LISBON VALLEY MINING CO

Class III Underground Injection Control Permit Application

Lisbon Valley Mining Company LLC
Lower Lisbon Valley LLV Project

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Acronyms

Acronym	Definition
AEB	Aquifer Exemption Boundary
AOR	Area of Review
BC	Burro Canyon
bgs	below ground surface
BLM	Federal Bureau of Land Management
CFR	Code of Federal Regulations
cm	centimeter
EPA	United States Environmental Protection Agency
ft	feet
gpm	gallons per minute
ILS	intermediate leachate solution
ISR	In-situ recovery
Jmb	Jurassic Morrison Formation, Brushy Basin Member
LLV	Lower Lisbon Valley
M, I&I	Measured, Indicated, and Inferred
MIT	mechanical integrity test
MSHA	Mine Safety and Health Administration
N	Navajo
PLS	pregnant leachate solution
POC	point of compliance
POE	point of exposure
POO	Plan of Operations
PV	Pore Volume
QAAP	Quality Assurance Project Plan
SDWA	Safe Drinking Water Act
sec	second
SGR	Shale Gouge Ratio
SITLA	School Institutional Trust Lands Administration
SLBM	Salt Lake Base Meridian
SX/EW	Solvent Extraction / Electrowinning
TDS	total dissolved solids
the Company	Lisbon Valley Mining Company, LLC
the Project	The proposed ISR project
TRG	target restoration goal
UAC	Utah Administrative Code
UCL	upper control limit
UDEQ	Utah Department of Environmental Quality
UDOGM	Utah Division of Oil, Gas and Mining
UDWQ	Utah Division of Water Quality
UIC	Underground Injection Control

USDW	Underground Sources of Drinking Water
WHP	well head pressure

Glossary

Aquifer Exemption: The process by which an aquifer, or portion of an aquifer, that meets some of the criteria for an underground source of drinking water, for which protection under the Safe Drinking Water Act has been exempted under the criteria in 40 CFR § 146.4. Injection of fluids through a Class I, II, or III injection well into any aquifer that meets the classification as a USDW requires a demonstration that the aquifer is not currently serving a drinking water system and is not expected to do so in the future.

Aquifer Exemption Boundary: A boundary defined 500 feet outside of the limits of the aquifer to be exempted. The Aquifer Exemption Boundary defines the Project Area.

Bleed: Excess production or restoration solution withdrawn to maintain a cone of depression so native groundwater continually flows toward the center of the production zone.

Confining Bed (layer): A geologic formation, group of formations, or a part of a formation of low permeability above or below an aquifer that confines groundwater flow within the aquifer.

Point of Compliance: A designated aquifer monitoring well location to be sampled for exceedance of upper control limits for two or more point of compliance indicators.

Injection Well: A well used to inject lixiviant or restoration fluids into the production zone for copper extraction or aquifer restoration.

In-situ Recovery (ISR): The in-place recovery of a mineral resource without removing overburden or ore. This method of mining is typically accomplished by installing a well and recovering the resource directly from the natural deposit by exposing it to the injection and recovery of the lixiviant that causes dissolution of the mineral.

Lixiviant: A solution composed of native groundwater, sulfuric acid oxygen and other elements pumped underground to recover the copper-laden solutions from the ore body.

Monitor Well: A well used to obtain water quality samples or measure groundwater levels.

Ore Body: The mapped extents of ore mineralization that is expected to be commercially producible. Also referred to as Ore Zone.

Ore Horizon: The vertical position of the ore mineralization within the host sand unit, formation, aquifer, or between two confining units. There may be more than one ore horizon within a host unit.

Pore Volume (PV): An indirect measurement of a unit volume of aquifer affected by ISR extraction. Pore volume is typically calculated by multiplying the surficial area of a well field by the ore horizon thickness by the porosity.

Project Area: Physical boundary of the area of planned ISR activities.

Process Facilities: The Company owns and operates and SX/EW copper production facility as part of its current open pit mining operations which will be used to produce all copper from the ISR project.

ISR Injection Well: A well designed to inject lixiviants in ISR wellfield.

ISR Production Well: Also known as 'extraction well' or 'recovery well' for ISR, usually located in the center of a 5- or 7-spot well pattern; used to pump the copper-bearing solution to the surface for recovery of copper.

Safe Drinking Water Act (SDWA): The main federal law that ensures the quality of Americans' drinking water. The SDWA sets the framework for the UIC Program to control the injection of fluids. EPA and states implement the UIC Program, which sets standards for safe injection practices and bans certain types of injection.

Underground Source of Drinking Water (USDW): An aquifer or portion of an aquifer that supplies any public water system or that contains a sufficient quantity of ground water to supply a public water system, and currently supplies drinking water for human consumption, or that contains fewer than 10,000 mg/l total dissolved solids and is not an exempted aquifer.

1.0 Introduction

The Lisbon Valley Mining Company (LVMC or the Company) proposes to produce copper at the Lisbon Valley and Lower Lisbon Valley (LLV) area using in-situ recovery (ISR) (the Project). This report has been developed to address the permitting requirements for a Class III Underground Injection Control (UIC) permit application in Utah. The UIC Programs within the state of Utah are overseen by the Utah Department of Environmental Quality (UDEQ) Division of Water Quality (UDWQ). This report is being submitted to the United States Environmental Protection Agency (EPA) to demonstrate that the Project will meet the requirements of the UIC Program promulgated under the Safe Drinking Water Act (SDWA) and as overseen by UDWQ.

The SDWA was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supplies. It authorizes EPA to set national health-based standards to protect drinking water and its sources: rivers, lakes, reservoirs, springs, and public water supply wells. EPA, states and water districts work together to ensure protection against naturally- occurring and anthropogenic contaminants. The UIC Program found in 40 CFR Parts 144-147 is one such program designed to implement the SDWA by regulating underground injection practices to protect underground sources of drinking water (USDWs).

To fulfill 40 CFR Parts 144-147 informational needs, the following attachments are included with this UIC permit application:

- PART A – Determination of Area of Review (AOR)
- PART B – Permit Application Maps
- PART C – Tabulation of Artificial Penetration
- PART D – Corrective Action Plan
- PART E – Injection Zone Formation Testing Plan
- PART F – Well Stimulation Plan
- PART G – Injection Well Construction Plan
- PART H – Injection Well Construction Details
- PART I – Injection Well Operating Plan and Procedures
- PART J – Monitoring, Recording and Reporting Plan
- PART K – Contingency Plan
- PART L – Plugging and Abandonment Plan
- PART M – Financial Responsibility
- PART N – Aquifer Exemption
- PART O – Expected Changes Due to Injection

1.1 Project Overview

The proposed ISR project (the Project) is located in Lower Lisbon Valley(LLV), approximately 17 miles southeast of the unincorporated town of La Sal, in San Juan County Utah (Figure 1.1). The Project will involve ISR recovery of copper from a poor-quality aquifer that lays confined by geologic features within LLV. The Project Area includes the Burro Canyon (BC) aquifer (and ore host copper mineralization occurs) and the deeper Navajo (N) aquifers and covers 4, 803 acres. The Company is already permitted for open pit mining and exploration activities as part of the Company's existing open pit mining and beneficiation operation.

The Project Area land ownership includes 1,994 acres of BLM land, 2,079 acres of private land, and 730 acres of lands owned by the Utah School Institutional Trust Lands Administration (SITLA). The Project Area, which will include all proposed Project activities, is located entirely within Sections 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, and 17, Township 31 South, Range 26 East, Salt Lake Base Meridian (SLBM), Sections 31 and 32, Township 30 South, Range 26 East, SLBM, Section 36, Township 30 South, Range 25 East, SLBM, and Section 1, Township 31 South, Range 25 East, SLBM (Figure 1.2).

Figure 1.1 Project Location Map

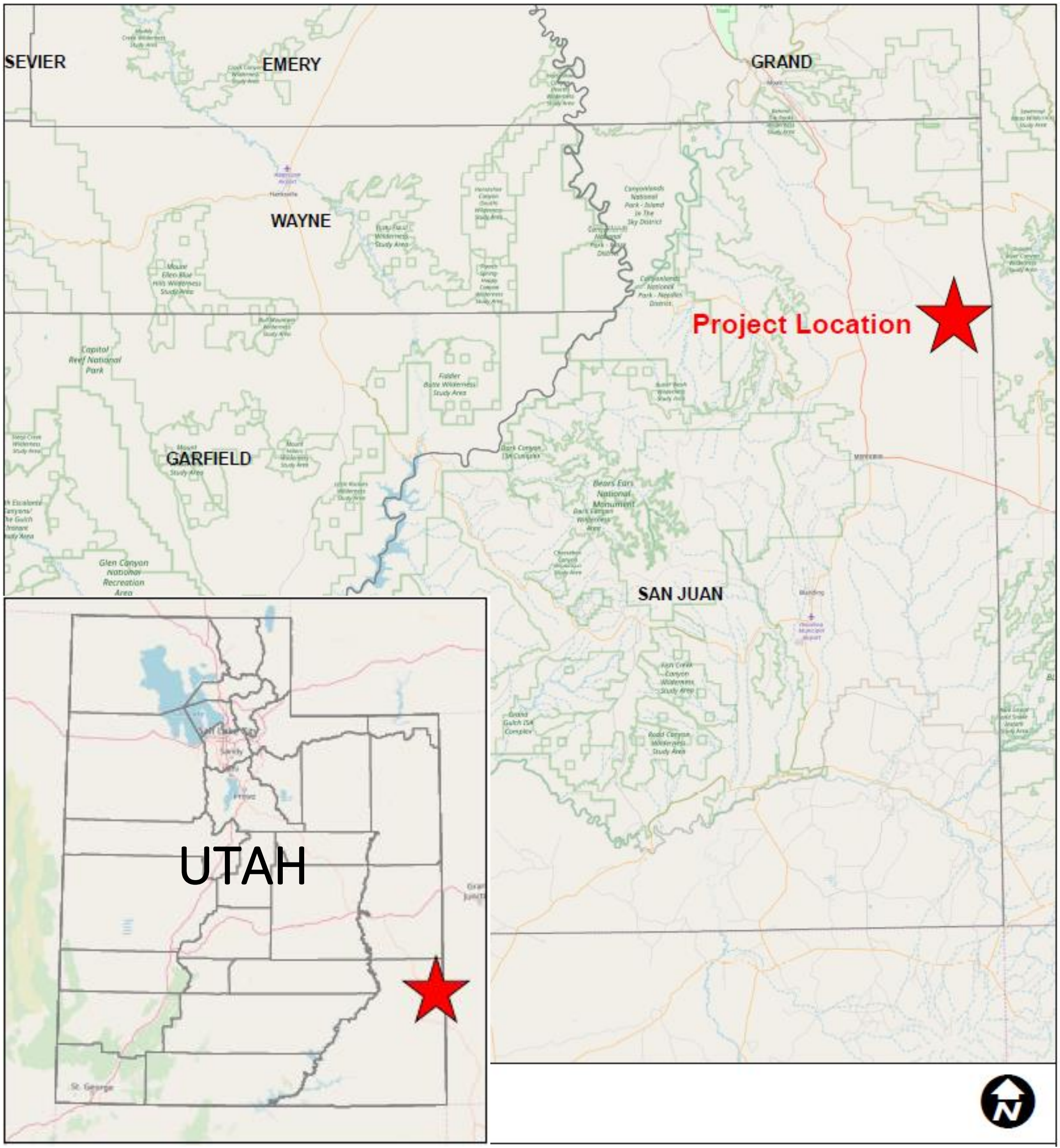
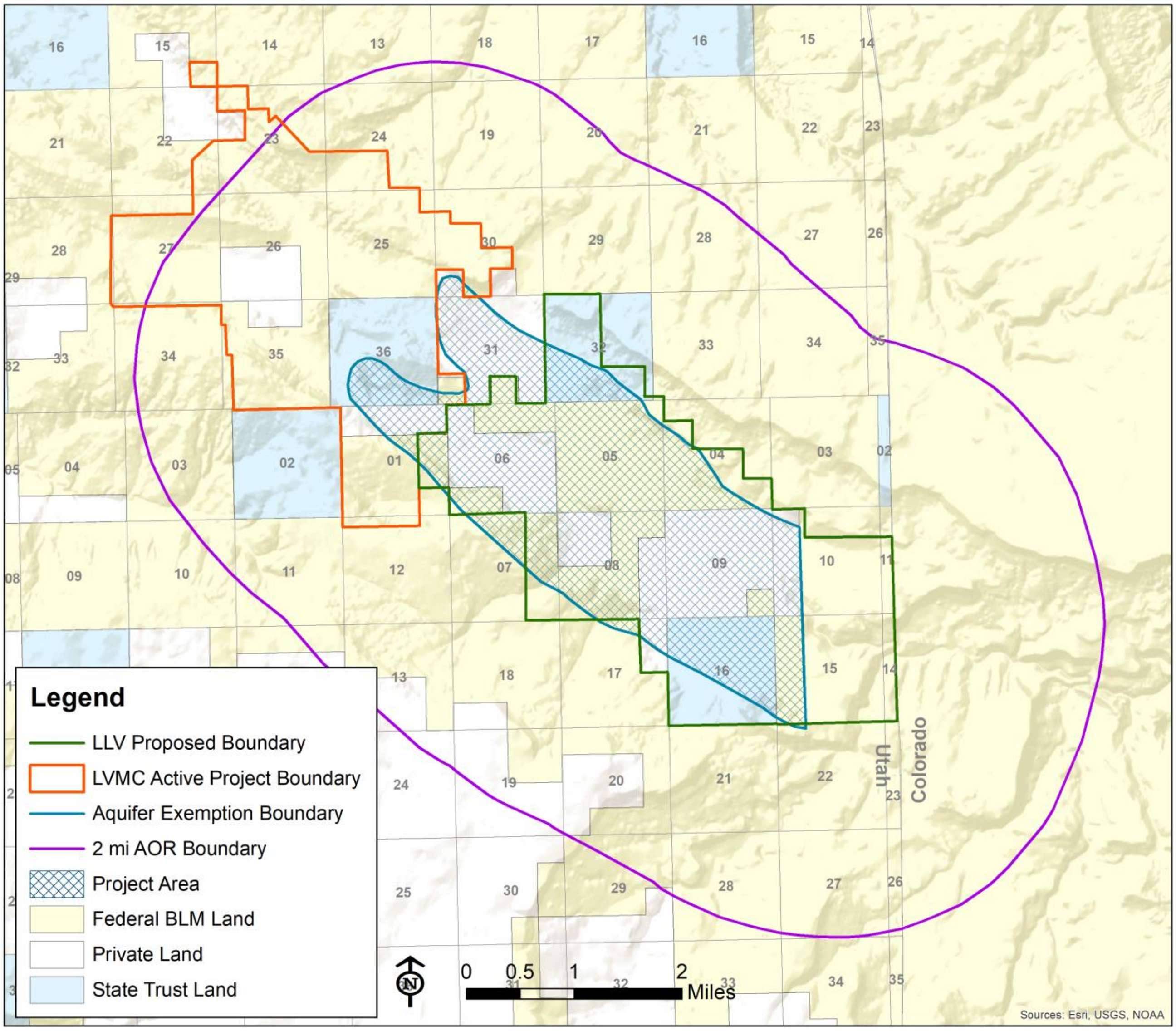


Figure 1.2 LVMC Project Area, Mine Boundary, Aquifer Exemption Boundary and Area of Review

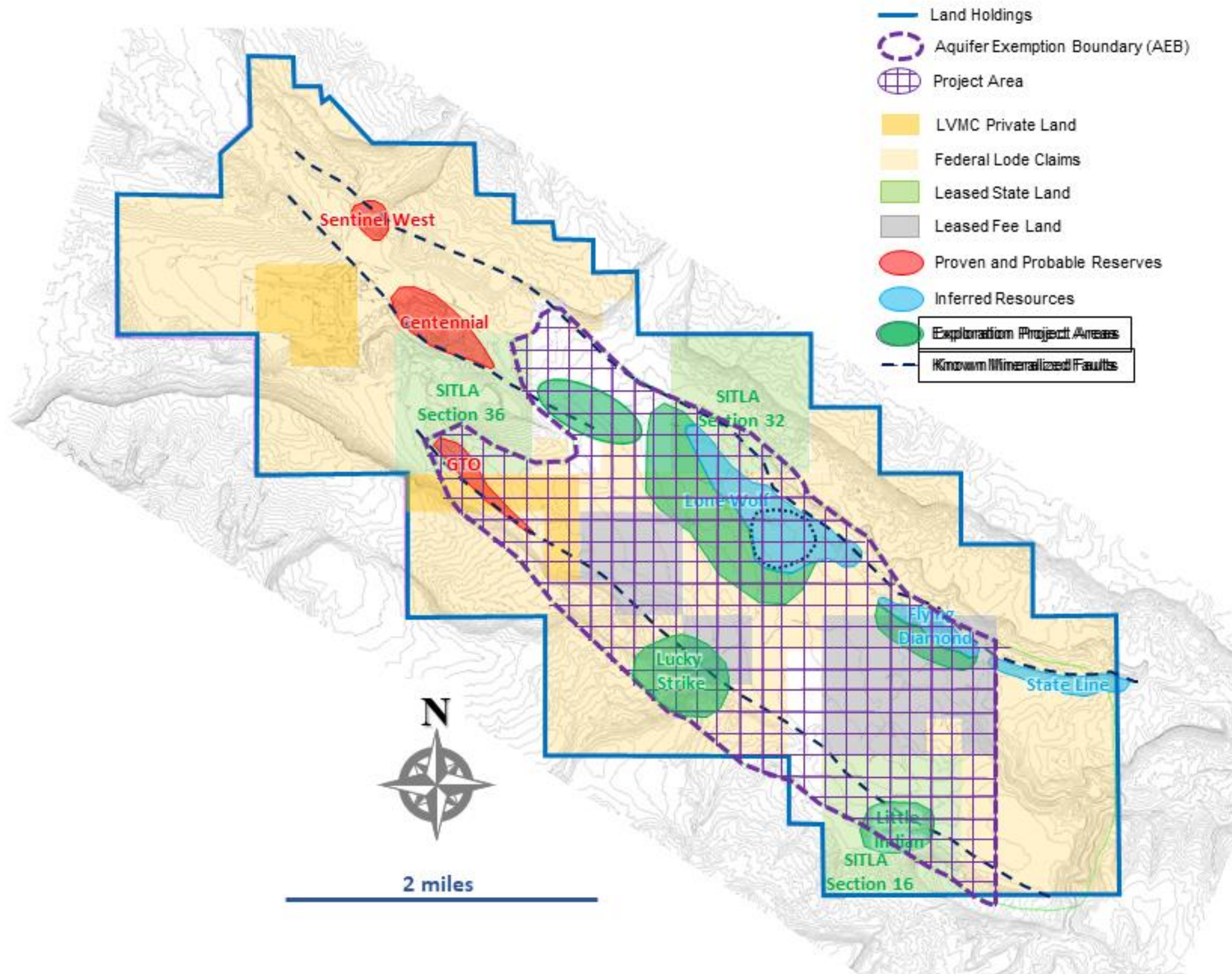


The Project Area is located in the Lisbon Valley Mining District, a prolific producer of brine metals, including copper, uranium, oil, and gas. Within the Project Area, copper occurs in the Cretaceous Burro Canyon Formation and common aquifer (BC). The BC aquifer is approximately 450 feet thick and is situated between 200 to 900 feet below ground surface (bgs). The BC is perched above a second aquifer, the Navajo aquifer (N aquifer) situated between 1,100 to 1,300 feet bgs. The aquifers are separated by an approximate 400-foot thick aquitard, the Jurassic Morrison Formation, Brushy Basin Member (Jmb). The BC is laterally confined by valley bounding faults which confine the copper and BC groundwater to the Project Area.

The BC aquifer sandstone is mineralized with commercial grade copper and other brine metals in the Project Area. As a result, the BC groundwater quality is very poor, and there are no registered domestic, residential, municipal, or other commercial water wells in the BC aquifer in the Project Area besides LVMC. There are two stock wells in the BC aquifer and Project Area, one of which is a dry hole and abandoned. The closest municipal water well is 14 miles from the Project Area in the upgradient direction.

It is important to note that the BC is both an aquifer and the predominant copper host (ore zone) in the Project Area. There are three copper deposits currently identified within the Project Area that have been defined by drilling activity to date. These deposits are GTO, Lone Wolf, and Flying Diamond (Figure 1.3). The combined deposits are estimated to contain >800 million pounds of copper suitable for ISR recovery. Additional drilling is planned to identify additional ISR targets and copper appears in drill holes throughout the LLV Project Area.

