NEVADA DIVISION OF MINERALS
Commission on Mineral Resources

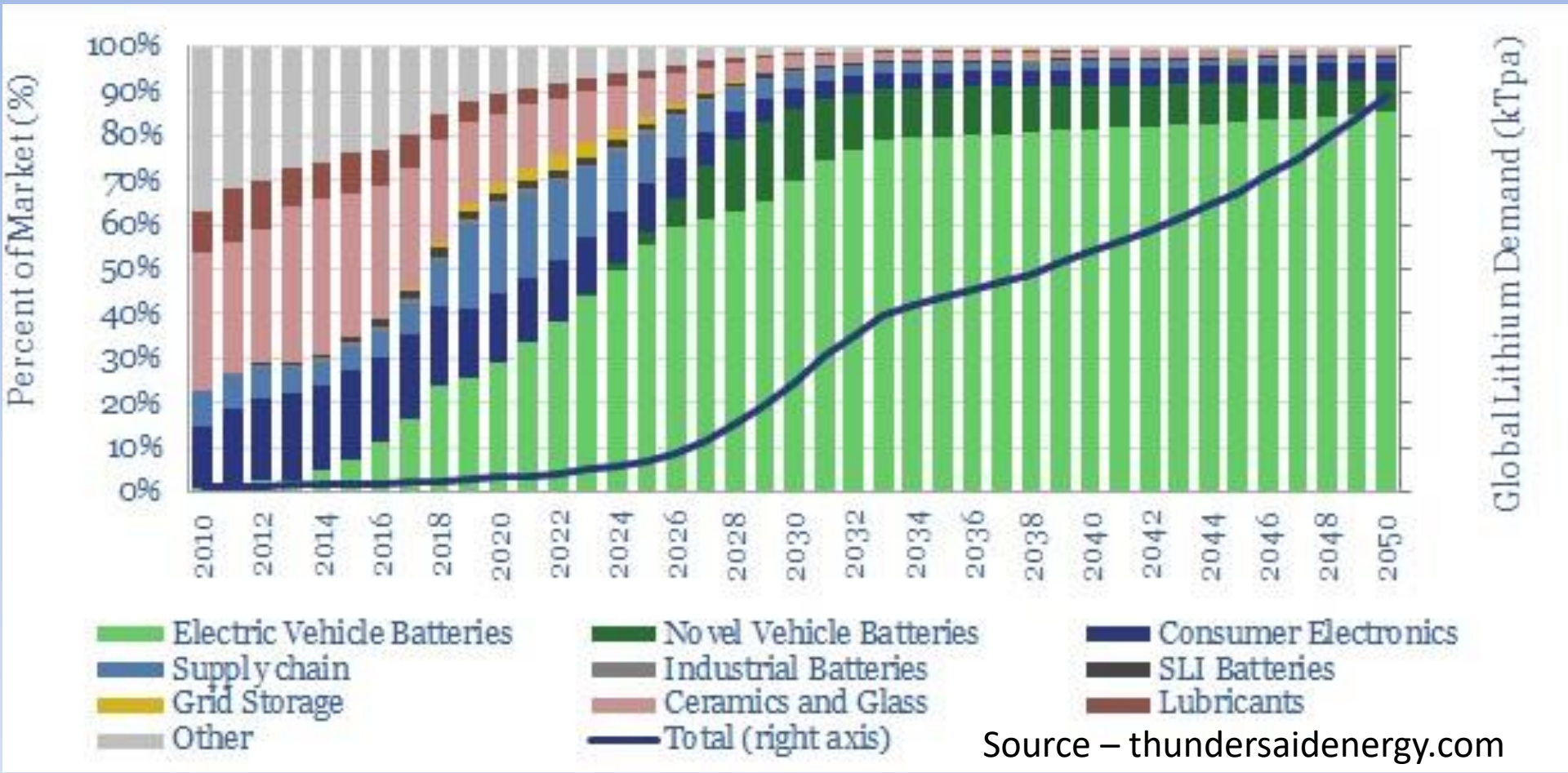
Lithium Exploration and Mining in Nevada

State Land Use Planning Advisory Council

June 3, 2022

Mike Visher, Administrator

Global Demand For Lithium



Source – thundersaidenergy.com

- The Tesla/Panasonic battery factory alone needs 5X the amount of lithium mined annually in Nevada.


Lithium Prices: January 2016 - April 2022
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$0
USD / Tonne
Jan 16
Nov 16
Sep 17
Jul 18
May 19
Mar 20
Jan 21
Nov 21
Lithium Carbonate (Min 99.2%)
BENCHMARK MINERAL INTELLIGENCE

NEVADA

THE LITHIUM STATE

Lithium Deposits* in the U.S.

Source: USGS

**Map shows deposits containing >15,000 tonnes of lithium.*

Deposit tonnage, tonnes of lithium

- >1,000,000
- 500,001 - 1,000,000
- 100,001 - 500,000
- 50,001 - 100,000
- 15,000 - 50,000

Thacker Pass, a highly prospective, pre-feasibility study stage open-pit lithium mining project, is located in **Kings Valley.**

Albemarle, the world's third-largest lithium mining company, operates America's only lithium-producing mine in **Clayton Valley.**

US Magnesium began producing lithium in 2020

Lithium in Brine vs. Lithium in Clay/Rock

Lithium Brine

- Albemarle's Silver Peak mine is the only active lithium mine in US, operating since 1966.
- Solar evaporation in ponds over 18-24 months increases concentration of lithium chloride (100X ,~0.54%) prior to processing into lithium carbonate.
- Cheaper processing costs but lower recovery %s (~50%).
- Requires placer mining claims and significant water rights
- Newer technologies may not require same timeframe nor large consumptive water use
- 17 other playa basins in Nevada being explored (>21 projects)

