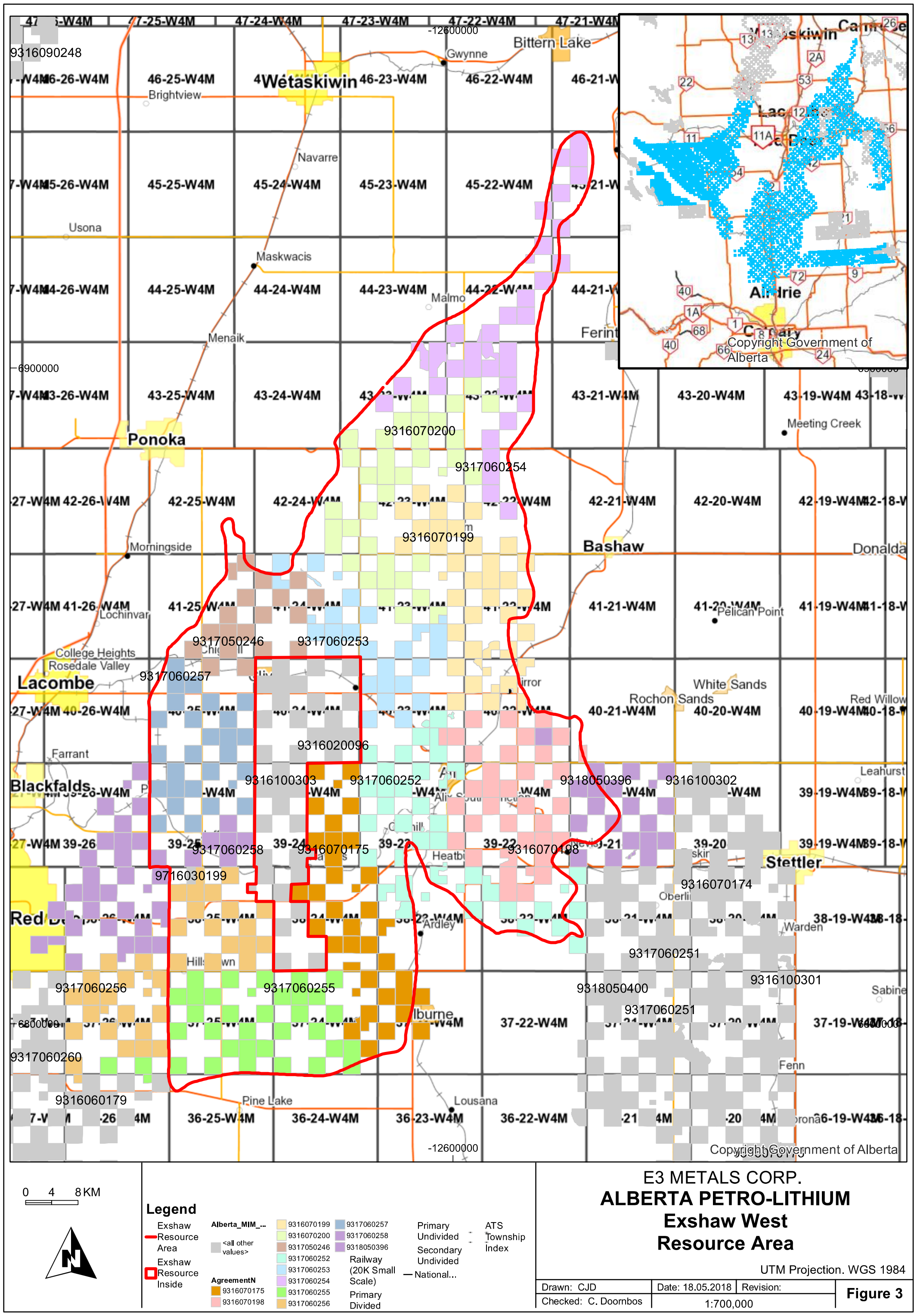


Figure 3. Location of Exshaw West Resource Area and permits held within the Alberta Lithium Project, Alberta, Canada (E3 Metals, 2018). The center of the permit holdings is at 52.49 N 113.2878 W in the NAD83 datum. The blue lands (subset map) are held by 1975293 Ab Ltd, a wholly owned subsidiary of E3 Metals Corp.

Alberta Metallic and Industrial Mineral Permits grant the explorer the exclusive right to explore for metallic and industrial minerals for seven consecutive two-year terms (total of fourteen years), subject to traditional biannual assessment work. Work requirements for maintenance of permits in good standing are \$5.00/ha for the first two-year term, \$10.00/ha for each of the second and third terms, and \$15.00/ha for each the fourth, fifth, sixth and seventh terms.

The statutes also provide for conversion of Permits to Metallic Minerals Leases once a mineral deposit has been identified. Leases are granted for a renewable term of 15 years and require annual payments of \$3.50/ha for rent to maintain them in good standing. There are no work requirements for the maintenance of leases and they confer rights to minerals. Complete terms and conditions for mineral exploration permitting and work can be found in the Alberta Mines and Minerals Act and Regulations (Metallic and Industrial Minerals Tenure Regulation 145/2005, Metallic and Industrial Minerals Exploration Regulation 213/98). These and other acts and regulations, with respect to mineral exploration and mining, can be found in the Laws Online section of the Government of Alberta Queen’s Printer website (www.qp.alberta.ca/Laws_Online.cfm).

The mineral permits are interspersed with privately owned (Freehold) land, where the surface and/or minerals rights are owned by private individuals and/or companies and not the crown (the white areas interspersed within the E3 Metals Permit Area in Figure 3). The Freehold lands do not pose an obstacle to initial brine assay and mineral processing test work within the mineral permits owned by E3 Metals. Given a favorable distribution of contiguous Permit coverage and completion of advanced characterization studies focused on the drawdown effect of the liquid resource (particularly laterally), it is possible that E3 Metals does not have to acquire Freehold Land in order to produce Li-brine from aquifers within the properties.

The inferred resource estimate outlined within this report has been completed on portion of the Exshaw Property (See Figure 2). The Exshaw West Resource Area (EWRA) consists of 84,156 ha across 13 Metallic and Industrial Mineral (MIM) Permits that completely or partially intersect the EWRA (Figure 3). The 13 MIM permits have a total of 103,843 ha with a first 2-year in-ground expenditure commitment of \$519,215.08 (Appendix A).

4.3 Environmental Issues

At the current stage of the project, there are no environmental liabilities to E3 Metals. Environmental considerations and permitting for this project at a later stage are outlined in Section 20.

5 Accessibility, Climate, Local Resources, Infrastructure and Physiography

5.1 Accessibility

The Exshaw property is readily accessible by air and ground transportation (Figure 4). There are international airports in Calgary (YYC) and Edmonton (YEG). Red Deer hosts a regional airport (YQF).

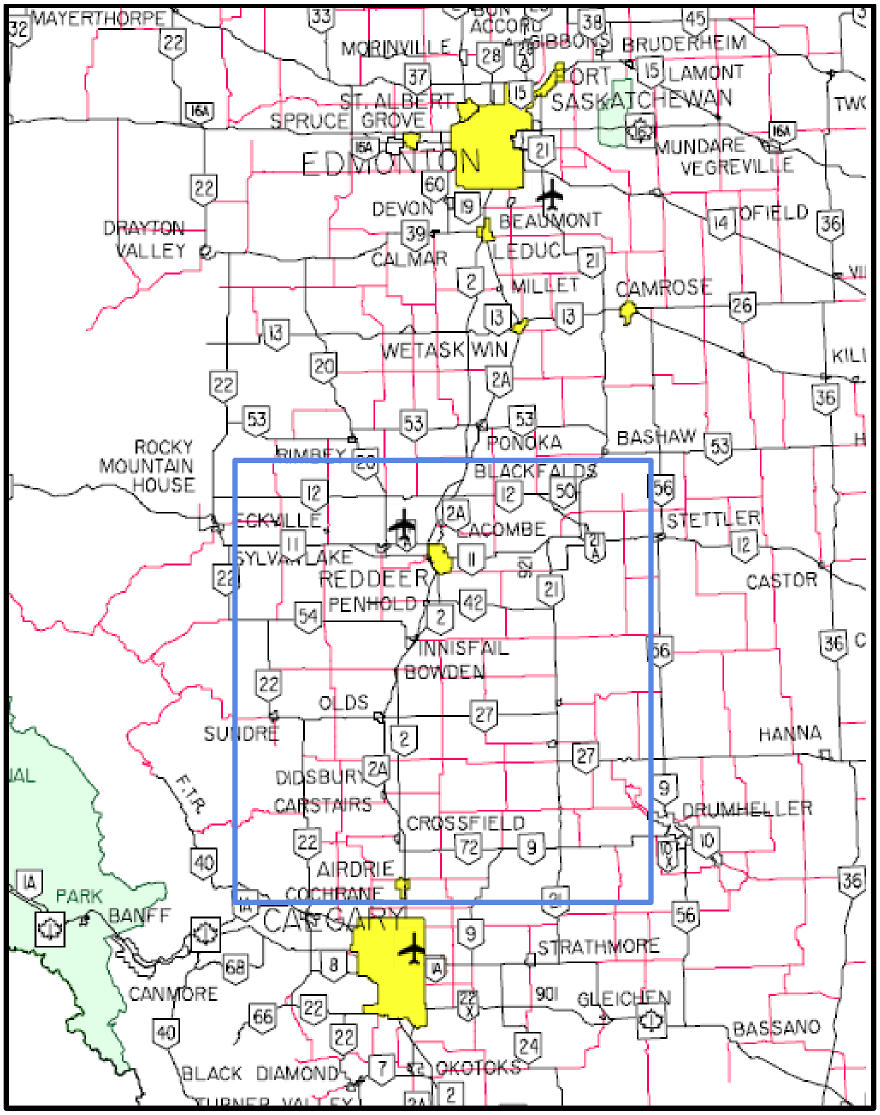


Figure 4. Primary roads, secondary roads and air access to Project area (blue rectangle) (www.transportation.alberta.cacialNetworkMap)

Major and secondary provincial highways, and all-weather roads developed to support oil/gas infrastructure, occur throughout the permit areas. The City of Red Deer (population of 100,400) is located at the junction of Alberta Provincial Highway 2 ("Hwy 2") and Highway 11; Hwy 2 is the main corridor between Edmonton and Calgary and runs North-South directly through the Exshaw Property. Further access to the properties is provided by secondary one- or two-lane all-weather roads, and numerous all weather and dry weather gravel roads. The resource area can be accessed year-round, ensuring mineral test work and extraction is not limited to certain months of the year. Two rail lines (Canadian Pacific Railway and the Canadian National Railway) are present throughout the area and connect to the major centers of Edmonton and Calgary which occur north and south of the resource area and then all of North America.

5.2 Climate

Calgary, Alberta has a humid continental climate with severe winters, no dry season, warm summers and strong seasonality (Köppen-Geiger classification: Dfb).

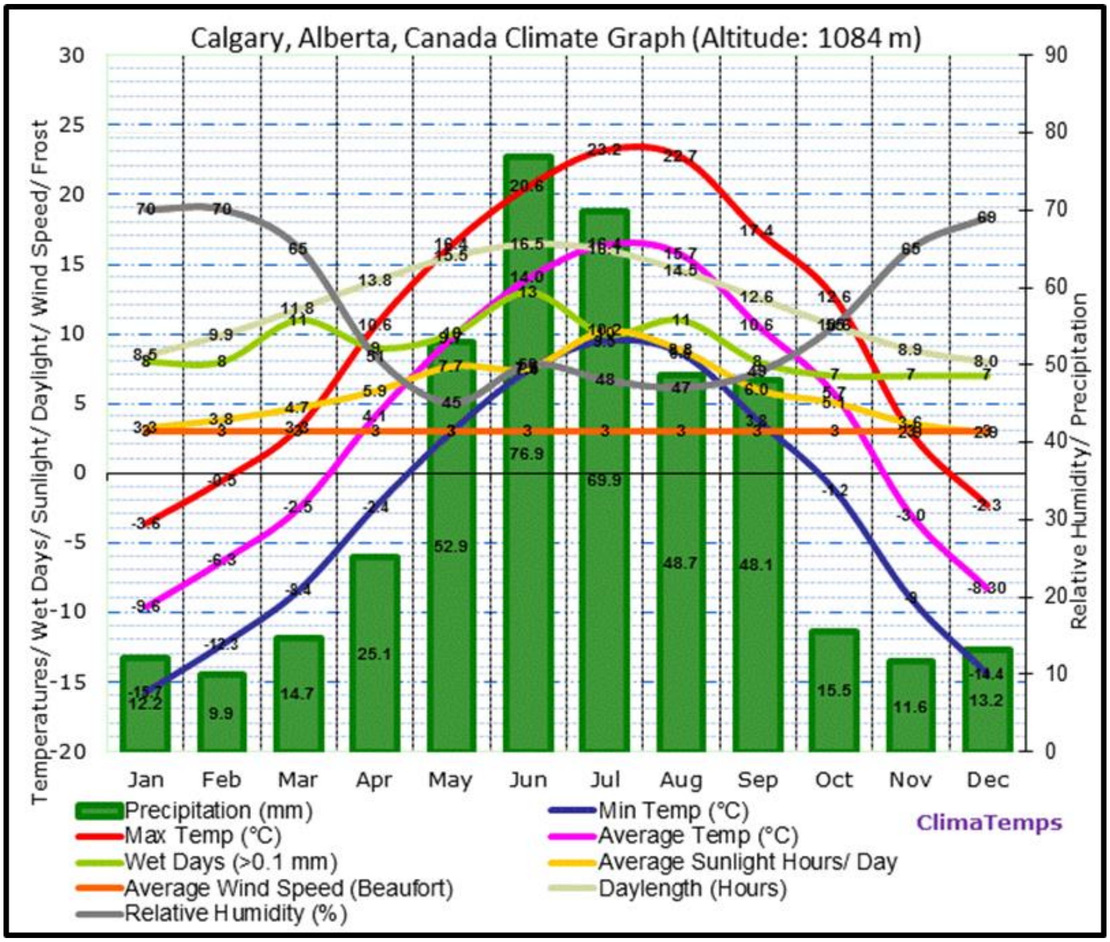


Figure 5. Summary of monthly annual climate data for Calgary, AB. (http://www.calgary.climatemps.com/)

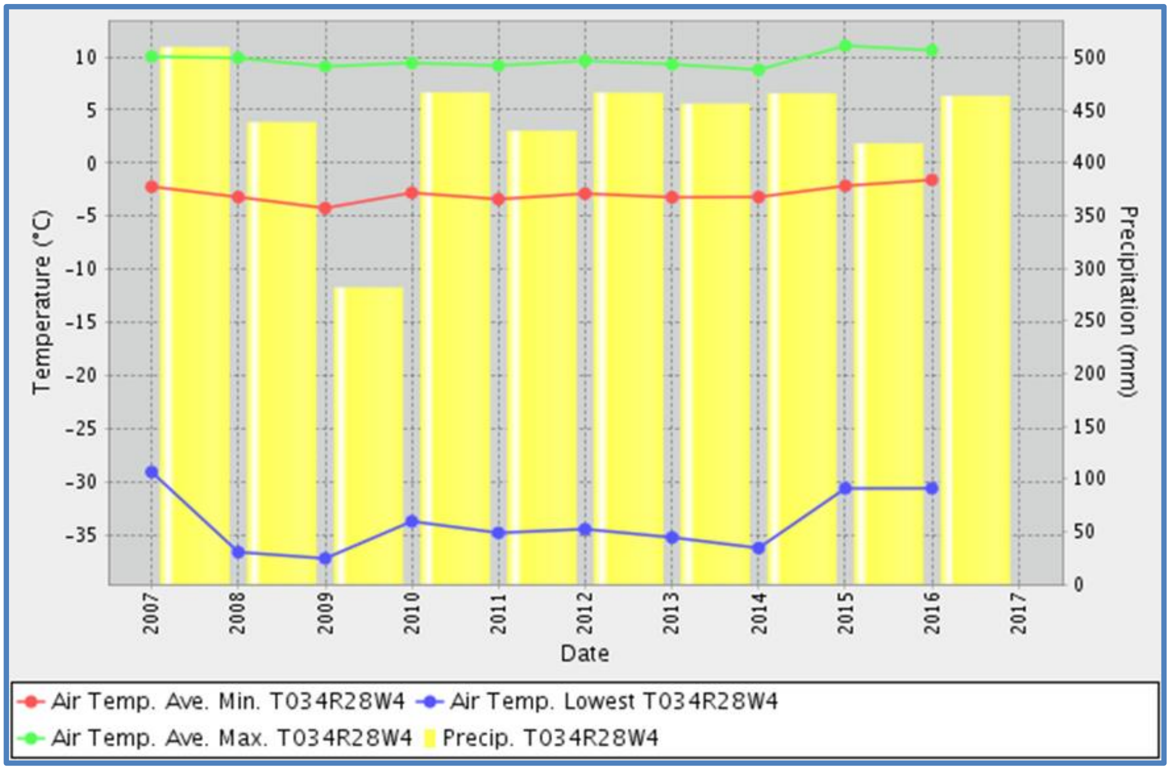


Figure 6. 10-year temperature and precipitation ranges for township 34, range 28 W4M, the center of the Exshaw claims, and adjacent to the EWRA (ACIS, 2017).

During summer, average high temperatures are 22.2°C (71.9°F) and average low temperatures are 8.5°C (47.3°F). Fall temperatures have average highs of 11°C (51.7°F) during the day and lows of -2.1°C (28.2°F) generally shortly after sunrise. Total annual Precipitation averages 398.7 mm (15.7 inches). A summary of Calgary climate data by month is shown in Figure 5. A 10-year summary of high-low-mean air temperature and mean precipitation for township 34N, range R28 west of the fourth meridian (the center of the Exshaw claims, and adjacent to the ERWA) is shown in Figure 6.

5.3 Local Resources

Accommodation, food, fuel, and supplies are readily obtained in the City of Red Deer (pop. 100,418 (2016)) and the towns of Olds, Sylvan Lake and Innisfail. Internet and phone coverage is available throughout the permit areas. Many trained workers live in the area and work in the oil and gas sector. These workers have the skills and expertise required to develop lithium from their related experience in oil and gas. Service companies, including those providing wireline services, testing, workovers and drilling all operate locally and will be capable of meeting the company's needs relating to drilling, production and construction.

5.4 Infrastructure

There is a significant amount of infrastructure in the area to support over 70 years of oil and gas development operations. Oil and gas is typically produced in the area using pump jacks. Hydrocarbons and water produced from the wells are delivered to separation facilities (either on site or at a satellite location) via underground pipelines. After separation, the various fluids and phases enter into a network of pipelines designed for the transportation of gas, oil and water to specific destinations for upgrading, processing, to market, or for disposal. Pipelines specific to water are designed mainly to transport wastewater for disposal and/or injection purposes. These water pipeline networks are specifically located in the areas developed for oil and gas.

Main highways are properly maintained and upgraded, and secondary gravel roads are well maintained. Grid electrical distribution and transmission infrastructure is available throughout the resource area and many of the locations sampled for this resource have power accessible directly at the lease.

There is adequate land for the location of process plants and related required future infrastructure.

5.5 Physiography

The project area lies within the Southern Alberta uplands and Western Alberta plains as part of the Aspen Parkland. The dominant landform is undulating glacial till plains, with about 30 percent as hummocky, rolling and undulating uplands. The average elevation is 850 meters above sea level (masl) but ranges from 500 masl near the Alberta–Saskatchewan border to 1,250 masl near Calgary. The Red Deer River is the dominant topographic feature; it is situated between the Exshaw East and Exshaw West sub properties as well as cuts across the south end of the EWRA. The region is dominantly farmland with numerous creeks and wetlands occurring throughout the property. Clusters of forested terrain are dominated by aspen, balsam poplar, lodge pole pine and white spruce. Vegetation in the wetland areas is characterized by black spruce, tamarack and mosses. The area is generally composed of farmland and prairie grasses.

6 History

In the Permit area, there have been no drilling exploration programs to target lithium enriched brine specifically. Historical testing of lithium in water was conducted as part of routine chemistry analysis by oil and gas operators in the area. This data was compiled in a comprehensive overview of the mineral potential of formation waters from across Alberta by the Government of Alberta (Hitchon et al., 1993 and 1995). Subsequent collection of brine water from actively producing oil and gas wells was conducted by the AGS by Eccles and Jean (2010) and later by Huff (2016) and was analyzed for lithium. A summary of the petroleum exploration and production and the lithium brine related geological data sourced from the petroleum industry are summarized below.

6.1 Oil Drilling History

Existing wells in this area were drilled for petroleum and natural gas. Early operators for oil and gas fields in the area included such companies as Husky Oil & Refining Ltd, Shell Oil Company of Canada, Hudson's Bay Oil & Gas Co., and British American Oil Co. Ltd. (Gulf Canada). These companies were active in the resource areas as early as 1951 and some remain active to date.

The Leduc #1 well, drilled by Imperial Oil, was one of the first oil wells in Alberta drilled into the Late Devonian Leduc formation in 1947. Some of the most prolific formations produced historically are the Devonian formations, which includes the Swan Hills, Beaverhill Lake, Leduc, Nisku, and Wabuman Formations. The Leduc reefs were a prevalent target for hydrocarbons from the mid to late century due to their size and very high porosity and permeability. Currently there is resurgence in drilling activity in the Devonian with the improvement of technology allowing for the development of unconventional oil reservoirs such as the Duvernay formation. A significant volume of petroleum-related fluid has been produced from the Devonian as well as from some of the younger zones above in the Mississippian and Cretaceous. It is the Leduc Formation and the underlying Cooking Lake Aquifer that is of significance with respect to this assessment for mineral brine potential in the EWRA.

The Exshaw area contains several Leduc oil pools of note (e.g. Clive, Bashaw, Nevis). Oil and gas production in the EWRA began in September 1950 and historical production from the Leduc has been reported from most townships in the EWRA. A total of over 7000 wells have been drilled within the EWRA, and 1684 wells have intercepted the Leduc Formation. A total of 383 wells in and adjacent to the EWRA are classified as having produced or currently producing from the Leduc Formation. Similarly, 29 wells in or adjacent to the EWRA are classified as having injected or currently injecting into the Leduc Formation.

6.2 Well Logs

Open hole wireline logging technology is the predominant method for evaluating reservoir properties. Wireline logs (also called well logs) are a standard tool employed by the petroleum industry when drilling for and developing oil and gas pools. They provide physics-derived information about rock properties and fluid dynamics in the subsurface. This information is used to interpret the depths, lithology and fluid composition of subsurface rock formations. Interpretations from well logs are used to select formation boundaries and to determine the reservoir properties discussed in Section 14.

A rich database of wireline log information exists in the area due to oil and gas development dating back to the 1950’s, and this data can be leveraged for the purposes of Petro-Lithium exploration. Wireline tool technology has advanced considerably over the last few decades. Data resolution and quality improved significantly after the 1980’s. Due to the variety of well vintage and depth, a wide range of type and quality of well log data exists. Only wireline logs with sufficient depth and quality were used in the analysis of this resource.

The well logs available in the area are as follows:

- Gamma Ray Log: measures the radioactivity of rocks and helps determine lithology (http://petrowiki.org/Gamma_ray_logs, 2017)
- Induction Log: measures rock conductivity, and helps determine lithology and fluid composition (http://petrowiki.org/PEH:Resistivity_and_SP_Logging, 2017; Archie, 1942).
- Density and Neutron logs: measures hydrogen concentration and electron density (American Association of Petroleum Geologists, 2017), and helps determine lithology and pore space in the rock
- Photoelectric logs: measures atomic weight of the rocks, and helps determine lithology

Well logs penetrating through both the Leduc and the Cooking Lake Formation were used to determine the top and bottom of the formations and, the lateral extent of the Leduc over top of the Cooking Lake Platform. After formation tops were selected, well logs were then used to determine fluid contacts and reservoir parameters within the Leduc and Cooking Lake reservoirs.

6.3 Drill Stem Tests

A Drill Stem Test (DST) is an oilfield test that isolates a particular range of depths in a wellbore to measure the reservoir pressure, permeability (ability to flow fluid) and fluid types present at specified depths. DSTs have been run in the vicinity of the resource areas since December 1950. Data collected during DSTs are compiled by the Government of Alberta and were accessed through third party software (GeoSCOUT 2018). DST data was reviewed to determine reservoir pressure and permeability in the resource areas.

Prior to adopting DST-derived pressure estimates as representative of the reservoir, a quality assurance (QA) program was followed that eliminated suspect or erroneous data. The QA program reduced the initial data set of 382 wells with extrapolated pressures to 320 wells with extrapolated pressure measurements. The resulting data set consisted of 318 pressure measurements in the Leduc Formation and 2 pressure measurements in the Cooking Lake Formation.

These measurements were distributed throughout the resource area and were measured between 1951 and 2000. These pressure measurements were used to estimate the current day reservoir pressure and to contribute to the characterization of the hydraulic continuity of the reservoir.