Figure 1.3 Project Area and Copper Deposits Map



Copper minerals will be recovered by ISR. ISR involves the injection of groundwater fortified with low levels of sulfuric acid and dissolved oxygen into a series of injection wells. Low pH leaching solution dissolves and mobilizes available iron in the rock formation and oxygen works to transform available iron to its ferric state resulting in a “lixiviant” suitable to harvest the copper deposit as a copper sulfate solution. Copper ISR follows the same principles and metallurgy that the company has used to commercial open pit mine and leach its copper minerals from 2006 to date.

The recovery solution, pregnant leachate solution (PLS), will be pumped into surface ponds from solution extraction wells. The PLS solution will be pumped through near-surface piping to the Company’s existing solvent extraction electrowinning (SX/EW) plant where a final copper product is produced (Grade A Cathode Copper). As the copper is removed from the ground, the groundwater will be refortified with sulfuric acid and oxygen and recirculated through solution injection wells. Each copper deposit will be leached until copper recovery is no longer economical. The Company estimates that individual well field operating lives will be approximately 5 years, with multiple well fields typically in operation at any given time. The Company estimates a total ISR project life of approximately 28 years based on existing copper resources, with potential for additional project life if additional planned drilling identifies additional copper resources for ISR. LVMC already owns and operates almost all of the required surface infrastructure, power supply, water supply, and processing facilities required for in-situ leaching as part of its existing open pit mining and production operations.

The BC aquifer is hydraulically confined vertically and laterally from the underlying N Aquifer and all other USDW. It is confined vertically as a function of stratigraphy. This includes hundreds of feet of low-permeability shale above and below. It is confined laterally by geologic structures and non-transmissive faults. Valley-bounding faults truncate the BC on north and south boundaries. Elevating structures dewater the BC on east and west boundaries. The BC and N aquifer confinement is supported by head contrasts vertically as a function of stratigraphy and laterally where juxtaposed along valley faults. The BC and N aquifer confinement is further supported as a function of groundwater chemistry, including major ion, isotopic, and age contrasts.

Hydraulic gradients intrinsic to the ISR mining process will ensure that all mining fluids associated with ISR activities are contained and controlled. The Project includes plans to monitor the ISR wellfields by use of perimeter monitoring wells and wells in the underlying N Aquifer.

Concurrent aquifer restoration will be completed following copper recovery of approximately five years in each well field. During aquifer restoration, the groundwater in the well field will be rinsed and restored in accordance with UDWQ requirements. Additional restoration applications are available and will be utilized if needed for restoration purposes.

The Company does not anticipate producing any liquid or solid waste as part of the Project. All in situ solution will be managed within the Company’s existing lined and monitored closed circuit processing system that only produces low levels of lead flake which is collected and shipped for recycling consistent with existing permits and operating practice.

The Company is requesting a Class III UIC permit and Aquifer Exemption for the BC aquifer in order to advance its ISR copper project in the Project Area.

1.2 Applicant Information

The Company is a privately-owned company which is permitted to conduct copper mining and processing activities by the Federal Bureau of Land Management (BLM) and the Utah Division of Oil, Gas, & Mining (UDOGM) in accordance with an approved Plan of Operations (POO). The authorized POO covers 4,480 acres. A separate POO is authorized for exploration on an additional 5,683 acres of land holdings which include private land (fee simple), unpatented mining claims, and state leases. The mine POO currently authorizes operation of three primary open pit deposits (Centennial, GTO and Sentinel), three waste dumps, a heap leach facility and a SX/EW facility. The exploration POO authorizes over 150 additional exploration borings in the mine area and additional sites which are located over an area that extends an approximate 1.5 miles to the north and 6.5 miles to the south of the existing mine. Multiple deposits occur north and south of the mine and several areas have been drilled sufficiently to support measured, indicated and inferred (M,I&I) resource classification containing over 500 million pounds of copper plus approximately 300 million pounds of potential copper resource contiguous to existing M,I&I resources as well as additional exploration potential.

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1.3 Project History

Copper was initially discovered in Lisbon Valley at the Big Indian mine at the north end of the valley in the early 1890s. The Big Indian Mining District was formed in 1892. The Big Indian District includes all of the uranium-vanadium and the copper deposits in Big Indian Wash and Lisbon Valley.

Early exploration and mining activities for copper were largely confined to two properties, the Blackbird (or Lisbon) mine at the southern end of Lisbon Valley and the Big Indian mine at the north end of Lisbon Valley. A small tonnage of hand-sorted ore was first shipped by burro from the Blackbird mine to Placerville, Colorado in 1908. By 1913, the property had been developed by an inclined shaft approximately 100 feet deep and by several surface trenches. Total production from the Blackbird mine prior to the 1950s was probably only a few hundred tons of hand-sorted ore. In the 1950s several thousand tons of ore, averaging approximately 2% Cu, was shipped to Kennecott's smelter in Salt Lake City, Utah.

At the Big Indian mine an inclined shaft had been sunk to a depth of 300 feet by 1900. Processing mills to concentrate the ore were constructed in 1916, 1925, and 1943. Between 1942 and 1946 the Ohio Copper Company of Utah mined and treated more than 150,000 tons of ore averaging about 1.5 percent Cu.

In the early 1960s, Micro-Copper Corporation set up a small 200 ton-per-day acid leach and iron precipitation operation at the Blackbird Mine. Micro-Copper mined malachite- and azurite-bearing sandstones outcropping above what is now the Centennial pit area. Head grades reportedly averaged 1.25 percent Cu. Recent analyses of both tailings from the vats and residue from coarse leach piles indicate recovery of copper was in excess of 90 percent.

Modern exploration and development of copper at Lisbon Valley commenced in the 1960s. Cleveland Cliffs Copper Corporation conducted the first documented exploration drilling in the area when they drilled 22 rotary drill holes in the area of the Centennial pit, defining a resource of 600,000 tons of 0.5% percent Cu. In 1967 George Wallace acquired the rights to the Big Indian Mine at the north end of Lisbon Valley, formed a joint venture with Cleveland Cliffs Copper Corporation and built a mill and acid leach plant on the Big Indian property. The plant was designed to crush and grind copper-bearing sandstone and then leach it with sulphuric acid. The precipitate was shipped to Kennecott's smelter at Ely, Nevada for further smelting and refining.

In 1969, George Wallace sold an interest in the property to Keystone Metals and formed Keystone-Wallace Resources (KWR). The objective of Keystone-Wallace was to operate and upgrade the leach and precipitation plant at Big Indian, and further develop the copper resources at both ends of Lisbon Valley. Plant capacity eventually reached 1,500 tons per day and at one point the plant was reportedly producing 750,000 pounds of copper per month. In 1970 Keystone-Wallace drilled in excess of 500 rotary holes and defined additional resources in the Big Indian, Centennial, and GTO deposit areas. KWR mined and processed these oxide ores between 1970 and 1973 for a total reported throughput of approximately 1 million tons of ore that produced approximately 25 million pounds of copper.

In 1974, with high-grade oxide ores mostly exhausted, the properties were optioned to Centennial Development Company. Centennial Development drilled a total of 223 rotary and 17 core holes in the Centennial pit area, to evaluate the sulfide copper potential. This drilling program outlined a reserve of 6.4 million tons grading 0.8 per cent Cu, mineable by open pit methods with a strip ratio of 3.61:1. RPM was commissioned to evaluate the feasibility of developing the sulfide copper resource based upon standard flotation recovery methods. In 1974 Centennial Development decided not to proceed with development of the Project, citing weak copper prices and an inadequate return on investment.

In 1975, Noranda Exploration Inc. optioned the properties and drilled 103 rotary holes and 11 core holes, mostly in southern Lisbon Valley. This drilling program increased the sulfide resource in the Centennial deposit area by 3.5 million tons at an average grade of 0.61 percent Cu. However, Noranda failed to find their minimum target size and dropped their option in 1976.

The properties lay dormant until 1985 when Kelmine Corporation obtained an option and performed metallurgical tests, including acid heap leach and recovery by solvent extraction and electrowinning technology, on samples of ore from the Centennial and GTO deposits. Kelmine Corporation applied for and received a mine operating permit from the Bureau of Land Management to produce 15,000 tons of ore per month. Their development plan called for production of copper sulfate for agricultural use, with an anticipated annual production of 4.4 million pounds of copper sulfate. Due to continued depressed copper prices, Kelmine Corporation was unable to finance development of the Project, and assigned their lease to MLP Associates, a Colorado Limited Partnership.

In 1989, MLP Associates brought in Sindor Inc., a Canadian Junior company, to evaluate the feasibility of developing the property as an open pit heap leach operation with recovery of copper by SX-EW processing. Sindor did additional drilling but was unable to raise sufficient capital to develop the property and withdrew in 1990.

In 1993, Kennecott Exploration Inc. optioned the property and drilled five widely spaced holes, mostly away from the known resource areas, looking for large sulfide ore bodies in stratigraphically lower sandstones at greater depths. Kennecott failed to find their minimum target size and withdrew later in 1993.

St. Mary Minerals Inc., a wholly-owned subsidiary of St. Mary Land & Exploration Company, optioned the properties in southern Lisbon Valley in late 1993, with objective to develop a large resource amenable to open pit mining and heap leach SX-EW processing. St. Mary assigned the option to a newly formed company, Summo Minerals Corporation, in exchange for shares in the new company. Summo drilled a total of 150 reverse circulation and core holes in the property, bringing the total number of drill holes in the data base at that time to approximately 1,069. This data base includes 597 holes at the Centennial deposit, 340 holes at the Sentinel deposit, and 132 holes at the GTO deposit representing approximately 208,779 feet of drilling.

In 1995, Summo submitted a proposed Plan of Operations to the Utah Division of Oil Gas & Mining and the BLM for development of the property as an open pit mine and heap leach SX-EW processing operation. The design capacity reflected anticipated production of 34 million pounds of copper annually for a minimum of eight years. Baseline environmental studies and groundwater sampling and monitoring were initiated in 1995, and an environmental impact study commenced.

A positive feasibility study was completed for Summo by Roberts & Schaefer Company of Salt Lake City in 1996, based upon a reserve of 46.5 million tons grading 0.43 percent Cu mineable by open-pit methods at a strip ratio of 2.36:1. By January 1997 all permits from the State of Utah were issued. A Final Environmental Impact Statement was approved by the BLM and published in the Federal Register in February 1997. A favorable Record of Decision was signed by the BLM in March 1997. In April 1997 Summo had arranged $45 million in senior debt financing and $5 million in subordinated debt for construction of the Lisbon Valley Copper Project.

In 2000 Summo commissioned The Winters Company to update the Feasibility Study taking into account the increases in capital and operating costs since construction was halted by the Appeal in 1997, and also the current prevailing lower copper price.

By 2002, Summo had spent in excess of $9.5 million to evaluate the Lisbon Valley copper deposits. On July 19, 2002 Summo Minerals Corporation became Constellation Copper Corporation by virtue of a name change. Construction on the present-day facility was commissioned in 2005 by Constellation.

Constellation Copper filed for bankruptcy protection during 2008 and the Lisbon Valley Mining Company was purchased out of Chapter 11 through a plan of reorganization during 2009. The Company has continuously produced 99.999% pure copper cathode since project inception in 2006 to date. The project's copper mineralization requires specific mining and chemistry operational strategies to leach copper over forty month year time period. The Company employs 65 -100 employees and operates 24/7 year round producing copper.

Beginning in 2014, the Company began to explore the concept of ISR copper production given favorable wide spread sedimentary rock bedding containing finely disseminated copper mineralization which occurs in a perched aquifer. Much of the copper mineralization contained in the Company's land position is too deep to open pit mine but is favorably situated for ISR copper recovery. The Company has spent approximately five years of research and development and drilled approximately 130,000 feet of reverse circulation and core in LLV and expanded its resources to total an estimated 500 MM lbs and an additional 300 MM lbs of potential resource. The Company may identify additional copper resources around its existing deposits and on undrilled acreage based on future planned drilling activity.

The Company began to examine the feasibility of ISR of copper since much of the Company's mineralization is located at 200 to 900 foot depth which requires substantial removal of overburden. Moreover, the location of the mineralization is co-located within a perched aquifer which the Company utilizes for its water supply within which the Company has collected extensive data for more than 20 years. The Company has studied in situ leaching for approximately nine years which includes extensive review of the copper deposits including hydrogeologic framework, porosity, permeability, and hydraulic confinement. Additionally, the Company has analyzed the BC aquifer confinement in as part of the Paradox Basin Paleofluids Research Project (Keck 2017). This analysis involved a comprehensive groundwater sampling project focused on aquifer groundwater geochemistry and age.

1.4 Permitting Requirements

The Company is currently working on obtaining all the necessary permits and permits for the Project. Table 1.1 presents the current permitting status.

Table 1.1 Permits and Licenses for the Lisbon Valley Mining Company Active Mining Project

Issuing Agency	Permit or License	Status
Federal Bureau of Land Management Moab Field Office	Record of Decision for Large Mining Activities (UTU-72499)	Approved for LVMC; modification in process for LLV expansion
	Lower Lisbon Valley Exploration Plan of Operations (UTU-77879)	Approved; annual reporting & disturbance updates ongoing
US EPA Region 8	Aquifer Exemption (Class III Wells)	In Process
	RCRA Small Quantity Generator (UTR000008672)	Approved and in good order
Utah Department of Environmental Quality	NPDES Industrial Stormwater Permit (UTR00737)	Approved for LVMC; modification in process for LLV expansion
	Class III UIC Permit	In Process
	Ground Water Discharge Permit (UGW370005)	Approved for LVMC; modification in process for LLV expansion
	Approval Order for Emissions Source (DAQE-AN114620014)	Approved for LVMC; modification in process for LLV expansion
Utah Department of Natural Resources	Large Mining Permit (M/037/0088)	Approved for LVMC; modification in process for LLV expansion
	Reclamation Contract (M/037/0088)	Approved for LVMC; modification in process for LLV expansion
	Exploration Permit (E/037/0115)	Approved; annual reporting & disturbance updates ongoing
	Water Rights 05-2593; 05-762	Approved and in good order
San Juan County	Conditional Use Permit	Ongoing
	Building Permit	Ongoing

1.5 Health, Safety and Environmental Responsibilities

The Company has been regulated by the Mine Safety and Health Administration (MSHA), an agency of the United States Department of Labor, and multiple Federal and State environmental agencies since 2005 and has maintained exemplary compliance records for both safety and environmental compliance for fifteen years. The Company will continue to maintain the health and safety of the workers, general public, and the environment.

2.0 PART A – Determination of Area of Review (AOR)

This attachment details the methods used to determine the AOR for the Class III UIC permit application.

2.1 Introduction

The AOR is established to maximize the data to be described before an aquifer exemption is granted in order to prove the integrity of the injection zones and their relationship to surrounding USDWs. For the purposes of this report, the AOR will examine the area within 2 miles from the proposed Project Area.

As previously described, the BC aquifer is geologically confined within the LLV. Therefore, the AOR is examining an area where the BC Aquifer is absent but does include the N aquifer which extends beyond the Project Area.

The Company has extensive exploration drilling data, groundwater sampling, and geological structural analyses from its mining operations since 2005 which demonstrate that the ore zone (the geologic sequence which contains economic-grade copper mineralization) within the BC aquifer are vertically and laterally isolated from USDWs. The ore zone is vertically isolated by the presence of a major confining unit, the Morrison Formation Brushy Basin Member (Morrison confining unit). The ore zone is laterally isolated from USDW by low permeability faults which exhibit very high Shale Gouge Ratios (SGR).

The isolation provided by fault boundaries is enhanced by influent hydraulic pressure gradients from adjacent USDW. The influent gradients will increase as a function of groundwater withdrawals during the mining process. This will further prevent excursions and potential impacts to USDWs.

2.2 Area of Review

The Company has examined the AOR, Figure 3.1, in accordance with (R317-7-9.1(D)(9); 40CFR146.34(a)(2)) to include the following:

- the number or name and location of all existing producing wells, injection wells, abandoned wells, dry holes, public water systems and water wells.
- surface bodies of waters, springs, mines (surface and subsurface), quarries and other pertinent surface features including residences and roads, and faults if known or suspected.
- only pertinent information of public record or otherwise known to the applicant is required to be included on this map

2.3 Population and Land Use

There are two residences within the Project Area. This includes a ranch and seasonal Bed & Breakfast. Seven people permanently reside within the Project Area. An additional two residences are located outside the project area in the AOR. All residences are included on Figure 3.1

Land within the AOR is roughly 80% BLM (24,338 acres) 12% Private (3,587 acres), and 8% State (2,552 acres).

The predominant land use within the Project Area is mining and ranching. Most of the land serves as grazing land for cattle. Some of the land is used for recreational activities primarily motorsports and hunting.

3.0 PART B – Permit Application Maps

3.1 Area of Review

Illustrations of the AOR, facility, and Aquifer Exemption Boundary (AEB) are provided in Figure 3.1 which includes the following:

- The proposed Project Area and Aquifer Exemption Boundary (the AEB is the perimeter of the Project Area)
- AOR boundary (discussed in Attachment A)
- Existing wells
- Surface bodies of water
- Historical mines (surface and subsurface)
- Residences
- Roads
- Faults

There are no domestic wells within the Project Area. There are six domestic wells in the AOR and three are reported to be out of use and dry (see Section 4.1). No injection wells, intake structures, discharge structures, or hazardous waste treatment, storage, or disposal facilities have been identified in the AOR. Class III injection wells are proposed for the LLV Project and are discussed in Section 10.1. There are no surface water bodies or flowing springs in the Project Area. There is one flowing spring in the AOR (Lisbon Spring) that is not located in the Project Area.

Attachment C (Section 4) describes the inventory of existing wells, exploration drill holes, and oil and gas wells and test holes. The following section describes the historical mines in the AOR.

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3.2 Proposed Facility and Aquifer Exemption Boundary

The proposed ISR facilities and AEB are shown on Figure 3.2, which includes the following information:

- ISR Wellfields
- Processing Ponds
- Processing Plant
- Acid Tanks
- Access Roads
- Overhead Power
- Wellfield Controls