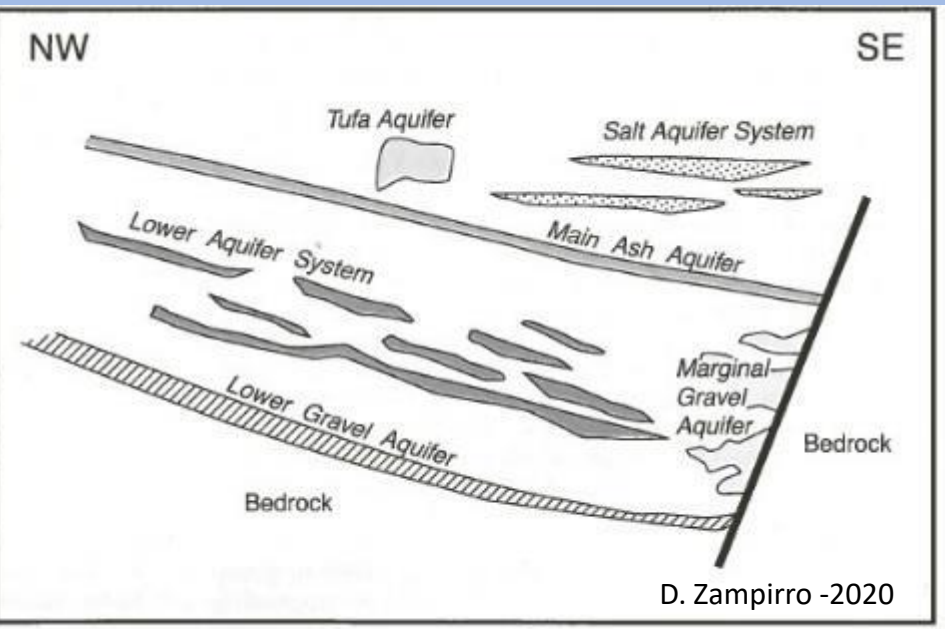
Lithium in Clay/Hard Rock

- No current mines, but 3 projects are in various stages of permitting:
  - Thacker Pass, Humboldt Cty
  - Rhyolite Ridge, Esmeralda Cty
  - TLC Project, Nye Cty
- Resources typically very large with long mine-life
- Processing is more expensive but yields higher recovery %s (~85%)
- Requires location of lode mining claims
- Much less water consumption but high sulfuric acid consumption
- At least five additional exploration projects in Nevada

Silver Peak Lithium Operations

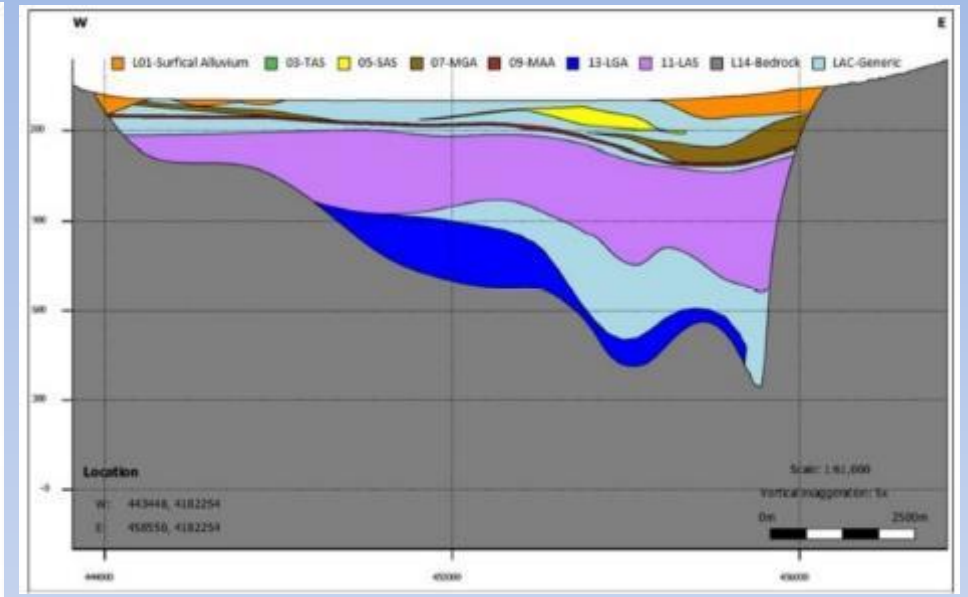
- 1912: Sodium and potassium brine discovered in Clayton Valley
- 1936: Leprechaun Mining secures first mining and milling water rights
- 1950s: Leprechaun Mining discovers lithium in groundwater
- 1964: Foote Mineral Co. acquires land in Clayton Valley
- 1966: Lithium mining operations begin
- 1967: Lithium carbonate first produced
- 1981: US Federal Court of Claims determines that lithium is locatable
- 1988: Cyprus Amax Minerals acquires Foote
- 1991: BLM acknowledges that Cyprus has the right to mine lithium within the patented area
- 1998: Chemetall purchases Cyprus Foote
- 2004: Rockwood Specialties Group buys Chemetall Foote
- 2015: Albemarle buys Rockwood Lithium
- 2021: Produced 12.7M pounds of lithium carbonate