6.4 Production, Injection and Disposal

Historical production volumes for the Cooking Lake and Leduc formations were exported from GeoSCOUT software (GeoSCOUT 2018). The reported production was queried from the EWRA and a buffer area around the EWRA, in order to include production from outside of the resource area that may directly affect pressures in the EWRA.

Historical production was queried from contiguous Leduc reef, including the EWRA and a 20-km buffer to the southwest. There is a total of 367 wells with reported production volumes. The wells were distributed across 31 townships with much of the production occurring in the Nevis and Clive areas. The first year of reported production was 1961. All of this production was reported from the Leduc Formation or from a combined interval of Leduc/Nisku. Total reported fluid production volumes in the EWRA are:

- 16,327,265 x 10^3 m^3 of gas produced;
- 44,478 m^3 of condensate produced;
- 12,497,279 m^3 of oil produced; and
- 24,883,051 m^3 of water produced.

The total fluid produced from the reef in the vicinity of the resource area peaked in the 1970s and has decreased considerably since then as hydrocarbons have been depleted. Beginning in 1957 water and gas have been injected into the Leduc Formation to dispose of produced water and to enhance hydrocarbon recovery through pressure maintenance of the reservoir.

- 169,393 x 10^3 m^3 of gas has been injected into 1 well in the Leduc Formation; and
- 33,833,301 m^3 of water has been injected into 19 wells in the Leduc Formation.

Injection into the Leduc Formation increased considerably since the 1970’s and peaked in 1998. It is noted that 8,950,250 m^3 more water has been injected into the Leduc Formation than has been produced from it. The additional water is believed to be freshwater injected into the Leduc Formation for enhanced oil recovery purposes and/or produced water from shallower production zones in the EWRA.

6.5 Historical Lithium Data

Section 6.5 was extracted from Eccles (2017) technical report for E3 Metals.

The first comprehensive overview of the mineral potential of formation waters from across Alberta was compiled by the Government of Alberta (Hitchon et al., 1993, 1995). 'Formation water' is used as a generic term to describe all water that naturally occurs in pores of a rock and if the rock is permeable (has the capacity to flow fluids through it) it could represent an aquifer. Hitchon et al. (1993, 1995) compiled nearly 130,000 analyses of formation water from various stratigraphic ages across Alberta. The data was derived from numerous sources including Alberta Energy Regulator ("AER") submissions for drilling conducted by the petroleum industry and various Government of Alberta reports (e.g., Hitchon et al., 1971; 1989; Connolly et al., 1990a, b and unpublished analytical data collected by the Government of Alberta).

The method for defining geographic areas with elements of possible economic interest in formation water was defined by Hitchon (1984) and Hitchon et al. (1995). For each element studied (e.g., calcium, magnesium, potassium, lithium, bromine and iodine), a 'detailed exploration threshold value' was determined by studying the concentrations in economically producing fields as defined in Hitchon (1984) and Hitchon et al. (1995). Additionally, a lower 'regional exploration threshold value' was defined to allow for contouring and extrapolation of data to undrilled areas. For example, the regional exploration threshold value for Li was considered to be 50 ppm and the detailed exploration threshold value was defined as 75 ppm (Hitchon et al., 1995). At the provincial scale, Hitchon et al. (1995) showed that lithium was analyzed and reported in 708 formation water analyses (out of the 130,000 total analyses examined). Of the 708 analyses: 96 analyses yielded Li concentrations above the 'regional threshold value' (greater than 50 ppm); and 47 analyses yielded Li concentrations above the 'detailed threshold value' of 75 ppm. Significantly, Hitchon et al. (1993, 1995) showed the highest concentrations of Li in formation water – up to 140 mg/L Li – occurred within Middle to Late Devonian aquifers associated with the Beaverhill Lake Group (Swan Hills Formation), Woodbend Group (Leduc Formation), Winterburn Group (Nisku Formation) and Wabamun Formation aquifers.

More recently, Eccles and Jean (2010) modelled 1,511 lithium-bearing formation water analyses throughout Alberta; this compilation supported the previous government author's conclusions that aquifers associated with Devonian strata comprise elevated concentrations of lithium in reef systems throughout Alberta. Of the 1,511 analyses, 19 analyses/wells contained greater than 100 mg/L Li (up to 140 mg/L), all of which were sampled from within the Middle to Late Devonian carbonate complexes.

There are 9 lithium samples from the EWRA which are reportedly from the Winterburn and Woodbend Groups (which includes the Leduc and Cooking Lake formations). The historical lithium concentrations range from 50 mg/L to 135 mg/L and have a mean of 75 mg/L. E3 Metals was unable to return to these exact locations for resampling because they have since been suspended or abandoned.

7 Geological Setting and Mineralization

7.1 Geological Setting

The E3 Metals Resource Areas are located in the southwestern part of the Western Canada Sedimentary Basin (WCSB). In this area, the Upper Devonian (Frasnian) sediments of the Woodbend Group were deposited in a shallow inland sea. The sea was bounded by the emergent Peace River Arch to the northwest and by the West Alberta Ridge to the southwest, creating a barrier between the sea and the open ancestral Pacific to the west (Potma et al. 2001). It is here that the flooded carbonate platform of the Cooking Lake provided relative structural highs and a favorable environment for the growth of the prolific reefal buildups of the Leduc Formation.

The Exshaw area covers a portion of the Wimborne-Bashaw complex to the east of the Meadowbrook Rimbey trend. The EWRA ranges from Township 36 to 45 and Ranges 21 to 26 West of the 4th Meridian (Figure 8). The basinal shales and carbonate muds of the Duvernay and Ireton conformably encase and overlay the Leduc buildups, creating traps for hydrocarbon pools (Figures 9 and 10). These low-permeability shales also form the aquitard, a formation of much lower water permeability than an aquifer, for the Leduc and Cooking lake aquifer systems.

The Leduc and Cooking Lake limestone deposits were, at some post burial stage, partially to completely replaced by dolomite. Dolomitization is the chemical process by which limestone ($CaCO_3$) is converted to dolostone ($CaMg(CO_3)_2$) through the dissolution of calcium carbonate and the precipitation of dolomite (American Association of Petroleum Geologists, 2017). Dolomite crystals are larger than limestone, and larger crystals typically improve permeability (Lucia, 1995).

There are many possible mechanisms theorized as to the source of dolomitizing Mg-rich fluids and the method for their transport into the Leduc system (Atchley et al. 2006; Amthor et al., 1993; Machel et. al., 2002). Dolomitization of the Leduc and Cooking Lake in this area generally enhances the porosity and permeability of the reservoir, except in some localized cases where secondary cementation has occurred to reduce the porosity. It is likely partly due to this process that the Leduc and Cooking Lake are hydraulically in communication and both contribute fluids as part of the overall system.

Formation water is currently being co-produced with petroleum and natural gas from existing wells. The formation water is separated from hydrocarbons at surface and re-injected into the subsurface as a wastewater. Pressure loss in the aquifer is being mitigated through re-injection of fluid from produced wells and possibly has included waters from other pools and other zones, as well as fresh water.

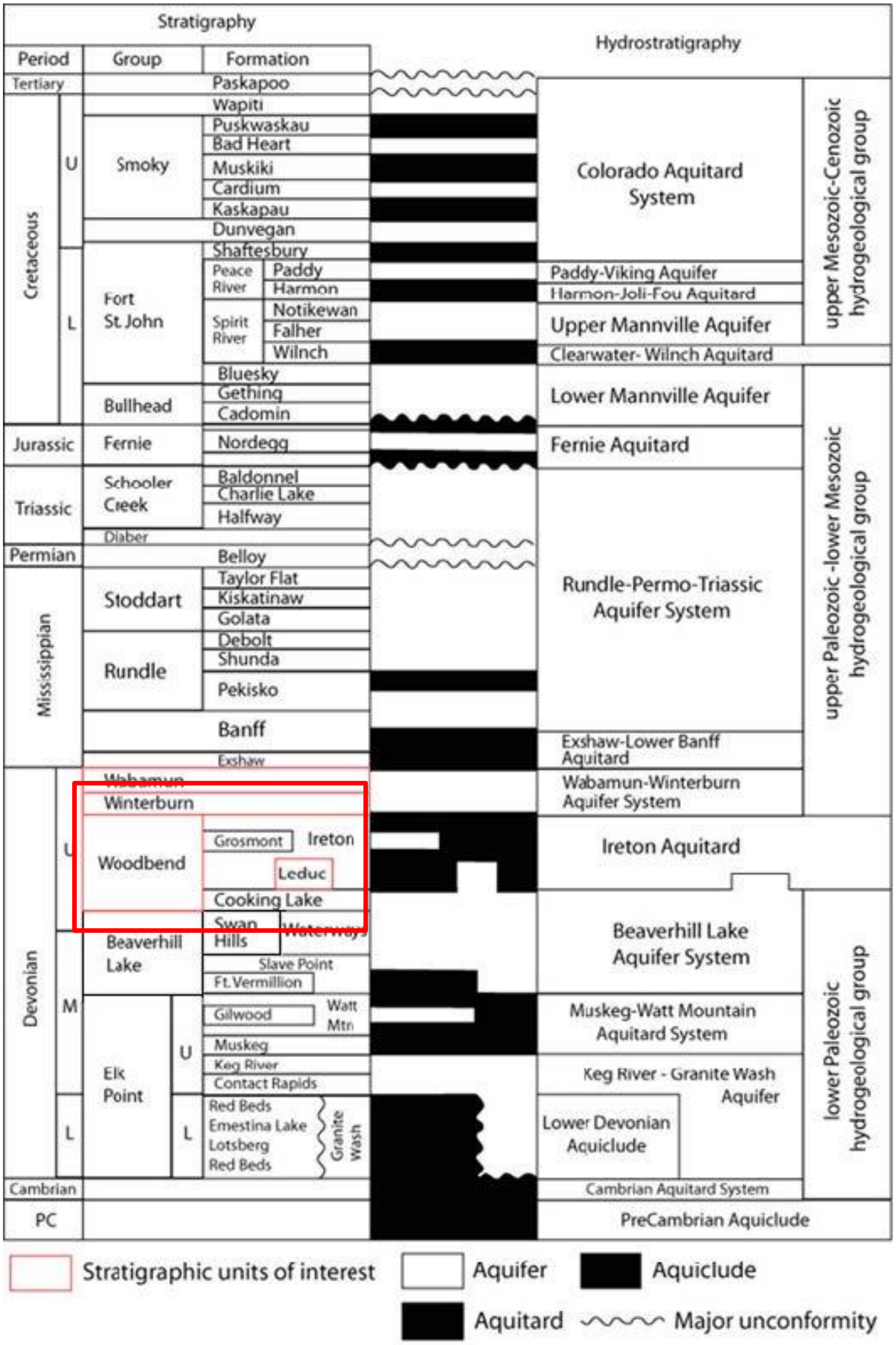


Figure 7. Regional stratigraphy/hydrostratigraphy in the vicinity of the EWRA in the Western Canadian Sedimentary Basin (adapted from Hitchon et al., 1990). The stratigraphic units of interest are denoted in red.

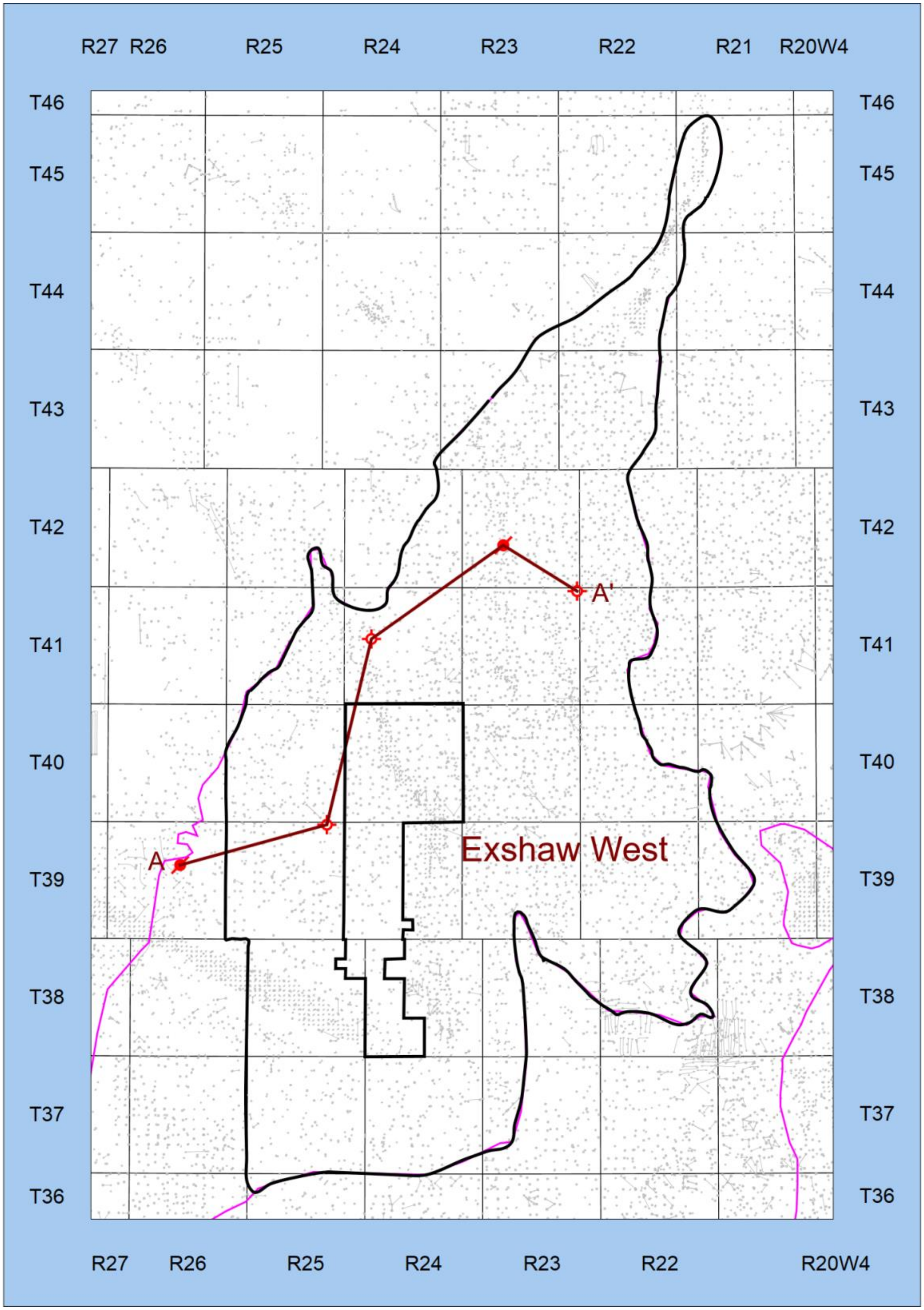


Figure 8. Area map of the EWRA and the regional Leduc edge (E3 Metals Corp. using GeoLOGIC Systems). The EWRA outline is in black and the Leduc edge is the pink line. Cross section reference lines (burgundy) are also included for Figures 9 and 10.

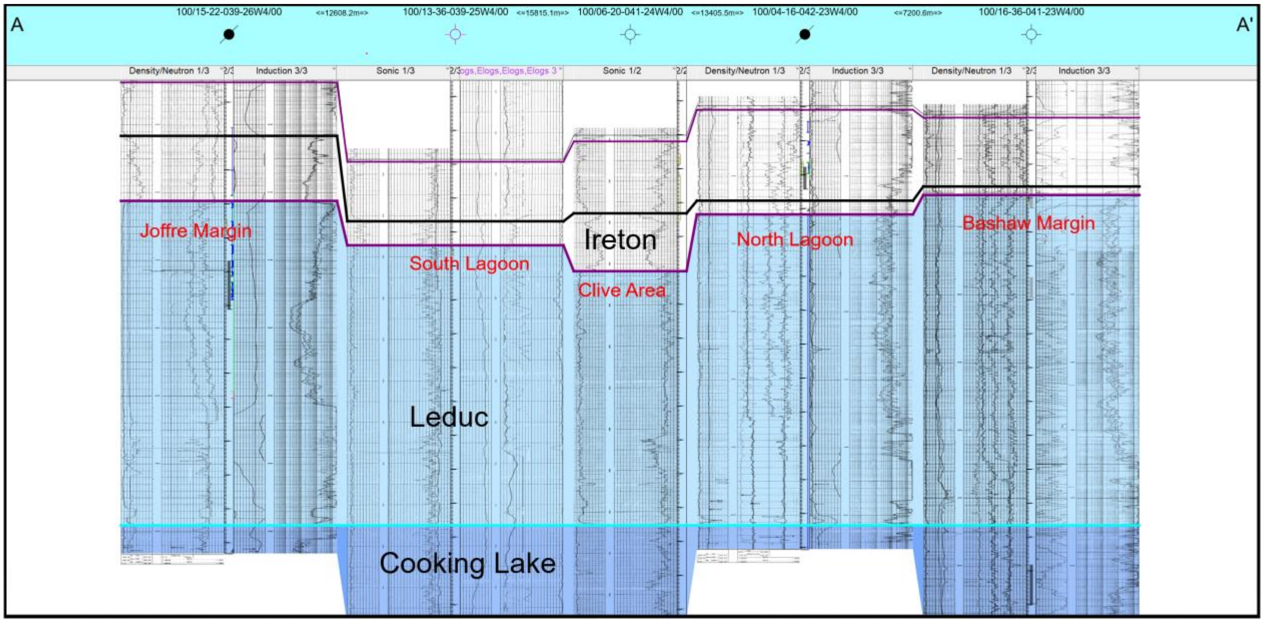


Figure 9. Geological stratigraphic cross section of the EWRA, line A-A' (Fig. 8) using a Cooking Lake Datum (E3 Metals Corp. using GeoLOGIC Systems). This cross section demonstrates the reservoir continuity across the Exshaw area Leduc platform. It highlights the relative thickness of the Leduc reef margins at Joffre and Bashaw to the thinner interior platform lagoons.

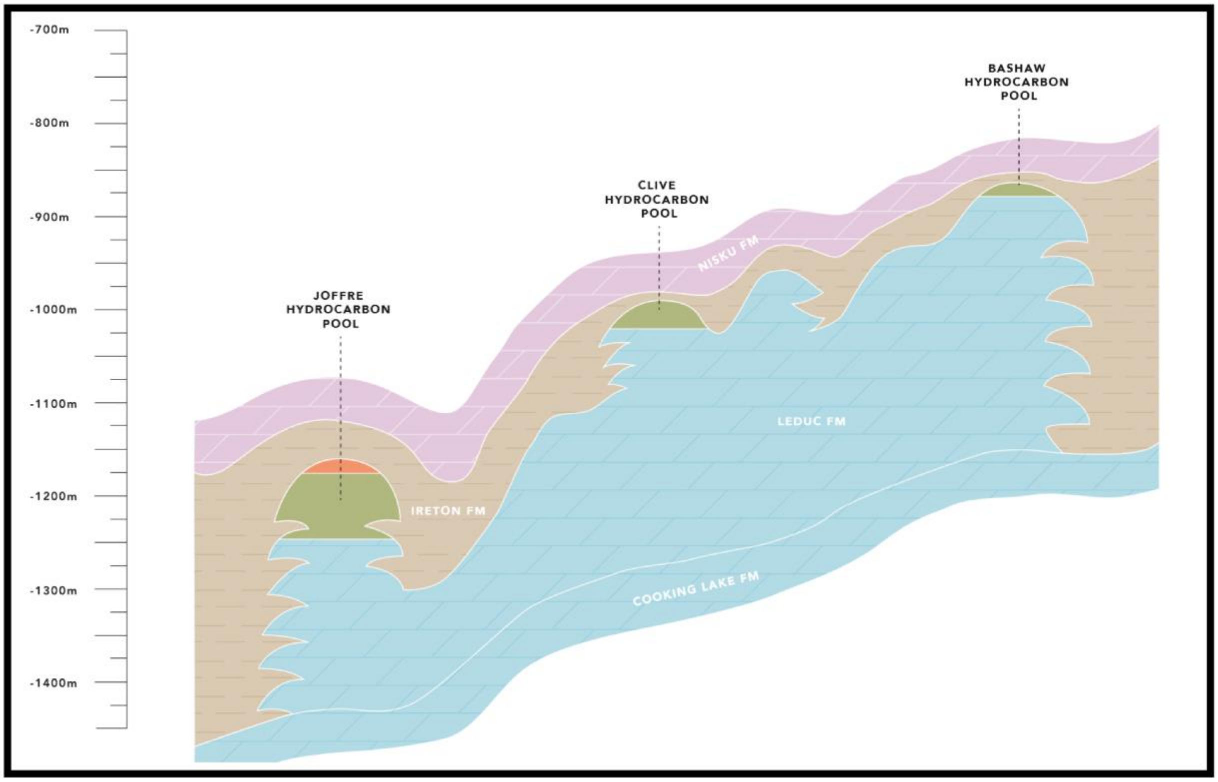


Figure 10. Schematic representation of the EWRA (to scale with vertical exaggeration) highlighting the current relationships of the geology, structure, and hydrocarbon pools. (E3 Metals, 2018)

7.2 Precambrian Basement

Section 7.2 was modified from E3 Metals Technical Report (Eccles, 2017).

The Exshaw property lies in the southern portion of the WCSB, which forms a wedge of Phanerozoic strata overlying the Precambrian basement. The basement underlying the Exshaw property is predominantly Lacombe Domain with the eastern portion of the property on the Hearn Terrane (Pană, 2003). The Hearn Terrane is part of the Churchill Province and formed at approximately 2.6 to 2.8 Ga (Ross et al., 1991 and 1998).

7.3 Phanerozoic Strata

Section 7.3 was modified from E3 Metals Technical Report (Eccles, 2017).

A thick sequence of Tertiary and Cretaceous clastic rocks and Mississippian to Devonian carbonate, sandstone and salt overlie the basement (e.g., Green et al., 1970; Glass, 1990; Mossop and Shetson, 1994). At the base of the Beaverhill Lake Group, the Elk Point Group is comprised of restricted marine carbonate and evaporite that gradationally overlies the Watt Mountain Formation (Mossop and Shetson, 1994). The Upper Elk Point, including the Ft. Vermillion, Muskeg and Watt Mountain formations represent an aquitard layer (Figure 7; Hitchon et al., 1990).

The Upper Devonian Woodbend Group conformably overlies the Beaverhill Lake Group (Figure 7). The Woodbend Group is dominated by basin siltstone, shale and carbonate of the Majeau Lake, Cooking Lake, Duvernay and Ireton formations, which surround and cap the Leduc reef complexes. The Leduc reefs are characterized by multiple cycles of reef growth including backstepping reef complexes and isolated reefs (Mossop and Shetson, 1994). The Leduc Formation (Woodbend Group) is the major host to prolific reserves of oil and gas in Alberta and contains elevated concentrations of Li (Hitchon et al., 1995). The Duvernay Formation is composed of dark bituminous shale and limestone which contain and preserve a large accumulation of organic carbon thought to be the source for most of the conventional hydrocarbons in the upper Devonian in Alberta. The Ireton Formation caps the Leduc reefs and was formed by an extremely voluminous influx of shale into the region (Mossop and Shetson, 1994). The Ireton Formation is an aquitard that forms an impermeable cap rock over the Leduc reefs (Hitchon et al., 1995). The Camrose Member represents the only significant carbonate deposition during the Ireton cycles of basin-filling shale (Stoakes, 1980).

The Woodbend Group is conformably overlain by the Winterburn and Wabamun Groups of upper Devonian age (Figure 7). In the area of the E3 Metals properties, the Winterburn thickness in south-central Alberta is available from the logs of holes drilled for petroleum and is composed of shale and argillaceous limestone. The Wabamun Group is composed of buff to brown massive limestone interbedded with finely crystalline dolomite at the base. These two Groups comprise the Wabamun-Winterburn Aquifer system from which a few anomalous Li analyses have been obtained (Hitchon et al., 1995).

The Wabamun Group is unconformably overlain by the Lower Carboniferous Exshaw shale, an aquitard. The Exshaw shale is overlain by the Banff Group, which is composed of a medium to light olive grey limestone with subordinate fine-grained siliciclastics, marlstone and dolostone overlying a basal shale, siltstone and sandstone unit (Mossop and Shetsen, 1994). The Rundle Group conformably overlies the Banff Group and is composed of cyclic dolostone and limestone with subordinate shale. Permian strata in the area are thin. The Permian Belloy Group unconformably overlies the Rundle Group and is unconformably overlain by the Triassic Montney Formation. It is composed of shelf sand and carbonate (Mossop and Shetson, 1994).

The overlying Mesozoic strata (mainly Cretaceous) are composed of alternating units of marine and nonmarine sandstone, shale, siltstone and mudstone. The Triassic includes fine-grained argillaceous siltstone and sandstone. The overlying Jurassic Fernie Group is composed of limestone of the Nordegg Formation that is overlain by interbedded sandstone, siltstone and shale (Mossop and Shetson, 1994). The Lower Cretaceous strata are represented by the Bullhead and Fort St. John groups which comprise a major clastic wedge on the Foreland basin (Figure 7).