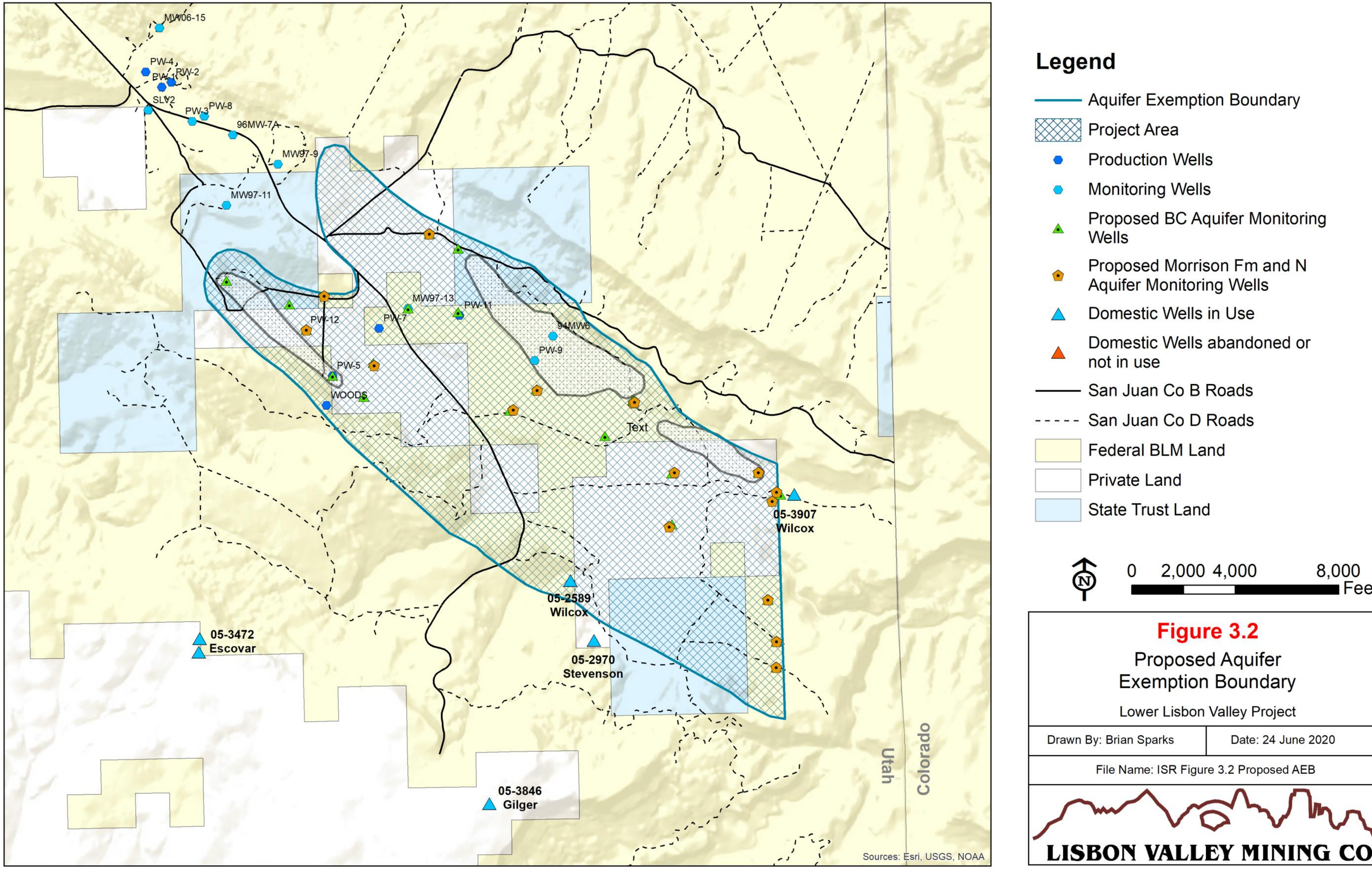


Figure 3.2

Proposed Aquifer Exemption Boundary

Lower Lisbon Valley Project

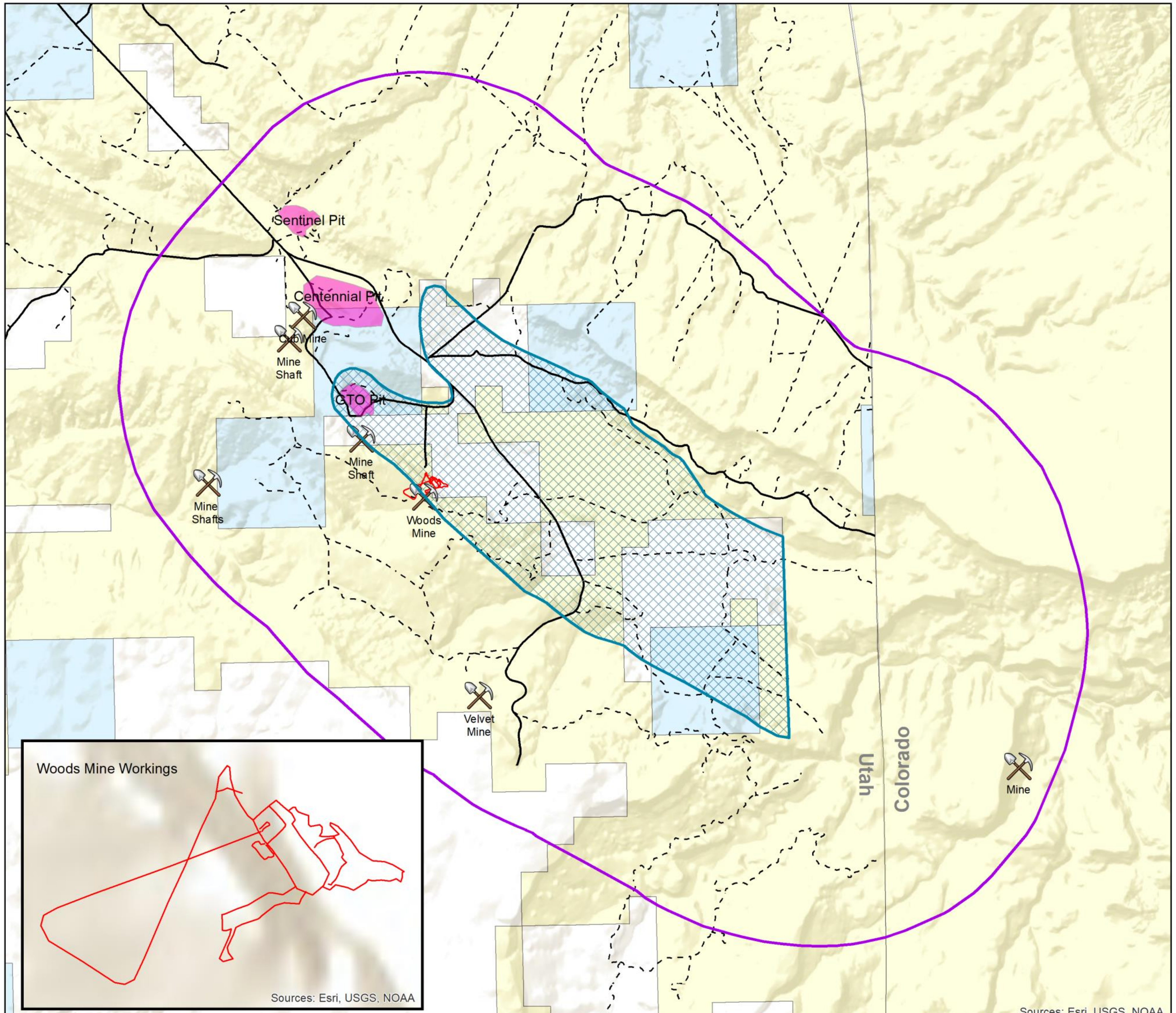
Drawn By: Brian Sparks | Date: 24 June 2020

File Name: ISR Figure 3.2 Proposed AEB

3.2.2 Historical Mine Workings

The Project occurs within a historic mining district. There are historic mine workings in the Project Area and AOR. Most of the historic mine workings are underground uranium workings that date back to the 1950's. There are two historic uranium mines adjacent to and below the Project Area and an additional five mines are found in the AOR. The mine locations are shown on Figure 3.2. All of the mine workings are either in the footwall outside of the Project Area or are confined below Project Area beneath the Morrison confining unit. None of the workings will affect ISR operation or containment.

There is one active, shallow open pit in the Project Area operated by the Company. The open pit is offset from ISR operations planned for the Project Area and the open pit will not affect ISR operation or containment.



Legend

- Aquifer Exemption Boundary
- Project Area
- 2 mi AOR Boundary
- Historic Mines
- Woods Mine Workings
- Open Pit Copper Mine
- San Juan Co B Roads
- San Juan Co D Roads
- Federal BLM Land
- Private Land
- State Trust Land

0 3,000 6,000 12,000 Feet

Figure 3.3

Location of Current and Historic Mines

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 22 June 2020
File Name: ISR Figure 3.3 Historic Mines	

LISBON VALLEY MINING CO

3.3 Summary of Maps and Cross Sections of USDWs

This section lists the regional scale maps and cross sections that show the geologic structure which frames the USDWs relevant to the Project. These maps and cross sections are provided in Section 3.4 below.

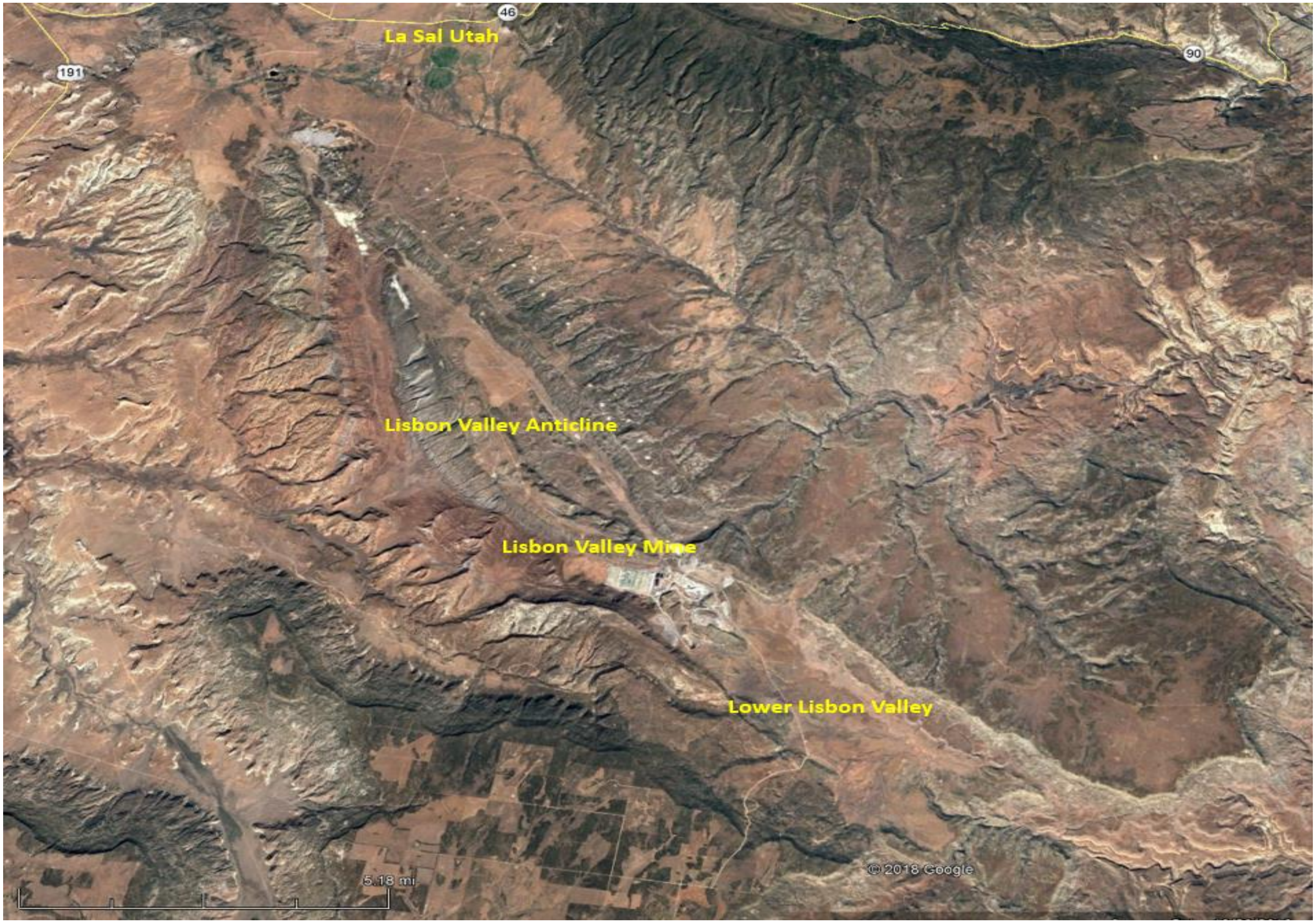
<u>Figures:</u>

3.4 Maps and Cross Sections of Regional Geologic and Hydrologic Setting

3.4.1 Regional Geologic Setting

The Lisbon Valley Mining District is located near the center of the Paradox Basin, a Pennsylvanian-age evaporite basin. The Lisbon Valley Mining District includes the Lisbon Valley Copper Mine and Project Area. The evaporites have been deformed into NW-trending diapiric anticlines that repeatedly breached the overlying section (Cater, 1970; Hite and others, 1972). The Lisbon Valley anticline (Figure 3.5), and the salt structure underlying Lower Lisbon Valley, were positive topographic features during the Triassic, but remained as salt-cored anticlines without developing diapiric piercement. Lisbon Valley, the topographic feature for which the anticline is named, is the surface expression of the apical graben along the crest of the anticline. LLV appears to be structurally similar to the Lisbon Valley anticline. On the southwest side, Jurassic rocks dip gently off to the southwest. On the northeast, Morrison, Burro Canyon, and Dakota Formations dip gently off to the northeast. A complex trend of normal faults drops the crest of the anticline down to form a graben.

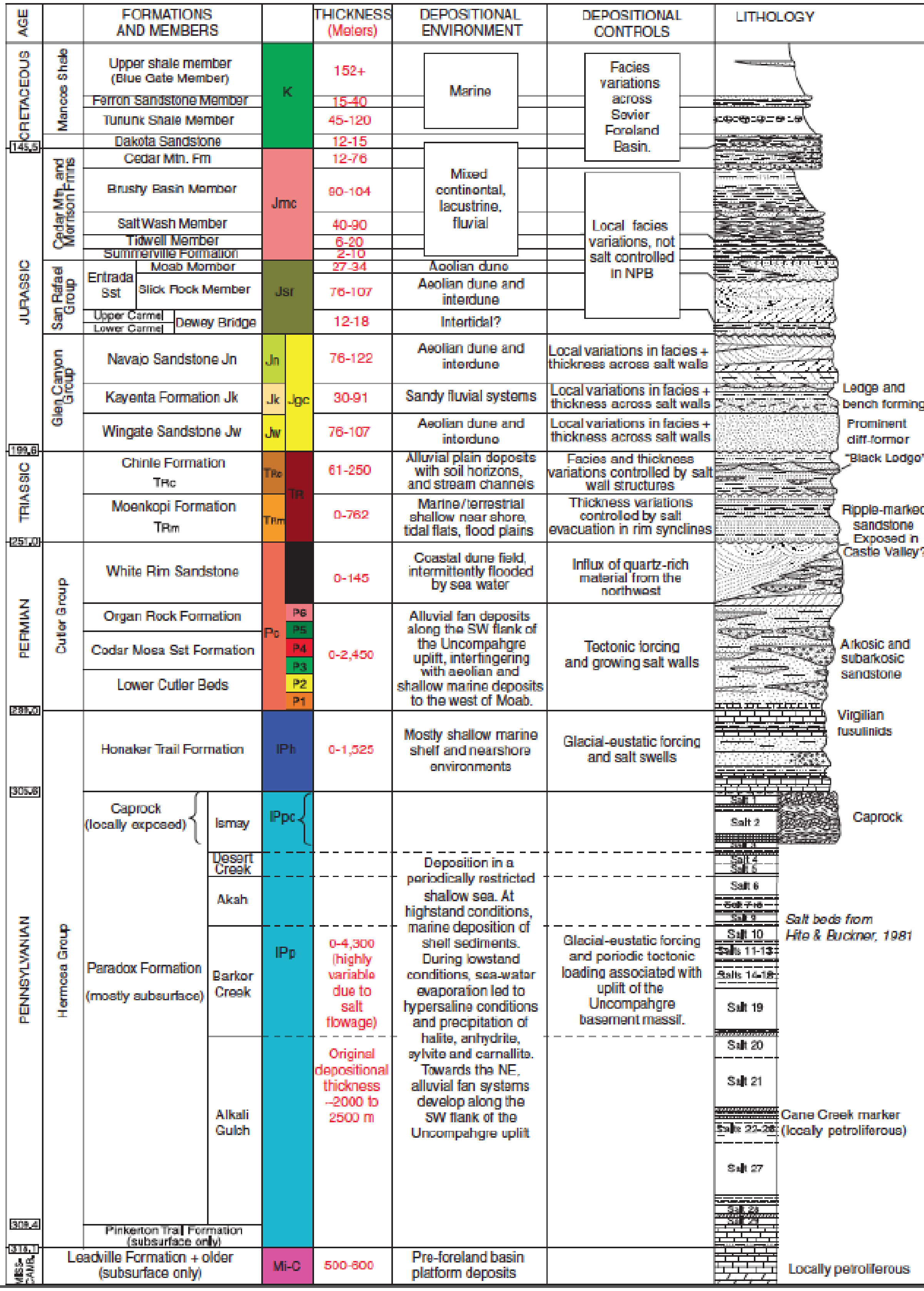
Figure 3.4 Lisbon Valley Anticline, Mine and Lower Lisbon Valley



3.4.2 Regional Stratigraphy

The regional stratigraphy of the Paradox Basin is shown below (Figure 3.6). Included are ranges of formation thickness, depositional environment and depositional controls. This figure distinguishes the depositional contrasts of the Dakota, BC, and Jurassic (N Aquifer) sandstone sequence. Also shown are the basal evaporites that underpinned the anticlinal development and subsequent collapse, forming Lisbon Valley and other salt-anticline valleys in Southeastern Utah. The AOR and AEB are shown in the context of regional geology on Figure 3.7

Figure 3.5 Regional Stratigraphy



[This page intentionally left blank. See attached fold-out of Figure 3.6]

3.4.3 Regional Geologic Cross Sections

This section provides a series of regional cross sections which show the structural theme of Lisbon Valley relative to the regional stratigraphy. A regional cross section location map is provided as Figure 3.8. Laterally, this series depicts the extent and thickness of regional aquifers and aquitards including Morrison and Chinle Formations. Vertically, the series show how the large graben structures collapsed into the valley forming large confined compartments of lithology. Section-specific descriptions are provided for each section.

Figure 3.7 Regional Cross Section Location Map

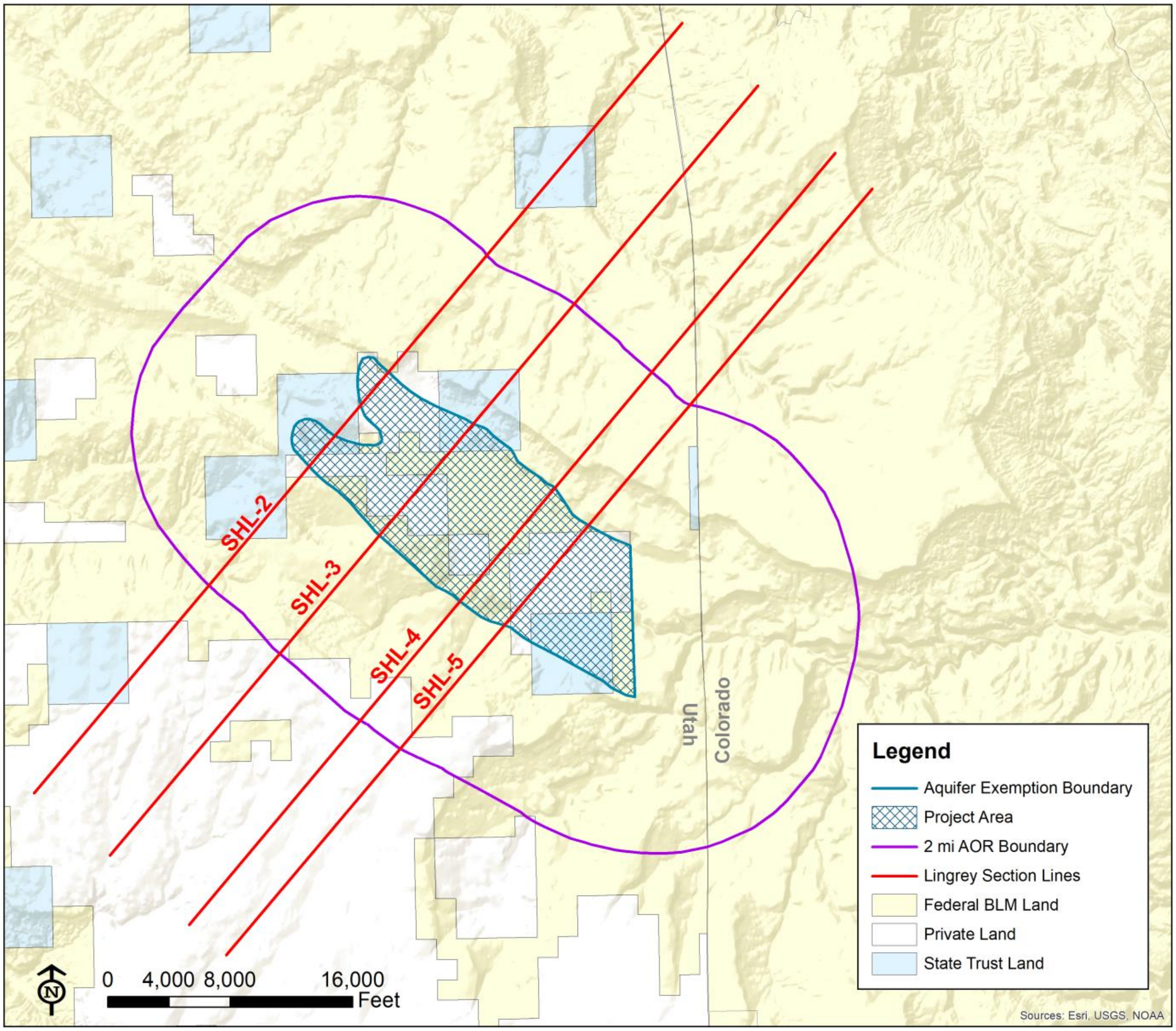


Figure 3.8 Regional Cross Section SHL-2

This figure identifies an inferred concept that earliest motion along the Lisbon Valley and 3-Step faults initiated in the Jurassic Period. The 3-Step fault predominates LLV structure as the Lisbon Valle fault attenuates south to the LVMC Centennial Pit.