Clayton Valley Brine Aquifers

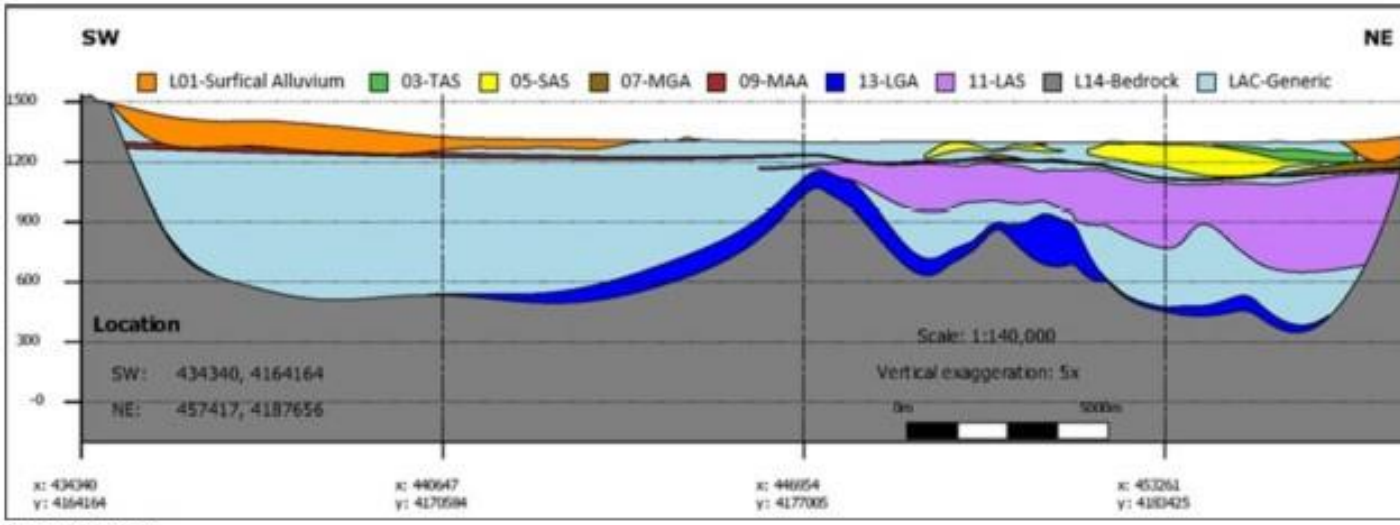


D. Zampirro -2020

Figure 3 - Aquifer stratigraphy at Clayton Valley



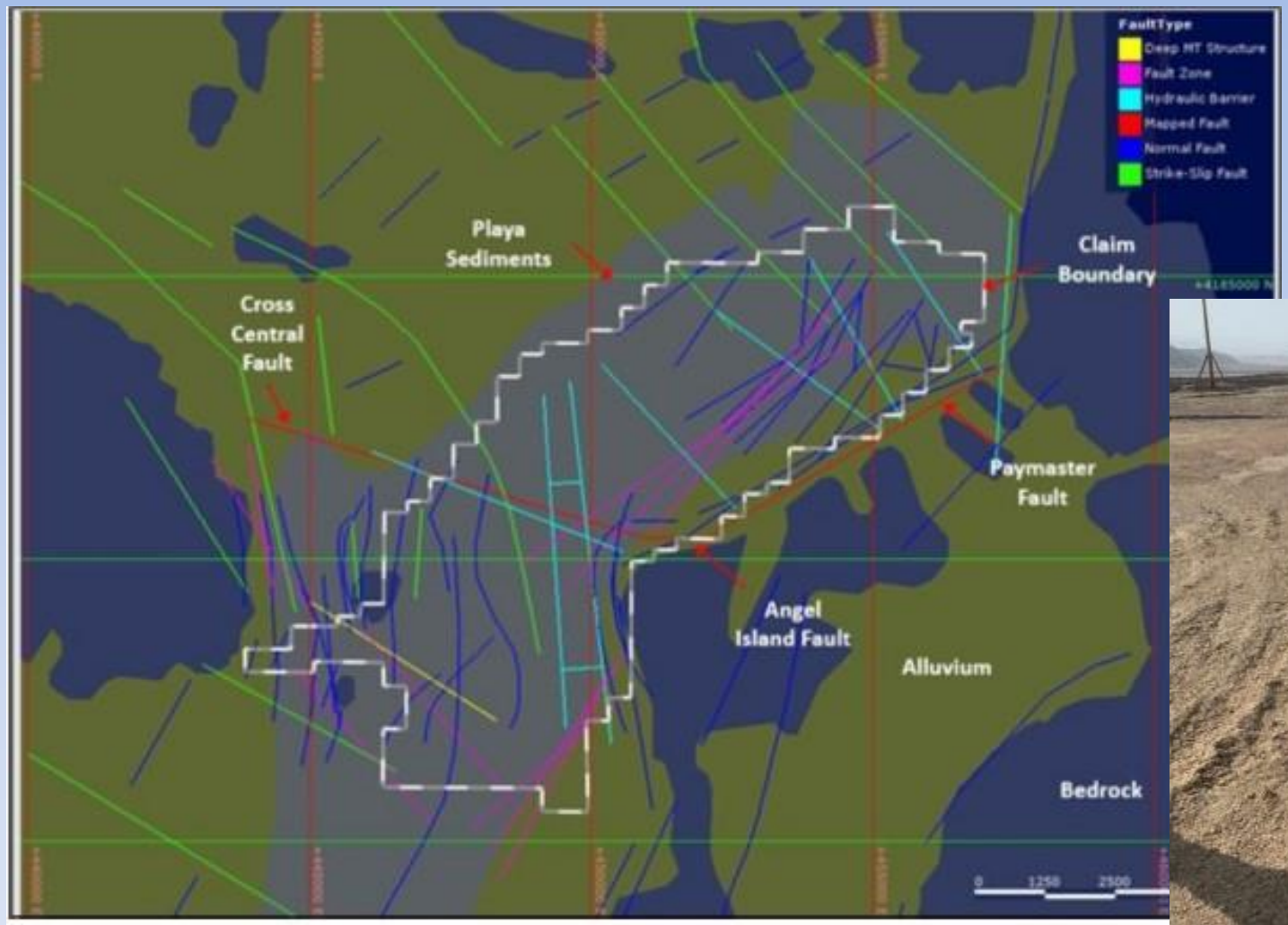
6 main aquifers, ranging in thickness from <1' to >350'



Source: SRK, 2021

Clayton Valley Faults

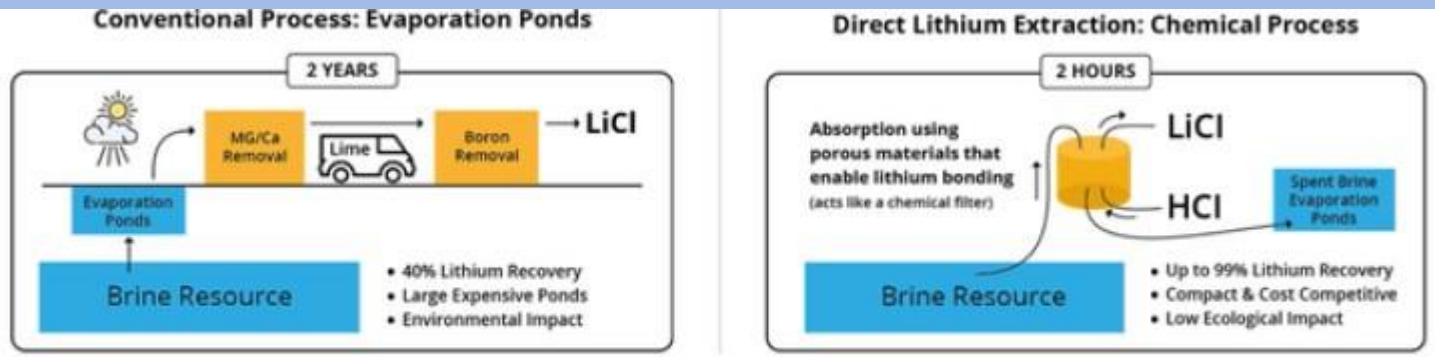
Numerous faults create discontinuity of Li-brine aquifers which can restrict production or require increased number of production wells.