Bedrock units underlying the Resource Areas include the late Cretaceous Horseshoe Canyon and Scollard formations and Tertiary Paskapoo Formation (Figure 7). Horseshoe Canyon strata consist of interbedded sandstone, siltstone, mudstone, carbonaceous shale and coal seams. The Scollard Formation consists primarily of sandstone and siltstone that is interbedded with mudstone. Coal seams in the upper portion of the Scollard are economically significant, particularly in western Alberta. Finally, the Paskapoo Formation underlies the EWRA, and much of southwestern Alberta. It consists of sandstone, siltstone and mudstone.

7.4 Quaternary Geology

Section 7.4 was modified from E3 Metals Technical Report (Eccles 2017).

During the Pleistocene, multiple southerly glacial advances of the Laurentide Ice Sheet across the region resulted in the deposition of ground moraine and associated sediments in south-central Alberta (Dufresne et al., 1996). The majority of the EWRA is covered by drift of variable thickness, ranging from a discontinuous veneer to just over 15 m (Pawlowicz and Fenton, 1995a, b). Bedrock may be exposed locally, in areas of higher topographic relief or in river and stream cuts. The advance of glacial ice may have resulted in the erosion of the underlying substrate and modification of bedrock topography. Limited general information regarding bedrock topography and drift thickness in south-central Alberta is available from the logs of holes drilled for petroleum, coal or groundwater exploration and from regional government compilations (Mossop and Shetson, 1994; Pawlowicz and Fenton, 1995a, b). Glacial ice is believed to have receded from the area between 15,000 and 10,000 years ago.

7.5 Structural History

Section 7.5 was modified from E3 Metals Technical Report (Eccles 2017).

The Exshaw permits are situated northeast of the Rocky Mountains. An extensive study by Edwards et. al. (1998) utilizing aeromagnetic data, gravity data, and lineament analysis indicates that faulting related to the Precambrian basement and the Snowbird Tectonic Zone appear to have at least partial control on the distribution of reefs and some of the oil fields in the area. Many of the Devonian reef complexes in the permit area are underlain by, or are proximal to, basement faults.

There are numerous reef complexes in the Exshaw properties (e.g., Bashaw, Clive, Nevis). These reef complexes promoted growth over long periods of time, and in the permit areas reach thicknesses of greater than 250 m in places. In such places, thick Leduc buildups are prominent structural features in the stratigraphic column.

7.6 Mineralization

The Leduc and Cooking Lake aquifer system contains lithium-enriched brine associated with reefal carbonates of the Woodbend and Winterburn Group (Hitchon et. al., 1995; Eccles and Jean, 2010). Potential aquifers were located in reef complexes of the Woodbend and Winterburn groups. Subsequent work by Eccles and Jean (2010), Huff et al. (2011, 2012) and Huff (2016) confirmed the presence of elevated Li (e.g. greater than 75 mg/L of lithium) in aquifers associated with the Devonian reef complexes.

Speculation exists as to the source of the lithium, but the source is ultimately unknown (Eccles et. al, 2012). For the Leduc and Nisku system in southern Alberta, Huff (2016) proposed a source involving lithium concentrated Devonian evaporates to the west and upward movement of Li-enriched brine into the Leduc and Nisku carbonates during later mountain building.

Formation water with high concentrations of lithium (mineralization) is expected to occur throughout the EWRA including vertically from the bottom of the Cooking Lake Formation to the top of the Leduc Formation and laterally coincident to the occurrence of the Leduc reef.

8 Deposit Types

Lithium brine deposits are accumulations of saline groundwater that are enriched in dissolved lithium and other elements. All present producing lithium brine deposits are referred to as Salars and share a number of first-order characteristics: (1) arid climate; (2) closed basin contained in a playa or salar; (3) tectonically driven subsidence; (4) associated igneous or geothermal activity; (5) suitable lithium source-rocks; (6) one or more adequate aquifers; and (7) sufficient time to concentrate a brine (Bradley et al., 2013).

A set of unique conditions such as those described above have not been identified for Petro-Lithium deposits. According to Eccles and Berhane (2011) “The source of lithium in oil-field waters remains subject to debate. Most explanations generally conform with models proposed for Li-rich brine solutions that include recycling of earlier deposits/salars, mixing with pre-existing subsurface brines, weathering of volcanic and/or basement rocks, and mobilizing fluids associated with hydrothermal volcanic activity (e.g., Garret, 2004). However, none of these hypotheses has identified the ultimate source for the anomalous values of Li in oil-field waters”.

In a comprehensive investigation of Li-isotope and elemental data from Li-rich oil-field brines in Israel, Chan et al. (2002) suggested that these brines evolved from seawater through a process of mineral reactions, evaporation and dilution. In this case, brines that were isotopically lighter than seawater were associated with lithium mobilized from sediment.” Huff (2016) suggests that Li-brine in the Nisku and Leduc formations in Alberta are the result of “preferential dissolution of Li-enriched late-stage evaporite minerals, likely from the middle Devonian Prairie Evaporite Formation, into evapo-concentrated late Devonian seawater”. Huff postulates that this was followed by downward brine migration into the Devonian Winnipegosis Formation and westward migration caused by Jurassic tilting, and during the Laramide tectonics, the brine was diluted by meteoric water driven into the Devonian of the southwestern Alberta Basin by hydraulic gradients.

Lithium brines associated with oil and gas production have been known for some time but are typically lower in grade when compared to the major lithium brine deposits of the world. Examples of such deposits are Salar de Atacama, Chile (site of production facilities of the two major producers Albemarle and SQM), Salar de Hombre Muerto in Argentina (home of the third major producer FMC) and Clayton Valley, USA (Owned by Albemarle, and the only lithium production facility in North America). These existing sites use surface evaporation ponds as part of the lithium concentration process, which typically are not feasible for Petro-Lithium. The recent advent of new “direct brine” dissolved metal recovery technologies and methods has made lower grade brines more economically viable.

9 Exploration

Hydrocarbon production by oil and gas operators in E3 Metals’ permit area is very often associated with co-produced brine water from the formation. Significant volumes of hydrocarbons and brine have been produced from the Leduc reservoir across the Resource Area since the 1960’s, and this has resulted in a rich database of reservoir and production data. Over time, the relative amount of water produced from the Leduc has increased in comparison to hydrocarbons. Water in some cases represents an excess of 98% of the total volume arriving at surface. Various oil and gas operators have allowed E3 Metals access to oil and gas infrastructure for brine collection across the permit areas and this has enabled E3 Metals to execute an exploration program without the costly requirement of drilling a well.

9.1 Sample Wells

Exploration activities undertaken other than the sampling program (Section 9.2) included a full geological and hydrological review of the Leduc Reservoir and formation water sampling from existing oil and gas production wells. Samples were collected for E3 Metals from existing Leduc Formation producing oil and gas wells by field crews contracted from Maxxam Analytics and AGAT Laboratories in Red Deer, Alberta. Wells were selected based on their status as an active Leduc producer, without any additional concurrent zone production (commingling), and their availability. Oil and gas operators generally cycle wells, so several field programs were completed to collect samples.

9.2 Field Sampling

Samples were either collected directly at the wellhead (Figure 11), or at test separators. Where sampling was conducted at the wellhead, a 4L jug was used to collect the production fluid at the pump jack. This fluid typically formed an emulsion of oil, water and gas, which readily separated out into phases in the bottle within seconds to minutes. Once the separation was complete, a small hole was created in the bottom of the bottle to allow only water to flow out of the 4L bottle and into a 1L or 2.5L opaque amber glass bottle.

Samples were also collected at test separators. Test separators (Figure 12) are used in the oil field to measure the flow rates of various wells and collect water and hydrocarbon samples from one or more wells at a satellite location. Test separators for this resource sampling program were either 2-phase or 3-phase. 2-phase means that oil and water are separated from gas, whereas 3-phase means that oil, water and gas are each separated. For both 3-phase and 2-phase, there is a valve on the tank that can be opened to produce a fluid sample. In all cases, the company ensured that the wells used went “into test” at least 24 hours prior to sample collection to flush the lines and ensure no risk of contamination from other wells.

Figure 11. Sample collection at wellhead. Left: Maxxam employee sampling from wellhead access port into a container. Right: Sample processing after collection by Maxxam employee.

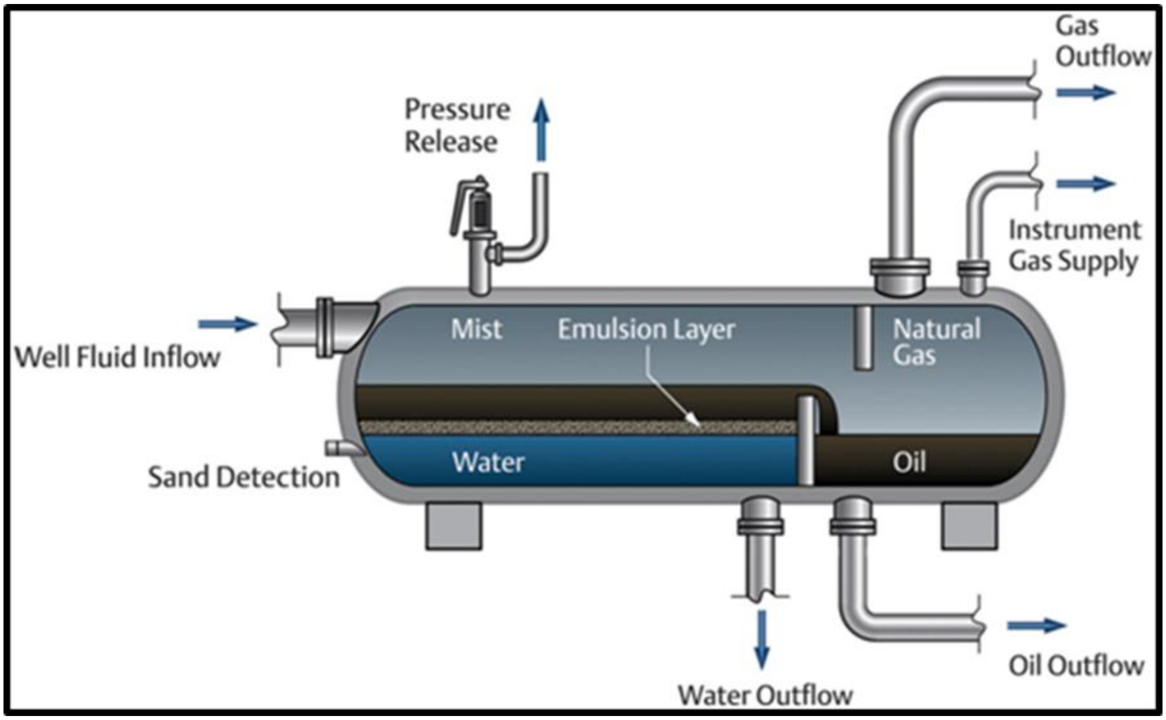


Figure 12. Schematic of Test Separator (Emerson website, 2017).

Figure 13. Example of sample collection at a test separator. Left: Maxxam employee collecting sample from test separator access port. Right: Sealed well samples.

On 2-phase separators, the valve was opened, and water was discharged into a test bottle to assess how much oil was in the separator before collecting directly into the opaque amber bottles. If there was a high volume of oil, sometimes the operator of the well was able to make adjustments on site to improve the amount of water flow. After adjustments were made, a mixture of oil and water was discharged into the 1L or 2.5L opaque amber bottles (Figure 13).

On 3-phase separators, a bottle of water can be collected with very little gas or oil. In this case, the valve was opened, and water was discharged directly into the opaque amber 1L or 2.5L bottles.

In all cases, two 1L or a single 2.5L opaque amber bottle of sample was collected on each well. The bottles were filled up to the very top with brine water to ensure no air could get trapped in the top. A cap was then screwed on, and the cap was sealed with electrical tape. An E3 Metals custody seal was affixed to the bottle and cap to ensure no sample tampering (Figure 13). These bottles were kept in a cooler with their chain of custody documents and delivered to the laboratory for testing once the sampling program was complete.

Sour gas (H_2S – hydrogen sulfide) was present at all the sites sampled. For this reason, safety precautions were taken by field samplers, including wearing H_2S sensors, and always having two personnel on site for sample collection. Where the H_2S content was high (above 10ppm), masks were worn over the face with an oxygen tank to ensure the field samplers were safe.

A list of well additives, such as demulsifier, corrosion inhibitor and paraffin inhibitor, was obtained for each wellsite to rule out potential lithium contamination. No sources of lithium contamination were identified.

A total of 57 samples from different UWI's were collected for analysis in the Clearwater, Rocky and Exshaw Sub-Properties. 19 wells are located within the EWRA. The results of the sampling program are discussed in Section 11.

10 Drilling

There has been no drilling completed by E3 Metals Corp. on the project.

11 Sample Preparation, Analyses and Security

11.1 Sample Preparation and Security

Samples were collected from oil and gas infrastructure into 1L or 2.5L opaque amber bottles (for detail see Section 9.1). The bottles were filled to the top to ensure no air was trapped at the top. The cap was screwed on and then sealed with electrical tape. Each bottle was labeled with the Unique Well Identifier (UWI) and date, and an E3 Metals custody seal was applied for security. These samples were kept secure in a cooler with their chain of custody information and delivered either to Maxxam Laboratories Edmonton or AGAT Laboratories Calgary for processing. Both AGAT and Maxxam are accredited by the Canadian Association of Laboratory Accreditation Inc.

In the laboratory, samples from the same UWI were combined into a large beaker in a fume hood for H_2S degassing. A reference beaker of water was placed beside each sample to measure the degree of evaporation over the degassing period. This evaporation was found to be <0.1% for all samples and is reported along with the lithium result. After H_2S removal the larger sample was stirred using a stir-bar for at least 1 minute prior to subsampling to ensure sample homogeneity. 100ml or 125ml of sample was discharged into two opaque amber glass or high-density poly ethylene bottles for trace metal testing at AGAT Laboratories in Calgary, AB (assay lab) and Maxxam Laboratories in Burnaby, BC (check lab). The samples were preserved with 2% by weight nitric acid, and then they were well packed and transported to their respective destinations with their chain of custody documents.

Samples received at the individual labs were mixed vigorously and a subset of sample was placed in a digestion tube. The samples were first digested with hydrogen peroxide, and then digested again with a mixture of nitric acid and hydrochloric acid. The purpose of the hydrogen peroxide digestion is to break down humic acid and various organics in the sample that are believed to interfere with the lithium measurement. Samples are then diluted to 20:1 and run through an ICP-OES machine for trace metals analysis.

11.2 Analyses

11.2.1 Standards and Blanks

A series of standard solutions were created at the University of Alberta Alessi Laboratory by Dr. Salman Safari on June 26, 2017, Oct 2, 2017, and Dec 21, 2017. The standards were comprised of a standard Li solution from Fisher Scientific that was diluted to 120 mg/L with de-ionized water. To assess standard quality and suitability for QA/QC purposes for each series of standard solutions, E3 Metals sent a single 120 mg/L lithium liquid sample to each of five industry accredited analysis laboratories: AGAT, Maxxam, ALS, Wetlab and Core Labs. The results are shown in Figure 14. The samples ranged between 0.8% and 2.5% of the 120 mg/L standard solution.

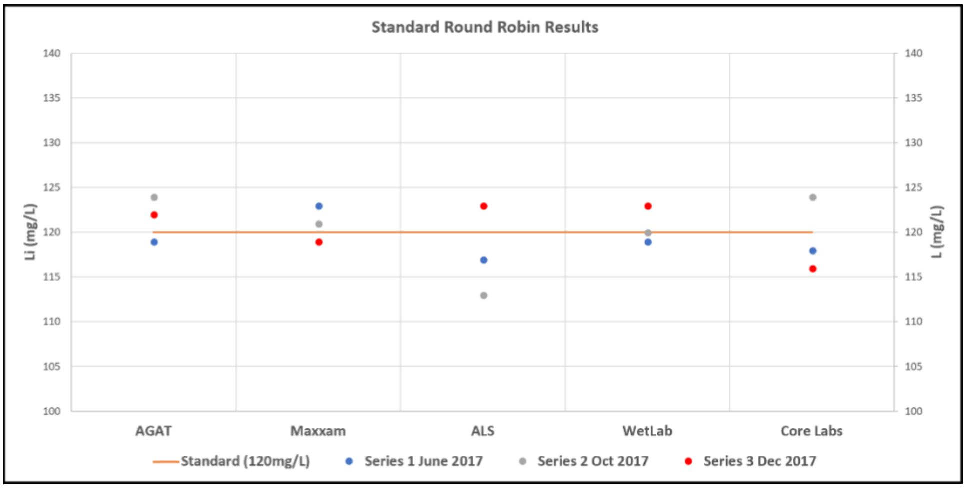


Figure 14. Results of lithium standard analyses from five laboratories.

Standards and blanks were inserted into ICP-OES analysis runs every 15-20 samples to ensure precision and accuracy.

11.2.2 Duplicate Analysis

Duplicate well brine samples from E3 Metals sub-properties (Clearwater, Rocky and Exshaw) were analyzed by both AGAT and Maxxam until October 2017. A rigorous process of analysis review and discussion with the labs resulted in E3 choosing AGAT as the primary lab and the development of a refined method for determining representative Lithium concentrations in the formation brines on E3's resource areas. Further details on this can be found E3 Metals NI 43-101 Central Clearwater Technical Report (Spanjers, 2017).

Starting in November 2017, one in 5 samples were analyzed in duplicate by Maxxam Laboratories in Burnaby, BC.

11.2.3 Sampling Program Results

Sampling results from across the Permit Areas are presented in Table 2 and Figure 15. A total of 57 samples were collected, each from a different location. It is the author's opinion that the data presented in this section has resulted from adequate sample preparation, security and analytical procedures.

E3 Metals project area	Min Li (mg/L)	Average Li (mg/L)	Max Li (mg/L)	Number of wells sampled
Clearwater	69.8	74.7	84.6	13
Exshaw West	44.4	69.7	84.8	19
Exshaw East	29.1	52.6	70.7	11
Rocky	26.7	54.2	61.3	14
Total				57

Table 2. Aggregate sampling results from E3 Metals' 57 well sampling program.

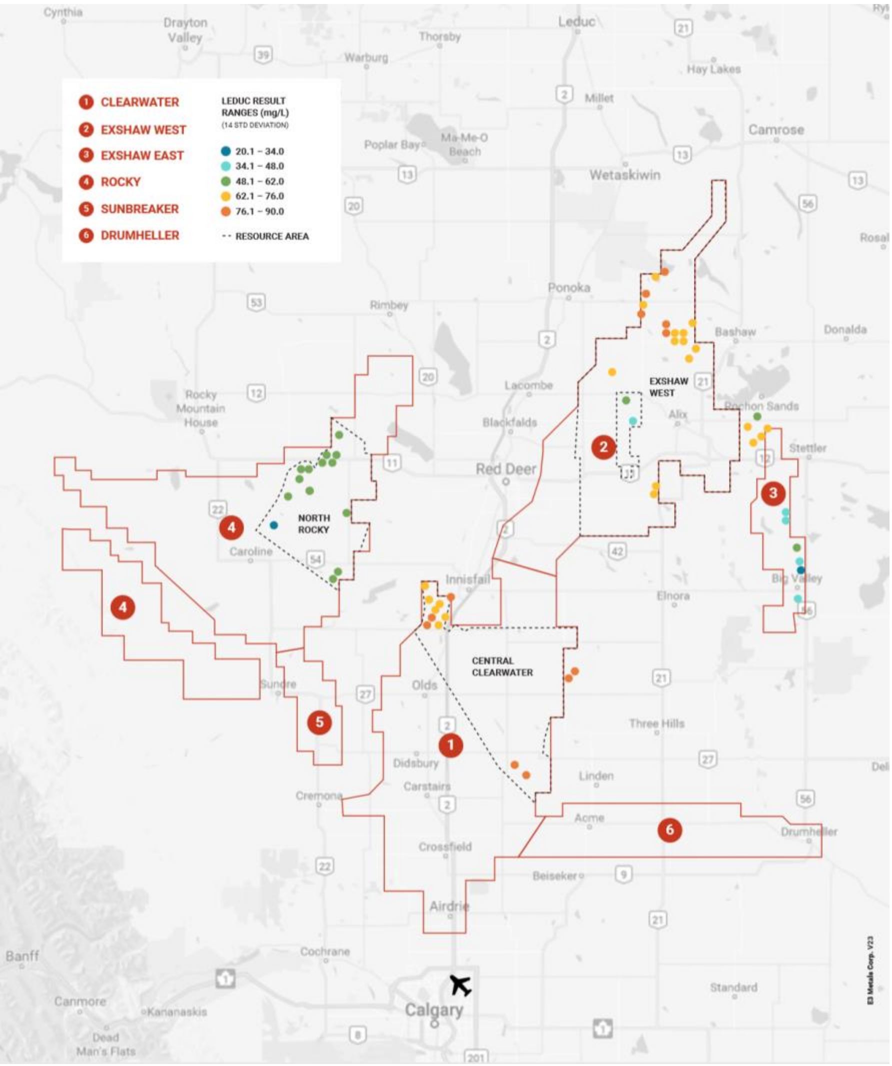
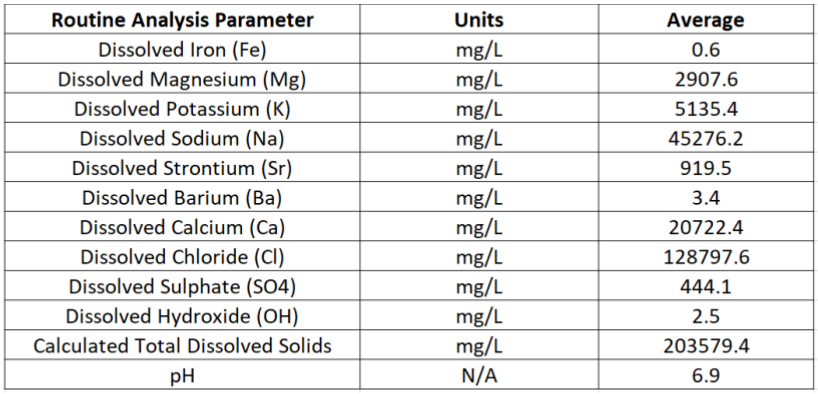


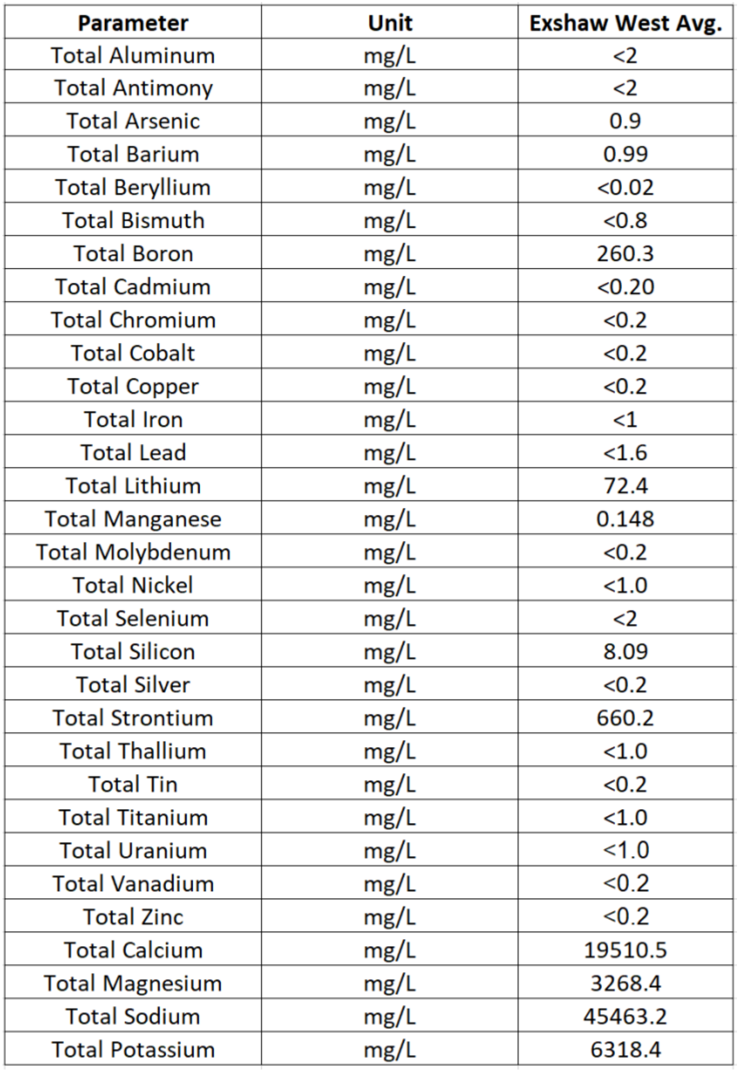
Figure 15. Lithium assay results for the Resource Area and locations outside the Resource Area. The Leduc is enriched in lithium across the tested areas, and the data demonstrates consistency throughout sub-properties.