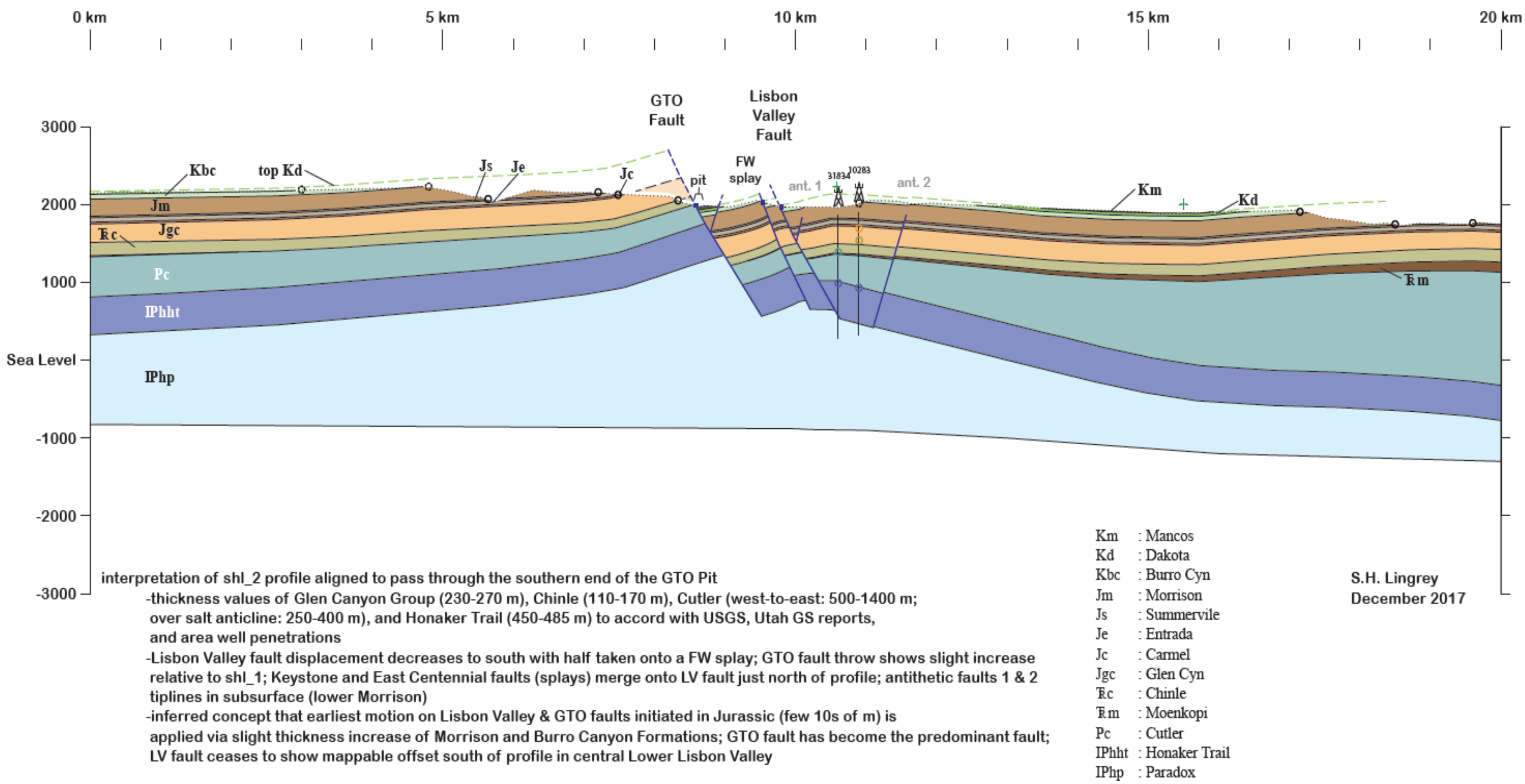


Figure 3.9 Regional Cross Section SHL-3

This Figure identifies a splay along the 3-Step fault and provides an inferred concept that most fault movement is post-Dakota. Mancos shale begins to covers Kbc. The antithetic fault (labeled 0) is the Coyote Footwall fault. The 3-Step Fault and Coyote Fault form a symmetrical graben at this location, showing juxtapositioning of Kbc against Trc on the south and Kbc against ---Jgc on the north. The majority of fault displacement is inferred to reflect mid Tertiary extension.

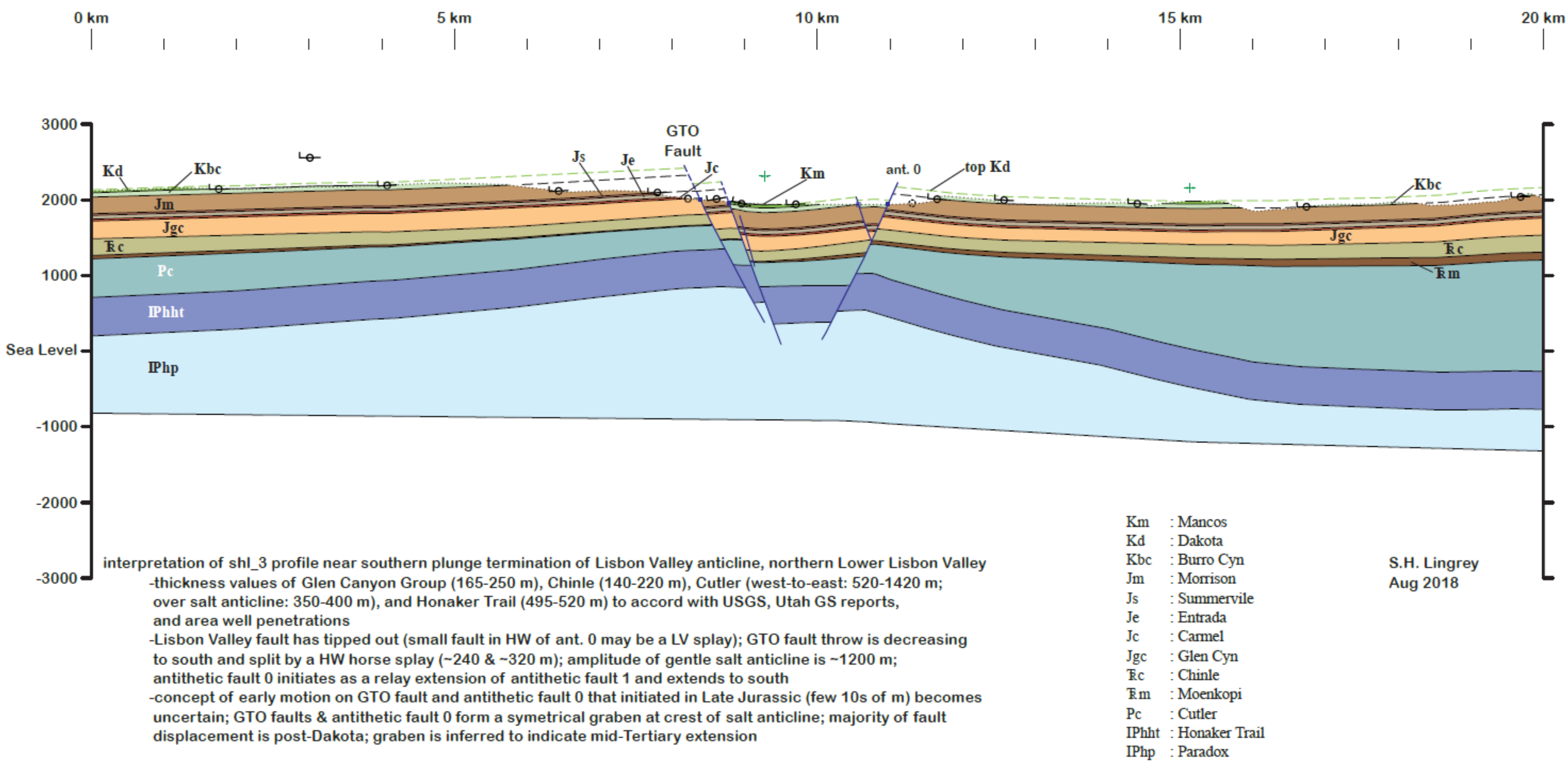


Figure 3.10 Regional Cross Section SHL-4

This Figure shows 3-Step fault throw decreasing, reduction of salt anticline elevation, and overall continuation symmetrical graben morphology. This includes juxtapositioning of Kbc with Js on the south and Kbc with Jsw-Jgc on the north.

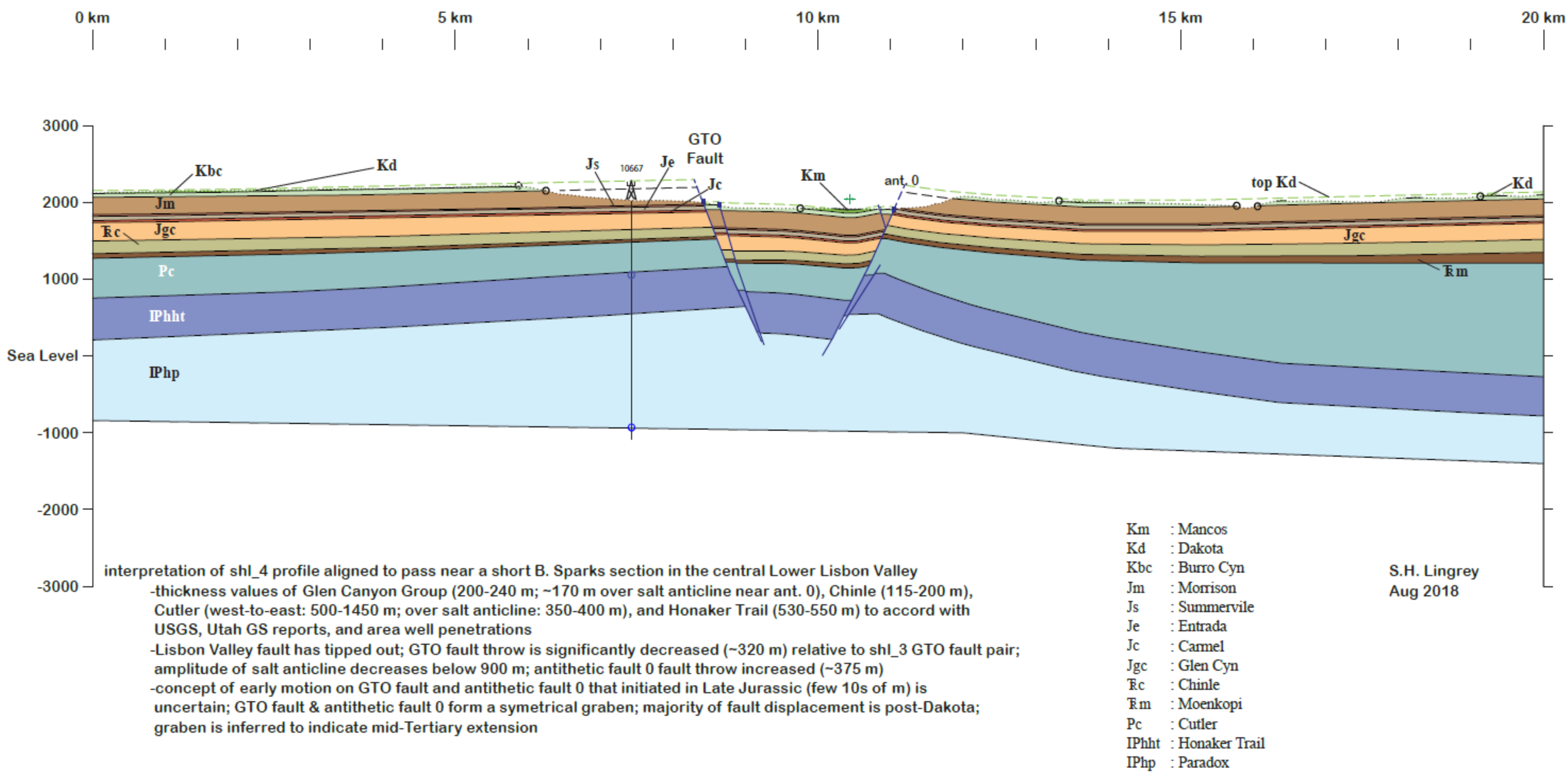
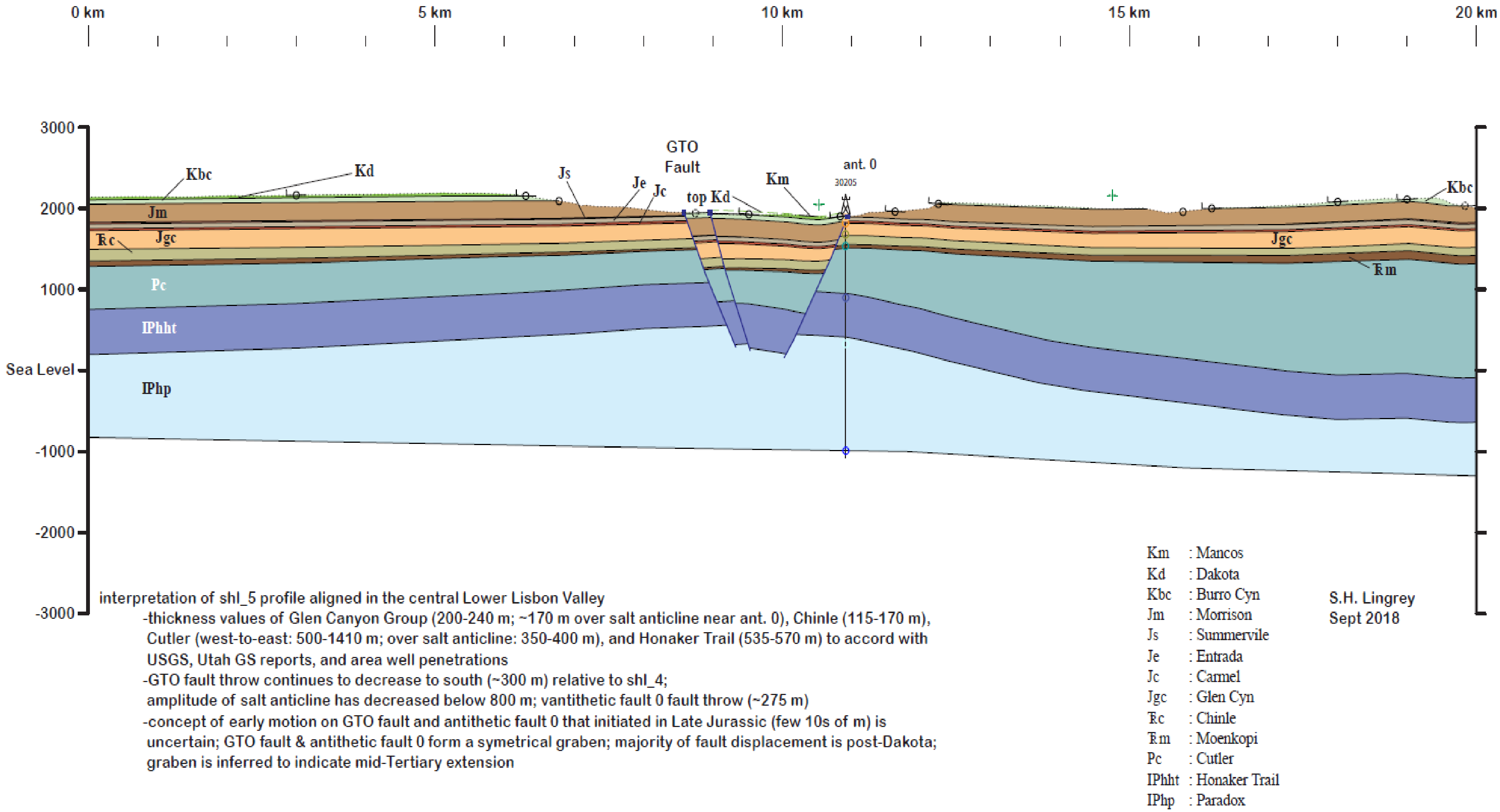


Figure 3.11 Regional Cross Section SHL-5

This Figure reflects continued graben symmetry with reduced fault throw on both sides of the valley. Kbc remains juxtaposed with Jsw on both sides of the valley.



3.4.4 Regional Hydrogeologic Setting

This section describes the regional hydrogeologic setting of the Paradox Basin which provides the framework for the occurrence and movement of groundwater in the Project Area.

The maximum known thickness of the post Precambrian sedimentary section is about 10,000 feet. The entire sedimentary section can be water bearing to some degree, though the permeability, thickness, and relation to recharge areas govern the water yielding ability of individual formations. Some of the water-yielding formations are grouped into aquifer systems following nomenclature of Cooley and others (Avery 1986).

3.4.4.1 Regional Structure

Laccoliths of Tertiary age which form the La Sal and Abajo Mountains have modified the local structure and influence local hydrology. The greatest recharge to any of the regional aquifers occurs on the flanks of these mountains. The La Sal Mountains are surrounded by anticlinal structures resulting from intrusions of salt domes which later collapsed due to salt dissolution. These processes formed the discrete valleys including Lisbon Valley which are bounded on the southwest side above each salt intrusion by a normal fault scarp of major displacement.

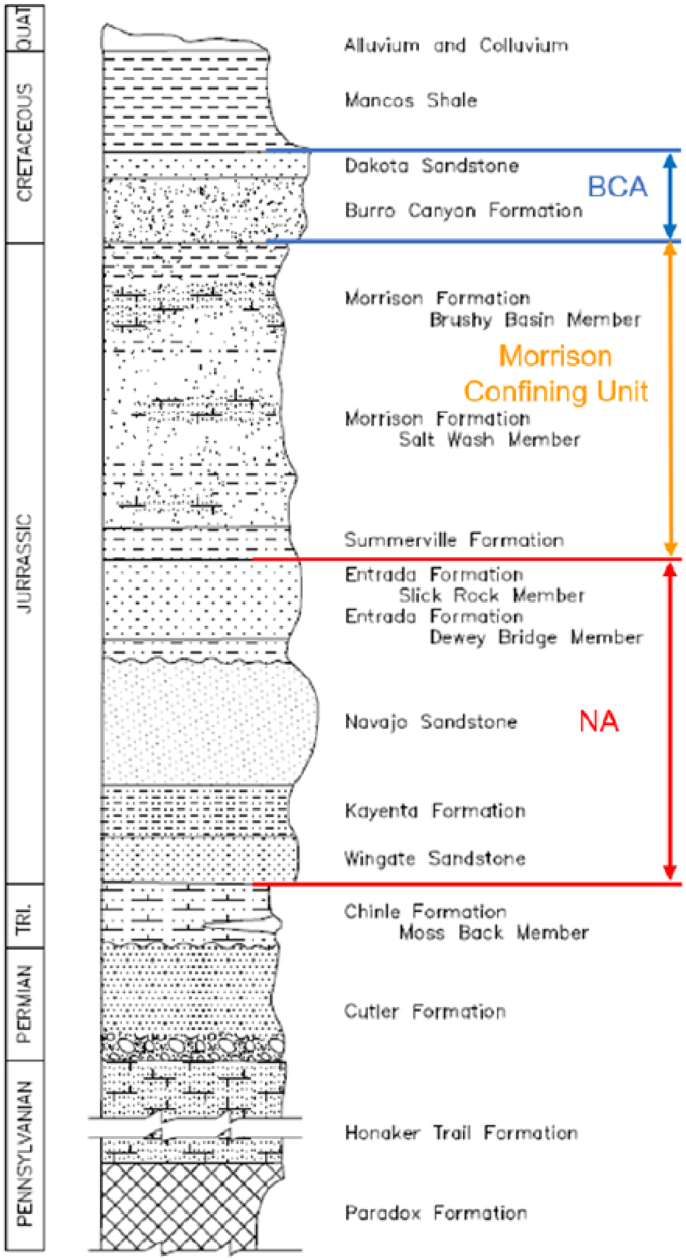
3.4.4.2 Regional Groundwater Occurrence

The water-yielding formations in the study area have been grouped together into five aquifers designated as P, C, N, M, and D in order of decreasing depth. A detailed description of regional geology and aquifer designations is provided in Table 3.1 [Appendix A (Avery 1986)]. Of these of these only the N and D Aquifers yield sufficient water to support domestic water supplies. A regional description of the N and D Aquifers is described below along with the intervening Morrison Formation which hydraulically confines them. The Morrison is a regional confining unit,and is described in further detail in Section 3.6 below.

3.4.4.3 Regional Hydrostratigraphic Units

The regional hydro stratigraphy of the Paradox Basin is shown below. At the bottom of the section are the Pennsylvanian evaporites which deformed and breached the overlying section (Permian-Cretaceous). Evaporites are included in the regional description since they form a lower boundary of for all aquifers and influence aquifer salinity at great depths. Also Included in this section are the primary regional aquifers, including BC Aquifer and N Aquifer. The BC Aquifer is comprised of Dakota and Burro Canyon Formations. The BC is confined above and below vertically by Manco Shale and the Morrison Formation. The N Aquifer underlies the BC and similarly confined vertically by Morrison and Chinle Formations.

Figure 3.12 Regional Hydro Stratigraphic Units



3.4.4.4 Navajo Aquifer

The N-aquifer consists of moderate to low-permeability sandstones and siltstones of the Entrada, Navajo, Kayenta, and Wingate formations, which generally behave as a single hydro stratigraphic unit (Avery, 1986). Because the Navajo is the most permeable of those formations, references to the "deep aquifer" in Lisbon Valley generally refer to the saturated Navajo Formation. In the Project Area, faulting has limited the areal extent and the hydraulic connection of the N-aquifer.