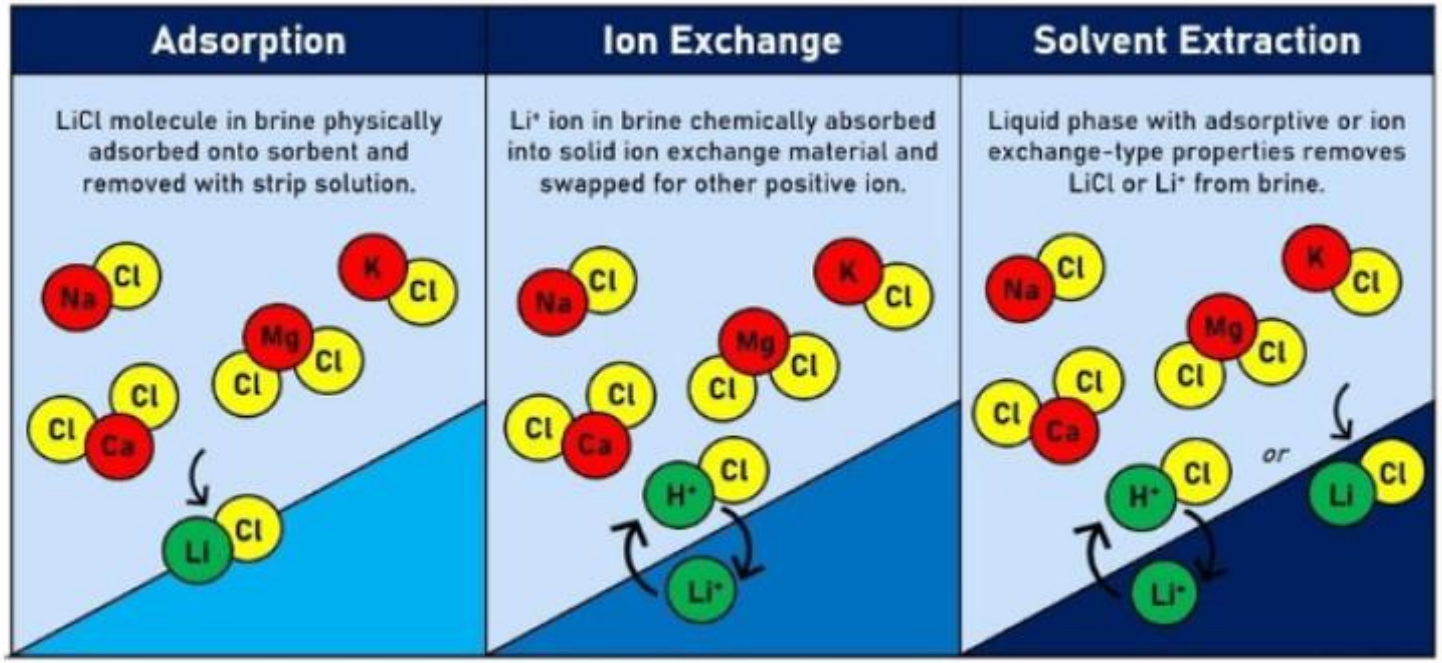
Source: SRK, 2021

Source: SRK, 2020

New Tech - Direct Lithium Extraction



Source: Lithium South Development Corp. website



Source: E3 Metals company presentation courtesy of Jade Cove partners

Lithium in the 1872 Mining Law

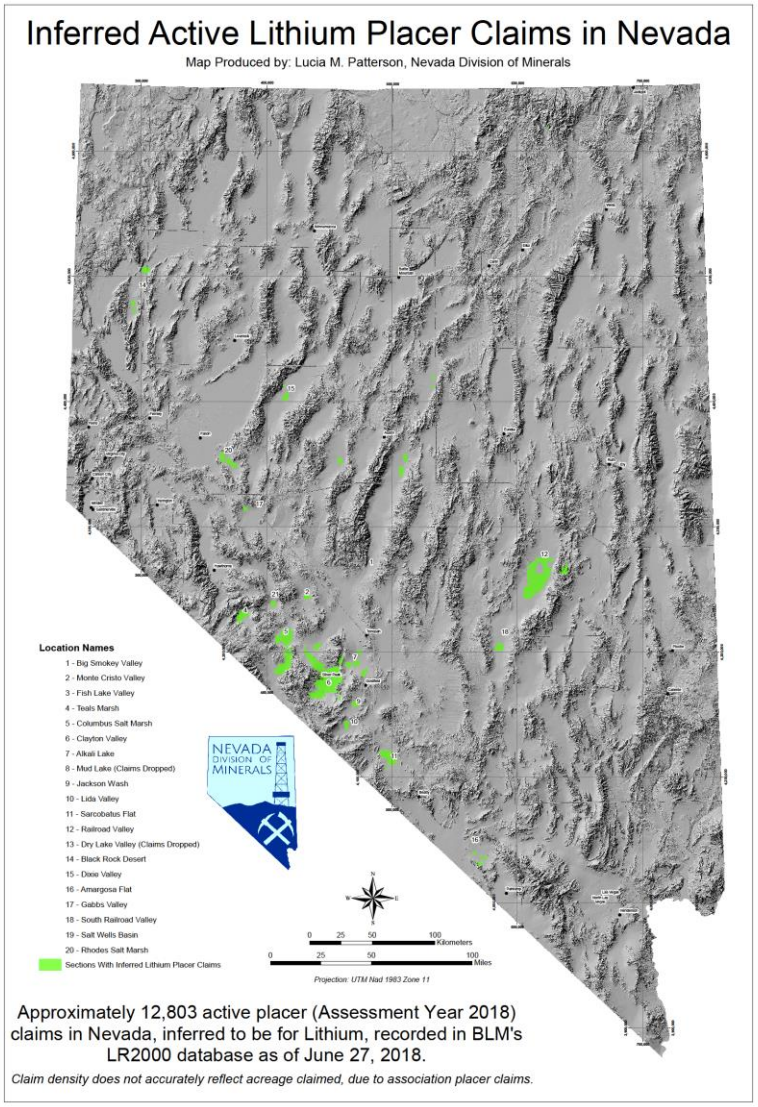
- **Lithium is a locatable mineral on Federal land under the General Mining Law of 1872**
- **Placer claims are used to locate potential lithium brine deposits**
- **Lode claims are used to locate potential lithium clay or hardrock resources**
- **Initial exploration performed under a BLM Notice (not a permit) which is a quick process**
  - **Only 15 days advance notice**
  - **Bond required before commencement of surface disturbance activities**
  - **Non-discretionary**

The Challenge to Lithium Brine Exploration in Nevada

- **Water belongs to the State of Nevada.**
- **The State Engineer regulates quantity and beneficial use.**
- **To pump and test for lithium in brine you need a water right, which is not a quick process and is subject to appeal.**
- **Some lithium brine projects located on top of active oil and geothermal leases.**
  - **Each party is entitled to explore but are regulated under two different "rulebooks".**
  - **BLM can't require lithium brine explorer to use blowout prevention equipment – potential safety issue in geothermal areas.**
- **Typical locatable mineral explorers not accustomed to drilling and designing wells for testing of water or use of precautionary measures for hot water.**
- **New law was needed to create a streamlined path for safe exploration of lithium brine with limited pumping.**

DISSOLVED MINERAL RESOURCE EXPLORATION (DMRE) - STATUTES AND REGULATIONS

- Sponsored by Governor Sandoval, Assembly Bill 52 was passed by the Nevada legislature in 2017.
- Created Chapter 354B in Nevada Revised Statutes, effective January 1, 2018.
- Established authority for the Division of Minerals to regulate exploration of dissolved mineral resources – NDOM regulates oil, gas, and geothermal exploration and development.
- NDEP, NDWR and NDOM jointly developed regulations.
- Regulations became effective May 16, 2018.
- First DMRE well approved January 10, 2018.
- First DMRE borehole approved February 1, 2018.



What is in the Statute ?

- **Defines a “dissolve mineral exploration borehole” and allows for sampling of water in exploration boreholes .**
- **Defines “dissolved mineral resource exploration well” and enables an application process by NDOM**
- **DMRE approved well permits expire after 2 years, can be extended for 2 more years.**
- **Defines a “dissolved mineral resource exploration project” as a notice or plan-level approved project on Federal lands (claims), or a defined project area on non-federal lands.**
- **Requires a Nevada licensed water well driller to drill DMRE boreholes and wells.**

What is in the Statute?

- **Allows for up to 5 acre-feet (6,165 cubic meters) of water to be pumped for testing <u>per project</u> (not annually).**
  - **This volume is considered adequate to determine presence of a resource but not necessarily to quantify and fully model it.**
- **> 5 acre-feet requires a water right from NDWR.**
- **Does not change the appropriation procedures in NRS/NAC 533, 534**
- **Allows for application fee for wells and fines for violations**

What is in the Regulations ?