Average brine chemistries from routine and trace metals scan analysis is presented in Tables 3 and 4.



Routine Analysis Parameter	Units	Average
Dissolved Iron (Fe)	mg/L	0.6
Dissolved Magnesium (Mg)	mg/L	2907.6
Dissolved Potassium (K)	mg/L	5135.4
Dissolved Sodium (Na)	mg/L	45276.2
Dissolved Strontium (Sr)	mg/L	919.5
Dissolved Barium (Ba)	mg/L	3.4
Dissolved Calcium (Ca)	mg/L	20722.4
Dissolved Chloride (Cl)	mg/L	128797.6
Dissolved Sulphate (SO4)	mg/L	444.1
Dissolved Hydroxide (OH)	mg/L	2.5
Calculated Total Dissolved Solids	mg/L	203579.4
pH	N/A	6.9

Table 3. Average chemical analyses of major cations and anions for 57 sampled wells in the Alberta Petro-Lithium project.



Parameter	Unit	Exshaw West Avg.
Total Aluminum	mg/L	<2
Total Antimony	mg/L	<2
Total Arsenic	mg/L	0.9
Total Barium	mg/L	0.99
Total Beryllium	mg/L	<0.02
Total Bismuth	mg/L	<0.8
Total Boron	mg/L	260.3
Total Cadmium	mg/L	<0.20
Total Chromium	mg/L	<0.2
Total Cobalt	mg/L	<0.2
Total Copper	mg/L	<0.2
Total Iron	mg/L	<1
Total Lead	mg/L	<1.6
Total Lithium	mg/L	72.4
Total Manganese	mg/L	0.148
Total Molybdenum	mg/L	<0.2
Total Nickel	mg/L	<1.0
Total Selenium	mg/L	<2
Total Silicon	mg/L	8.09
Total Silver	mg/L	<0.2
Total Strontium	mg/L	660.2
Total Thallium	mg/L	<1.0
Total Tin	mg/L	<0.2
Total Titanium	mg/L	<1.0
Total Uranium	mg/L	<1.0
Total Vanadium	mg/L	<0.2
Total Zinc	mg/L	<0.2
Total Calcium	mg/L	19510.5
Total Magnesium	mg/L	3268.4
Total Sodium	mg/L	45463.2
Total Potassium	mg/L	6318.4

Table 4. Average chemical analyses of trace metals for 19 wells in the EWRA.

12 Data Verification

12.1 Geochemistry Data

The author has reviewed the field sampling Standard Operating Procedure (SOP) and the Laboratory Testing SOP developed by E3 Metals to ensure consistent and accurate sample collection and analysis. The author has additionally reviewed the QA/QC results provided by E3 Metals and is satisfied that data presented in this report is adequate for the purposes of calculating an Inferred Resource.

During the author's March 23, 2018 site visit, he observed Maxxam employees collect samples as described in Section 9.2. During the observation, Maxxam employees demonstrated a competency of the E3 Metals SOP and executed sampling accordingly. The sites were located in the Clive sub-property of the EWRA. Samples were delivered to the laboratory for degassing by Maxxam field staff upon the completion of the sampling program.

Figure 16. Maxxam field personnel processing sample collection, March 23, 2018.

12.2 Metallurgical Test Data

The metallurgical testing procedure and results performed by the U of A (University of Alberta) have been independently reviewed and verified by the author of Section 13. At the U of A, the QP observed sorbent production and lithium recovery, including all aspects of the synthetization of the chemical sorbent and ion exchange testing at bench scale. Raw brine samples were sealed on delivery to the laboratory. Samples prepared for analytical testing were tagged and sealed prior to dispatch. Analytical testing was performed on the raw brine, treated brine, and concentrate by a third-party accredited laboratory, AGAT Laboratories in Calgary.

13 Mineral Processing and Metallurgical Testing

13.1 Summary

E3 Metals Corp, in collaboration with the University of Alberta (U of A), are currently developing a process flowsheet for the direct extraction of lithium from brine resources within E3 Metals' Alberta Petro-Lithium permit areas. The metallurgical testing procedure and results performed by the U of A have been independently reviewed and verified by the author of Section 13. The lithium extraction process flowsheet is comprised of two processing steps:

Step 1: Concentration

The concentration step utilizes a unique ion exchange technology to process low grade Alberta brine to produce a higher-grade lithium concentrate solution with low impurity levels. This stage also results in a reduction of brine liquid volume. The technology has been developed to achieve a minimum of 10 times concentration factor for the total solution and a reduction in total dissolved metals to at the most, 5% of the original concentrations.

Step 2: Polish and Purification

Polishing and purification involves further reducing the remaining impurities in the concentrated lithium solution produced in Step 1, to create an even higher purity lithium concentrate solution. The purified concentrate solution can be further processed to produce lithium carbonate and/or lithium hydroxide. The ultimate objective for Step 2 of the process is to further reduce impurity levels to enable production of battery grade lithium carbonate and/or lithium hydroxide.

The lithium concentration step is critical to the extraction process as it reduces the volume of brine and impurities thus simplifying downstream processing. E3 Metals has focused the development of the concentration technology towards optimizing the volume concentration and lithium recovery. The test work is aimed at generating a 10 times concentration factor and a lithium recovery target of in excess of 90% from low grade Alberta brine. E3 Metals' continued optimization of the concentration step will help improve the transfer of the technology towards commercial scale operation.

E3 Metals has reviewed third party technology for polishing and purification. The review indicated the concentrate feedstock could be processed directly using currently available commercial technologies. E3 Metals is currently collaborating with third party experts to analyze the efficiency of polishing and purification for processing the E3 Metals' concentrated lithium solution from Step 1.

A total of six extraction tests have been performed and are summarized in Table 5.

	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Li - Raw Brine (mg/L)	76	76	67	74.6	73	72
Li - Concentrate (mg/L)	1060	992	1085	1206	1085	1059
Lithium Recovery	70.2%	65.7%	81.2%	80.9%	73.9%	73.3%
Concentration Factor	14	13	16	16	15	15
Test Brine Volume (mL)	200	200	20	150	20	130
Sorbent Concentration in Brine (g/L)	2	2.5	2.5	2	2	2
Critical Metals Reduction %						
Na - Raw Brine (mg/L)	48,000	48,000	48,993	52,313	52,943	53,314
Na - Resultant Concentrate (mg/L)	36	58	BDL*	BDL*	59	BDL*
Reduction of Metal (%)	>99.9%	>99.9%	>99.9%	>99.9%	>99.9%	>99.9%
Ca - Raw Brine (mg/L)	20,300	20,300	18,443	19,324	20,177	19,967
Ca - Resultant Concentrate (mg/L)	531	489	287	287	217	196
Reduction of Metal (%)	99.9%	99.9%	99.9%	99.9%	99.9%	>99.9%
Mg - Raw Brine (mg/L)	3,400	3,400	3,137	3,050	3,501	3,078
Mg - Resultant Concentrate (mg/L)	151	109	126	BDL*	79	BDL*
Reduction of Metal (%)	99.8%	99.8%	99.8%	>99.9%	99.9%	>99.9%
K - Raw Brine (mg/L)	6,570	6,570	5,588	5,923	6,181	6,071
K - Resultant Concentrate (mg/L)	BDL^	BDL^	5	BDL*	4	BDL*
Reduction of Metal (%)	>99.9%	>99.9%	>99.9%	>99.9%	>99.9%	>99.9%
Sr - Raw Brine (mg/L)	765	765	602	627	666	631
Sr - Resultant Concentrate (mg/L)	33	28	28	23	19	18
Reduction of Metal (%)	99.8%	99.8%	99.8%	99.8%	99.9%	99.9%
B - Raw Brine (mg/L)	279	279	265	297	282	267
B - Resultant Concentrate (mg/L)	18	19	22	17	19	17
Reduction of Metal (%)	99.7%	99.7%	99.6%	99.7%	99.7%	99.7%

^ BDL = Below Detection Limit, ICP-OES K=12 mg/L
* BDL = Below Detection Limit, ICP-MS Na =0.07 mg/L, Mg=0.07 mg/L, K = 1 mg/L

Table 5. Summarized results from metallurgical test work for lithium extraction using ion-exchange

13.2 Metallurgical Testing Summary

E3 Metals has been conducting metallurgical testing at the U of A's Alessi Laboratory to develop the ion exchange technology which utilizes a chemical sorbent, to selectively extract lithium and concentrate the brine. Lithium extraction has been demonstrated at the laboratory scale, (20 mL and 200 mL feed brine) using Leduc Formation water from within the Company's Petro-Lithium Project area. E3 Metals believes the technology is well suited for commercial scalability for direct brine extraction from low grade Alberta brine.

E3 Metals' ion exchange process, first selectively binds lithium to the sorbent, followed by liberating the lithium using a washing agent at a specific ratio to the original brine volume, to produce a higher-grade lithium concentrate solution. At the laboratory scale, the concentration technology has been demonstrated to be highly selective for lithium in the presence of competing ions (impurities) such as sodium (Na^+), potassium (K^+), magnesium (Mg^{2+}) and calcium (Ca^{2+}).

To independently verify the reproducibility of the procedure and results obtained by the U of A, E3 Metals contracted the author to observe the sorbent production and lithium recovery. All aspects of the synthetization of the chemical sorbent and ion exchange testing at bench scale were observed. Raw brine samples from E3 Metals' resource were sealed on delivery to the laboratory. Samples prepared for analytical testing were tagged and sealed prior to dispatch. Analytical testing was performed on the Raw Brine, Treated Brine and Concentrate by a third party accredited laboratory, AGAT Laboratories (AGAT) in Calgary. Earlier test solutions were analyzed at the University of Alberta and provide indicative information.

The 6 metallurgical tests presented in this report were conducted on raw brine samples collected from two wells within E3 Metals' Exshaw West permit area. There is no information provided to determine the representivity of the brine solutions in comparison to the overall resource.

13.3 Metallurgical Testing Procedure

The metallurgical testing procedure was observed which included production of the sorbent material and its subsequent preparation prior to lithium extraction, the lithium extraction and stripping tests and sampling. The tests observed, comparing two different sorbent to brine ratios, clearly demonstrated that precise documented procedures were followed and the equipment used did not detract from the accuracy of the test work. A brief precis of the procedure outlined:

- Production and synthesizing of a specific mass of solid chemical sorbent through the mixing of raw reagents, calcining of the reaction product and subsequent processing and drying.
- The prepared solid sorbent is mixed with 200 mL of brine at a specific Brine:Sorbent ratio and agitated for a specific period of time.
- The Treated Brine / sorbent mix, (with the lithium extracted), is then separated from the solid sorbent.
- The solid sorbent is washed by mixing with a washing agent at a ratio of 20:1 to the original brine volume for a specific period of time.
- The concentrated brine solution (Concentrate) is separated from the sorbent.
- The resultant test work solutions were labelled and sealed before dispatch to AGAT for analytical testing.

13.4 Metallurgical Testing Results

A total of six extraction tests have been performed. The tests are reproducible within the accuracy of the test procedures. Tests 1 and 2 were observed using the procedure as outlined above, at the University of Alberta with the author present. Analytical testing was completed by a third party accredited lab, AGAT Laboratories on the Raw Brine, Treated Brine and Resultant Concentrate from Tests 1 and 2. Brine analysis was consistent within the assay accuracy and comparison of AGAT assays on separate brine samples showed extremely good correlation.

Tables 6 and 7 summarize the results from the observed metallurgical tests. Recovery and Removal Efficiencies are defined as the mass of the residual element in the Resultant Concentrate divided by the mass of the element in the Raw Brine solution.

	Raw Brine A00462 (mL)	Resultant Concentrate Solution A00778 (mL)	Concentration Factor	Recovery or (Extent of Removal) Efficiency %
Volume	200	10	20:1	
	mg/L	mg/L		
Li	75.5	1060	1:14	70.2
Na	48,000	36		(>99.9)
Ca	20,300	531		(99.9)
Mg	3,400	151		(99.8)
K	6,570	< 12*		(>99.9)
Sr	765	33		(99.8)
B	279	18		(99.7)

*Below Detection Limit

Table 6. Table 13-2: Test 1 Sorbent:Brine Ratio of 2:1

	Raw Brine A00462 (mL)	Resultant Concentrate Solution A00781 (mL)	Concentration Factor	Recovery or (Extent of Removal) Efficiency %
Volume	200	10	20:1	
	mg/L	mg/L		
Li	75.5	992	1:13	65.7
Na	48,000	58		(>99.9)
Ca	20,300	489		(99.9)
Mg	3,400	109		(99.8)
K	6,570	<12*		(>99.9)
Sr	765	28		(99.8)
B	279	19		(99.7)

*Below Detection Limit

Table 7. Test 2 Sorbent:Brine Ratio of 2.5:1

The University of Alberta had previously completed 4 additional metallurgical tests based on the same procedure outlined in this report. For these tests, analysis of the Raw Brine, Treated Brine and Resultant Concentrate solution was completed by the U of A utilizing their ICP-MS. While great care is taken at the

U of A in assaying the solutions, the laboratory and facilities used are not accredited and the results should be viewed as indicative. The U of A test analyses tended to show lower concentrations, (on average 10%) than the assays from AGAT. Metallurgical testing results from these four tests are summarized in Tables 8, 9, 10 and 11.

	Raw Brine A00462 (mL)	Resultant Concentrate Solution (mL)	Concentration Factor	Recovery or (Extent of Removal) Efficiency %
Volume	20	1	20:1	
	mg/L	mg/L		
Li	67	1085	1:16	81.2
Na	48,993	<0.07*		(>99.9)
Ca	18,443	287		(99.9)
Mg	3,137	126		(99.8)
K	5,588	5		(>99.9)
Sr	602	28		(99.8)
B	265	22		(99.6)

*Below Detection Limit

Table 8. Test 3 – U of A Results Metallurgical Testing Sorbent:Brine Ratio of 2.5:1

	Raw Brine A00098 (mL)	Resultant Concentrate Solution (mL)	Concentration Factor	Recovery or (Extent of Removal) Efficiency %
Volume	150	7.5	20:1	
	mg/L	mg/L		
Li	75	1206	1:16	80.9
Na	52,313	<0.07*		(>99.9)
Ca	19,324	287		(99.9)
Mg	3,050	<0.07*		(>99.9)
K	5,923	<1.1*		(>99.9)
Sr	627	23		(99.8)
B	297	17		(99.7)

*Below Detection Limit

Table 9. Test 4 - U of A Results Metallurgical Testing Sorbent:Brine Ratio of 2:1

	Raw Brine A00098 (mL)	Resultant Concentrate Solution (mL)	Concentration Factor	Recovery or (Extent of Removal) Efficiency %
Volume	20	1	20:1	
	mg/L	mg/L		
Li	73	1085	1:15	73.9
Na	52,943	59		(>99.9)
Ca	20,177	217		(99.9)

Mg	3,501	79		(99.9)
K	6,181	4		(>99.9)
Sr	666	19		(99.9)
B	282	19		(99.7)

*Below Detection Limit

Table 10. Test 5 - U of A Results Metallurgical Testing Sorbent:Brine Ratio of 2:1

	Raw Brine A00098 (mL)	Resultant Concentrate Solution (mL)	Concentration Factor	Recovery or (Extent of Removal) Efficiency %
Volume	130	6.5	20:1	
	mg/L	mg/L		
Li	72	1059	1:15	73.3
Na	53,314	<0.07*		(>99.9)
Ca	19,967	196		(>99.9)
Mg	3,078	<0.07*		(>99.9)
K	6,071	<1.1*		(>99.9)
Sr	631	18		(99.9)
B	267	17		(99.7)

*Below Detection Limit

Table 11. Test 6 U of A Results Metallurgical Testing Sorbent:Brine Ratio of 2:1

The test work indicates that recoveries above 65% lithium are consistently possible under the current test work parameters. The process is extremely efficient in the elimination of other ions in the Brine with results showing greater than 99% of the Na, Ca, Mg, K, B and Sr can be removed from the Brine. Test work is being conducted to determine the number of service cycles prior to exhaustion and the regeneration requirements for the sorbent.

While this technology, as applied to lithium, is still under development it is the opinion of the author that the resulting concentrate solution produced via E3 Metals' technology has the potential for being further processed into lithium carbonate and/or lithium hydroxide.

13.5 Conclusion

E3 Metals' is continuing development of their lithium extraction process flowsheet that has the potential to be a viable means of processing formation water (Petro-Lithium brines) from the Leduc in Alberta. Currently, Oil and Gas producers are required to develop additional water disposal/management strategies associated with the handling wastewater from their operations. The lithium contained in the wastewater may be concentrated with E3 Metals' technology. This additional processing step is a potential value adding step from within the wastewater management strategy. E3 Metals is evaluating options to develop independent production from the Leduc Formation to provide larger volumes of Petro-Lithium brines.

Metallurgical testing completed at the University of Alberta using E3 Metals' ion exchange technology has achieved lithium concentrations ranging from 13 to 16 times relative to the raw brine lithium content. Modifications in the sorbent chemistry have demonstrated variations in recovery. Demonstrated recoveries range in excess of 65% and indicated recoveries up to 81% are achievable.

E3 Metals' technology has also demonstrated a significant elimination of impurities from the raw brine. The sorbent has been shown to be highly selective for the extraction of lithium to the extent that greater than 99% of targeted competing ion exchange cations; magnesium, calcium, potassium and sodium are removed from the concentrated solutions. Achieving this reduction in impurities with E3 Metals' ion exchange technology would greatly benefit the efficiency of downstream processing steps.

The independently verified test results obtained from AGAT have shown that low grade lithium brines in Alberta could be processed to produce a higher-grade lithium concentrate solution. Based on E3 Metals' analysis of publicly available information, technology utilized to purify lithium concentrate could be readily integrated downstream of E3 Metals' concentration technology to produce high grade lithium hydroxide.

E3 Metals plans to conduct further metallurgical testing to continue to evaluate the efficiency of the ion exchange chemistry utilized within the concentration step and demonstrate the scalability of the process. Test work will be completed to modify and optimize the chemistry to repeatedly achieve lithium recoveries greater than 95%, concentration factors beyond 20 times and maintain elimination of impurities beyond 99%. Achieving these performance goals will further improve the efficiencies and utility requirements for the polishing and purification steps within the overall lithium processing flowsheet.

It is the understanding of the author that the E3 Metals' technology development work will continue to be progressed through leading Canadian research and development organizations that possess specific expertise in developing and testing ion exchange technologies.

13.6 Assumptions and Risks

With any novel laboratory extraction test work, scalability is a significant risk in developing a process from bench scale to commercial operations. Some of the risks include the impact of physical parameters of such as reaction vessel dynamics, variation in brine lithium and impurity concentrations and process control requirements. The cost implications are also significant in any up-scaling and development to commercialization. The intent of the information presented in Section 13 is to demonstrate that the lithium-enriched brine in the Leduc Reservoir over E3 Metals' Resource area has the potential for extraction and concentration. Downstream processing of the lithium concentrate has not been tested. It is the opinion of the author that this will not be an inhibition to the development of the technology and overall lithium processing flowsheet. As with all novel technology developments, there is no guarantee that the process outlined above will be economically viable.

14 Mineral Resource Estimate

The mineral resource estimate was completed by a multi-disciplinary team lead by Fluid Domains Inc. with Gordon MacMillan acting as the QP. The mineral resource estimate benefited from a considerable amount of data compiled by the oil and gas industry and made public by the Government of Alberta. The estimate incorporates the reservoir geometry and measurements of the porosity, permeability, pressure and lithium concentrations.

14.1 Reservoir Geology

14.1.1 Reservoir Geometry

Petroleum drill well data, described in Section 6, was used to define the shape and extent of the Leduc and Cooking Lake formations. Defining the geometry of the Leduc and Cooking Lake reservoirs is an iterative process which involves analysis of existing wells drilled for the exploration and production of hydrocarbons in the resource area. This geological mapping process using well data has been in practice in Alberta's petroleum industry in Alberta for over 70 years to define geological formations.

A total of 1,181 wells penetrate the top of the Leduc formation in and around the resource area and were completed within the Leduc formation. This is typical of wells drilled for the purpose of hydrocarbon production in the Leduc. Of the 1,181 wells, twenty-two wells penetrated the full stratigraphic section of the Leduc Formation. In addition, 107 wells in and around the resource area penetrated the full stratigraphic section of the Cooking Lake Formation, either below the Leduc formation or below the Ireton and Duverany shales.

The Leduc reef edge is defined as the point at which the Leduc Reef Margin slope is no longer distinguishable (zero-edge). This edge differentiates the high porosity reefal buildups of the Leduc from the surrounding low porosity carbonate muds and shales of the deep-water basin sediments occurring in the Ireton and Duvernay formations. The zero-edge was defined primarily using well data. In the absence of well data, existing industry-standard Leduc Formation edge interpretations were consulted (Mossop et. al., 1994; GeoScout Devonian Subcrop, 2017). The local and regional geological context was also taken into consideration when making interpretations.

The Leduc sits atop the limestones and dolomites of the regionally extensive Cooking Lake Formation, which is differentiated from the Leduc by the presence of a regional argillaceous (shale) zone. This argillaceous zone is not present in all wells, and in those cases, the top of the Cooking Lake was defined based on offsetting wells using relative thicknesses and geological context. Generally, the Cooking Lake has a slightly lower gamma ray response than the Leduc. The base of the Cooking Lake was chosen where the more argillaceous Beaverhill Lake Group became evident.

Stratigraphically, the Leduc reef built upwards from the Cooking Lake platform and occurs today as a prominent feature in the stratigraphic column. These reefs, some of which reached heights of over 250 m, are overlain and encased laterally by the shales of the Ireton and Duvernay formations.

The Ireton shale drapes over top of the Duvernay, Leduc and Cooking Lake formations and forms the primary hydrocarbon trap and formation water aquitard of the Leduc system. It is generally identified using the Gamma Ray well log. The presence of clays and associated minerals generally increases the radioactivity of rocks, and the Ireton can be distinguished from the Leduc by its higher radioactive signature on the Gamma Ray well log. The Ireton and Duvernay may be distinguished by subtleties in the radioactive gamma ray signature (Ireton has a higher gamma signature than the Duvernay). Duvernay and Ireton may also be distinguished from each other using the induction well log. At the molecular level, the Ireton most often contains water, whereas the Duvernay most often contains hydrocarbons, which decreases its hydraulic conductivity.

14.1.2 Hydrostratigraphic Units

Hydrostratigraphic (flow unit) definitions were determined based on their hydraulic properties and their potential to contribute to regional groundwater flow. The flow units (Figure 17) were defined and subdivided as follows:

- *Leduc Reef Margin*: Outer edge of the Leduc Reef
    - Joffre
    - Wood River
    - Malmo
    - Duhamel
    - New Norway
    - Bashaw
    - Nevis
    - Mikwan
    - Three Hills Creek
- *Leduc Platform Interior*: Area Bounded by Reef Margins
    - North Lagoon
    - South Lagoon
- *Clive Channel: Area in and adjacent to northwest – southeast trending channel in the middle of the resource area.*
    - Clive: porous carbonate material
    - Clive Channel: predominantly argillaceous material
- *Cooking Lake Platform*: Present throughout Resource Area

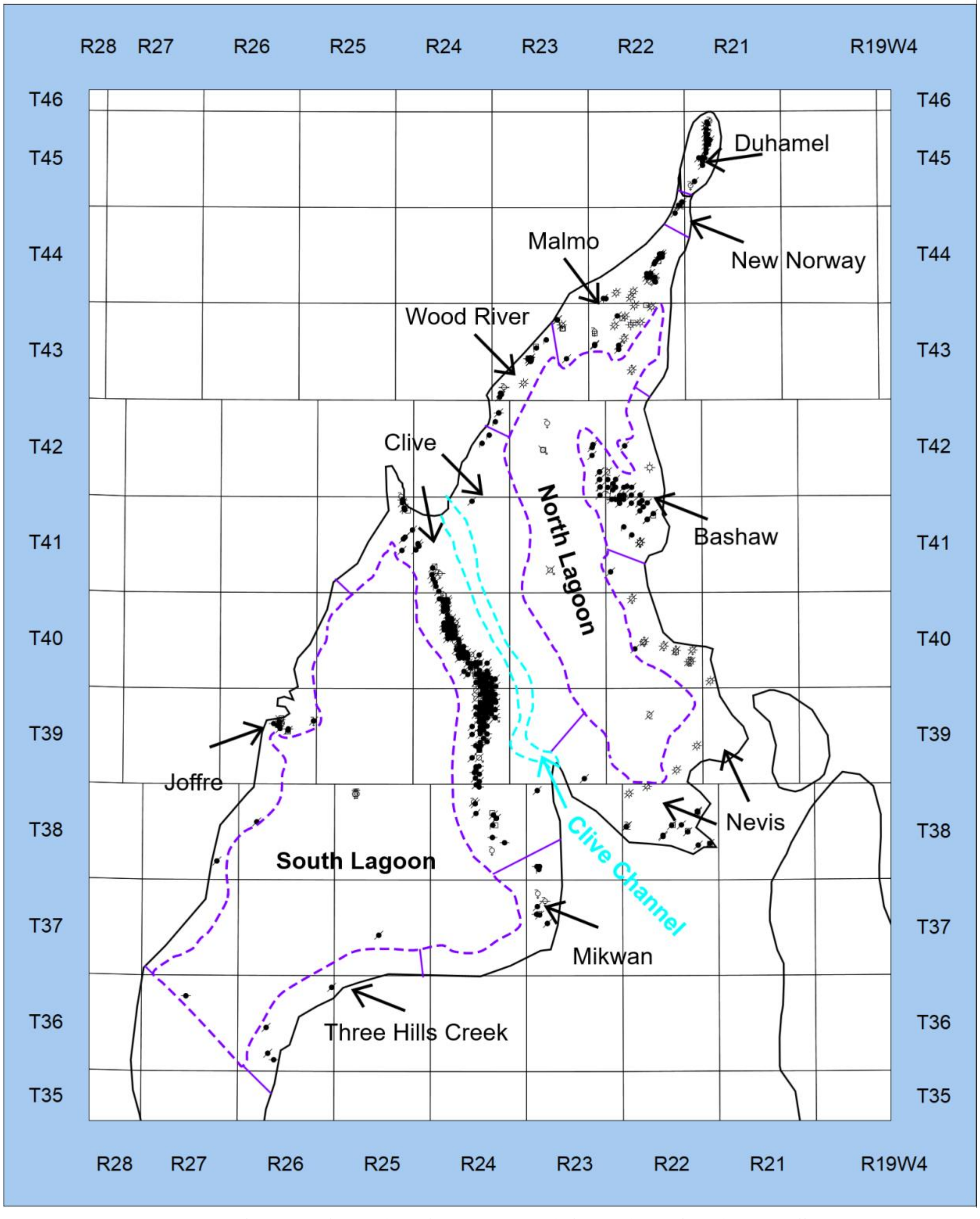


Figure 17. Map showing the Leduc Flow Units and the Leduc oil and gas wells (GeoSCOUT 2018).