3.4.4.5 Morrison Brushy Basin Member Confining Unit

The Morrison Formation, because of its low permeability and continuity beneath the Project Area, is the lowermost confining unit for the proposed ISR operations. The Brushy Basin member is approximately 400feet thick and is composed of waxy, calcareous, non-carbonaceous massive shale with numerous limestone lenses and a few thin fine-grained sandstones. Analyses of hydraulic heads, groundwater chemistry, and groundwater ages above and below the Morrison demonstrate its function as a robust groundwater aquitard. Any degree of fracturing in the Morrison is not sufficient to allow hydraulic communication between the overlying BC Aquifer and underlying N Aquifer. The conclusion is supported by distinct hydraulic head and geochemical contrasts in the BC and N Aquifers. The hydraulic separation has been thoroughly evaluated and included current research conducted by the University of Arizona (see Appendix C).

3.4.4.6 Burro Canyon Aquifer

The BC Aquifer is comprised of the Dakota Sandstone and the Burro Canyon Formation. The aquifer is approximately 450 feet thick. Throughout the Project Area, the Dakota Sandstone is primarily unsaturated and aquifer water is located is the relatively high-permeability sandstone of the lower unit (Bed15) of the Burro Canyon Formation. The BC aquifer is the also the ore host in the Project Area and therefore has been extensively drilled, cored, sampled and tested.

The Burro Canyon Aquifer is confined within LLV. The north boundary of the aquifer is defined by the Lone Wolf/Flying Diamond fault which terminates the BC Aquifer against the Coyote Footwall. The south boundary is defined by the Lisbon Valley Fault which terminates the aquifer against the Three Step Footwall. The east boundary is defined by geologic structure which elevates the Burro Canyon formation above the piezometric surface, effectively pinching out the aquifer, and above the ground surface, exposing the Burro Canyon Formation in Little Indian Canyon. The west boundary is defined by geologic structure which elevates the Burro Canyon formation above the piezometric surface, effectively pinching out the aquifer.

3.4.4.7 Regional Groundwater Flow

As described above, the La Sal Mountains modified the structure of the overlying formations and influence groundwater flow into the points south. These include the coyote Syncline and Lisbon Valley Anticline.

The general direction of movement of water in the N Aquifer is shown by the potentiometric surface in Figure 3.14. The potentiometric surface is necessarily generalized because of differences of water level in many places due to vertical gradients.

South of the La Sal Mountains, water moves west and southeast from a groundwater divide that extends in a southwest direction. Further south, water is confined in the non-collapsed north limb of the Lisbon Valley anticline.

Five discrete regional flow systems are known in the BC aquifer. Near La Sal, groundwater flow generally coincides with surface water. East of La Sal, the flow is toward the southeast. On the west flank of the La Sal Mountains, flow is down dip. Figure 3.15 shows regional BC Aquifer movement from La Sal Mountains.

Figure 3.13 Regional N Aquifer Groundwater Movement (Avery, 1986)

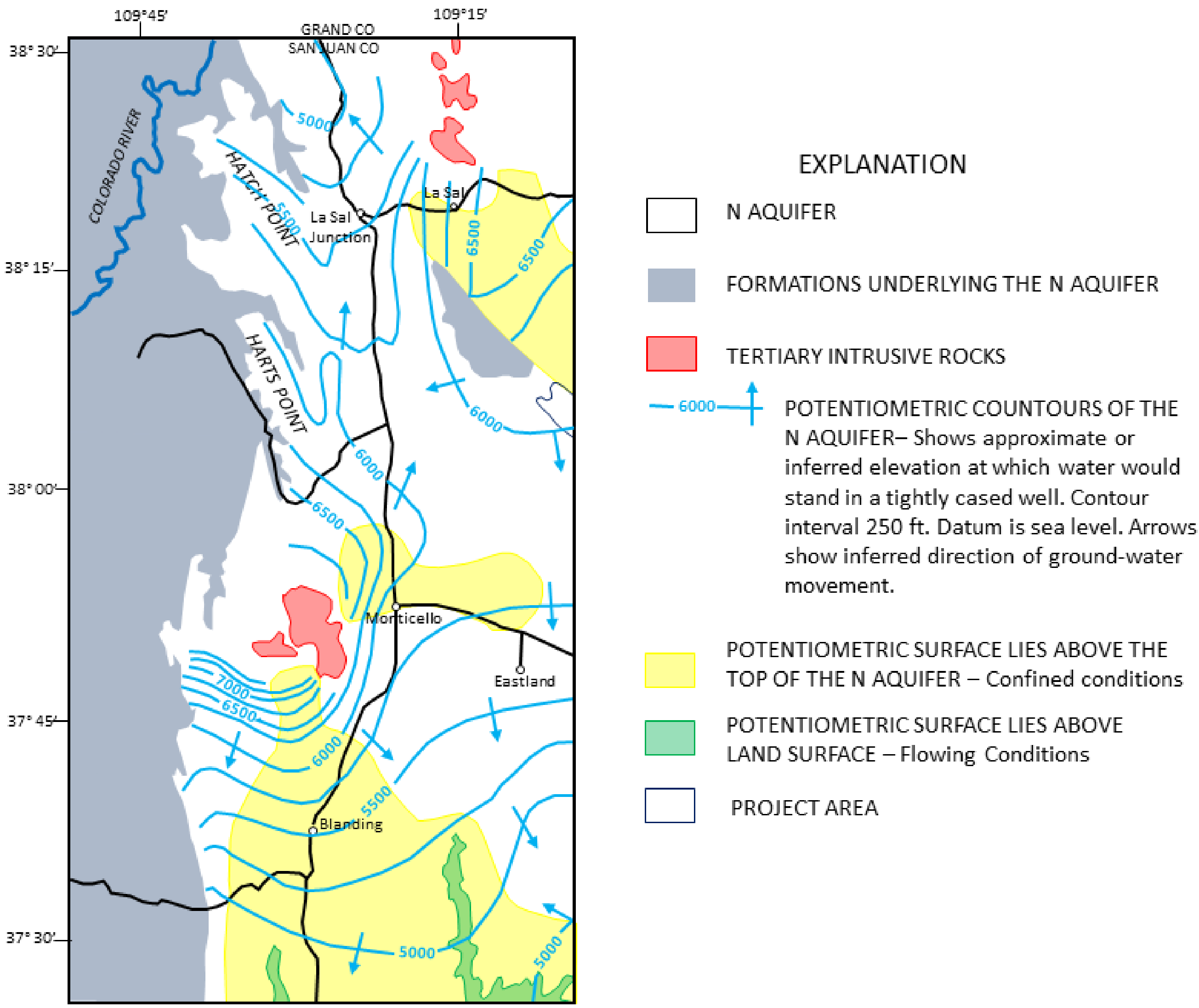
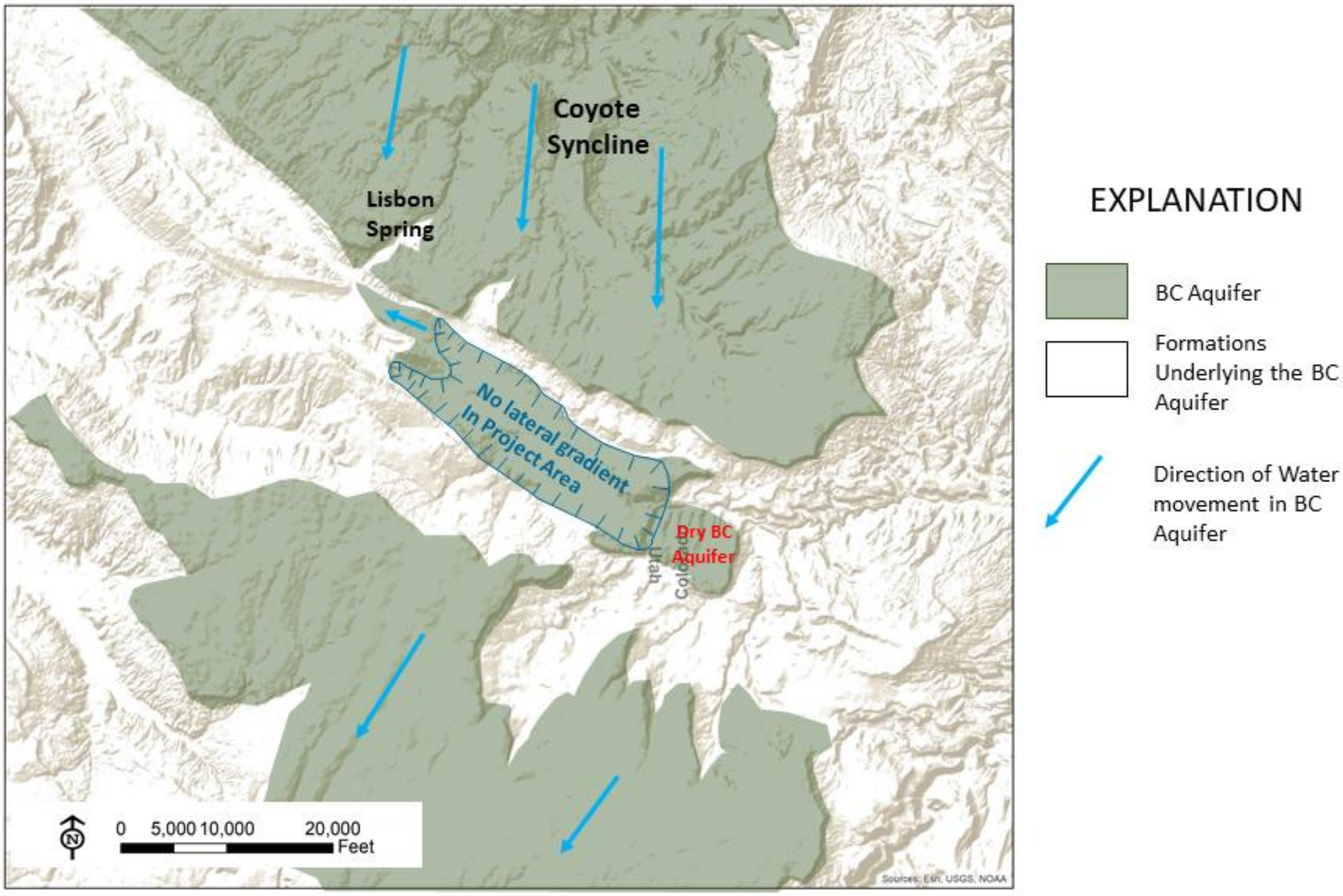


Figure 3.14 Regional BC Aquifer Groundwater Movement (Avery 1986)



3.5 Maps and Cross Sections of Local Geology, Hydrology, and Lithology

This section lists the localized maps and cross sections that show the geologic structure of the Project Area. The descriptions and classifications are based on thousands of feet of drilling, sampling and assay. These maps and cross sections are provided in Section 3.6 below.

Figures:

3.6 Local Geology

Stratigraphic units within the Project Area consist of Late Cenozoic continental deposits, Mesozoic continental and minor marine strata, and Paleozoic marine and minor continental strata. Most of the Paleozoic strata occur only in the subsurface. Mesozoic strata outcrop over extensive parts of the area.

3.6.1 Paleozoic Deposits

3.6.1.1 Pennsylvanian

The Paradox Formation is composed of salt cyclically interbedded with strata containing black shale, dolomite, and anhydrite. The Lisbon Valley area is located near the center of the evaporate basin and near the western margin of the area of thicker Paradox Formation Deposits. During development of the Lisbon Valley non-diapiric structure, the Paradox Formation was significantly deformed and thickened by salt flowage.

The Honaker Trail Formation is the oldest formation exposed at the surface in the Lisbon Valley Project area. The upper one-third of the formation is composed of gray fossiliferous limestone interbedded with red-brown to brown sandstone and gray, green and red shale. The lower two-thirds of the formation is composed of gray limestone interbedded with black shale containing thin anhydrite beds. The Honaker Trail Formation is approximately 1,200 to 2,000 feet thick.

3.6.1.2 Permian

The Cutler Formation overlies the Honaker Trail Formations with a locally gradational contact. The Cutler Formation is composed of maroon, red, purple, and yellow conglomerate and conglomeratic sandstone, interbedded with brown, red, and purple siltstone. Some thin gray limestone and chert lenses occur near the base. These strata represent deposition in a continental environment.

3.6.2 Mesozoic Deposits

3.6.2.1 Triassic

The Triassic period is represented in outcrop, in the Lisbon Valley area, by the Chinle Formation, which is composed of red, brown, and gray sandstone and conglomerate and red, brown, purple, and green-gray mudstone. These rocks form a distinctive red colored sandstone to siltstone upper unit and a green colored mudstone and conglomerate lower unit, identified as the Moss Back Member. The formation is bond by an unconformity at the base and a para-conformable contact with the overlying Wingate Sandstone. The Chinle Formation is approximately 450 feet thick in the Lisbon Valley area. These strata represent continuing continental deposition during Triassic time, including fluvial, floodplain, and lacustrine environments.

3.6.2.2 Jurassic

Jurassic strata represent continuing deposition in continental environments. Eolian conditions deposited massive sandstones, while interbedded sandstone, shale, and siltstone formed in fluvial environments. Local freshwater limestones were deposited in lacustrine settings.

The Wingate Sandstone is composed of massive orange-gray to red-brown cross-bedded sandstone. This resistant sandstone is the basal formation of the extensive west-dipping cuesta that forms the western flank of the Lisbon Valley anticline. The Wingate Sandstone is approximately 250 feet thick in the Project Area.

The Kayenta Formation overlies the Wingate Sandstone. The Kayenta is composed of thin-bedded red and purple cross-bedded sandstone, irregularly interbedded with red siltstone. Both upper and lower contacts are gradational. The Kayenta forms a broad ledge slope between the Wingate sandstone and the overlying Navajo Sandstone. The Kayenta Formation is approximately 200 feet thick in the Lisbon valley area.

The Navajo Sandstone is composed of massive white and yellow to orange cross-bedded sandstone. The Navajo Sandstone is not as resistant as the Wingate Sandstone and forms low mounds and rolling topography. The Navajo Sandstone is approximately 250 feet thick in the Project Area.

The Entrada Sandstone overlays the Navajo Sandstone in an unconformable contact. The Entrada is divided into three members. The lower is the thin-bedded Dewey Bridge Member, composed of red siltstone and sandstone. The Dewey Bridge Member has a gradational contact with the overlaying massive Slick Rock Member. The Slick Rock Member is composed of massive, gray, yellow, red and brown cross bedded sandstone. The Slick Rock Member is approximately 200 feet thick in the Lisbon Valley area. The Moab Tongue Member is the upper member of the Entrada Formation but only the Dewey Bridge Member and the Slick Rock Member are present in the Lisbon Valley area.

The Summerville Formation overlies the Slick Rock Member of the Entrada Sandstone. The Summerville Formation is comprised of red, thin-bedded mudstone and gray to yellow sandstone. The Summerville Formation is approximately 75 feet thick in the Project Area.

The Morrison Formation overlies the Summerville Formation, and is comprised of two members in the Lisbon Valley area. The lower Salt Wash Members consists of brown lenticular sandstone interbedded with red mudstone and thin gray limestone at its base. The Brushy Basin Member is the upper member of the Morrison Formation. The Brushy Basin is composed of gray and red-brown bentonitic mudstone and brown conglomeratic sandstone. The bentonitic component is derived from large quantities of volcanic ash carried in by streams that flowed north and northwest through the area. The Morrison Formation forms alternating cliff and slope topography beneath the overlying Burro Canyon Formation and is approximately 600 feet thick in the Lisbon Valley area.

3.6.2.3 Cretaceous

The Cretaceous strata represent marine and transitional depositional environments. Conglomerates, sandstone, mudstone, and coal deposits were formed in transitional costal river deposits and coastal beach and swamp deposits. Limestone and fossiliferous shale were formed in marine environments.

The Burro Canyon Formation is composed of brown-orange and gray sandstone and conglomerate. Thin beds of dense gray limestone and green-purple mudstone are also present. The Burro Canyon Formation has an intertonguing relationship with the underlying Morrison Formation. The upper contact with the Dakota Sandstone is an unconformity between Lower Cretaceous and Upper Cretaceous strata. The Burro Canyon Formation is one of the host rocks for copper mineralization in the Lisbon Valley area. The resistant Burro Canyon Formation and the overlying Dakota Sandstone form caps on the tops of several mesas in the Lisbon Valley area. The thickness of the Burro Canyon Formation is variable because of the unconformity defining the formation top, and ranges from 150 feet to 300 feet in the area.

The Dakota Sandstone is composed of brown and yellow sandstone and conglomerate and interbedded gray-black carbonaceous mudstone and local coal. The Dakota Sandstone outcrops are much less extensive than the Burro Canyon Formation, and occur as thin sheets and patches above the formation. The Dakota Sandstone is a copper host in the Lisbon Valley are and is approximately 150 feet thick.

The Mancos Shales overlies the Dakota Sandstone and is the youngest Cretaceous unit in the Lisbon valley area. The Mancos Shale is composed of gray thin-bedded, fissile shale that is locally fossiliferous. The Mancos Shale is primarily eroded away in the Lisbon Valley area but is present up to 400 feet thick in wedges along the Lisbon Valley Fault.

3.6.3 Cenozoic Deposits

Quaternary deposits mapped in the Lisbon Valley area include eolian and alluvial sand and silt, landslide and talus deposits, and alluvial fan deposits. Eolian and alluvial sand and silt occur as thin sheet-like deposition the tops of mesas and plateaus, and as relatively thick valley fill. Landslide deposits form extensive aprons of hummocky topography and partly dissected thin sheets of mass-movement material that are usually derived from failure within the Brushy Basin Member of the Morrison Formation.

3.6.4 Detailed Site Stratigraphy

The Company has a detailed understanding of the local stratigraphy, particularly down to the Morrison Formation. This interval has been extensively drilled, sampled, evaluated, and mined from the surface. In support of mine engineering, the Quaternary Alluvium, Mancos Shale, Dakota, and Burro Canyon Formations have been divided it into 17 Bed numbers. A lithologic description of each bed is provided below.

Bed 1: Quaternary overburden: Unconsolidated sand, silt, and clay.

Bed 2: Mancos Shale (Km): Black fissile shale with trace amounts of gypsum. The upper 20-30 feet is usually weathered to a brownish olive-green color.

Bed 3: Dakota Sandstone (Kd): Fine to medium grained buff sandstone, sometimes separated from bed 4 by black shale. Beds 3, 4, and 5 are usually identical and inseparable, forming a 45-60 foot thick well-sorted, buff sandstone bed.

Beds 4 and 5: Dakota Sandstone (Kd): fine to medium-grained buff sandstone, sometimes with minor gray shale and carbonaceous material. In outcrop med 5 shows a rectangular jointing pattern with spacing of about 5 feet.

Bed 6: Dakota Sandstone (Kd): Coal bed in and around the Centennial pit, grading to a carbonaceous shale or carbonaceous sandstone in Lower Lisbon Valley. Thickness is 5-20 feet.

Bed 7 Dakota Sandstone (Kd): Gray shale to siltstone and sometimes fine-grained silty sandstone. Usually 10 feet thick.

Bed 8: Dakota Shale (Kd): Coal bed usually silty or sandy and poorer grade coal than Bed 6. Bed is typically 6-8 feet thick.

Beds 9-10: Dakota Sandstone (Kd): Beds 9 and 10 are usually indistinguishable. Light to dark gray shaley siltstone, sometimes sandy. Beds are together typically 35 feet thick.

Bed 11: Dakota Sandstone (Kd): Buff to bleached white fine to medium-grained sandstone. Can contain thin interbedded black shale. The thickness of Bed 11 is variable between 2 to 35 feet. Bed 11 is a copper host and frequently has ore grade copper near the Lisbon valley fault.

Bed 12: Dakota Sandstone (Kd): Green to light green to gray shale formed from altered volcanic ash. Bed 12 usually contains abundant pyrite. 5 to 20 feet thick.

Bed 13: Dakota Sandstone (Kd): Buff to orange to bleached white medium-grained sandstone and chert pebble conglomerate at the base of the bed. Bed 13 can have interbedded black shale lenses. Bed 13 is a copper host and typically has ore grade copper in the Centennial and GTO deposits. Bed 13 is 20 to 50 feet thick.

Bed 14: Upper Burro Canyon Formation (Kbc): Bed 14 is composed of red, purple, and green shales, silty to sandy limestone and massive chert beds. Bed 14 varies from 50 to 120 feet thick.