- Exploration Boreholes: notice of intent form required , no fee, allows for sampling (e.g. HydraSleeve) but not pumping
- DMRE wells: permitting process, application fee ($1,000/well)
- Well design approval required: casing, seals, etc.
- Regulations are very similar to those for NDWR
- Well permits <u>not</u> retroactive to existing MM waivers <u>or</u> existing permitted rights issued by NDWR

What is in the Regulations ?

- Drilling within “Areas with Limitations” subject to additional conditions
- 100’ setback from existing oil, geothermal or water wells.
- No limit on number or boreholes or wells, but total pumping for sampling is limited to <5 AF per project
- Plugging logs signed by licensed water well driller to be submitted for all boreholes and wells
- Reclamation bonding required
  - Held by BLM if on federal land
  - Held by NDOM if on private land

Areas With Limitations

- Regulatory mechanism for additional review to ensure proposed DMRE activity is safe and doesn't impact permitted oil, gas, and geothermal (OGG) wells and resources.
- Uses map published on NDOM website depicting:
  - NDOM-permitted OGG wells
  - Federally-authorized oil, gas, and geothermal leases
  - Groundwater basins having increased thermal gradient (125F at 1,500ft or 52C at 460m, using gradient of 67.42C/km)
- Depth limitations for drilling without Blowout Prevention Equipment
- Monitoring of drilling mud temperatures with requirement for cooling equipment when mud is >125F/52C

Nevada Division of Minerals Open Data Site

Oil, Gas, and Geothermal Resources and Groundwater Basins with High Temperature Gradients

with Web AppBuilder for ArcGIS

Layer List

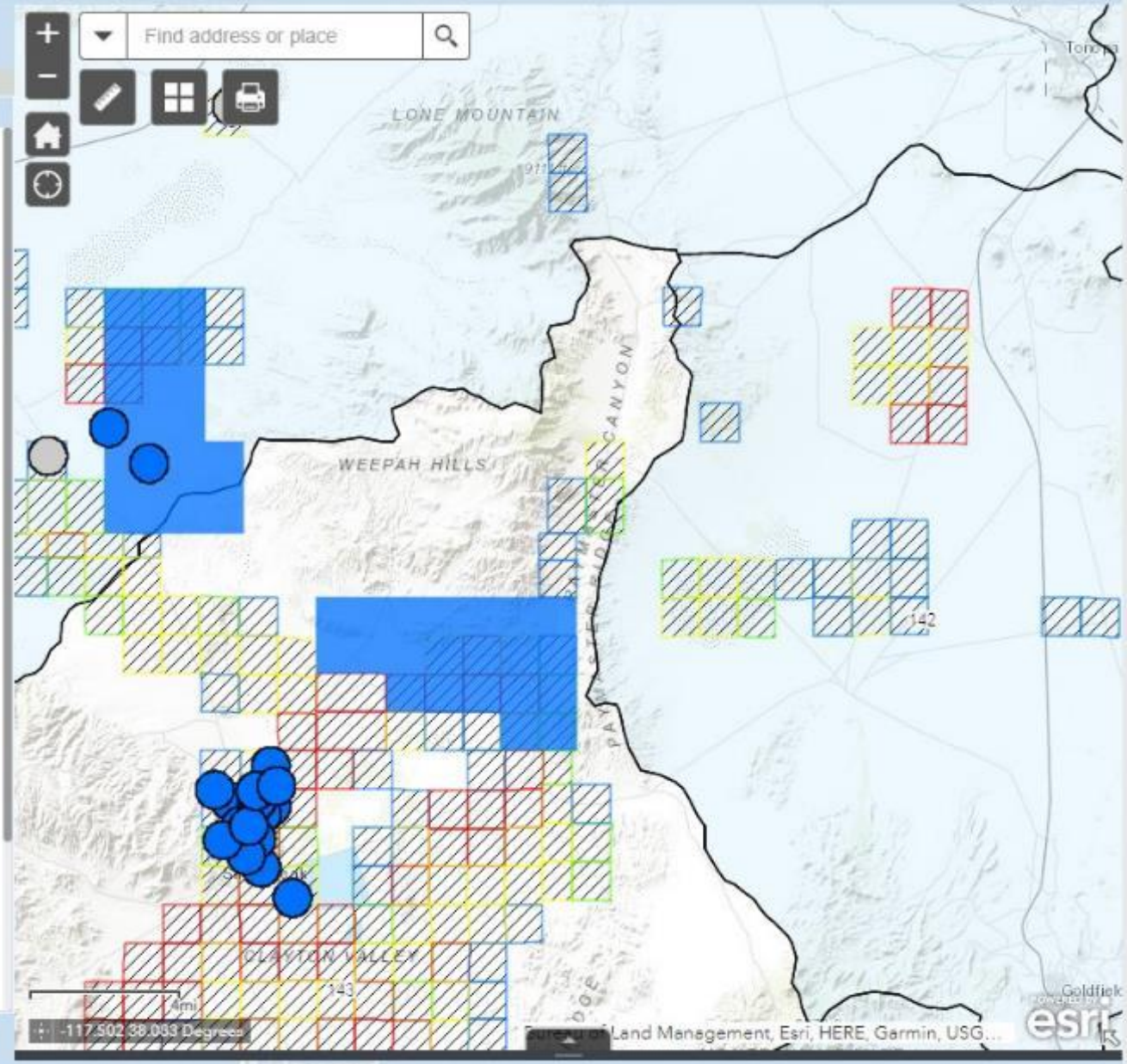
Layers

- Inferred Li Placer Claim Point Listings
- "Areas With Limitations" Active Oil Wells with 1/2 Mile Buffer (Date as of January 05, 2022)
- "Areas With Limitations" Active Geothermal Wells with 1/2 Mile Buffer (Date as of January 05, 2022)
- "Areas With Limitations" Active Geothermal Lease Points (Date as of January 20, 2022)
- "Areas With Limitations" Authorized Oil and Gas Lease Points (Date as of January 20, 2022)
- "Areas With Limitations" Authorized Geothermal Leases Per Section (Date as of January 20, 2022)
- "Areas With Limitations" Authorized Oil and Gas Leases Per Section (Date as of January 20, 2022)
- Inferred Li Placer Claim Listings Per Section

Count

- 33 - 260
- 21 - 32
- 11 - 20
- 0 - 10

- Hydrographic Basin Boundaries
- "Area With Limitations" Basins With High Temperature Gradient
- Surface Management Symbology