The hydrostratigraphic units were based on trends of porosity (pore space in the rock) and permeability (ability for fluid to flow in the rock). Trends of porosity and permeability occur spatially and relate to depositional environments. These groupings of rock with similar properties (also called facies) are established in the literature for the Leduc reservoir. They are grouped into two broad categories; platform margin facies and internal lagoonal facies (Mountjoy, 1980; Hearn, 1996; Potma et al., 2001; Atchley et al., 2006) and formed the basis for hydrostratigraphic definitions.

The reef margin is defined based on its position on the platform and forms the edge of the reef buildup. These facies are typical of high energy environments where most of the aggradation and reef growth occurred, and therefore is typically the best part of the primary reservoir with the highest porosity and permeability. The platform margins were defined and mapped based on the "raised rim" morphology related to greater cementation in the reef buildups providing a rigid framework. This allowed for anomalously thicker Ireton draping the reef crests and showing greater differential compaction of the Ireton formation in the lagoonal areas (Hearn, 1996).

Comparisons of modern and Triassic aged reefs indicate slopes along the reef margin range from approximately 20 degrees to up to 35 degrees (Schlager & Reijmer, 2009). This is expected to be consistent with Devonian-aged reefs, and an average of 25-degree slope is considered representative of the Leduc in the region.

The width of the margin over the Bashaw complex has been mapped with widths ranging from 10's of meters to approximately 5 km (Atchley et. al., 2006; Hearn, 1996). The margin width is dependent on several factors, including reef topography, prevailing wind direction, spatial reef geometry, and differential compaction and thickness of overlying Ireton shale (Hearn, 1996). Thinner margins are expected where the reef is locally protected or drowned, whereas thicker margins are expected where the reef is located in a windward position, with the exception to the Clive reef. The Clive reef, situated in the interior of the platform presumably was fed essential nutrients for reef growth by the Clive Channel which would have been a conduit to the open ocean. The margin was typically 2 to 3 km wide on the western side of the resource area and up to approximately 10m wide in the Clive area. Adjustments to the margin width were made where the data indicated a wider margin (e.g. locally wide margins in the Malmo, Bashaw and Nevis fields).

The platform interior is a lagoonal setting on the back side of the reef margin and is dominated by facies common in low energy environments. These interiors (or lagoons) are bounded by the margin facies. These depositional environments consist of carbonate muds, storm washover debris, shoals, and occasional patch reefs. The Clive channel is interpreted to have a similar facies and lithology as the North and South Lagoon consisting of relatively dense carbonate muds and some anhydrite (Inkster, 1987).

Based on the aggrading (vertical upwards growth) and in some cases backstepping (vertical backwards growth) nature of the Devonian Leduc reef buildups (Stoakes, 1992; Mossop et. al., 1994), the facies were assumed to be vertically continuous throughout the reef thickness.

The Cooking Lake Formation is a carbonate platform that sits beneath the Leduc. This formation encompasses the flow unit below the Leduc Formation and above the Beaverhill Lake Group. The Cooking Lake Formation is continuous throughout the EWRA.

14.1.3 Structure and Thickness

Geological mapping was completed by E3 Metals and formation tops were provided to Fluid Domains for construction of geologic surfaces and isopachs (thickness maps). The geologic data set used to construct the model is comprised of 1,203 wells with intersections marking the top of the Leduc, 440 wells with intersections marking the top of the Cooking Lake, and 107 wells with intersections marking the top of the Beaverhill Lake.

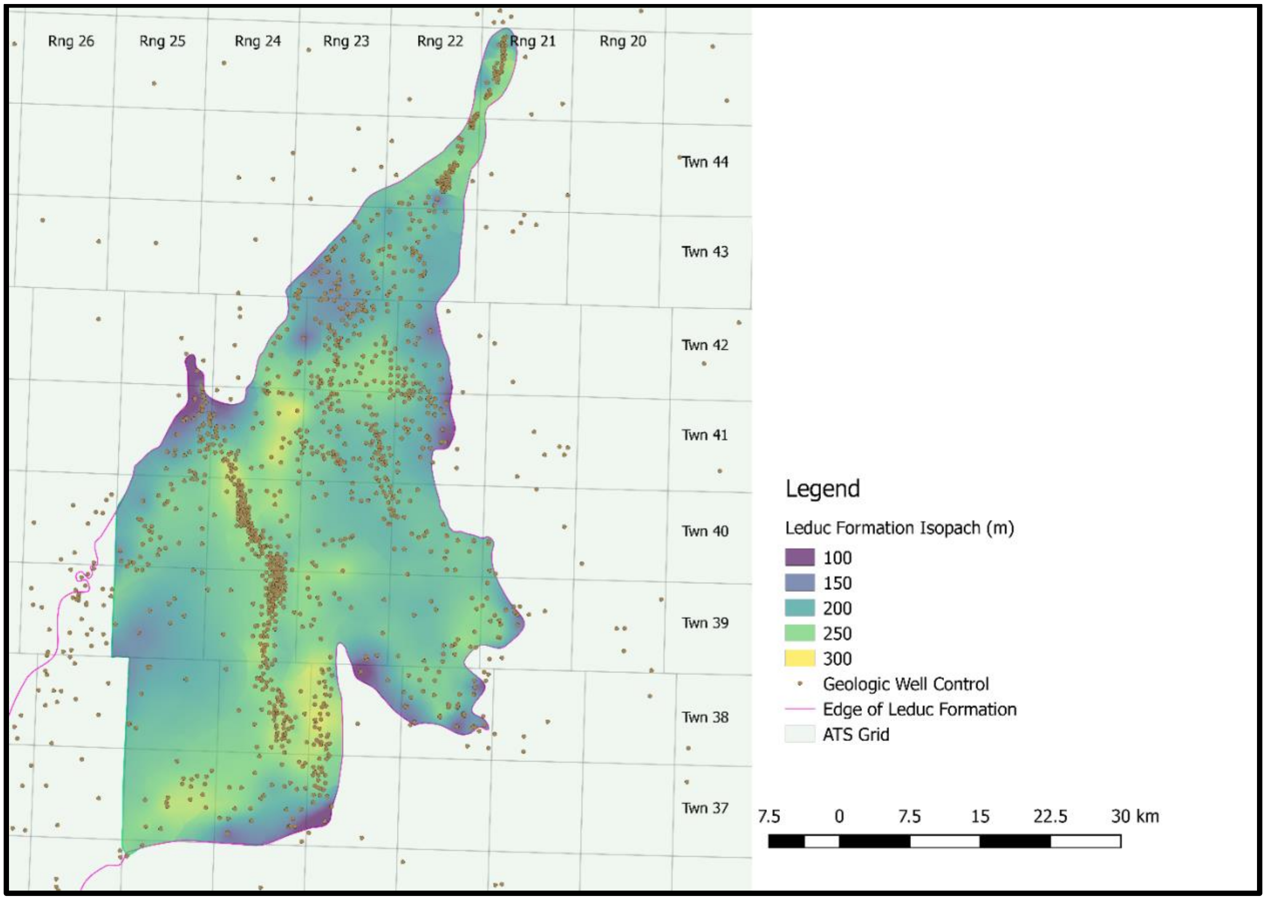


Figure 18. Isopach map of the Leduc Formation

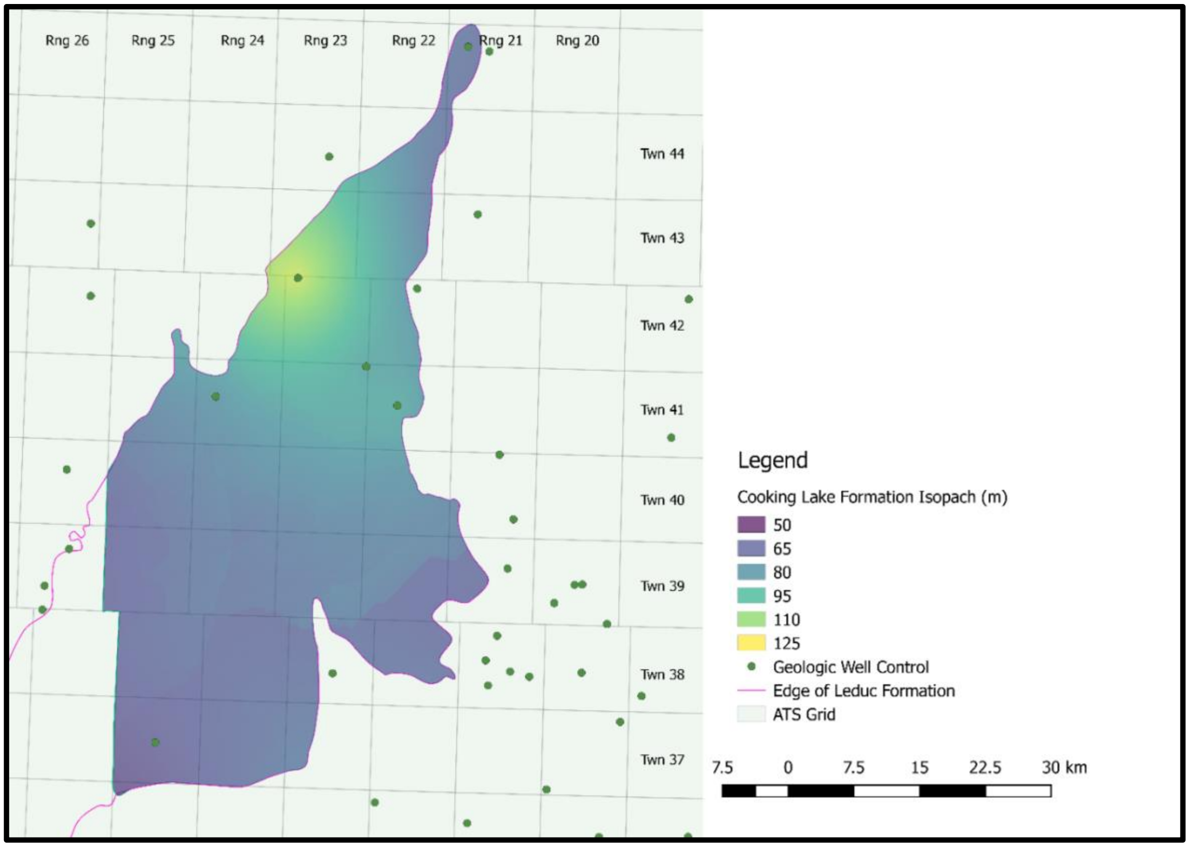


Figure 19. Isopach map of the Cooking Lake Formation

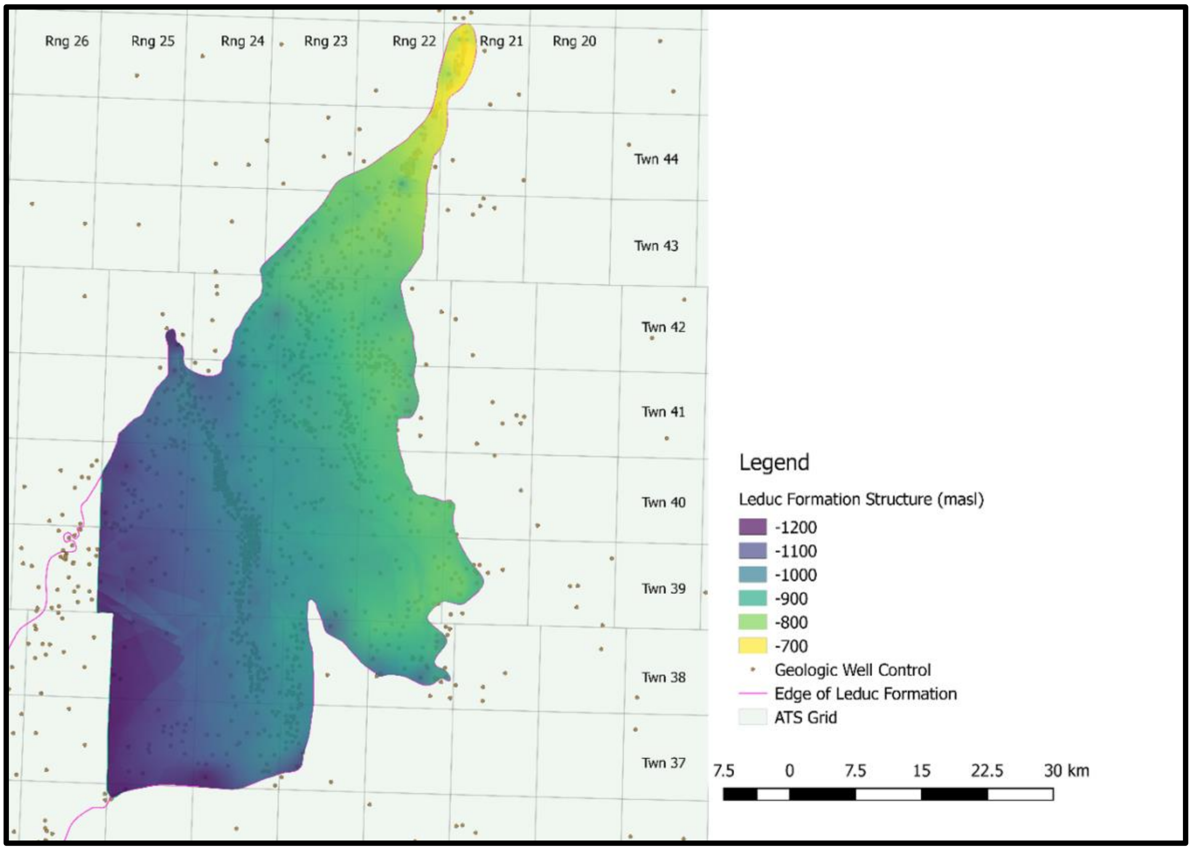


Figure 20. Leduc Formation Structure

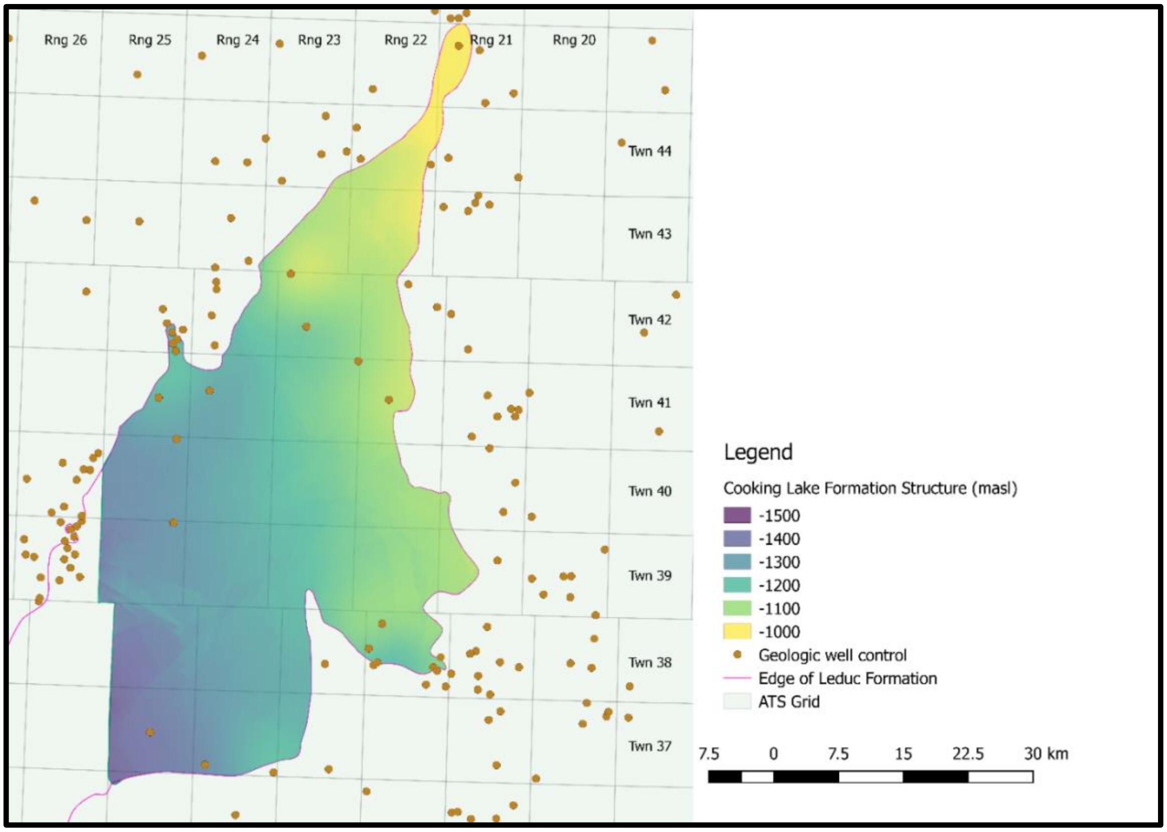


Figure 21. Cooking Lake Formation Structure

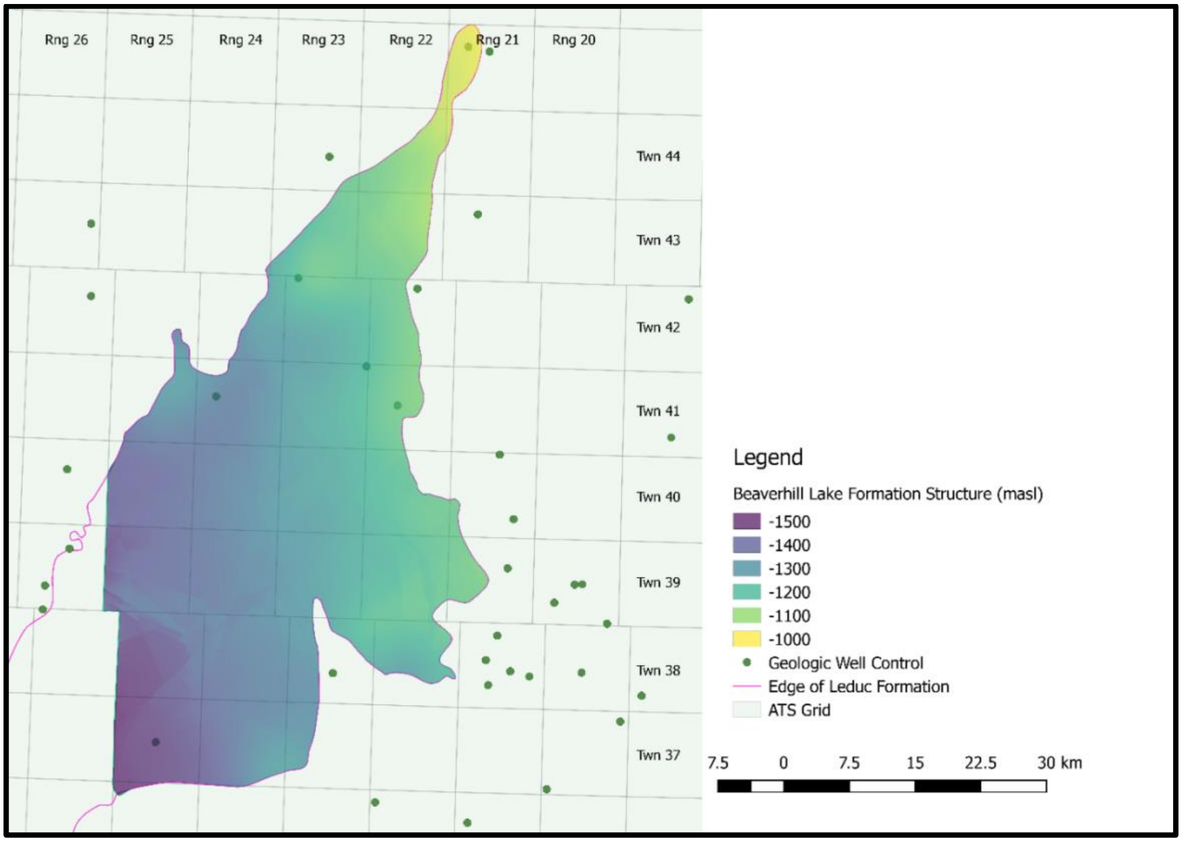


Figure 22. Beaverhill Lake Group Structure

Isopach maps of the Leduc and Cooking Lake formations (Figures 18 and 19) and maps depicting the structural top of the Leduc Formation (Figure 20), Cooking Lake Formation (Figure 21) and Beaverhill Lake Group (Figure 22) were created by Fluid Domains.

The top of the Beaverhill Lake Group reflects a regional dip to the southwest of approximately 0.7% (Figure 22).

14.2 Reservoir Properties

The work described in this report benefited from a considerable amount of data compiled by the oil and gas industry and made public by the Government of Alberta. The data was accessed through a third-party software (geoSCOUT 2018).

Key data sets used to determine reservoir parameters in the resource area include drill stem tests (pressure, water quality, and permeability), core plug analyses (porosity and permeability), downhole wireline logs (lithology, porosity, effective porosity and permeability), and historical production volumes of hydrocarbons and water (context for reservoir pressure, evaluation of reservoir continuity, and evaluation of water quality).

Hydrocarbon production has taken place in the vicinity of the resource area since 1961 resulting in a considerable amount of data to constrain reservoir parameters: 322 drill stem tests (DSTs) with extrapolated pressures considered representative of formation pressure; DSTs in 20 wells with recorded pressure build-ups allowing for the calculation of reservoir permeability, 7881 core plug analyses of porosity, 7641 core plug analyses of permeability; and 367 wells with historical production volumes between 1961 and 2018.

14.2.1 Reservoir Pressure

Drill Stem Test are downhole tests that can yield pressure and permeability (flow capability) measurements from a specific depth interval. Equivalent freshwater hydraulic head was determined from the DST pressures, and is calculated to normalize pressure data for comparative analysis. This measurement is calculated in metres above sea level (masl). DST data was reviewed by Fluid Domains to ensure the extrapolated pressures were representative of formation pressure. This was accomplished by reviewing the recorded quality control code reported in geoSCOUT, comparing the depth of the pressure recorder to the middle of the perforated interval, and extrapolating the recorded pressure to a representative pressure in the middle of the perforated interval based on the reported fluid in the drill stem. The quality assurance program reduced an initial dataset of 381 extrapolated pressures to 320 pressures considered representative of formation pressure. These pressures were then compared to another 184 extrapolated pressures from the region previously reported in E3's inferred resource for the CCRA (Spanjers 2017).

The equivalent freshwater hydraulic head in the EWRA and throughout the region was observed to decrease over time in response to the historical production of fluids and gases (Figure 23). Considering that the pressure data was measured in wells that are distributed throughout the region, the consistency of the pressure trend suggests the Leduc Formation is hydraulically connected across the region and across the margin and interior portions of each reef.