Bed 15: Lower Burro Canyon Formation (Kbc): Buff to bleached white fine to medium-grained sandstone with interbedded chert pebble conglomerate. Within Lisbon Valley Bed 15 is bleached. Bed 15 typically has interbedded green shale beds originating from altered volcanic ash. Bed 15 has weak to strong silicification throughout Lisbon Valley. Bed 15 varies from 50 to 120 feet thick. Bed 15 is and copper host and contains ore grade copper mineralization in all copper deposits in Lisbon Valley.

Bed 16: Early lithologic studies distinguished Bed 16 from bed 15 but that designation is no longer used.

Bed 17: Morrison Formation, Brushy Basin Member (Jmb): Red to brown siltstone with minor interbedded red to buff sandstone. The brushy Basin Member is not a copper host and used as a marker bed as the bottom of the copper deposits in Lisbon Valley.

3.6.5 Local Geologic Cross Sections

This section describes a series of eight local geologic cross sections. Figure 3.15 shows cross section locations

Figure 3. 15 Local Geologic Cross Section Location Map

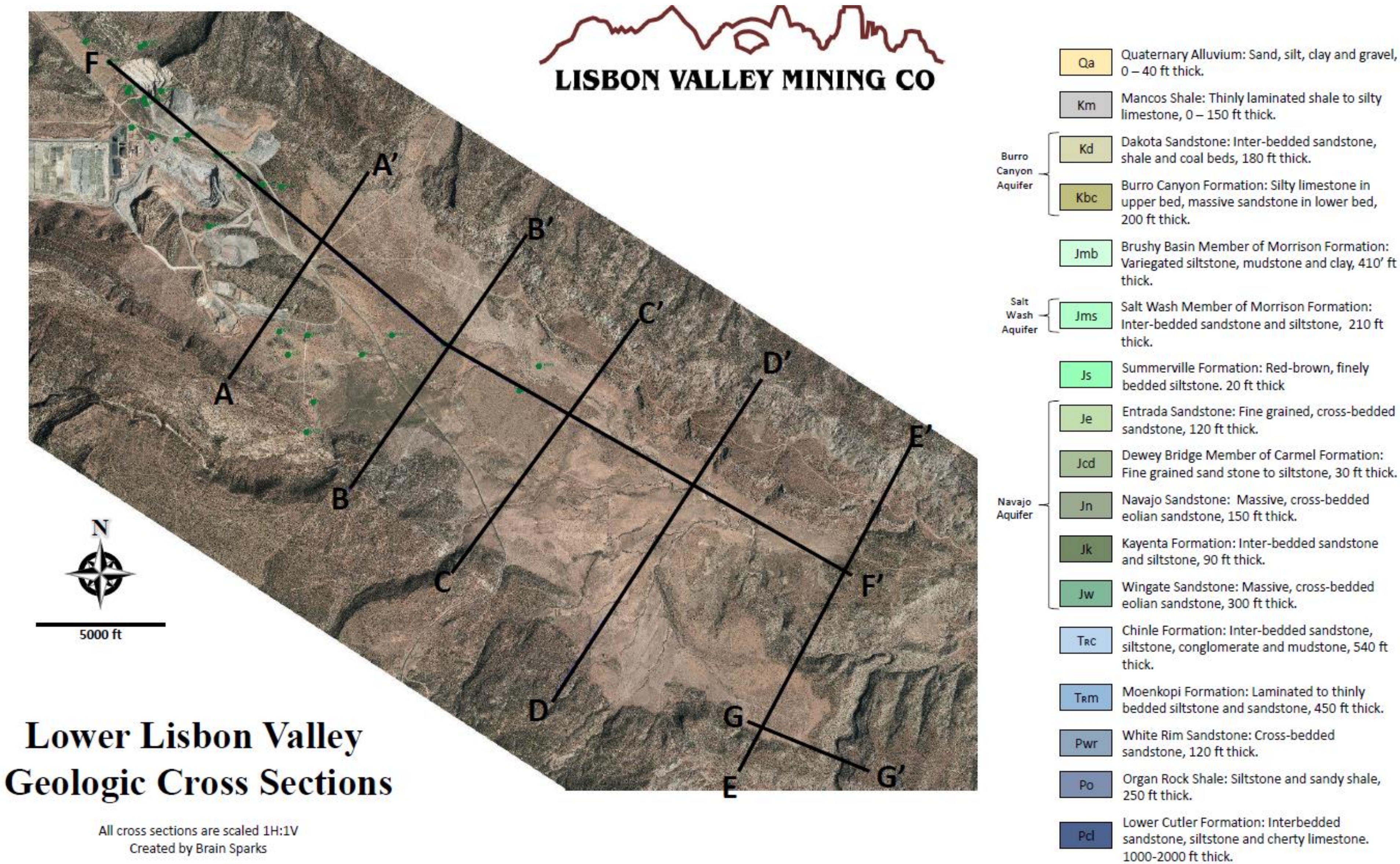


Figure 3.16 Local Geologic Cross Section A-A’

A-A’ illustrates a relay fault system transmitted fault movement on the Lisbon Valley Fault to the SW, widening the Lower Lisbon Valley. The relay fault rotated a block in the center of the valley upward, exposing the Burro Canyon Aquifer at the surface. The relay structure has also down dropped the GTO graben.

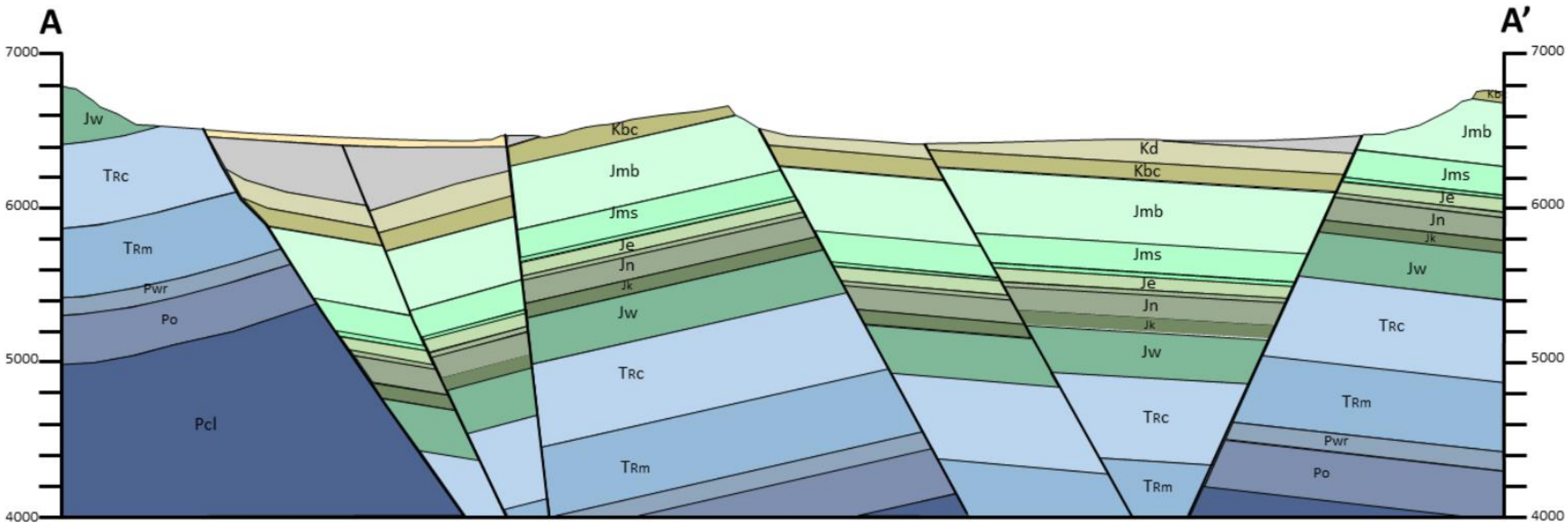


Figure 3.17 Local Geologic Cross Section B-B'

B – B' Figure 3.18 shows the Lower Lisbon Valley bounded by the Lisbon Valley Fault on the SW and the Lone Wolf Fault on the NE. The Lisbon Valley anticline broke into several fault blocks as it collapsed forming the valley. The collapsed faults blocks retain the general shape of the anticline with Dakota Sandstone outcropping in the center of the valley and plunging toward the bounding faults.

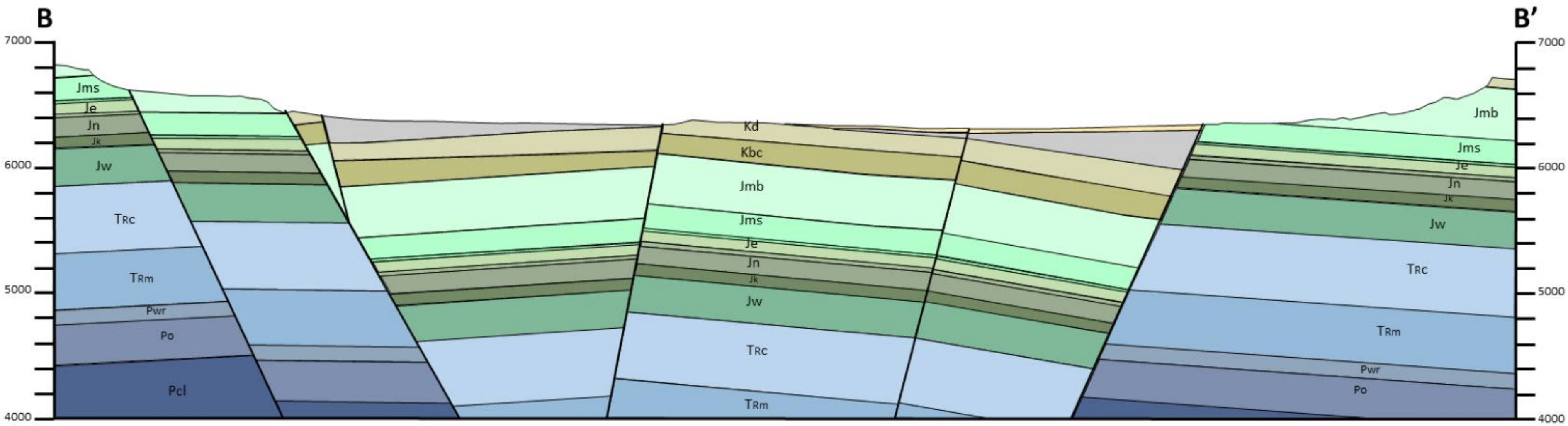


Figure 3.18 Local Geologic Cross Section C-C'

C – C' Figure 3.19 shows faulted blocks in the collapsed Lisbon Valley anticline have enough offset to prevent ground water communication between blocks. Through most of Lower Lisbon Valley, the Dakota Sandstone outcrops at the surface in the anticline crest towards the center of the valley. Here the Burro Canyon formation lies above the ground water table as a function of its elevated position.

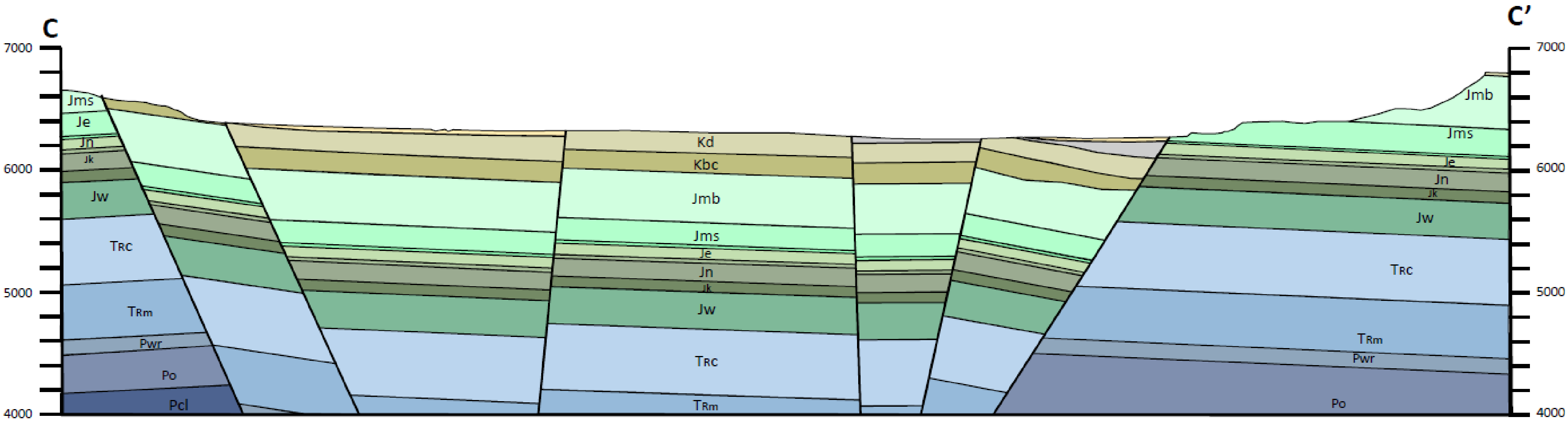


Figure 3.19 Local Geologic Cross Section D-D’

D – D’ Figure 3.20 shows the deepest collapse of the Lisbon Valley anticline with Mancos Shale covering the Dakota Sandstone across the entire valley.

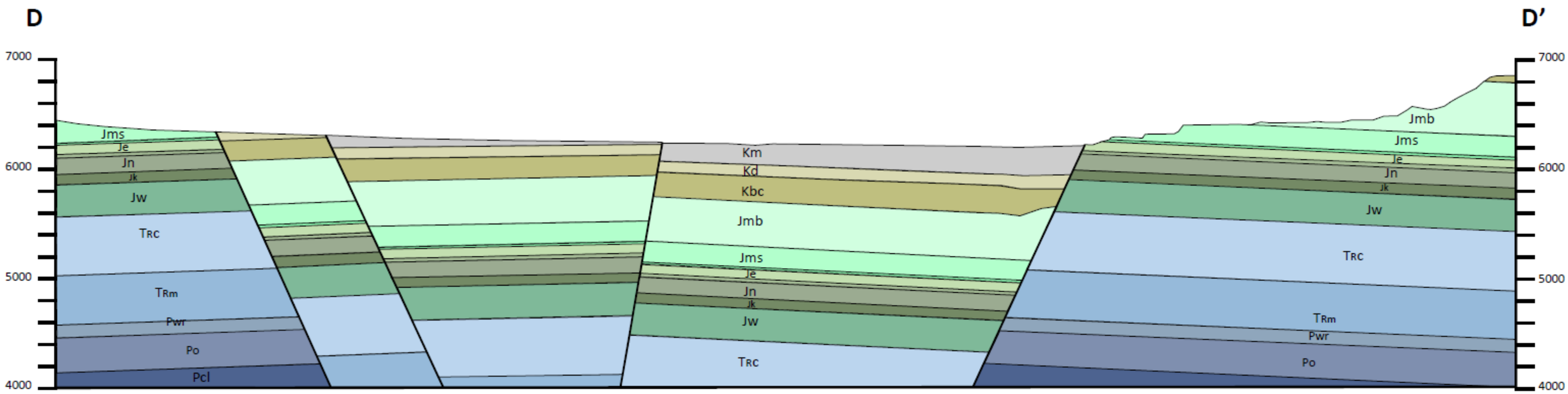
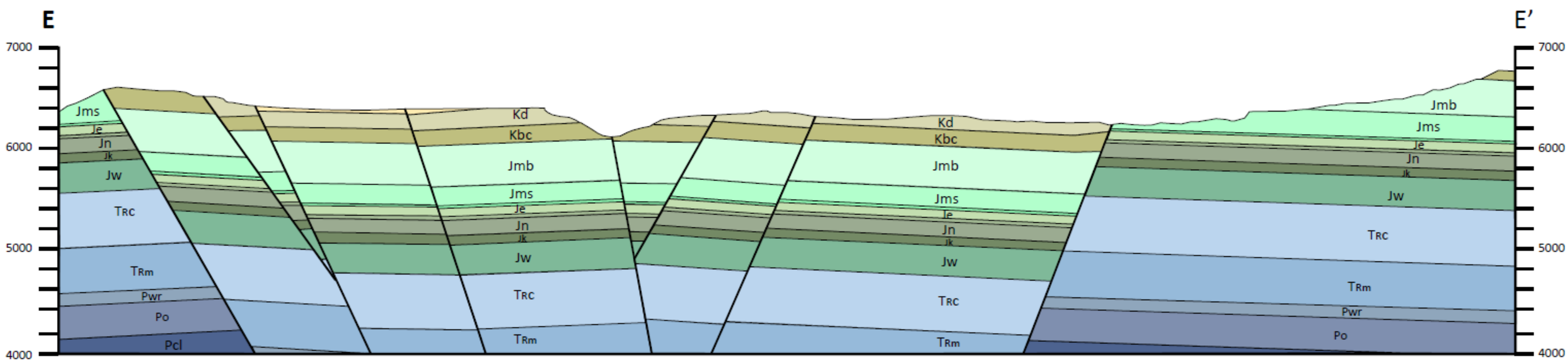


Figure 3.20 Local Geologic Cross Section E-E’

E – E’ Figure 3.21 is located at the SE end of Lower Lisbon Valley where bedding rises to expose the Dakota Sandstone and the Burro Canyon Formation at the surface.

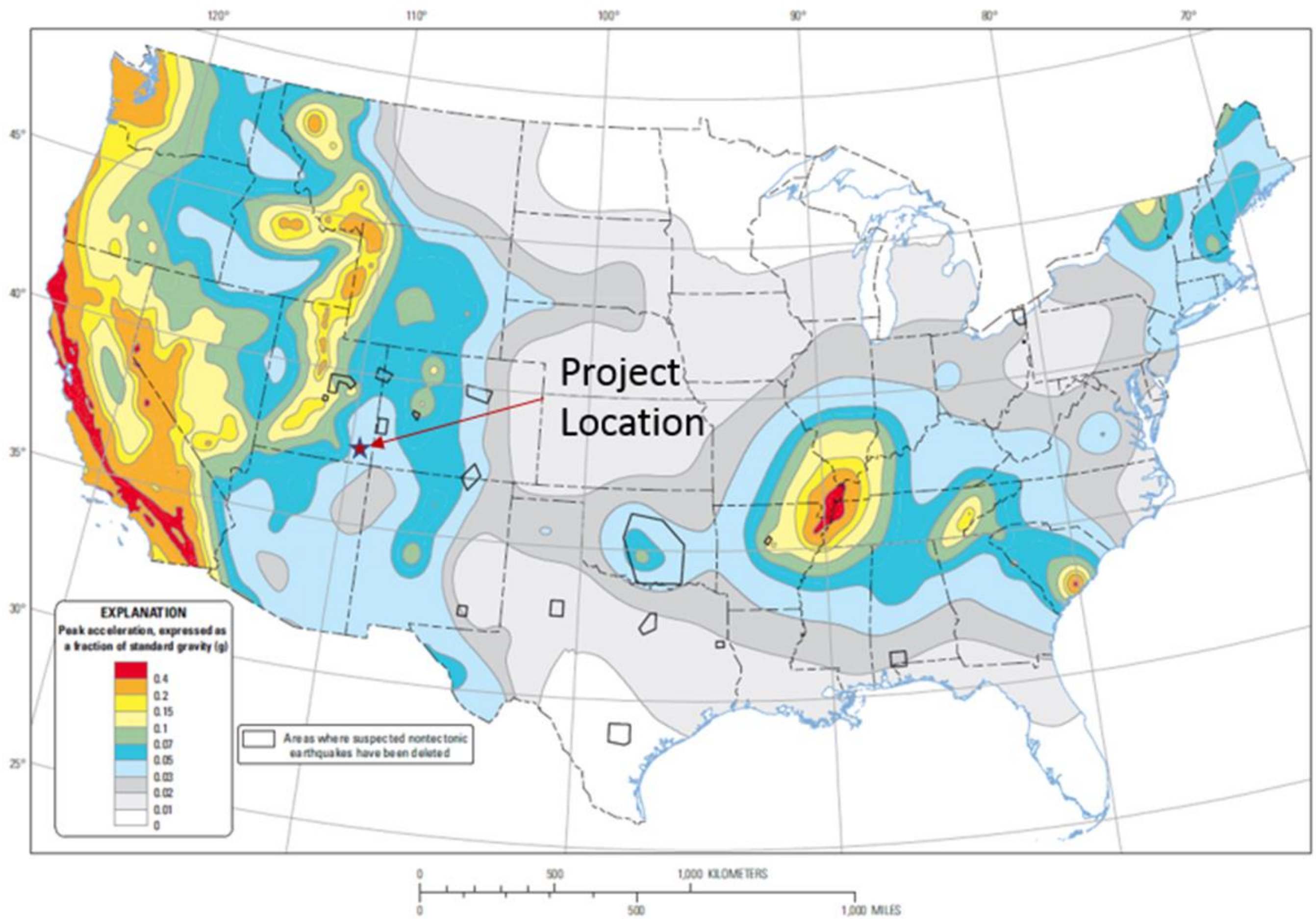


3.7 Seismology

The Project Area is located in an area with the lowest range of seismic potential in Utah and a below average potential nationally. Figure 3.22 illustrates seismicity and peak ground acceleration (PGA) maps for the Project Area, and Appendix B provides a summary of the USGS database results for historical earthquakes recorded within 200 km from the Project Area since 1975.