Inferred Lithium Placer Claims Location 2017 - 2021

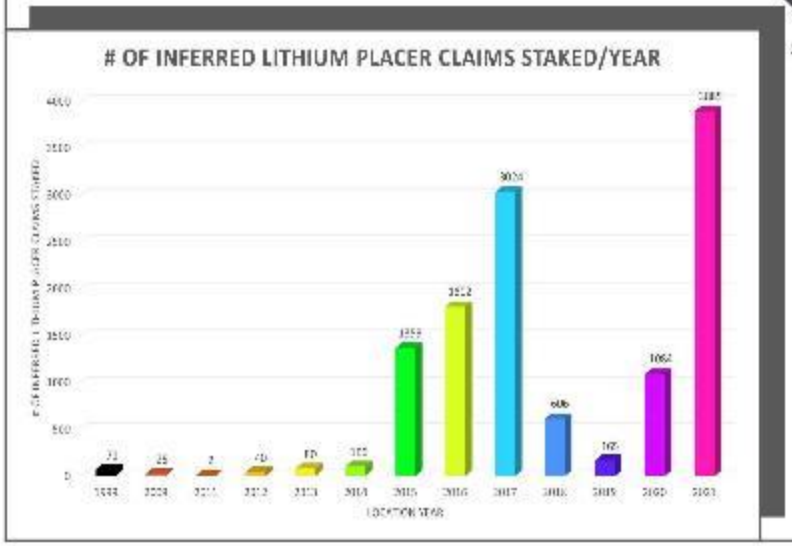
Map Produced By:
Lucia Patterson, Nevada Division of Minerals
UTM NAD 1983 Zone 11
February 23, 2022

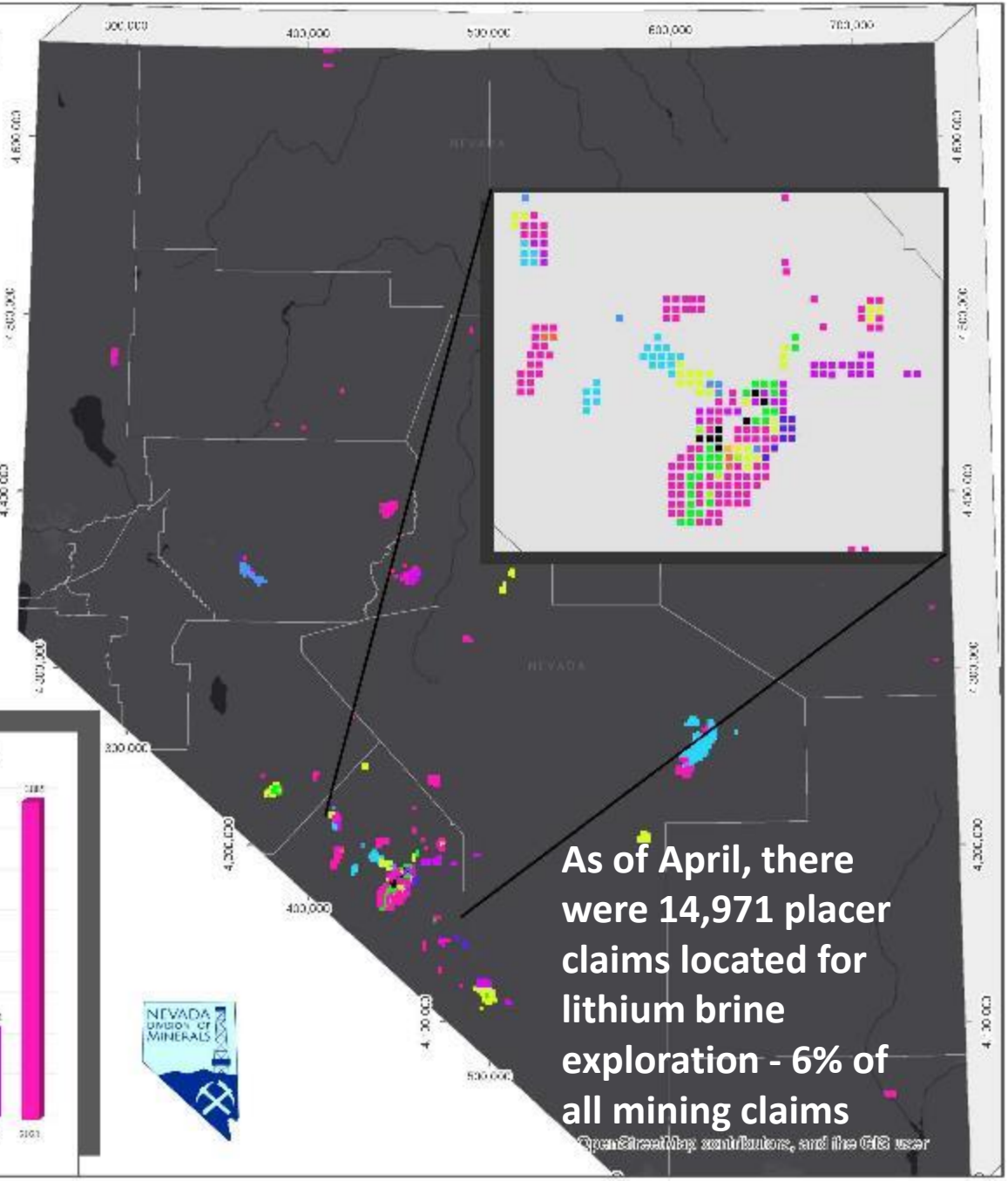
N

0 25 50 100 Miles

0 25 50 100 Kilometers

There is an estimated 12,291 active, filed, and submitted placer claims in the BLM's MLRS database, presumably for lithium brine, as of January 24, 2022.