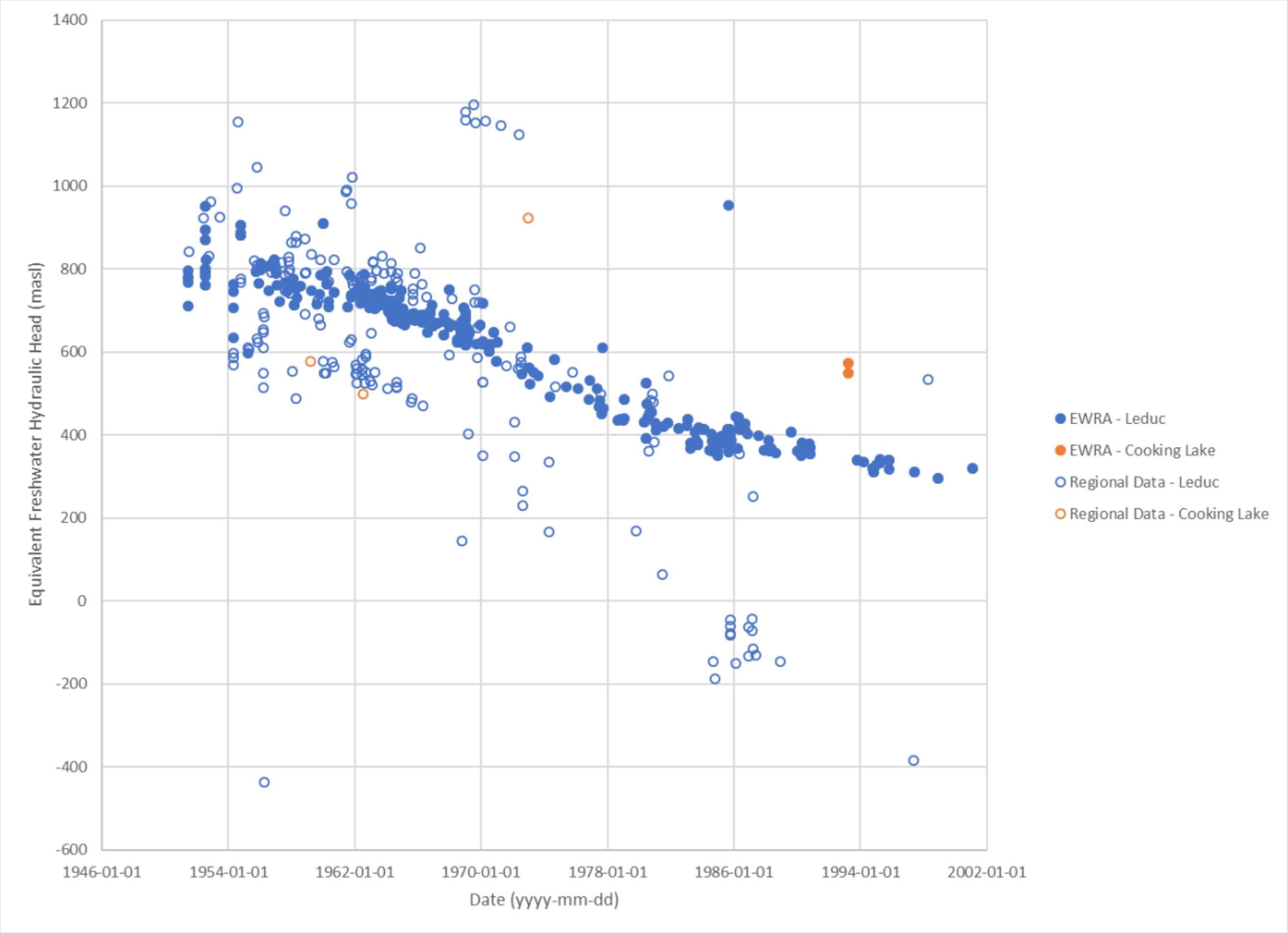


Figure 23. EWRA DST derived hydraulic heads over time as compared to regional data.

Equivalent freshwater hydraulic heads are estimated to have decreased from approximately 850 masl in the 1950's to 300 masl in the 2000's. Based on a top of Leduc elevation in the EWRA that is typically deeper than -700 masl there is an estimated 1,000 m or more of available head in the Leduc.

14.2.2 Reservoir Permeability

Multiple techniques were used to determine the permeability of the reservoirs. In addition to published permeability estimates of the Leduc and Cooking Lake formations, the permeability of hydrostratigraphic units in the resource area were further informed through two measurement techniques: core plug test analysis and DST analysis.

A DST analysis was completed by Melange Geoscience Inc. on a subset of DST data that had two shut-in pressures or more. Pressure build-up curves were analyzed on 20 DSTs in or adjacent to the EWRA. DSTs were selected for analysis from both the reef margin and reef interior (Table 12).

The core plug permeabilities reflect high quality estimates of permeability on a small-scale (cm-scale) and the DST derived permeabilities reflect high quality estimates of permeability on a local-scale (m-scale to 10s of m-scale). Given the larger scale of the DST permeability estimates, these were preferred for the characterization of the hydrostratigraphic units. Table 12 provides a summary of the permeability data for the Leduc Formation.

Hydrostratigraphic Unit	Count of Wells with Core Plugs	Core Plug Permeabilities			Drill Stem Test Derived Permeabilities				Representative Values	
		Count	Geometric Mean of Average Kmax in Each Well (mD)	Average of Harmonic Mean of Kmax in Each Well (mD)	Count	Minimum (mD)	Geomean (mD)	Maximum (mD)	Permeability (mD)	Hydraulic Conductivity (m/s)
Bashaw	23	436	304	31	0	---	---	---	304	8E-06
Clive	92	3824	377	3.5	6	1.1	41	623	332	9E-06
Duhamel	7	325	227	1.6	0	---	---	---	227	6E-06
Joffre	7	374	904	8.2	2	30.1	132	576	635	2E-05
Malmo	19	611	281	6.9	0	---	---	---	281	8E-06
Mikwan	2	73	233	0.7	1	10.3	10	10.3	104	3E-06
Nevis	27	1438	460	8.3	2	0.1	1.0	10.8	404	1E-05
New Norway	3	128	478	1.3	0	---	---	---	478	1E-05
Three Hills Creek	3	38	82	4.0	1	0.004	0.04	1.7	23	6E-07
Wood River	2	36	2008	19	0	---	---	---	2008	6E-05
North Lagoon	8	87	47	14	1	6.9	6.9	6.9	26	7E-07
Clive Channel	0	---	---	---	0	---	---	---	31	9E-07
South Lagoon	11	271	115	4.3	7	0.1	6.6	1412	37	1E-06

Table 12. Summary of measured and representative Leduc reservoir permeability and hydraulic conductivity

The best estimates of representative horizontal permeability were determined based on the geometric mean of the average core plug permeability at each well combined with the geometric mean of the DST derived permeabilities. In determining a representative permeability for the Leduc Formation, the core plug data was weighted at 1%, whereas the DST derived permeabilities were weighted at 99% (Table 12). The assignment of a higher data weight on DST derived permeabilities was based on professional judgement and reflects both the larger number of core plug samples and the local-scale (m-scale to 10s of m-scale) nature of the DST derived permeabilities.

The permeability of the Cooking Lake Formation was measured in core from two wells. Based on the core plug permeabilities the permeability of the Cooking Lake may be in the range of 3 mD (Table 8).

Count of Cooking Lake Wells with Core Plugs	Count of Core Plugs With Permeabilities	Geometric Mean of Average Kmax in Each Well (mD)	Average of Harmonic Mean of Kmax in Each Well (mD)	Representative Permeability (mD)	Representative Hydraulic Conductivity (m/s)
2	46	3	0.13	3	9E-08

Table 13. Summary of measured and representative Cooking Lake reservoir permeability and hydraulic conductivity.

Vertical permeability is a measure of how easily fluid will flow vertically within the reservoir. Typically, fluids will move more easily in a horizontal direction in sedimentary rocks. Vertical permeability is not captured by DST analysis and was therefore determined using core plug analysis.

Vertical permeability in sedimentary rocks can be the result of sedimentary layers with contrasting permeability. Based on the range of measured core plug permeabilities encountered at each well, this layered heterogeneity may be encountered in the Leduc Formation. In a flow unit with layered heterogeneity, Leonards (1962) suggest an effective vertical hydraulic conductivity can be determined using the harmonic mean of the contributing layers. Based on the core plug analyses available for the

Leduc and Cooking Lake formations the vertical permeability in each hydrostratigraphic unit likely ranges from less than 1 mD to 31 mD.

Hydraulic conductivity of the reservoir was determined from the reservoir permeability and the properties of the water (viscosity of 4×10^{-4} kg/m·s and a density of 1,150 kg/m^3). Transmissivity of the reservoir can be determined by multiplying the mapped reservoir thickness (Section 14.1) by the hydraulic conductivity.

14.2.3 Reservoir Porosity

Multiple techniques were used to determine the porosity of the reservoirs. Porosity estimates of hydrostratigraphic units in the EWRA were informed by facies-based porosity estimates published by Atchley et al. (2006) and further constrained by core plug measurements and wireline data.

Reservoir porosity was determined using several sources of geology and wireline data depending on the location and data availability. Wireline Photoelectric (PE) curve data was used to determine lithology, specifically in this case between limestone and dolomite (Kennedy M.C., 2002). This distinction is important to the characterization of porosity as dolomite typically has a higher porosity than limestone.

The Leduc Formation has undergone extensive dolomitization in the resource area. Dolomitization generally increases towards the top of the Leduc reservoir.

In the EWRA, the Cooking Lake Formation beneath the Leduc reef is predominantly limestone and has relatively low porosity.

A representative porosity for each flow unit was determined using good quality porosity log data, that penetrated the entire Leduc Formation (Section 6.2). The majority of the wireline derived porosity measurements were determined using petroleum industry standard neutron/density open hole logs, which measure hydrogen concentration and electron density, respectively (American Association of Petroleum Geologists, 2017). In flow units where representative wireline porosity logs were unavailable, representative net interval porosity was estimated based on measured core plug porosity values.

Hydrostratigraphic Unit	Core Plug Porosity Measurements				Wireline Porosity		Representative Values	
	Count	Mininmum Average at each Well	Mean Average at each Well	Maximum Average at each Well	Estimated Porosity	Net/Gross from Wireline Logs	Porosity in Net Interval	Effective Porosity of Gross Interval
Bashaw	456	4.1	6.5	10.2	8.1	0.80	8.1	6.5
Clive	3912	3.4	6.1	9.4	---	---	6.1	4.1
Duhamel	333	4.3	8.1	11.2	---	---	8.1	5.3
Joffre	416	4.1	8.0	9.7	6.0	0.58	6.0	3.5
Malmo	625	4.0	7.3	11.1	---	---	7.3	4.8
Mikwan	75	3.2	5.2	8.8	7.0	0.54	7.0	3.8
Nevis	1483	4.6	7.5	13	9.4	1.0	9.4	9.4
New Norway	143	4.4	6.6	9.3	---	---	6.6	4.3
Three Hills Creek	38	4.4	4.9	6.1	---	---	4.9	3.8
Wood River	39	7.6	7.6	7.6	---	---	7.6	4.1
North Lagoon	87	2.3	4.9	6.9	7.7	0.64	7.7	4.9
Clive Channel	0	---	---	---	---	---	6.6	3.6
South Lagoon	274	2.2	4.8	8.4	5.5	0.40	5.5	2.2

Table 14. Summary of measured and representative Leduc reservoir porosity.

The Leduc reef margins typically have more available data due to the drilling density from oil and gas development. Representative net interval porosities for hydrostratigraphic units on the reef margin range between 4 to 9% (Table 9).

Wireline porosity log data is preferentially used in flow units where the logs penetrate the full depth and when each individual log is of good enough quality to derive porosities. Assignments of rock properties for areas of poor well control such as the Clive, Duhamel, and Malmo flow units rely on well control from analogous areas with good well control. In addition, regional context is applied to interpret porosity, including depositional setting, cross sections and general knowledge of platform architecture. Each of these elements contribute to the estimation of a representative net porosity for each flow unit (Table 9).

Net porosity thickness is the total thickness of the reservoir with porosity above a 3% porosity cut-off (Inkster, 1987). A net porosity thickness represents the rock thickness with measured porosity above 3% and that is expected to contribute to fluid flow. A net to gross ratio is then calculated by dividing the net porosity thickness by the gross thickness of the reservoir. This value represents the relative proportion of the reservoir above the porosity cut-off. Rock with porosity below the cut-off is expected to contribute to the overall system but likely has a lower permeability.

Pore space filled by hydrocarbons in the oil and gas fields in the EWRA, was excluded from the calculations and a net porosity was not calculated within the oil and gas legs of those areas. The net to gross ratio for the EWRA ranges from 0.4 to 1.0.

The porosity of the Cooking Lake Formation was measured in core from two wells. Based on the core plugs from these wells the porosity of the Cooking Lake may be in the range of 2% (Table 10).

Count of Cooking Lake Wells with Core Plugs	Count of Core Plugs with Porosity	Min Average Well Porosity	Mean Porosity	Max Average Well Porosity	Representative Effective Porosity of Gross Interval
2	46	1.4	2.5	3.6	2.0

Table 15. Summary of measured and representative Cooking Lake reservoir porosity.

In the EWRA, the Cooking Lake is predominantly lower-porosity (tight) limestone. Average porosity in the Cooking Lake at the EWRA is approximately 2% and there were no intervals mapped to have porosity above 3% resulting in a net/gross ratio of zero (Table 10). Few wells penetrate to the top of the underlying Beaverhill Lake Group. Wells that did not intersect the Beaverhill Lake Group were not used to characterize the Cooking Lake porosity because the thickness of the Cooking Lake could not be determined and net/gross numbers could not be calculated. Instead, wells in the greater surrounding area, including those in the area of interest, were used to estimate the average value for porosity for the Cooking Lake. Although the rock properties of the Cooking Lake fall below the porosity cut-off, and therefore do not have a net flow unit value, the Cooking Lake is considered a low flow unit in this area as it still holds some water in the available pore space and has some developed permeability.

The porosity estimates of the Leduc and Cooking Lake formations were used to estimate a representative effective porosity of the gross interval. The representative effective porosity of the gross interval is a value that can be applied to the total thickness of the hydrostratigraphic unit and represents an upscaling porosity value of the net interval (the proportion of the aquifer that contributes most to the migration of formation water and injected water). The representative effective porosity of the gross interval was calculated by multiplying the porosity of the net interval by the ratio of net to gross.

Estimates of effective porosity based on core data and wireline logs are summarized for each hydrostratigraphic unit in Table 9. Leduc Formation representative effective porosity values in the EWRA range from 2% in the South Lagoon to 9% in Nevis (Table 9). Two representative porosity values were provided for each hydrostratigraphic unit: the porosity of the net interval and the representative effective porosity of the gross interval.

The representative effective porosity in the gross interval was used to estimate the volume of recoverable porewater in the EWRA.

14.2.4 Storage Estimates of Reservoir

The specific storage of the Leduc and Cooking Lake formations in the resource area was estimated based on the compressibility of water and the compressibility of the rock. The relationship between specific storage (S_s) and compressibility is described by Domenico and Schwartz (1990, page 113).

$$S_s = \rho_w \, g \, (\beta_p + n\beta_w)$$

Where:

ρ_w = density of water (M/L^3)
g = acceleration due to gravity (L/t^2)
β_p = bulk compressibility (L^2/Force)
n = porosity

β_w = compressibility of water (L^2/Force)

Based on the representative effective porosities presented in Tables 9 and 10, a water density of 1,150 kg/m^3, a rock compressibility of 3.3 x 10^{-10} m^2/N, and a water compressibility of 4.8 x 10^{-10} m^2/N, the specific storage in each hydrostratigraphic unit is estimated to be approximately 4 x 10^{-6} m^{-1}. These values are similar to but slightly greater than Fluid Domains' experience completing regional scale modelling in the WCSB. For the purposes of evaluating the potential to recover formation water, a slightly more conservative regional value of 1 x 10^{-6} m^{-1} was deemed to be representative of Cooking Lake and Leduc formations.

Storativity of the reservoir can be determined by multiplying the mapped reservoir thickness (Section 14.1) by the specific storage.

14.3 Estimate of Water Production

14.3.1 Water Production Methodology

The EWRA has an areal extent of 2,300 km^2 and reservoir thicknesses of greater than 250 m in the Leduc and greater than 110 m in the Cooking Lake. Based on the effective porosities in Tables 9 and 10 there are approximately 19 km^3 of formation water contained in high permeability zones.

In order to produce lithium, the formation water will be pumped to surface from a production well (produced water). The produced water will need to be processed at surface in order to remove the lithium and approximately the same volume of water as was pumped to surface will be injected into the reservoir (injected water).

The rate at which groundwater can be produced is a function of the aquifer properties (hydraulic conductivity, thickness, specific storage, and available head) and of the production well network design (number of wells and well spacing).

The duration that a production well would pump is expected to be limited by the arrival of injected water with low concentrations of lithium (injected water) at the production well. The arrival time of injected water at a production well and the degree of mixing between injected water and formation water will be a function of well network design and hydrodynamic dispersion. Hydrodynamic dispersion refers to the spread of solute (e.g. lithium reduced brine) concentrations as they migrate through an aquifer due to variability in pore space and large scale preferential flow paths.

Key considerations that affect the design of a production well network include:

- Well trajectory; wells were assumed to be vertical and fully penetrate the Leduc and Cooking Lake formations.
- Production-injection well spacing; there is a preference for the injection wells to be distal to the production wells to maximize the life of the production well network before the arrival of low concentrations of lithium in the injected water.
- Permeability-based well configurations; a close spacing of producing and injecting wells for hydrostratigraphic units with low long-term potential yield in order to increase the production rates.

- Optimized production-injection volumes; a preference for more injection wells than production wells to facilitate the maximum recovery of formation water production, and strategically distributing the injected water.
- Geologically-based production-injection geometry; a consideration of the geometry of the hydrostratigraphic unit and the properties of the adjacent hydrostratigraphic units.

Because of the net-zero groundwater withdrawal strategy (the volume of water produced is the same as the volume injected), a large rate of groundwater withdrawal can be sustained from a low permeability unit by placing the injection well in close proximity to the production well. While this could sustain high production rates, it would be undesirable for lithium recovery because the injected water (with low concentrations of lithium) would be withdrawn from the production well after a short period of time. This means the effective lifespan of the production well would be reduced.

In order to optimize the trade-off between production rates and the life-span of production wells, future production well networks will be designed for each hydrostratigraphic unit and optimized based on the permeability and geometry of that hydrostratigraphic unit.

Multiple production well networks will ultimately be required to produce as much lithium as possible from each hydrostratigraphic unit. The production well networks will be distributed across each resource area. The well networks can be operated in parallel or in series depending on the desired production timelines.

The design and operation of production wells will also need to consider the effects of well loss (including formation damage from the drilling process) and pump capacity (ability for the pump and associated infrastructure to move the large water production rates).

14.3.2 Estimated Production from Resource Area

Based on the large amount of available head in the EWRA and the flexibility in the well network design, it is expected that large volumes of water can be produced with a relatively small number of wells.

This was the finding of an E3 numerical modelling study in the CCRA (Spanjers 2017), which is located along the same contiguous reef trend approximately 20 km south of the EWRA. The CCRA modelling study found that formation water can be produced at a rate of up to 20,000 m^3/d with production well networks of one production well and between one and three injection wells. Furthermore, the production well networks were predicted to have a life of up to 44 years before the injected water reaches the production well.

Because of the similarity between the CCRA and EWRA with respect to the hydraulic conductivity, porosity, and available head in the Leduc and Cooking Lake formations, the well network findings of the CCRA numerical modelling study are equally applicable to the EWRA.

14.4 Estimate of Lithium Production

14.4.1 Resource Estimate Methodology

The inferred mineral resource estimate has been prepared in line with the NI 43-101 Standards of Disclosure for Mineral Projects (National Instrument, 2016); Form 43-101F1 (National Instrument, 2011);

CIM Definition Standards (CIM 2014); and the CIM Best Practice Guidelines for Reporting of Lithium Brine Resource and Reserves (CIM 2012).

The technical guidance provided in CIM (2012) is focused on the production of lithium brines in salars which is a very different hydrogeologic setting than the deep, confined, carbonate reservoirs in the EWRA.

Examples of the CIM (2012) technical guidance that are not applicable to the EWRA includes:

- A focus on draining the basin (salar) infill which can be unconfined, semi-confined, or confined. Much of the guidance is focused on water released from pore spaces when a water table is lowered (specific yield and specific retention). The maximum elevation of the Leduc reservoir in the EWRA is approximately -700 masl. The Leduc and Cooking Lake formations are both confined with more than 1,000 m of hydraulic head above the top of the reservoir. Because of the depth and the high pressure, the reservoirs will not be drained during the recovery of lithium.
- As described in the guideline (CIM 2012, page 2) salars “tend to be deposited in a typical concentric shell-like sequence from gravel outside, through sand, silt, clay, followed by carbonate, gypsum, and finally halite in the center.” The setting results in: “a relatively rapid gradient from near-fresh water to brine” (CIM 2012, page 2); this setting has the potential for density driven convection currents; and brine chemistry that can be variable over time. By comparison, the reservoir in the EWRA has a very low salinity gradient, and the water in the reservoir is stagnant (very little flow in or out of the reservoir) because it is greater than 1,400 m below ground surface where the dynamic forces of precipitation, and evapotranspiration at surface do not influence flow in the reservoir.
- “Salar brines are contained within a matrix in which the porosity, permeability, brine composition, and hydrostratigraphic characteristics such as conductivity, transmissivity, anisotropy, and resistance may vary with the passage of time.” (CIM 2012, page 4). The hydrogeologic properties of hydraulic conductivity, transmissivity, anisotropy and hydraulic resistance of confining layers, however, are not time variant in the EWRA. This is because the water density and the aquifer saturation will not change during lithium recovery.

Although parts of the CIM (2012) guidelines are not applicable to the EWRA, the spirit and intent of the guidelines were applied.

Because of the low lithium concentration gradients and the confined nature of the reservoir, there will be little to no change in brine chemistry over time due to “external (catchment basin) effects” (CIM 2012, page 6). There will, however, be temporal changes due to “internal (extraction induced) effects” (CIM 2012, page 6). Lithium rich water will be pumped to surface with production well networks comprised of production wells and injection wells. The injected water will be void, or nearly void, of lithium. This will mix with the formation water still in the reservoir as it propagates towards the production well. Over time the production wells will begin to pump some of the injected water. This is a key consideration in this inferred resource estimate.

If the production well network was operated indefinitely, the lithium concentration (C) of water pumped from the production well would transition from the initial lithium concentration (C_o) to a concentration that is nearly void of lithium. This is illustrated in Figure 24.

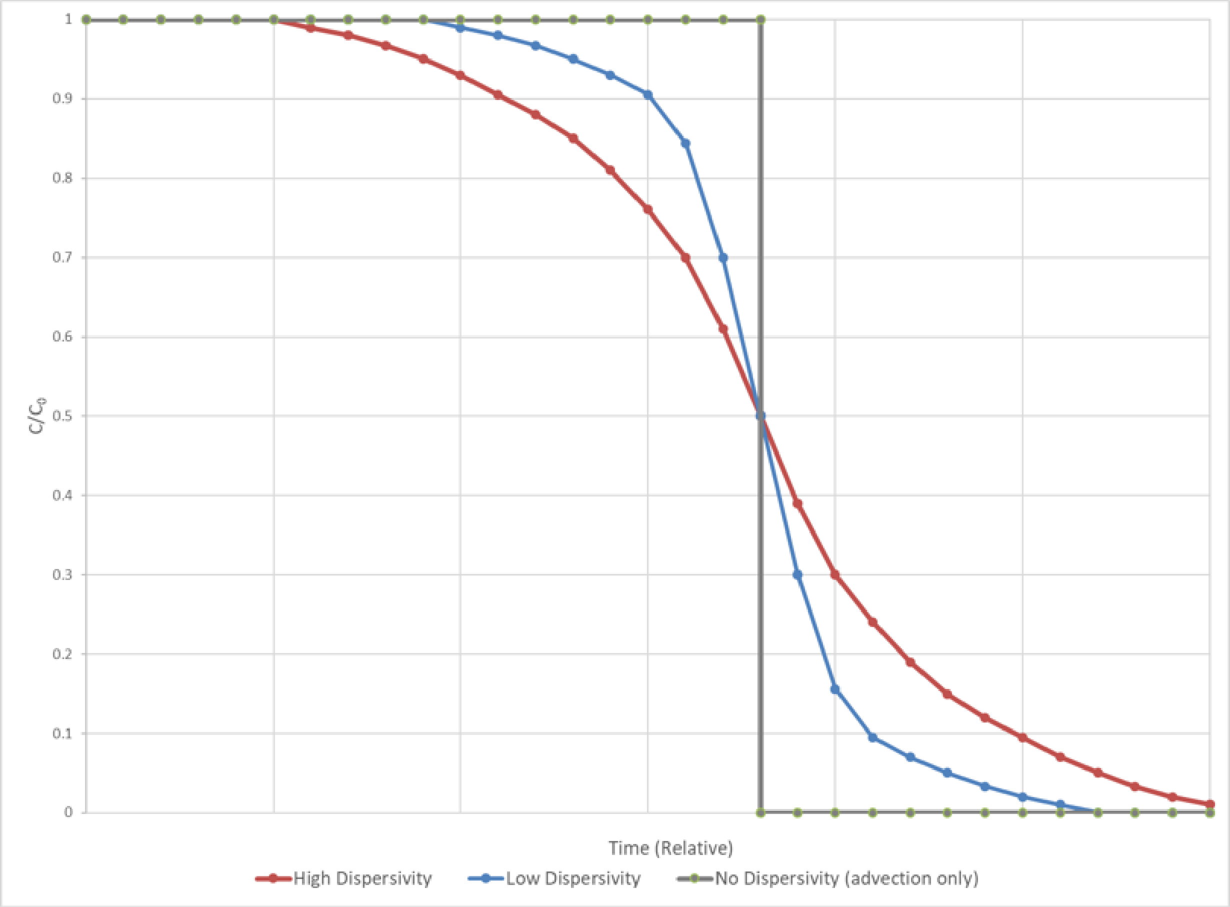


Figure 24. Schematic demonstrating the potential relative change in lithium concentration over time at the production well with no dispersivity (gray), low dispersivity (blue), and high dispersivity (red).