The closest capable fault zone (as defined in 10 CFR Part 100, Appendix A, Section III(g)) to the Project Area is located 60-75 km (35-50 mi) from the site. According to the USGS 2014 Seismic Hazard Mapping Program, PGA derived from the probabilistic maximum bedrock acceleration with a 10 percent exceedance in 50 years is 0.03 to 0.05g (Figure 3.22) for the southeastern portion of Utah.

Figure 3.21 Seismic Probability Map



Ten-percent probability of exceedance in 50 years map of peak ground acceleration

3.8 Site Hydrogeology

This section details the site-specific hydrogeologic units and describes how the LLV graben structure frames its confinement.

3.8.1 Burro Canyon Aquifer

The BC Aquifer comprises the primary aquifer in the Project Area, primarily due to depth and accessibility. It is discontinuous and segmented, lying at a depth of 200-900 feet below the surface, and approximately 450 feet in thickness. Importantly, it occurs only within the axial graben of the Lisbon Valley anticline. It is eroded away south of the Lisbon Valley Fault and sits exposed above the static water level on the north side of Lisbon Valley. Within the valley, it is disrupted by faults associated with the axial graben, which locally place the host sandstones above the static water level within the valley. As a result, there are fault blocks where the host sandstones are saturated juxtaposed adjacent to fault blocks where the host sandstones are dry, and fault blocks where the aquifer is only partially saturated.

As shown on Figure 3.14, the regional BC Aquifer flow is southerly away from the elevated La Sal mountains. This gradient is not observed in Lower Lisbon Valley where the BC Aquifer is truncated by faulting and geologic structure. Here the BC Aquifer is essentially comprised of a series of confined blocks with varying head pressures with no lateral gradient and no connection with regional recharge. The overlying Mancos shale further reduces surface water recharge. The confinement and lack of recharge in Lower Lisbon Valley supports the poor groundwater quality and elevated TDS concentrations observed in BC Aquifer groundwater samples.

Although the Dakota Sandstone and Burro Canyon Formations are often described as a single unit due to their similarity, they are distinguished by depositional environment. Dakota Sandstone is a nearshore oceanic deposit and is relatively-hard to hard, generally fine-to-medium grained, and is cemented by kaolinite clays. The Dakota Sandstone locally contains discontinuous interbeds of siltstone, shale, and conglomeratic materials. Porosity is primarily intergranular. For the purposes of this report, reference to the BC aquifer is assumed to include the Dakota Sandstone.

The Burro Canyon is a terrestrial deposit of deeply agglomerated fluvial channel deposits. It hosts most of the perched groundwater at the site. The Burro Canyon Formation is generally more poorly sorted, contains more conglomeratic materials, and becomes argillaceous near its contact with the underlying Brushy Basin Member. The permeabilities of the Dakota Sandstone and Burro Canyon Formations range from 10^{-2} to 10^{-4} cm/sec.

Water quality in the Burro Canyon aquifer is poor. The poor water quality is largely due to limited or no recharge of the BC aquifer in addition to confinement which is reflected in the Company's water well production data. To date the BC aquifer water quality below the Lisbon Valley Mine is Class III. This includes the GTO deposit area where free phase oil distillates are encountered in exploration hole. The groundwater in the Lisbon Valley Mine Area has been classified as Class III by the State of Utah (UDEQ, 1998) because it naturally exceeds Utah Ground Water Quality Standards (R317-6-2) for uranium, gross alpha, and gross beta particle activity.

3.8.2 Morrison Formation Brushy Basin Member

As previously described the Morrison Formation Brushy Basin Member is composed of gray and red-brown bentonitic mudstone. It is a regional confining unit with vertical permeabilities ranging from $1.27x10^{-8}$ $5x10^{-9}$ (Adrian Brown 1998). The Brushy Basin member is approximately 400 feet thick in the Project Area.

3.8.3 Navajo Aquifer

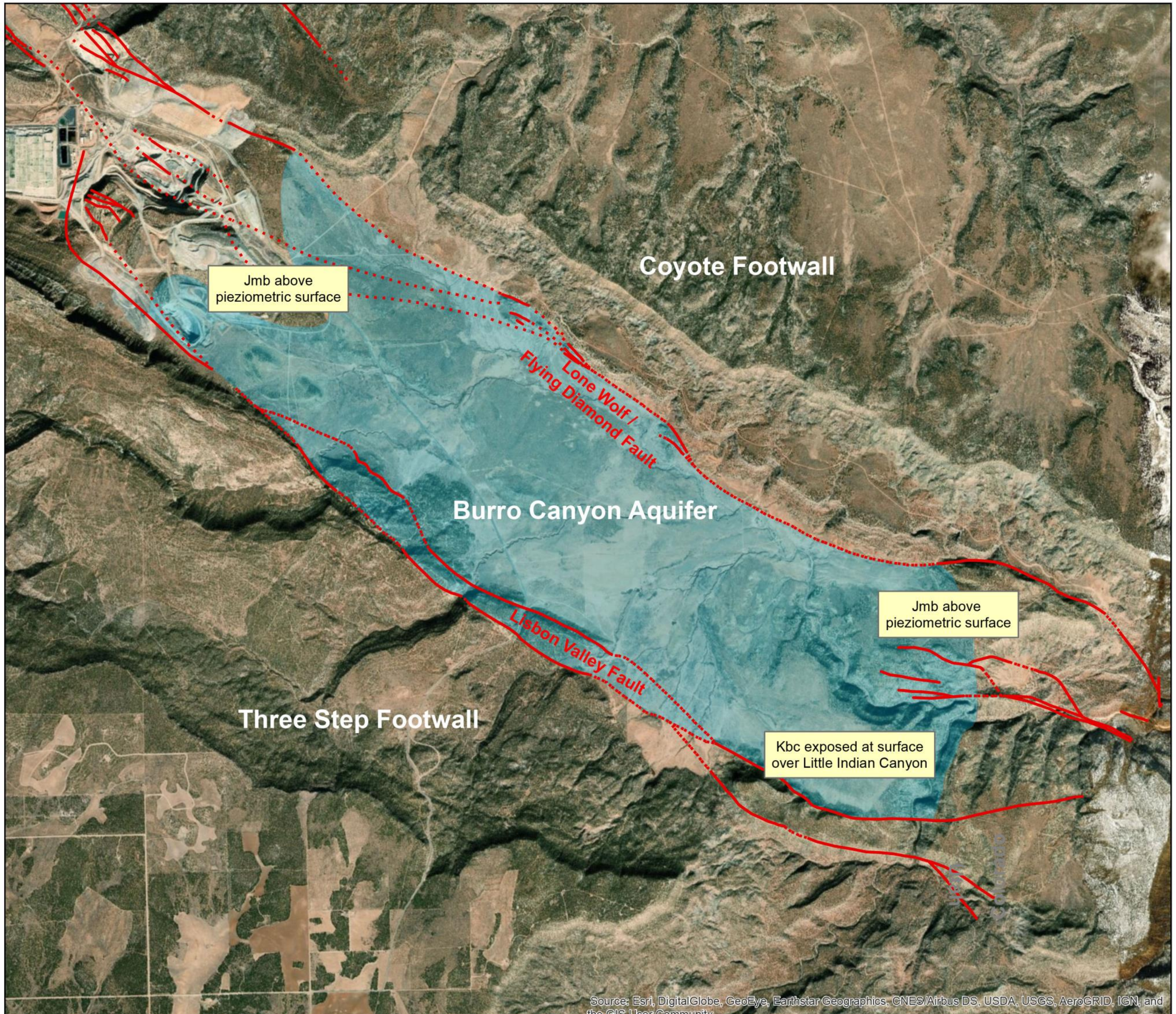
In the Project Area, faulting has limited the areal extent and the hydraulic connection of the N Aquifer, which lies at a depth of 800 to 2,200 feet below the surface. The Lisbon Valley Fault strikes N40°W and dips 30 to 55 degrees to the northeast. In addition, the Lisbon Valley Fault splays into numerous "horsetail" faults to the south. These faults have significant vertical displacement and juxtapose permeable units against relatively impermeable units. This juxtaposition, along with gouge material along the fault surfaces, causes the fault zones to behave as barriers to groundwater flow. As a result, there is substantial compartmentalization of the N-aquifer.

3.8.4 LLV Graben Structure

As previously described, LLV is a graben structure resulting from salt anticlinal collapse. The collapse truncated and down-dropped both BC and N Aquifers into a confined graben structure. The graben juxtaposes the younger BC Aquifer with older formations including Morrison and N-Aquifer formations. Figure 3.23 shows the occurrence and areal extent of the BC Aquifer in LLV. The BC aquifer is confined laterally by geologic structures and non-transmissive faults. Valley-bounding faults truncate the BC on north & south boundaries. Elevating structures dewater the BC on east & west boundaries. The BC Aquifer is vertically confined above and below by the Mancos Shale and Morrison Formation Brushy Basin Member.

Figure 3-24 characterize how the BC and N Aquifers occur bounded by the impermeable faults common to the collapse structure. Figure 3.24 is a LLV thematic cross section that shows how geologic structure truncates the BC and N Aquifers along the north and south valley boundaries. The figure also shows how the aquifers comprise ore bodies at the GTO and Lone Wolf Deposits.

Figure 3-25 combines the cross sections presented in Section 3.6 and shows how and how the BC and N Aquifers are occasionally juxtaposed as a function of the graben structure. Figure 3.25 is a collage of the geologic sections presented in Section 3.6. This figure builds on the concept introduced in Figure 3.9 and adds groundwater occurrence to the geologic intervals that comprise the BC and N Aquifers. The occurrence of groundwater is overlain using a stipple pattern.



Legend

- Faults Inferred
- Faults
- Burro Canyon Aquifer

N

0 2,000 4,000 8,000 Feet

Figure 3.22

Occurrence and Extent of BC Aquifer in LLV

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 23 October, 2019

File Name: ISR Figure 3.23 Burro Canyon Aquifer

LISBON VALLEY MINING CO

Figure 3.23 Occurrence of USDW in LLV

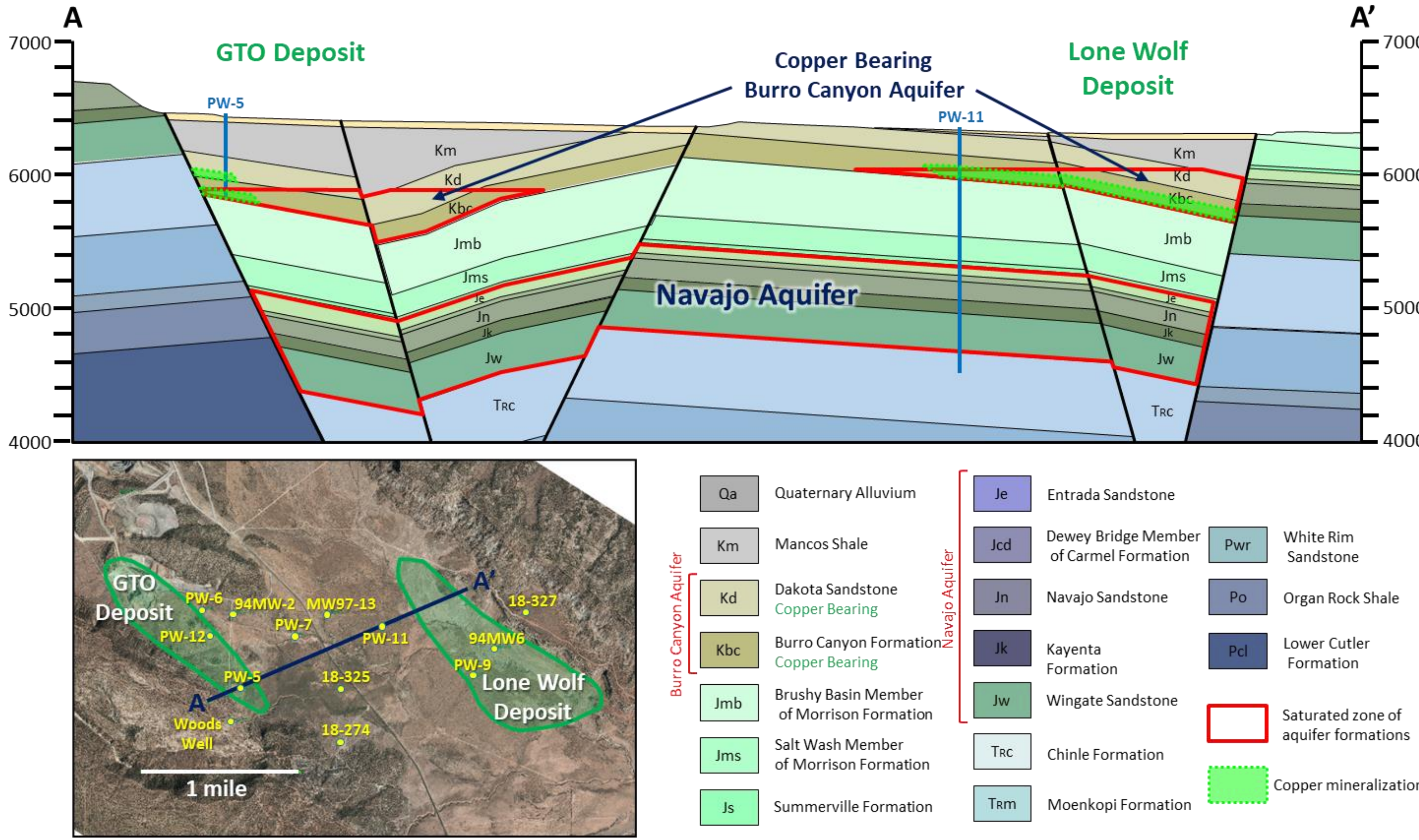
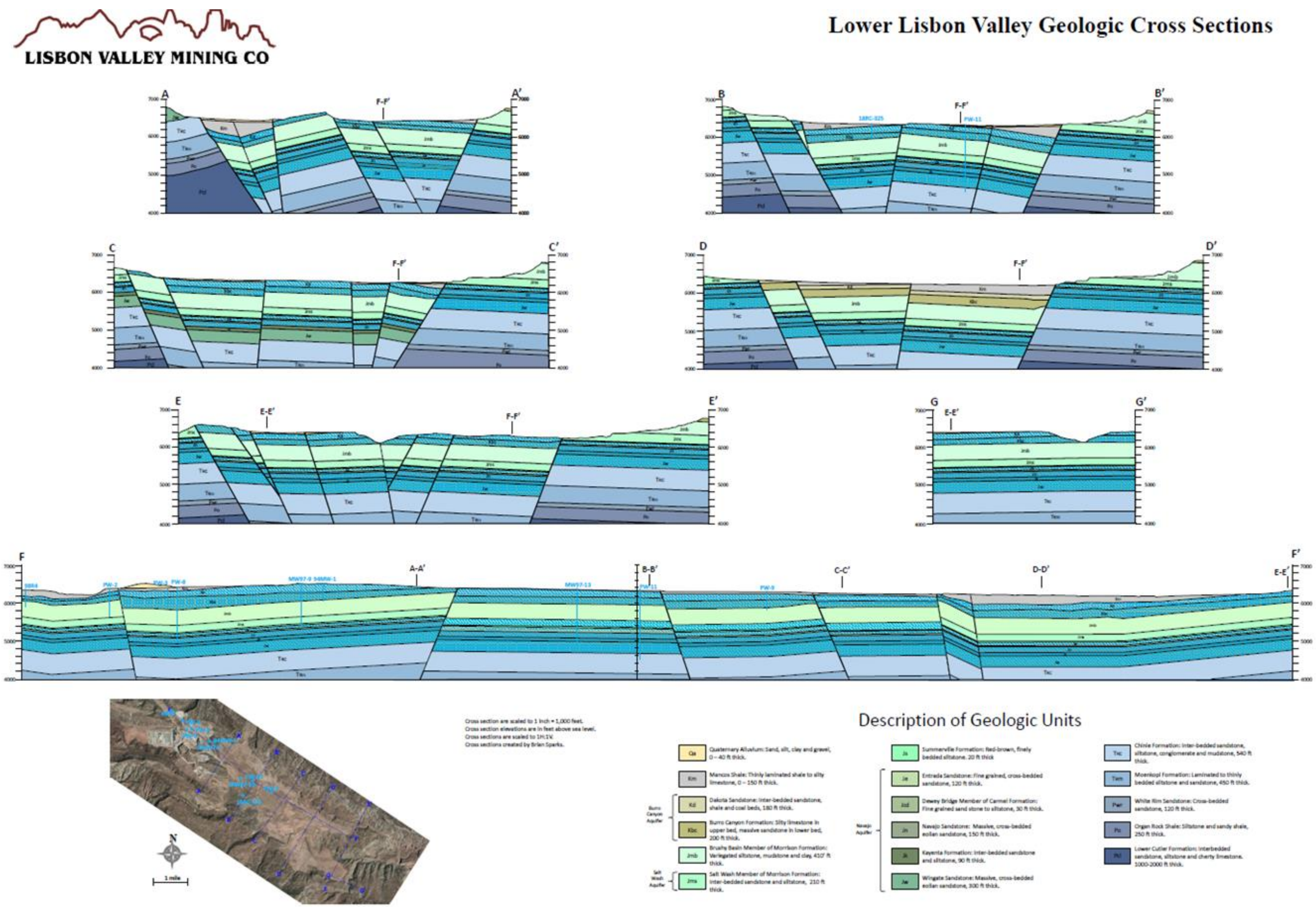


Figure 3.24 Detailed Mapping of USDW in LLV



3.8.5 Groundwater Heads

BC and N Aquifer head pressures are distinct vertically and laterally in the Project Area. This reflects hydraulic separation as a function of the aquitards, LLV graben structure, and low permeability valley-bounding faults.

The N Aquifer groundwater head within the Three Step Footwall maintains an elevation of +6,200 feet amsl. This head is maintained for a distance of 4 miles along the southern Project Area boundary. The N Aquifer head in LLV graben ranges between 5,500, and 5,650 feet amsl. The BC Aquifer heads in the Project Area range from 5,826 on the NW end to 6,175 on the SE. The N Aquifer head within the Coyote footwall has not yet been measured, and is planned for well installation and evaluation in 2020.

3.8.5.1 Vertical Contrasts

As previously described, the Morrison Formation is a regional confining unit. It separates the BC and N Aquifers vertically by approximately 600 feet and creates a BC/N head contrast ranging from 500 to 650 feet. The vertical head contrast is shown on Figures 3-26 and 3-27, underscoring the hydraulic separation and robust perching characteristics of the Morrison Formation.

3.8.5.2 Lateral Contrasts

The lateral head contrasts include both BC/N Aquifer and N/N Aquifer contrasts. These contrasts occur where the N Aquifer is truncated by non-permeable bounding faults or formations. Figure 3-26 (Section B-B') shows the lateral head contrast between N Aquifer within the Three Step Footwall and both BC and N Aquifers in LLV. The influent head from the Three Step Footwall creates an influent head contrast (N/BC) ranging from 455 feet in the NW Project Area to 60 feet in the SE Project Area. A similar contrast is noted when comparing the N Aquifer offsets. Figure 3-26 (B-B') documents > 700 feet of head contrast (N/N) where the N Aquifer is dropped into LLV. The contrasting lateral groundwater heads in LLV underscore the relevance of geologic structure and the occurrence of low-permeability fault boundaries.