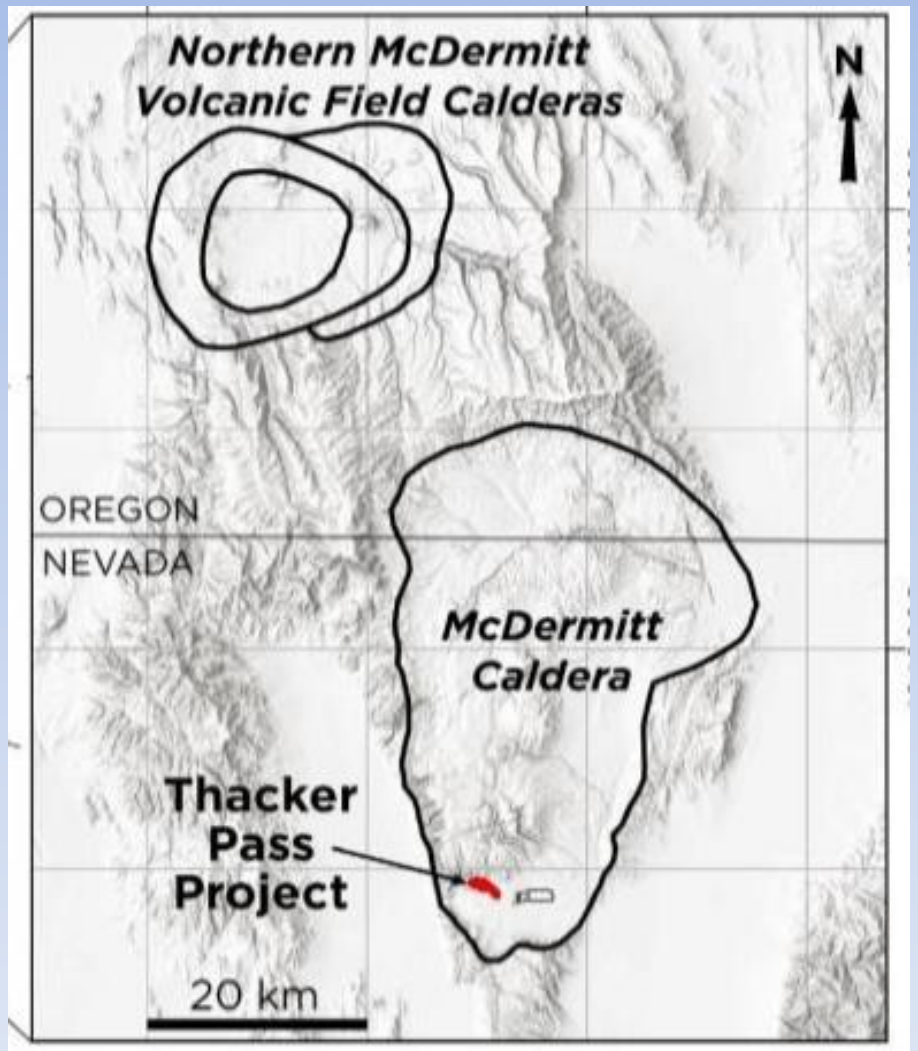




As of April, there were 14,971 placer claims located for lithium brine exploration - 6% of all mining claims

OpenStreetMap contributors, and the GIS user

Lithium Americas – Thacker Pass Project



- Reserves – 3.1M tonnes LCE at 2,358 ppm Li
- Strip ratio – 1.6:1
- Mine life – 46 years
- Processing time - <24 hours
- Lithium recovery – 83%
- Pilot plant operational in Reno
- BLM issued Record of Decision on 1/15/2021
- ROD appeal expected to be complete by Q3/2022
- NDEP permits issued 2/25/2022, appealed by GBRW, to be heard by SEC end of June

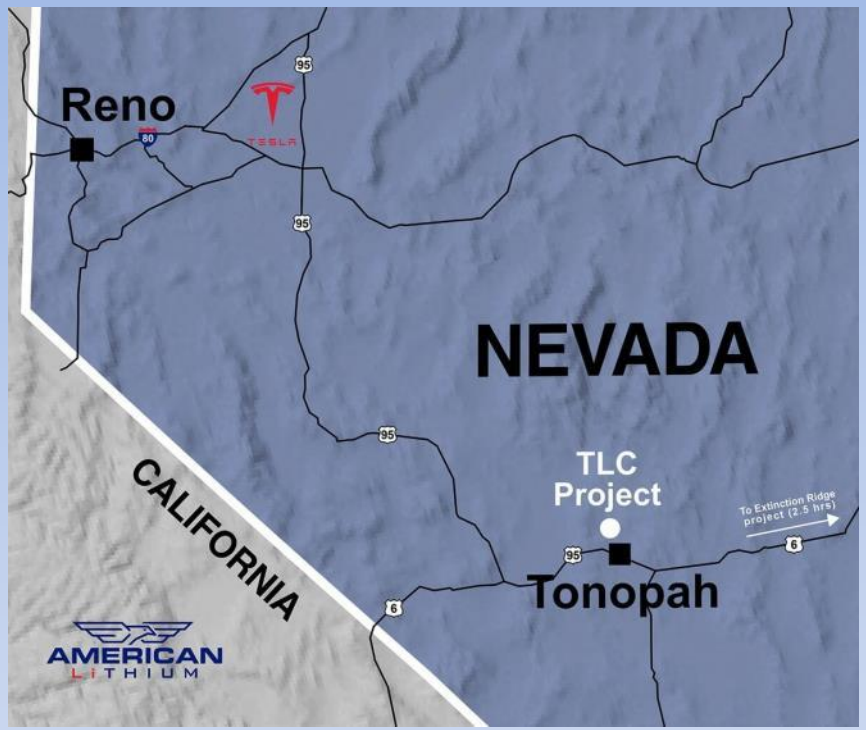
ioneer's Rhyolite Ridge Project

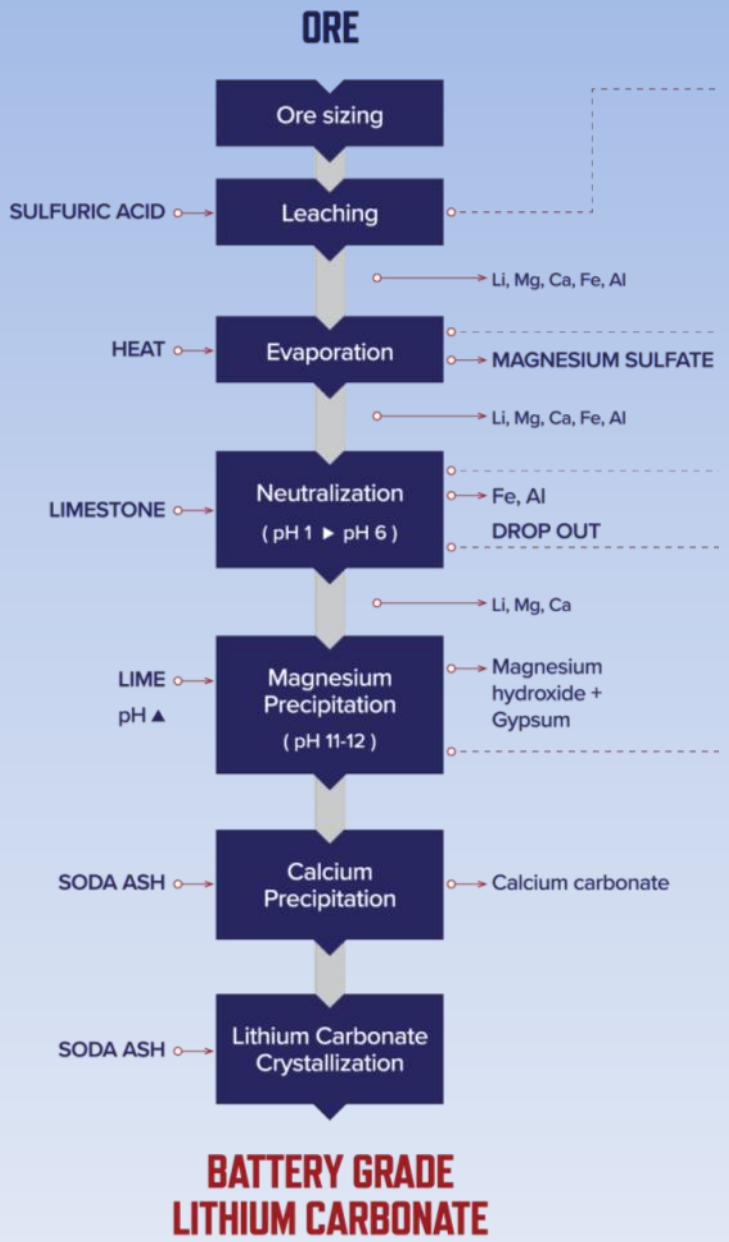
Project overview

A searlesite resource that is different to other sedimentary lithium deposits - it is suitable for a simple acid leach process