The magnitude of hydrodynamic dispersion is a product of the flow velocity (rate of groundwater movement in the reservoir) and the dispersivity (a property of the reservoir). The dispersivity is commonly considered to be a function of scale (Zheng and Bennett, 2002) and aquifer homogeneity (Huang et al., 2012). Predicting the migration of injected water and the change in lithium concentration over time due to hydrodynamic dispersion requires a high degree of characterization and computational effort. This level of characterization is considered to be beyond the scope of an inferred resource estimate.

The guidelines (CIM 2012, page 8) state “It is recommended that total porosity and effective porosity are not used for resource estimation since not only is the ratio of total (and effective) porosity to specific yield different for different aquifer materials, but the use of these parameters lead to unrealistic production expectations.” As previously stated, specific yield does not come into consideration for confined reservoirs that aren’t being dewatered. As such, in order to honor the spirit and intent of not using the effective porosity in the resource estimation, a production factor cut-off is applied based on the hydrogeologic setting and the expected operation of the production well networks. The production factor cut-off is discussed further in Section 14.4.3.

14.4.2 Lithium Grade

Based on the geologic setting (Section 14.1) and the observed long-term response across the resource area to historical production of fluids (Section 14.2), the Leduc and Cooking Lake formations are judged to be hydraulically continuous throughout the EWRA. Based on this and the consistency of the lithium assay results obtained from sampling (Section 11), it is reasonable that the lithium concentrations are continuous across the resource area.

As described in Section 11, Leduc Formation lithium concentrations were measured at 32 data points in the vicinity of the EWRA. Figure 15 shows the location of Li data points with respect to the proposed EWRA. Two of these data points were in close proximity to disposal wells that have historically injected large volumes of wastewater. Based on the proximity of the disposal wells, the volume of the historical wastewater disposal and an analysis of the major ions, two of the water samples are believed to be affected by injected wastewater. It is believed that the historical injection of wastewater has displaced Formation water in the vicinity of the disposal wells and that water recovered from the 100/10-35-039-24W4/00 and 100/03-15-040-24W4/00 wells reflect a mix of wastewater and formation water. These samples were eliminated from the data set of representative formation water samples.

Assuming a similar geological environment for all data recorded in the Leduc Formation, 30 data points were used to build the variogram needed to perform kriging. The variogram is a mathematical representation of the spatial structure identified from the initial data and is used to perform the estimation. The variogram included a spherical variogram (range of 4,500 m and normalized sill of 90%) and a nugget effect corresponding to 10% of the sill.

Lithium concentration data provided by E3 Metals was obtained from the sampling program outlined in Sections 9 and 11. A total of 17 samples were in the Leduc Reservoir in and around the EWRA (Figure 25) were considered representative of formation water. Lithium concentration was kriged using the variogram described above and the Li data points located in the EWRA. Simple kriging was performed, using the mean Li concentration of 75 mg/L (30 samples) for the EWRA as the kriging mean.

The interpolated lithium concentrations in the EWRA range from 72 to 78 mg/L and have a volume-weighted average of 75 mg/L. The interpolated lithium concentrations are relatively consistent throughout the EWRA (Figure 25).

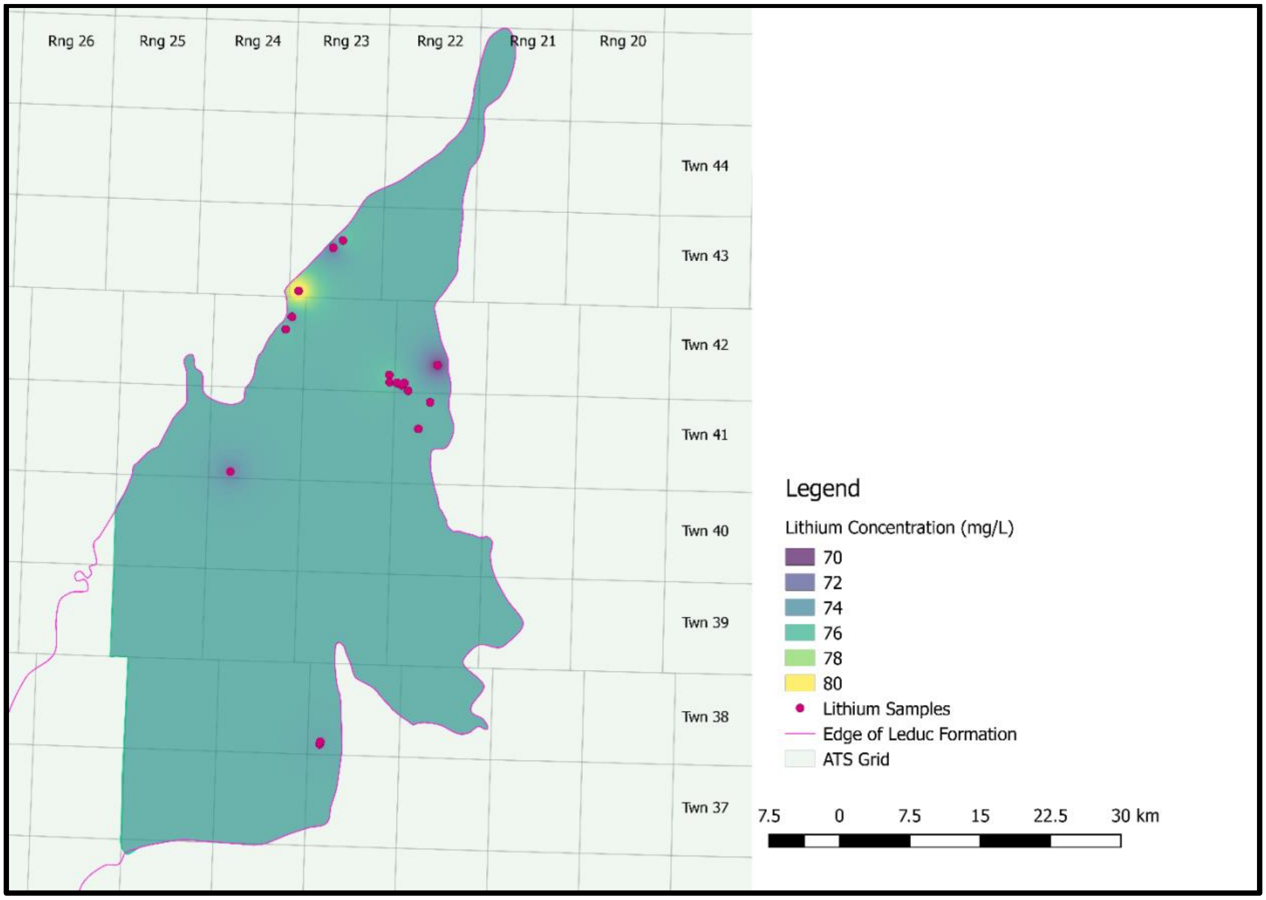


Figure 25. Kriged lithium concentrations in the EWRA.

14.4.3 Temporal Effects During Production

The mass of lithium in the EWRA was calculated using the kriged concentrations, the thickness of the formations and the representative effective porosity of the gross interval for each hydrostratigraphic unit. In order to convert the mass of lithium in-place into an estimate of the mass of lithium that can be produced, there are two factors that needed to be considered:

1. Hydrodynamic dispersion. The injected water placed back into the reservoir from the processing and lithium extraction will be void, or nearly void, of lithium. This will mix with the formation water as it propagates towards the production well. The mixing results in decreased concentrations of lithium pumped from the production well even before the advective front is predicted to arrive at the production well (compare early time concentrations in Figure 24 between the low and high dispersivity curves).
2. When producing formation water from each hydrostratigraphic unit, more than one production well network will be required. The proportion of water that can be produced before the arrival of injected water (low lithium concentration water) will be dependent on the timing of operations of the multiple production well networks and the distribution of the injected water from previously operated production well networks.

The final production well network design, the timing of production well networks, and the hydrodynamic dispersion of low-concentration lithium injected water have not yet been determined. For the purposes of this inferred resource estimate, it is assumed that once the concentration of lithium in the produced water drops below a critical threshold, the production well will be shut-in. As such, some lithium mass will be left in the reservoir, however the lithium concentration near the injection wells and throughout most of the drainage area will be nearly void of lithium.

Multiple production well networks will be required to produce lithium from the resource areas. Because the dimensions of the drainage areas are sensitive to heterogeneity, it is recognized that some lithium will not be captured by any of the production well networks. The amount of lithium that will remain in the reservoir is difficult to estimate, particularly at this early stage of the project because it will be influenced by design and operation of the production well networks and by reservoir heterogeneities.

Based on the two factors discussed above, the mass of lithium in-place was multiplied by production factor cut-offs between 30% and 100%. A production factor cut-off of 50% was selected based on professional judgement as a conservative value. With further characterization of the reservoir and optimization of the production well networks, the lithium recovery (and production factor cut-off) may be increased.

14.4.4 Inferred Resource Estimate

The data sources used for the mineral resource include well data from historical oil and gas operations and brine samples collected from currently operating Leduc wells by E3 Metals. This resource estimate is classified as inferred because geological evidence is sufficient to imply but not verify geological, grade or quality continuity. It is reasonably expected that the majority of the Inferred Mineral Resource Estimate could be upgraded to Indicated Mineral Reserves with continued exploration, enhanced reservoir resolution and sampling. Further exploration may include seismic evaluation and a more detailed geological model.

Resource Area	Volume of Water in Effective Porosity (m^3)	Lithium Grade (mg/L)	Production Factor Cut-off	Production Volume (m^3)	Inferred Lithium Resource Estimate (tonnes)
Exshaw West	19,511,285,152	75	1	19,511,285,152	1,462,014
	19,511,285,152	75	0.9	17,560,156,637	1,315,813
	19,511,285,152	75	0.8	15,609,028,122	1,169,611
	19,511,285,152	75	0.7	13,657,899,606	1,023,410
	19,511,285,152	75	0.6	11,706,771,091	877,208
	19,511,285,152	**75**	**0.5**	**9,755,642,576**	**731,007**
	19,511,285,152	75	0.4	7,804,514,061	584,806
	19,511,285,152	75	0.3	5,853,385,546	438,604

Table 16: Summary of the mass of lithium that can be produced in the EWRA for a variety of production factor cut-offs. Lithium mass represents the combined mass of the Cooking Lake and Leduc formations.

The data in Table 11 can be converted from Lithium metal (tonnes) to Lithium Carbonate Equivalent in tonnes. As a producer of raw materials, E3 Metals will not be able to sell Lithium directly to an off-taker. It is useful for the company to convert lithium to lithium carbonate equivalent using the following equation:

Lithium Carbonate Equivalent (LCE), tons = Lithium (tons) x 5.323

The Inferred Lithium Resource Estimate of 730,000 tonnes equates to 3.9 million tonnes of Lithium Carbonate Equivalent (LCE).

14.5 Resource Statement

The two key findings of the mineral resource evaluation include the determination that high-lithium concentration formation water could be produced and an estimation of the mass of lithium in the effective porosity of the gross interval.

Based on the large amount of available head in the resource area and the flexibility in the well network design, it is expected that large volumes of water can be produced with a relatively small number of wells. This was the finding of a E3 numerical modelling study in the CCRA (Spanjers 2017) which is located along the same contiguous reef trend and located approximately 20 km south of the EWRA. The CCRA modelling study found that groundwater can be produced at a rate of up to 20,000 m^3/d with production well networks of one production well and between one and three injection wells. Furthermore, the production well networks were predicted to have a life of up to 44 years before the injected water reaches the production well.

Because of the similarity between the CCRA and EWRA with respect to the hydraulic conductivity, porosity, and available head in the Leduc and Cooking Lake formations, the well network findings of the CCRA numerical modelling study are equally applicable to the EWRA.

Over time, a proportion of injected water void of lithium will be produced at the production well. When the concentration of lithium at the production well drops below an undetermined economic threshold, it is expected that the production wells will be shut-in. Due to the hydrodynamic dispersion of injected water and the expectation that the multiple drainage areas (each associated with a production well network) will not provide complete coverage of the entire resource area, it is expected that the total mass of lithium in-place cannot be produced. As such, a conservative 50% production factor cut-off was applied to the total mass of lithium in-place to calculate the inferred resource estimate.

The Inferred Mineral Resource estimate for the EWRA is based on the total volume of water in the effective porosity, the interpolated lithium concentration, and the 50% production factor cut-off. The inferred mineral resource estimate, expressed as a mass of lithium carbonate equivalent, is 9.8 billion m^3 at 75 mg/L, totaling 3.9 Mt LCE.

The resource is classified as inferred because geological evidence is sufficient to imply but not verify geological, grade, or quality continuity. It is reasonably expected that the majority of the Inferred Mineral Resource Estimate could be upgraded to an Indicated Mineral Resource with continued exploration.

15 Mineral Reserve Estimates

The Project is in an early stage and this section is not applicable.

16 Mining Methods

The Project is in an early stage and this section is not applicable.

17 Recovery Methods

The Project is in an early stage and this section is not applicable.

18 Project Infrastructure

The Project is in an early stage and this section is not applicable.

19 Market Studies and Contracts

The Project is in an early stage and this section is not applicable.

20 Environmental Studies, Permitting and Social or Community Impact

20.1 Environmental Studies

Drilling wells in Alberta have an impact on the surface of the land in the form of transportation, lease construction, pipelines, and wellheads. Certain "protected" areas require environmental assessments prior to construction for drilling a well. Similarly, some areas fall under the federal government jurisdiction of wildlife protection and also require studies to ensure minimal disruption to species at risk. Such areas often have more stringent guidelines as to the drilling of wells and may require additional surveys and may have restrictions as to the placement of wells and/or the timing in which wells may be drilled.

20.2 Permitting

In Alberta, the regulation and permitting of water wells is determined by the salinity of the water being produced from the reservoir. Wells drilled for the purpose of producing water with salinity greater than 4,000 mg/L are exempt from requiring a license under the Water Act. These wells follow standard oil and gas regulation through the Alberta Energy Regulator (AER). Because the Leduc brine salinity is greater than 200,000 mg/L, the company’s permitting process will fall within the standard oil and gas AER regulations.

The permitting process for a production and injection water well pair with salinity greater than 4,000 mg/L, such as those designed to produce from the Leduc Formation in E3 Metals’ permit area, is well defined. The process will involve obtaining a license with the Alberta Energy Regulator for a Water Source Well and a Water Injection Well under AER Directive 56: Energy Development Applications and Schedules (http://www.aer.ca/documents/directives/Directive056.pdf). The company will be required to consult with various stakeholders and gain authorization from mineral rights owners, including First Nations, trappers and surface land owners under a Participant Involvement Program, and obtain an AER business associate (BA) code from the Petroleum Registry of Alberta.

A Lahee classification is a “pre-spud” (pre-drilling) assignment given to each well based on the geological complexities relating to oil and gas exploration. The Lahee classification applicable to wells drilled for brine production and water disposal is “OTH” and may be licensed under Regulation Section 2.020 or

2.040 of the Oil and Gas Conservation Regulations (OGCR). This regulation section is indicated in the Well License Application. The Well License Application can be found in Schedule 4 of Directive 56.

Because the water will likely contain various amounts of dissolved H_2S, Schedule 4.3 of Directive 56 will be required for the license application. An emergency planning zone (EPZ) will need to be identified and a mitigation strategy outlined to ensure safe operations. A setback from permanent dwellings, public facilities, etc. will be required based upon the wells' H_2S release rate, similar to that applied to the existing development in the area.

Injection and disposal requirements will be met as per AER Directive 51: https://www.aer.ca/documents/directives/Directive051.pdf. The injection wells will be categorized as Class II for injection of produced water (brine) or brine equivalent fluids. The directive outlines the cementing requirements, testing to ensure zone isolation and monitoring parameters.

20.3 Social or Community Impact

Oil and gas development has occurred in the resource area over the last 70 years, primarily for Nisku and Leduc targets, in addition to some Cretaceous, Mississippian and deeper Devonian targets. This has resulted in the evolution of many communities who sustain themselves economically on a foundation of oil and gas activity. Many of the oil and gas fields in the resource area, while still producing, are well beyond peak production and produce only at marginal rates. A majority of oil and gas wells targeting the Leduc in the area have been shut in, and it is uncertain whether they will produce again. Lithium production in Alberta will be closely tied to oil and gas operations and could support oil and gas development through strategic pressure support and liability transfer. This activity could revitalize the area and provide jobs to an underutilized workforce.

Production of a lithium product in Alberta could spur economic activity and growth related to the use of lithium in the energy storage supply chain. Companies like Volvo, Tesla and Volkswagen are driving huge demand for lithium as they commit to electric vehicle fleets. Lithium production in Alberta could attract battery manufacturers, electric vehicle manufacturers and other industries along the EV and energy storage supply chain to the Alberta economy. The availability of raw materials in Alberta will support and facilitate the growth of these industries.

In addition to improving the standard of living for Albertans through economic prosperity, producing lithium will also help Alberta meet its goals related to climate change. Electric vehicles, powered by lithium-ion batteries, help reduce greenhouse gas emissions in comparison to internal combustion engines. Lithium is also used in industry-grade battery storage and could support an economic, non-fossil fuel related source of electricity stability for intermittent renewable energy sources. As it is anticipated that most of the development of renewable energy sources over that time frame will be in the form of wind or solar power, energy storage, supported by large scale Li-ion batteries, could be a vital component of grid stability and energy security.

21 Capital and Operating Costs

The Project is in an early stage and a mineral reserve estimate is not applicable.

22 Economic Analysis

The Project is in an early stage and a mineral reserve estimate is not applicable.

23 Adjacent Properties

An adjacent property is defined as a reasonably proximate property in which the issuer does not have an interest and has similar geological characteristics to those of the subject of this Technical Report. Alberta is currently experiencing a high level of industry interest in its oilfield Li-brine potential. A variety of exploration companies have staked permits throughout Alberta; these properties have essentially staked all historical instances of lithium-in-brine enrichment. E3 Metals properties are bounded in a handful of areas by other exploration companies that are also exploring the Devonian petroleum system for Li-brine (Figures 1 and 3).

The Exshaw claim blocks enclose two small permits in the center. One permit is owned by Ryan Berthold Kalt, which was staked in 2016 and the other is owned by Jared Michael Lazerson and was staked in 2016.

The Exshaw claims are interspersed in a checkerboard configuration with privately owned land called Freehold. On Freehold lands, metallic and industrial minerals are owned by private individuals, companies or corporations. The Freehold land will not inhibit E3 Metals from developing the area, though surface land owners will need to be consulted prior to development.

Outside of the permit areas (large white areas in Figure 1), the lands are held by a combination of Freehold and Crown ownership.

24 Other Relevant Data and Information

The current policy regulation for the production of lithium in Alberta being defined. E3 Metals assumes that current oil and gas regulations would be applicable and may potentially guide the operational aspects of lithium resource production.

According to Alberta regulation, water is a resource owned wholly by the Crown. A water source well licensed under Directive 56 would allow for the production of water under the regulations for the purpose of extracting lithium. While offset rules normally do not apply in a mining context, E3 expects that offset rules would apply for the extraction of lithium as they do for oil and gas under the Oil and Gas Conservation Act (https://www.aer.ca/documents/actregs/ogc_reg_151_71_ogcr.pdf) because the lithium occurs dissolved in the brine and must be produced as a fluid. It is also expected that designated drill spacing units (DSU) would exist as they do for oil and gas, and that competitive drainage would be regulated through the use of buffers and well spacing. In this circumstance, E3 would apply under Directive 65 (https://www.aer.ca/documents/directives/Directive065.pdf) to accommodate possible amendments to the spacing of well configurations and/or well placement that may be required to produce water at volumes required to extract lithium.

Existing synergies between Petro-brine production and oil and gas, including the re-injection of lithium disposal water for strategic pressure support beneath oil and gas fields, could provide a mutual benefit for both lithium extraction and oil and gas production. Co-located operations could evolve in a symbiotic approach that ideally would contribute to each industry's success. This may involve the limitation of re-injection or disposal of oilfield wastewater in an area near to E3's unproduced mineral permit area to limit the dilution of the lithium resource. It is expected that MRLs (maximum rate limitations), designed to optimize oil production, could be avoided or negotiated through collaborative effort and industry partnerships.

25 Interpretation and Conclusions

The E3 Metals Corp EWRA overlies Devonian reef formations where Li-brines are co-produced with oil and gas. Brine production over the last 5 years has been averaged 1,400 m^3/d (GeoSCOUT^{TM}). The weighted average lithium concentration from the kriging estimation completed within the EWRA resource model was 75 mg/L.

Drill Stem Test (DST) data across the region through time suggest that the Leduc Formation is hydraulically connected across the margins and interiors of the EWRA reef. However, separate pressure trends in non-contiguous areas of the Leduc indicate that reefs in different geological trends outside the EWRA are not well connected hydraulically and that the Cooking Lake Formation has low permeability.

The Fluid Domains' review of the reservoir volume and reservoir properties suggest the following:

- Inferred Resource of 3.9 M tonnes LCE at a conservative 50% production factor.
- Potential production rate of up to 20,000 m^3/d from each production well network.
- Individual production well network life spans of up to 44 years before the injected water reaches the production well.

Metallurgical testing completed at the University of Alberta using E3 Metals' ion exchange technology has achieved lithium concentrations ranging from 13 to 16 times relative to the raw brine lithium content. Modifications in the sorbent chemistry have demonstrated variations in recovery. Demonstrated recoveries range in excess of 65% and indicated recoveries up to 81% are achievable.

E3 Metals' technology has also demonstrated a significant elimination of impurities from the raw brine. The sorbent has been shown to be highly selective for the extraction of lithium to the extent that greater than 99% of targeted competing ion exchange cations; magnesium, calcium, potassium and sodium are removed from the concentrated solutions.

26 Recommendations

The confidence of the resource estimate in the EWRA can be improved through further work. The following is a brief description of the recommended work program broken in to 4 phases.

26.1 Further Characterization of Lithium Distribution

The reservoir characterization used a significant amount of existing well data but relatively few Li-brine analyses. To increase confidence and potentially upgrade the resource to measured and indicated, additional formation water samples are needed, where possible, to confirm brine chemistry throughout the EWRA. The cost of collecting and analyzing approximately 50 additional samples is estimated at $50,000. This would include samples collected at locations previously sampled (repeat samples) and samples collected from other producing locations not previously sampled.

The existing samples from well heads and separators do not give a vertical profile of the Lithium concentration in the Leduc and Cooking Lake formations. Vertical profile sampling of Li concentrations within the reservoir at one or more locations is recommended at an estimated cost of approximately $200,000 per location.

26.2 Further Characterization of Reservoir Permeability

The available permeability measurements are representative of a scale of meters to 10s of meters. Further investigation of the reservoir permeability would be beneficial to the development of modifying factors.

This investigation would have two components: 1) a desktop exercise that involves further characterization of faults, fractures, or discrete high permeability zones through reviewing core, wireline logs and seismic data; and 2) measurement of the reservoir's hydraulic conductivity at a 1 to 5 km scale (a scale similar to the likely production well network design) by completing a production test.

The cost of completing further reservoir permeability characterization and the upgrading of the resource to measured and indicated is estimated at $1,000,000.

26.3 Testing the Lithium Recovery from Brine

E3 Metals should consider developing a Preliminary Economic Assessment (PEA) to understand the overall economics of the project. Some key inputs to a PEA would include the continual development of the lithium extraction process flowsheet, a detailed review of infrastructure costs from currently operating petroleum wells, and a detailed review of lithium extraction and processing costs to develop estimated capital and operating costs for the commercialization of the project.