- Total Resource[1] of 4.1 million tonnes lithium carbonate & 10.9 million tonnes boric acid
- Including 121 million tonnes of lithium-boron ore containing:
  - 1.1 million tonnes lithium carbonate
  - 8.6 million tonnes boric acid
- Lithium only clay mineralisation to be stockpiled

American Lithium – TLC Project

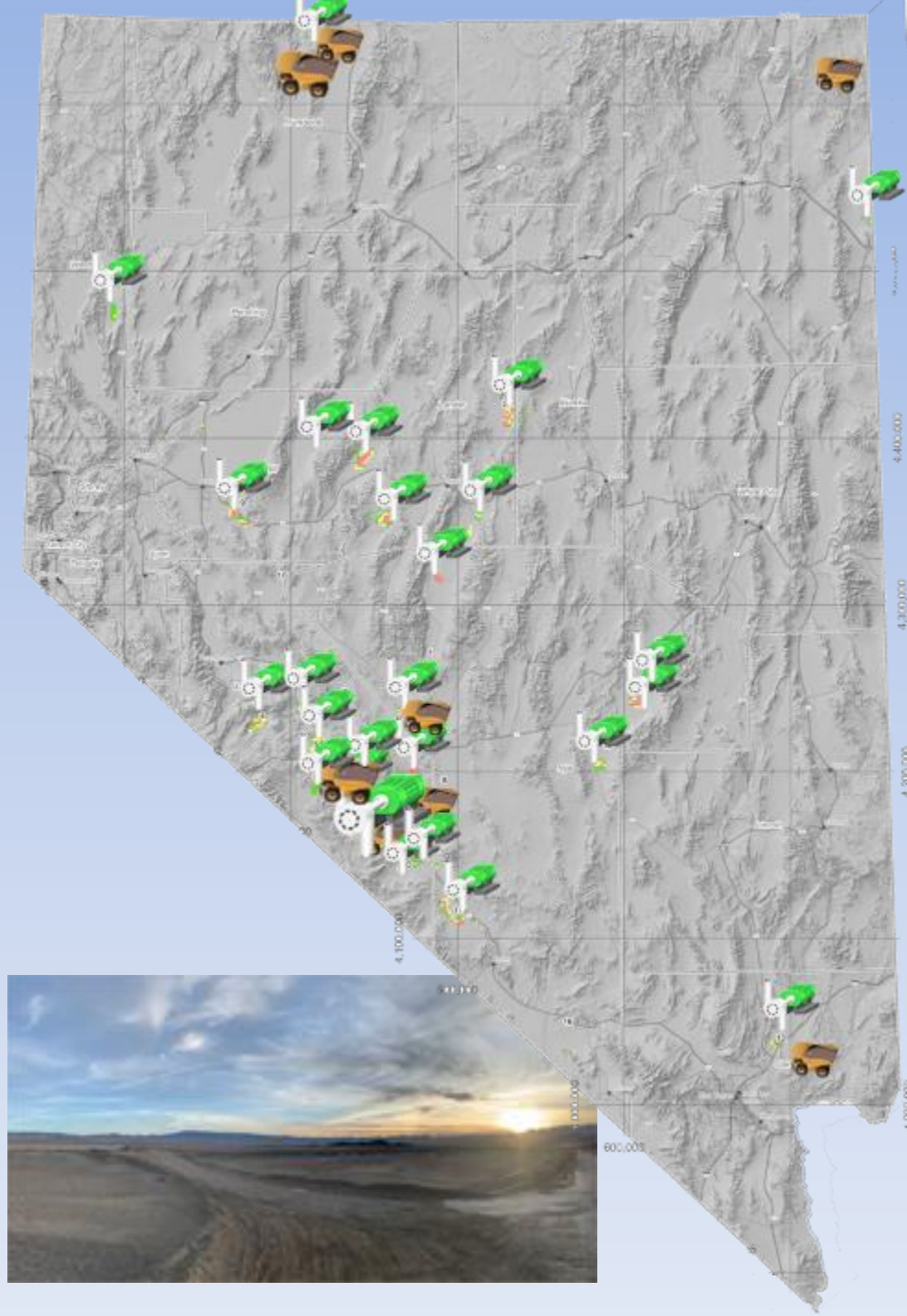




- Measured and indicated resource of 5.4 Mt lithium carbonate equivalent
- Lithium ore at the surface
- Preliminary metallurgical tests indicate >90% recovery in <10 minutes using sulfuric acid leach
- Large drilling program permitted and economic analysis is underway

Lithium Exploration Activity

- > 40 companies in various stages of exploration; ~30,000 mining claims (~13% of total mining claims in NV)
- ~30 companies involved in Clayton Valley alone, with numerous joint ventures/agreements
- ~12 lithium in clay projects (open pit)
- >30 lithium brine projects (DLE), none are considering solar evaporation concentration process
- NeoLith Energy (Schlumberger Energy) has permitted the Clayton Valley Pilot Plant to evaluate their DLE technology ($15M invested to date) and has a collaboration agreement with Panasonic Energy to optimize process for battery-grade feed
- 24 approved DMRE Notices
- 14 Approved DMRE well Permits
- ~11 different playas have been drilled for lithium brine under DMRE regulations
- Advancements in DLE are critical to future of lithium brine production



Programs

Abandoned Mine Lands (AML)

Bond Pool (Reclamation)

Dissolved Mineral Resource Exploration (DMRE)

- DMRE Forms
- Approved Notices
- Approved Permits
- Filed Permit Applications
- Filed Reports

Education and Outreach

Geothermal

Mining

Oil & Gas

Dissolved Mineral Resource Exploration (DMRE)

Assembly Bill 52 of the 2017 session was signed into law in June, 2017. The purpose of this legislation is to define a permitting path for dissolved mineral exploration, including lithium brines, and to develop regulations to ensure exploration drilling for dissolved minerals is protective of groundwater, as well as oil and geothermal resources. The legislation authorizes regulation by the Division beginning on January 1, 2018. The Division of Minerals is now accepting applications for Dissolved Mineral Resource Exploration (DMRE) wells and notices of intent for DMRE exploration boreholes. All forms for the program are located below, can be picked up at the Division office, or mailed to the public upon request.

- NRS 534B
- NAC 534B (codified)
- Response to Summary Comments on Proposed Regulations, April 25, 2018
- Oil, Gas, and Geothermal Resources and Groundwater Basins with High Temperature Gradients - Areas with Limitations Map 01/15/2020
- NDEP – BMRR Permitting Requirements for Lithium Exploration and Extraction Activities (2019 edit)

Areas with Limitations Interactive Map

This map is to be utilized in order to determine if a proposed

Dissolved Mineral Resource Exploration Contact

Cortney Luxford
Fluid Minerals Program Manager
cluxford@minerals.nv.gov

Statute & Regulations

NRS 534B

NAC 534B (codified)

Mining Links

State and Federal Permits Required Before Mining or Milling Can Begin

DMRE Frequently Asked Questions (FAQ)