26.4 Metallurgical Testing

E3 Metals' focus is to optimize the sorbent chemistry by completing high intensity iterative testing of the chemical formula to achieve repeatable recoveries greater than 95%. This test work is also planned to demonstrate that lithium can be concentrated greater than 20 times to further improve the efficiencies of downstream processes required to produce lithium hydroxide. The Company will also manufacture the sorbent chemistry into a resin material that is both porous and robust to allow it to be re-used in repetitive sorption/desorption cycles. This material will be tested in a continuous flow ion exchange column at the lab scale. Electrolysis test work will also be initiated through the University of Alberta and external experts to further refine the direct brine extraction flowsheet.

The cost of completing further lithium extraction testing is estimated at $700,000.

27 References

Alberta Government website www.transportation.alberta.cacialNetworkMap.

Amthor J., Mountjoy E., Machel H., 1993. Subsurface dolomites in Upper Devonian Leduc Formation buildups, central part of Rimbey-Meadowbrook reef trend, Alberta Canada. Bulletin of Canadian Petroleum Geology, Vol 41, No. 2 pp164-185.

Atchely, S., West, L., Slugget, J., 2006. Reserves Growth in an mature oil field: The Devonian Leduc Formation at Innisfail field, south-central Alberta, Canada. AAPG Bulletin, v. 90, No. 8 pp. 1153-1169

Banks, Jonathan, 2016. Deep-Dive Analysis of the Best Geothermal Reservoirs for Commercial Development in Alberta: Final Report.

CIM 2012. Best Practice Guidelines for Reporting of Lithium Brine Resources and Reserves. November 1, 2012. http://web.cim.org/standards/MenuPage.cfm?sections=177,180&menu=328

CIM 2014. CIM Definition Standards for mineral resources and mineral reserves. May 10, 2014. http://web.cim.org/standards/MenuPage.cfm?sections=177&menu=178

Connolly, C.A., Walter, L.M., Baadsgaard, H., Longstaff, F.J. (1990a): Origin and evolution of formation waters, Alberta Basin, Western Canada Sedimentary basin; Applied Geochemistry, v.5, n.4, p. 375-395.

DHI 2017. FEFLOW. Finite-Element simulation system for subsurface flow and transport processes. V. 7.0 (update 11). August 2017.

Divestco 2017. GeoCarta software. Distributed by Divestco Inc. Calgary Alberta. http://www.divestco.com/Solutions/Geological/GeoCarta.aspx

Domenico, P.A. and Schwartz, F.W., 1990. Physical and chemical hydrogeology. John Wiley & Sons Inc.

Dwight Bradley, LeeAnn Munk, Hillary Jochens, Scott Hynek, and Keith Labay, 2013. A Preliminary Deposit Model for Lithium Brines, USGS Open-File Report 2013–1006.

Edwards, D., Brown, R.J., 1999. Understanding the influence of Precambrian crystalline basement on Upper Devonian carbonates in central Alberta from a geophysical perspective. Bulletin of Canadian Petroleum Geology, Vol 47, No. 4 pp. 412-438.

Edwards , D., Lyatsky H. V. and Broten R.J., 1998. Regional interpretation of steep faults in the Alberta Basin from public-domain gravity and magnetic data: an update, CSEG Recorder Vol 23 No 1

Eccles, D.R. and Berhane, H., Geological Introduction to Lithium-Rich Formation Water with Emphasis on the Fox Creek Area of West-Central Alberta (NTS 83F and 83K). Energy Resources Conservation Board/ Alberta Geological Survey (ERCB/AGS) Open File Report 2011-10.

Eccles, D.R., 2017,. Geological Introduction to E3 Metals Corp. Clearwater and Exshaw Lithium-Brine Properties in South-Central Alberta.

Eccles, D.R., Dufresne, M.B., McMillan, K., Touw, J. and Clissold, R.J. (2012): Li-K-B-Br-CaMg-Na report on lithium-enriched formation water, Valleyview Property, west-central Alberta; Technical Report completed on behalf of Lithium Exploration Group Inc., March 2012

Eccles, D.R. and Jean G.M., 2010. Lithium Groundwater and Formation Water Geochemical Data; Alberta Geological Survey, Digital Data DIG 2010-0001.

Emerson website, 2017

geoLOGIC 2017. geoSCOUT software. Distributed by geoLOGIC Systems. Calgary Alberta. http://www.geologic.com/products/geoscout/

Hearn, Mark R., 1996. Stratigraphic and Diagenetic Controls on Aquitard Integrity and Hydrocarbon Entrapment, Bashaw Reef Complex, Alberta, Canada. Masters of Science, University of Alberta Department of Earth and Ocean Sciences.

Hitchon, B., Bachu, S., Underschultz, J.R., Yuan, L.P., 1995. Industrial Mineral Potential of Alberta Formation Waters; Bulletin 62, Alberta Geological Survey, 64 p.

Hitchon, B., 1984. Formation Waters as a Source of Industrial Minerals Alberta. In: G.R. Guillet and W. Martin (eds.), The Geology of Industrial Minerals in Canada; Canadian Institute of Mining and Metallurgy, Special Volume 29, p. 247-249.

Hitchon, B., Billings, G.K., Klovan, J.E., 1971. Geochemistry and origin of formation waters in the Western Canadian sedimentary basin – III Factors controlling chemical composition; Geochemica et Cosmochimica Acta, v. 35, p. 567-598

Hitchon, B., 1990. Hydrochemistry of the Peace River Arch area, Alberta and British Columbia; Alberta Research Council Open File report 1990-18.

Hitchon, B., Sauveplane, C.M., Bachu, S., 1989. Hydrogeology of the Valleyview Area, Alberta: Evaluation for deep waste injection; Bulletin 58, Edmonton, Alberta Research Council.

Hitchon, B., Underschultz, J.R. and Bachu, S.,1993. Industrial mineral potential of Alberta formation waters; Alberta Research Council, Alberta Geological Survey, Open File Report 1993-15, 85 p.

Inkster, R.G., 1987. Clive Geological Study

Petrowiki.org, 2017. http://petrowiki.org/Gamma_ray_logs

Aapg.org, 2017. http://wiki.aapg.org/Density-neutron_log_porosity

Huang, L., Ritzi, R.W. and Ramanathan, R., 2012. Conservative models: Parametric entropy vs. temporal entropy in outcomes. *Groundwater*, *50*(2), pp.199-206.

Huff, G.F., 2016. Evolution of Li-enriched oilfield brines in Devonian carbonates of the south-central Alberta Basin, Canada; Bulletin of Canadian Petroleum Geology, No. 3, Vol. 64, p. 438-448

Kennedy, M.C. 2002, Solutions to some problems in the analysis of well logs in carbonate rocks, in M. Lovell and N. Parkinson, eds., Geological application of well logs: AAPG Methods in Exploration No. 13, p61-73.

Kuflevskiy, Sergey, 2015. Dolomite Recrystallization Along the Rimbey-Meadowbrook Reef Trend, Western Canada Sedimentary Basin, Alberta, Canada. U of A Masters Thesis.

http://petrowiki.org/Gamma_ray_logs

http://wiki.aapg.org/Density-neutron_log_porosity

Machel, H. G., G.D. Jones, E. W. Mountjoy, and B.J. Rostron, 2002, Toward a sequence stratigraphic framework for the Frasnian of the Western Canada basin (discussion): Bulletin of Canadian Petroleum Geology, v. 50,pp. 332-338.

Mossop, G. and Shetsen, I. (eds.), 1994. Geological Atlas of the Western Canada Sedimentary Basin. Calgary, Canadian Society of Petroleum Geologists and Alberta Research Council, 510 p.

Marquez, X. M., 1994. Reservoir Geology of Upper Devonian Leduc Buildups, Deep Alberta Basin. Doctor of Philosophy, McGill University, Department of Earth and Planetary Sciences.

Mountjoy, Eric, 1980. Some Questions about the development of upper Devonian carbonate buildups (reefs), Western Canada

Mountjoy, E. W., and X. M. Marquez, 1997, Predicting reservoir properties in dolomites: Upper Devonian Leduc buildups, deep Alberta Basin, in J. A. Kupecz, J. Gluyas, and S. Block, eds., Reservoir quality prediction in sandstones and carbonates: AAPG Memoir 69, p. 267 – 306.

National Instrument, 2011. Form 43-101 F1 Technical Report. June 24, 2011 https://www.bcsc.bc.ca/Securities_Law/Policies/Policy4/PDF/43-101F1__F__June_24__2011/

National Instrument, 2016. NI 43-101 Standards of Disclosure for Mineral Projects. May 9, 2016 http://www.osc.gov.on.ca/documents/en/Securities-Category4/ni_20160509_43-101_mineral-projects.pdf

Panǎ, D.I., 2003. Precambrian Basement of the Western Canada Sedimentary Basin in Northern Alberta; EUB/AGS Earth Sciences Report 2002-02. February 2003, 39 p.

Pawlowicz, J.J. and Fenton, M.M., 1995a. Bedrock topography of Alberta; Alberta Geological Survey, Energy and Utilities Board, Map 226, scale 1:2,000,000.

Potma K., Weissenberger J., Wong, P. Gilhooly, M., 2001. Toward a sequence stratigraphic framework for the Frasnian of the Western Canada basin: Bulletin of Canadian Petroleum Geology, v. 49, No. 1. pp. 7-85.

Blois, M., Weber, D., Burga, E. and Sawyer, V., 2017. NI 43-101 Technical Report Preliminary Economic Assessment of the Clayton Valley Lithium Project, Esmeralda County, Nevada. Prepared for Pure Energy Minerals.

Schlager, John J.G. & reijmer, Wolfgang, 2009. Carbonate platform slopes of the Alpine Triassic and the Neogene - a comparison: Austrian Journal of Earth Sciences, v. 102, pp4-14.

Spanjers, Raymond 2017. NI 43-101 Technical Report, Lithium Resource Estimate for the Central Clearwater Property South Central Alberta, Canada.

Switzer, et. al, 1994. Atlas of the Western Canada Sedimentary Basin; Devonian Woodbend- Winterburn Strata. Chapter 12

Stoakes F.A. 1992. Woodbend Megasequence, Copyright © 2012, The Society for Sedimentary Geology (SEPM) Devonian Early-Mississippian Carbonates of the Western Canada Sedimentary Basin (SC28), 1992

Weissenberger, J., 1994. Frasnian reef and basinal strata of West Central Alberta: a combined sedimentological and biostratigraphic analysis: Bulletin of Canadian Petroleum Geology, v. 49, p1-6.

Zheng, C. and Bennett, G.D., 2002. Applied contaminant transport modeling (Vol. 2). New York: Wiley-Interscience.

APPENDIX A

Exshaw West Resource Area (EWRA) Claims

Agreement No	Property	Representative	Zone description (Mer-Rge-Twp)	Sections Included	Term date	Expiry date	Area (ha)	2 Year Expenditure Commitment
9316070175	Exshaw West	1975293 Alberta Ltd.	4-23-037:	16; 18; 20; 28-30; 32	5-Jul-16	5-Jul-30	8796.1	$45,120.00
			4-23-038:	6; 18N,SW				
			4-24-037:	12; 13NW; 14; 23SEP; 24; 26NE; 36				
			4-24-038:	2S; 10-12; 13WP; 14; 16; 22; 24; 26NE; 28; 29; 34; 36				
			4-24-039:	2; 10-12; 14; 22; 24; 26NE; 34; 36				
9317050246	Exshaw West	1975293 Alberta Ltd.	4-24-041:	4; 6; 16; 18; 20; 22; 28; 30	12-May-17	12-May-19	4736	$23,680.00
			4-25-040:	34; 36				
			4-25-041:	2; 4; 10-12; 14; 24; 26NE; 35SE; 36				
9317060252	Exshaw West	1975293 Alberta Ltd.	4-22-038:	12; 14; 16; 20; 22; 24; 26NE; 30; 31SW; 36	26-Jun-17	26-Jun-19	9092.8	$45,464.00
			4-23-038:	20S,NWP,NE; 24; 26NE; 28SE; 29; 30N,SW,32S; 34S,NW,NEP; 36				
			4-23-039:	2L1; 4W; 6; 9L13P; 10; 11; 14; 15SEP,NEP; 16; 17SEP; 18; 20; 22; 25SWP,NWP; 26NE; 28-30; 32; 34; 35EP; 36N,SE,SWP				
			4-23-040:	2; 4; 6; 10; 11W; 13NWP; 14; 15SEP				
9317060253	Exshaw West	1975293 Alberta Ltd.	4-23-040:	29NWP; 30P; 32SWP	26-Jun-17	26-Jun-19	6247.6	$31,238.00
			4-24-041:	14SP,NWP,NE; 24SWP				
9317060254	Exshaw West	1975293 Alberta Ltd.	4-21-044:	30	26-Jun-17	26-Jun-19	9310.876	$46,554.38
			4-21-045:	6; 18; 20; 29; 30; 32				
			4-21-042:	16; 20; 29; 32				
			4-22-043:	4; 10; 14; 15L13P; 21L1P,L8P; 22; 27-30; 31SWP, L14; 32; 33SP, NW, NEP; 34				
			4-22-044:	4; 5EP; 6; 10; 11; 14; 24; 26NE; 36				
			4-22-045:	12				
			4-23-043:	16; 22; 24; 25W,NEP; 26EP; 35SE, NW, L9P, L10; L15P; 36				
9317060255	Exshaw West	1975293 Alberta Ltd.	4-24-037:	2; 4; 6; 10; 11; 16; 18; 20; 22; 28-30; 32; 34	26-Jun-17	26-Jun-19	8832	$44,160.00
			4-25-037:	2; 4; 6; 10-12; 14; 16; 18; 20; 22; 24; 26NE; 28-30; 32; 34; 36				
			4-26-036:	35NE				
			4-26-037:	2; 4				

	Agreement No	Property	Representative	Zone description (Mer-Rge-Twp)	Sections Included	Term date	Expiry date	Area (ha)	2 Year Expenditure Commitment
	9317060256	Exshaw West	1975293 Alberta Ltd.	4-25-038:	2; 4; 6; 10-12; 14; 16; 18; 20; 22; 24; 28-30; 32E; 34	26-Jun-17	26-Jun-19	9163.2	$45,816.00
				4-26-036:	31NE				
				4-26-037:	6; 10-12; 14; 15L12P,L13P; 16; 18; 20; 21NW,L1P; 22; 24; 25NE; 26NE; 28-30; 32; 34; 35NE; 36				
				4-26-038:	2; 4;				
	9317060257	Exshaw West	1975293 Alberta Ltd.	4-25-039:	16; 18; 20; 22; 24; 26NE; 28-30; 32; 34; 36	26-Jun-17	26-Jun-19	6720	$33,600.00
				4-25-040:	2; 4; 6; 10-12; 14; 16; 18; 20; 22; 24; 28; 29; 32				
	9317060258	Exshaw West	1975293 Alberta Ltd.	4-25-039:	2; 4; 6; 10-12; 14	26-Jun-17	26-Jun-19	9152	$45,760.00
				4-26-038:	3NW; 6; 10-12; 13NE; 14; 16; 18; 19SW; 20; 22; 24; 26NE; 28-30; 32; 34; 36				
				4-26-039:	2; 4; 10-12; 14; 22; 24; 26NE; 36				
				4-27-038:	11; 12N; 24				
	9316070200	Exshaw West	1975293 Alberta Ltd.	4-22-042:	30	18-Jul-16	18-Jul-18	9216	$46,080.00
				4-22-043:	6; 16; 18; 20				
				4-23-041:	14N,S,W; 16; 20; 22; 28-30; 32; 34				
				4-23-042:	6; 18; 20; 26NE; 28-30; 32; 34; 36				
				4-23-043:	2; 4; 6; 10-12; 14				
				4-24-041:	36				
				4-24-042:	2; 11; 12; 14; 36				
	9316070198	Exshaw West	1975293 Alberta Ltd.	4-21-040:	6E	18-Jul-16	18-Jul-18	8800.4	$44,002.00
				4-22-038:	28; 29; 32; 33NE; 34				
				4-22-039:	2; 4SE; SWP; 4N; 6; 10-12; 14; 16; 18; 20; 22; 24; 26NE; 28-30; 32; 34; 36				
				4-22-040:	2; 4; 6; 10; 12; 14; 16; 18				
				4-23-039:	12; 24				
				4-23-040:	11E; 12				
	9316070199	Exshaw West	1975293 Alberta Ltd.	4-22-040:	20; 22W; 28N,SW,L1,L7,L8;29SE; 30; 31NP; 32SW; 34N,SW	18-Jul-16	18-Jul-18	8820.62	$44,103.10
				4-22-041:	4S, NE; 5NP, SWP; 6; 10; 16; 18; 20; 22; 28-30; 32; 34				
				4-22-042:	4; 6; 18				
				4-23-040:	24; 36				
				4-23-041:	12; 24; 26NE; 36				
				4-23-042:	2; 4; 10-12; 14; 16; 22; 24				
	9318050396	Exshaw West	1975293 Alberta Ltd.	4-21-39:	2;3NP,SWP;4;6; 10-12;16;18;20;22;24;26NE;28-30;32;34;36	25-May-18	25-May-20	4955.43	$24,777.15
				4-22-040:	11				

APPENDIX B

Abbreviations Used in this Report

AER	Alberta Energy Regulator	masl	Mean above sea level (elevation)
C^{o}	degrees Centigrade	mg/L	milligrams er liter
DST	Drill Stem Test	mi	mile
DSU	drill space unit	ml	milliliter
EPZ	Emergency Planning Zone	mm	milli eter
et al.	and others	Mt	million tons
F^{o}	Degrees Farwenheit	mt	metric ton
Ga	billion years	mt/yr	metric tons per year
H_2s	hydrogen sulfide	Nb	niobium
ICP-OES	Induced Couppled Plasma - Optical Emission Spectcroscopy	OGCR	Oil & Gas Conservation Regulations
kg	kilograms	OSC	Ontario Securities Commision
kg/m^3	kilograms per cubic meter	ppm	parts per million
km	kilometer	QA	Quality Assurance
km^2	square kilimeter	QP	Qualified Person
kt	kiloton	R_W	Range West of meridian
LCE	Lithium Carbonate Equivalent	RA	Resource Area
LCE	Lithium Carbonate Equivalent (Li_2CO_3)	SME	Society for Mining, Metallurgy and Exploration
Li	Lithium	T_N	Township North of meridian
m	meter	USD	US Dollar
M.S.	Master of Science	UWI	Unique Well Identifier
m3/day	cubic meters per day		

Qualified Person (QP) Certificates

CERTIFICATE OF AUTHOR

GORDON MACMILLAN
CONSULTING HYDROGEOLOGIST
PO Box 1835
Cochrane Alberta, T4C 1B7
Telephone: 403-462-2007 Email: gmacmillan@fluid-domains.com

I, **Gordon MacMillan**, do hereby certify that:

1. I am currently engaged as a Hydrogeological Consultant.
2. I am a graduate of the University of Calgary with a Bachelor of Science in Applied and Environmental Geology (1998).
3. I am a Registered Professional Geologist through the Association of Professional Engineers and Geoscientists of Alberta, Membership Number 63537.
4. I have practiced as a professional in hydrogeology since 2000 and have 20 years of experience in mining, water supply, water injection, and the construction and calibration of numerical models of subsurface flow and solute migration. My experience includes work in the lithium industry focussed on evaluating aquifer continuity, potential pumping rates, and estimating the mass of lithium in the subsurface. I have performed three-dimensional numerical modelling of groundwater flow, solute transport and heat flow. I have been involved in multiple numerical modelling investigations of Alberta's Keg River Formation and Leduc Formation reefs for the purposes of water production, wastewater injection, and solute migration. I have completed various investigations into the mass balance of local and regional groundwater flow systems. I have published multiple peer-reviewed papers on the design of water well networks. I have worked with multi-discipline teams to develop and model detailed models of large-scale solute migration. I have prepared resource estimations for mineral projects.
5. I have read the definition of "qualified person" set out in NI 43-101 ("NI 43-101") and certify that by reason, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
6. I am responsible for the preparation of all sections except 13 and 26.4 of the report titled "NI 43-101 Technical Report LITHIUM RESOURCE ESTIMATE for the EXSHAW WEST PROPERTY SOUTH-CENTRAL ALBERTA, CANADA"
7. I visited the E3 Metals Corporation property on March 23, 2018.
8. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information for disclosure and is not misleading.
9. I do not hold, nor do I expect to receive, any securities or any other interest in any corporate entity, private or public, with interests in the properties that are the subject of this report or in the properties themselves, nor do I have any business relationship with any such entity apart from a professional consulting relationship with the issuer, nor to the best of my knowledge do I have any interest in any securities of any corporate entity with adjacent properties.
10. I am independent of E3 Metals Corporation according to the criteria stated in Section 1.5 of NI 43¬101.
11. I have read NI 43-101 and Form NI 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.
12. I consent to the public filing of the technical report titled "NI 43-101 Inferred Lithium Resource Estimate for the EXSHAW WEST PROPERTY SOUTH-CENTRAL ALBERTA, CANADA" and dated September 17, 2021 (the "Technical Report") by E3 Metals Corp. I also consent to any extracts from or a summary of the Technical Report in any type of disclosure document with any stock exchanges or other regulatory authority and any publication by them, including electronic publication in the public company files on the websites accessible by the public, of the Technical Report of E3 Metals Corp.

Dated this 17th day September 2021.

"Gordon MacMillan"

Signature of Qualified Person

Gordon MacMillan, P.Geol.

Print name of Qualified Person

Grahame Binks
formerly of Sedgman Canada Ltd., currently of Pinnacle Processing Pathways
Telephone: +61 400 055 993 Email: Grahame@PinnacleProcessingPathways.com

I, **Grahame Binks**, do hereby certify that:

1. I am currently engaged as a Principal Process Engineer/Senior Study Manager.
2. I am a graduate of the University of Melbourne with a Bachelor of Metallurgical Engineering (Hons) 1983 and Master of Engineering Science (Chemical) 1985.
3. I am a Registered Professional Engineer of Queensland, #08522. I am a Member of Australasian Institute of Mining and Metallurgy (“AusIMM”) Chartered Professional under the Discipline of Metallurgy.
4. I have practiced my profession since graduation and have diverse experience in Australian and International mineral plants, their development from concept to implementation and full project assessments. I have specialist experience in precious metals, copper, lead, zinc, nickel, tin, lithium and uranium and in a wide range of operating environments. I have worked for a number of major minerals companies, including CRA, Pasminco, Electrolytic Zinc Company of Australasia and Zinifex. I have been involved with a number of major projects including refurbishment of the Century Zinc concentrator and Manuka Resources gold plants, various feasibility and prefeasibility studies including the Zhairen and Shalkiya Lead/Zinc concentrators, Lomonosovskoye and Ponto Verde Iron Ore projects, Colquiri and Syrymbet Tin projects, Silangan, Tujuh Bukit, Taysan and Seminco Copper Gold projects, Intex Mindoro Nickel Project, Pasminco Iron Residue Disposal project, Zinifex Two Stage Neutral Leach, QGC Soda Ash, BHP Billiton Tails Leach Upgrade, BHP Billiton Yeelirrie and BHP Billiton Olympic Dam Expansion and several due diligence evaluations, Rentails and Project Andes. I have worked recently as a consulting Process Engineer and Study Manager and have consulted primarily in relation to the evaluation and engineering of copper, lead, zinc, tin, nickel, lithium, germanium and uranium projects in Australia, Brazil, Kazakhstan, Indonesia, Papua New Guinea, Peru, Philippines and Vietnam.
5. I have read the definition of “qualified person” set out in NI 43-101 (“NI 43-101”) and certify that by reason, I fulfill the requirements to be a “qualified person” for the purposes of NI 43-101.
6. I visited the University of Alberta laboratory on May 3-5, 2018 and oversaw experiments demonstrating E3 Metals’ ion exchange technology.
7. I am responsible for the preparation of Sections 13 and 26.4 of the report titled “NI 43-101 Technical Report LITHIUM RESOURCE ESTIMATE for the EXSHAW WEST PROPERTY SOUTH-CENTRAL ALBERTA, CANADA”
8. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information for disclosure, and is not misleading.
9. I do not hold, nor do I expect to receive, any securities or any other interest in any corporate entity, private or public, with interests in the properties that are the subject of this report or in the properties themselves, nor do I have any business relationship with any such entity apart from a professional consulting relationship with the issuer, nor to the best of my knowledge do I have any interest in any securities of any corporate entity with adjacent properties to any of the subject properties.
10. I am independent of E3 Metals Corporation according to the criteria stated in Section 1.5 of NI 43¬101.
11. I have read NI 43-101 and Form NI 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.
12. I consent to the public filing of the technical report entitled “NI 43-101 Technical Report LITHIUM RESOURCE ESTIMATE for the EXSHAW WEST PROPERTY SOUTH-CENTRAL ALBERTA, CANADA” and dated September 17, 2021 (the “Technical Report”) by E3 Metals Corp. I also consent to any extracts from or a summary of the Technical Report in any type of disclosure document with any stock exchanges or other regulatory authority and any publication by them, including electronic publication in the public company files on the websites accessible by the public, of the Technical Report of E3 Metals Corp.

Dated this 17th day September 2021.

Grahame Binks

Signature of Qualified Person

“Grahame Binks”

Print name of Qualified Person