Figure 3-25 BC and N Groundwater Heads NW Project Area

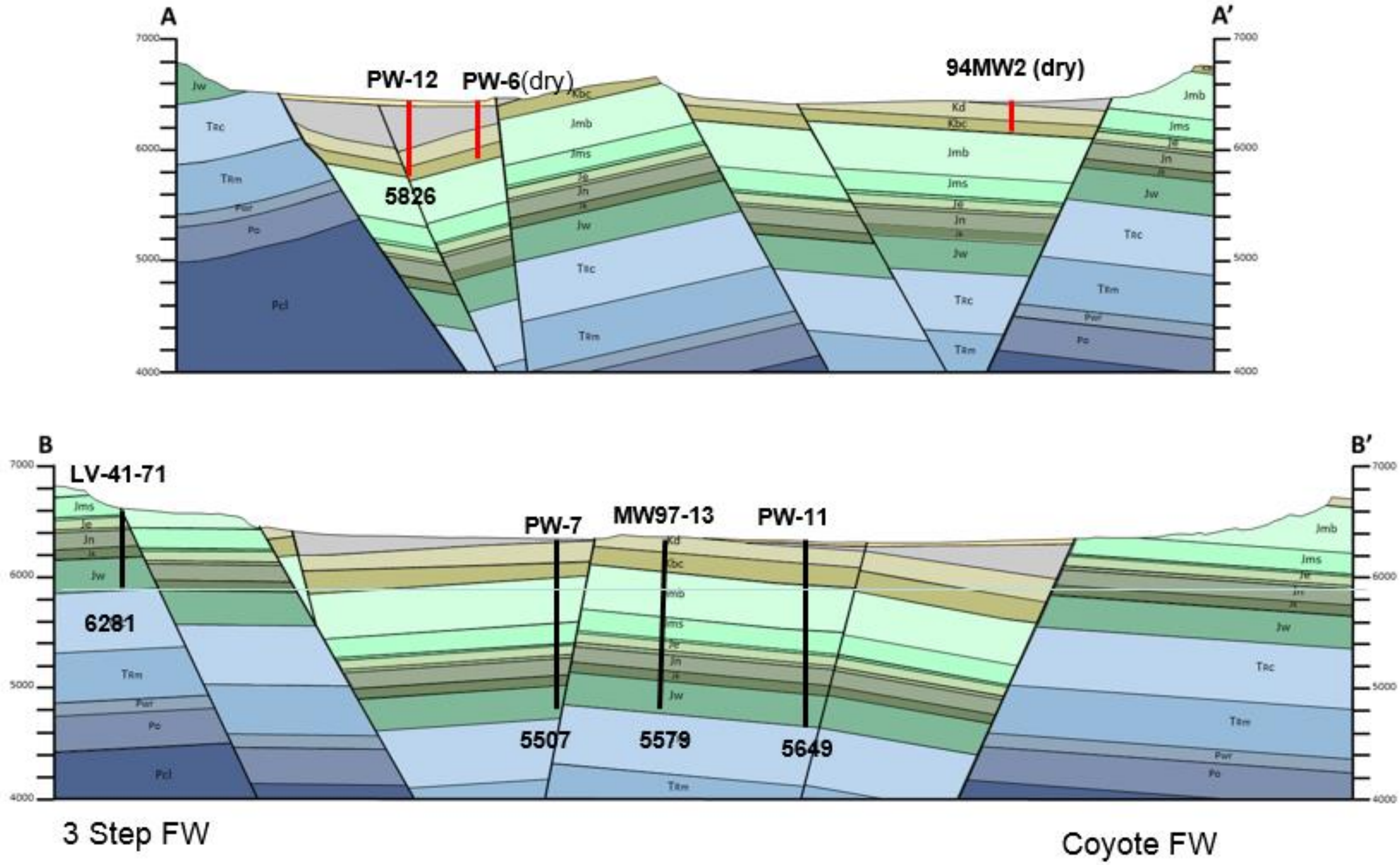
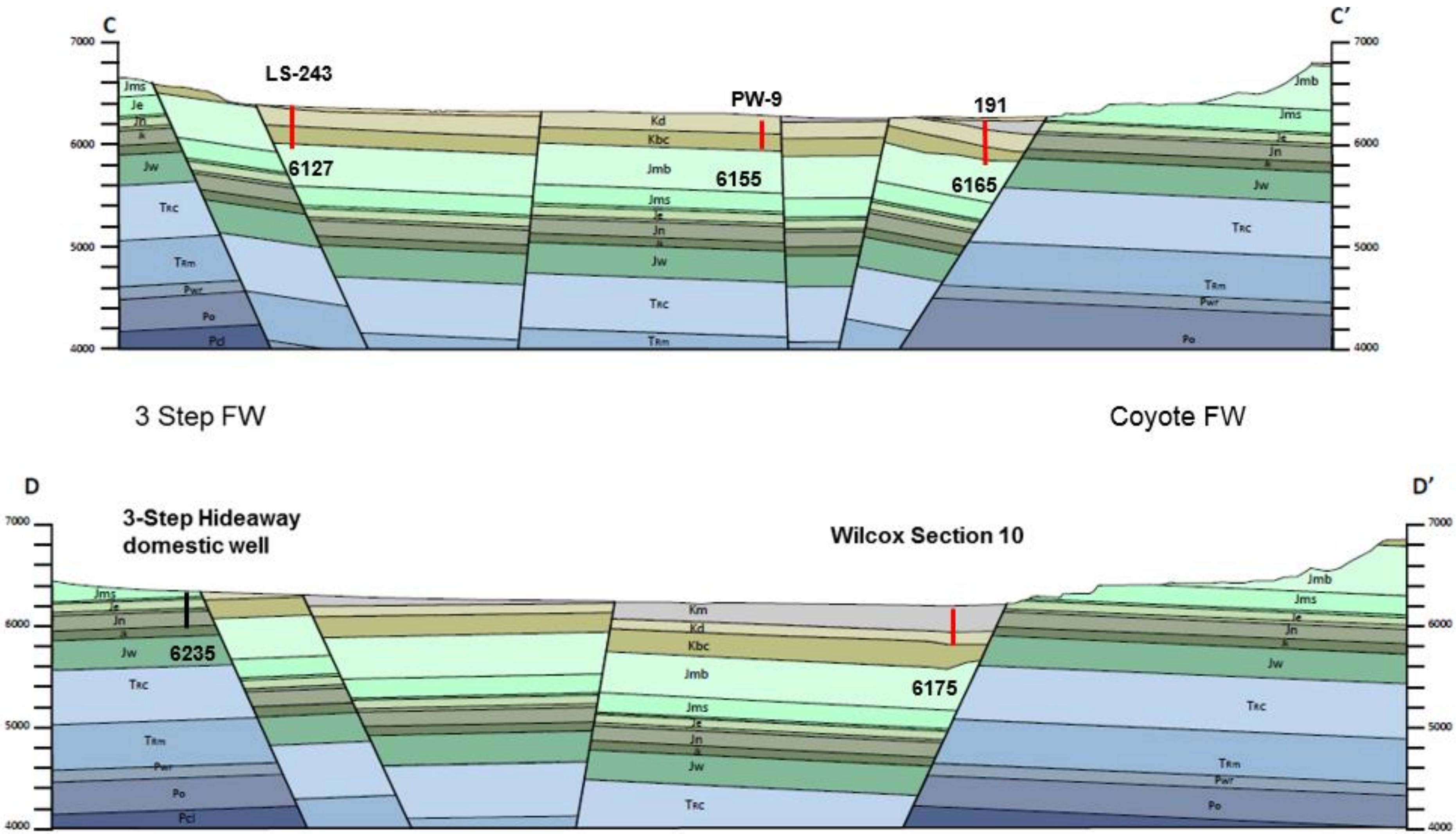


Figure 3-26 BC and N Groundwater Heads SE Project Area



3.9 Rationale for the Aquifer Exemption Boundary

The previous sections describe how the BC Aquifer is laterally and vertically bounded by aquitards and geologic structures in LLV. These structures physically separate the BC from surrounding USDW. The physical separation is supported by groundwater head contrasts. The head contrasts support hydraulic separation from surrounding USDW and support the occurrence of impermeable aquitards, geologic structures and faults. The hydraulic separation is further supported by geochemical and age contrasts with surrounding USDW. Combined, these criteria support vertical and lateral confinement of the BC Aquifer in LLV and provide rationale from with to define and circumscribe the AEB.

3.9.1 The Effect of Faults on the Fluid Flow (C. Broaddus, Dr. Bob Krantz, Fort Lewis College 2019)

Faults in Lisbon Valley act as hydrodynamic barriers between aquifers due to low permeability of fault gouge zones. Most gouge zones range from 3-15 ft wide, separating intact hanging wall and foot wall rock. Fault gouge zones have high measured clay mineral constituents that inhibit fluid flow. Shale Gouge Ratio (SGR) and fault permeability modelling predicts that faults in the Project Area will be effective seals to fluid flow where the BC and Navajo Aquifers are juxtaposed.

In 2019, Dr. Bob Krantz performed Shale Gouge Ratio (SGR) analysis and Fault Permeability Modeling on the Lisbon Valley Fault and the Lone Wolf / Flying Diamond Fault. The analysis focused on the north boundary of the Project Area along the Lone Wolf / Flying Diamond Fault where the majority of the fault trace juxtaposes the BC Aquifer against the N Aquifer, as shown I Figure 3-28. Four sites on the Lone Wolf Flying Diamond Fault, and two sites on the Lisbon Valley Fault (south Project Area boundary) were selected for analysis. Two analyses were performed at each site, one analysis where the Dakota Sandstone juxtaposes N Aquifer formations and the second analysis where the Burro Canyon Formation juxtaposes N Aquifer formations. SGR evaluation sites are shown on Figure 3-29.

Figure 3-27 BC and N Aquifer Juxtaposition

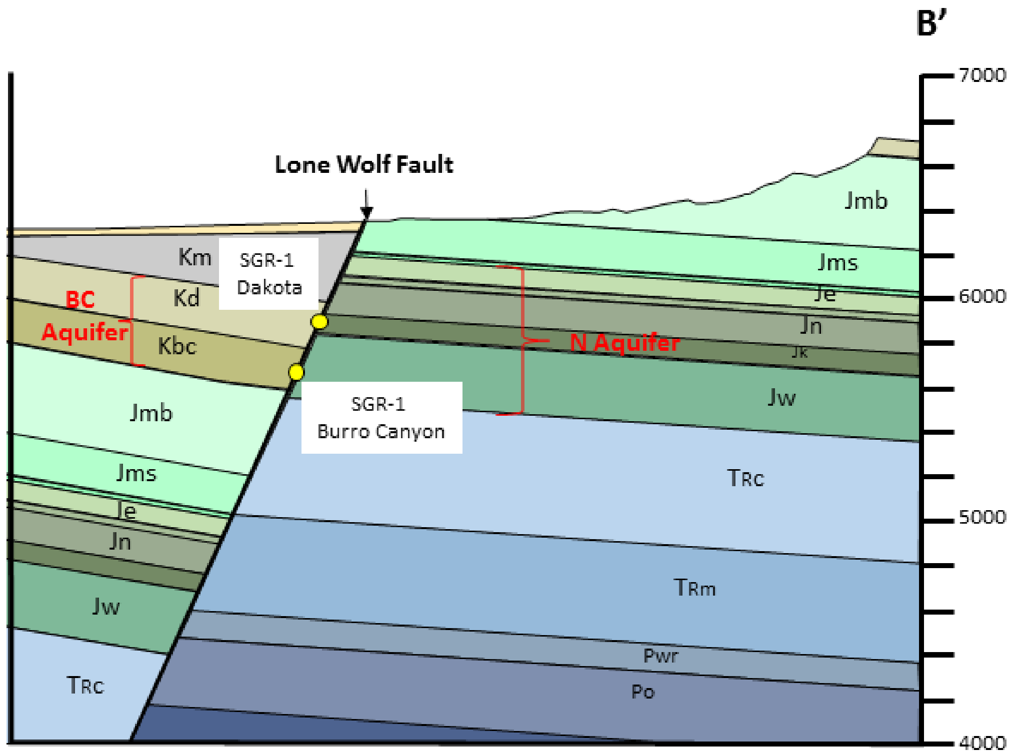
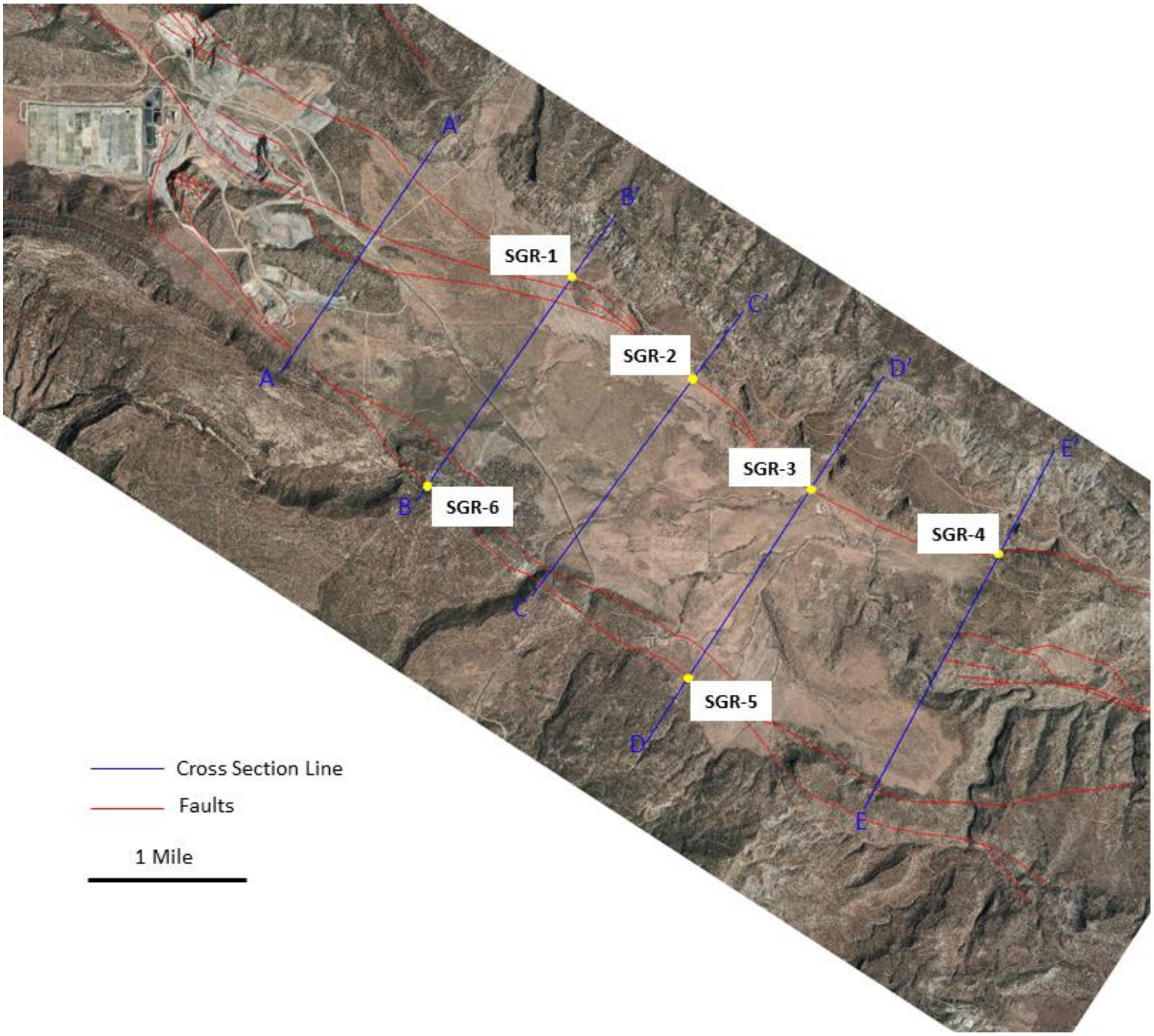


Figure 3-28 SGR Evaluation Locations



Fault gouge results from mechanical grinding and mixing of lithologies offset by the fault. SGR estimates the clay portion of the gouge as a function of the clay content of the faulted strata and throw. Abundant observations, mostly from oil field analyses, show fault seal dependency on clay content of fault zone gouge. Due to fault zone processes, especially cataclasis and shearing, fault gouge has reduced permeability compared to surrounding intact strata, even for rocks with equal clay content

Fault permeability modelling is an extrapolation of SGR that predicts a faults zone's permeability based on existing lab-tested fault permeability samples and their associated SGR values. SGR and permeability values for the Lisbon Valley Fault and Lone Wolf / Flying Diamond Fault sites are shown in Table 3.2. SGR values range from 0.38 to 0.54, corresponding to permeability ranges from 0.02 to 0.08 mD. Industry standards recognize a significant fault seal at SGR values above 0.2. (Fisher et al 2018)

Table 3.2 Fault Permeability Modeling Results

Dakota Sandstone in Hanging Wall

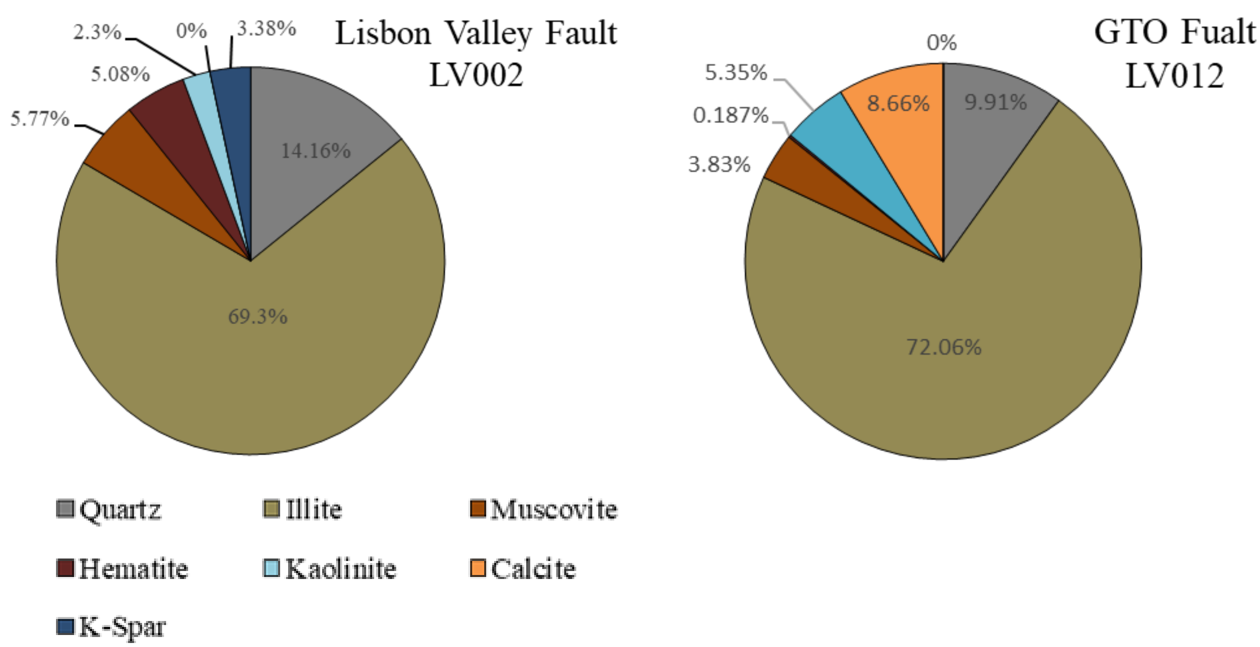
Location	FW Juxtaposition	Fault Throw (ft)	SGR	Perm (mD)
SGR-01	Jn, Jk, Jw	1300	0.45	0.04
SGR-02	Jn	1250	0.48	0.03
SGR-03	Jk, Jw	1400	0.44	0.05
SGR-04	na	na	na	na
SGR-05	Jms, Je	900	0.51	0.02
SGR-06	Jms	800	0.54	0.02

Burro Canyon in Hanging Wall

Location	FW Juxtaposition	Fault Throw (ft)	SGR	Perm (mD)
SGR-01	Jw	1300	0.4	0.06
SGR-02	Jk, Jw	1250	0.43	0.05
SGR-03	Jw	1400	0.38	0.08
SGR-04	Je, Jn	900	0.49	0.03
SGR-05	Je, Jn	900	0.49	0.03
SGR-06	Jms, Je	900	0.5	0.02

In 2018 and 2019, Bachelor of Science in Geology student C. Broaddus performed an evaluation of the effects of the faults on potential fluid flow within the Project Area. This evaluation was overseen and technically supervised by Dr. Bob Krantz, Professor at University of Arizona. Part of the Broadus study quantified fault gouge minerology through X-Ray Diffraction technology. Three samples were collected from the Lisbon Valley Fault for analysis. X-Ray Diffraction results show that all samples have extremely elevated levels of clay constituents, especially illite, with total clay percentages ranging from 50% to 78%. SGR analysis were also performed for the sample locations. SGR values predict clay content from 21% to 54% for those samples, 20%-50% lower than those measured by X-Ray Diffraction. The abundance of the clay mineral illite in the samples and the lower SGR values is strong evidence of clay enrichment in the fault gouge through argillic alteration processes. These processes are known to increase clay content in the fault gouge along with a corresponding reduction of permeability.

Figure 3.29 X-Ray Diffraction Fault Gouge Minerology of the Lisbon Valley Fault.



Summary

- SGR influences fault zone permeabilities surrounding the Project Area.
- BC/N Aquifer juxtapositions along the Lone Wolf/Flying Diamond Fault have SGR ranging from 0.38 to 0.54, which is twice the industry-standard limit for a fault to be considered sealing.
- Measured clay content in fault gouge in the Lisbon Valley fault is very high.
- Clay enrichment of fault gouge may increase clay content by 20% to 50%.
- Faults within the Project Area are acting as hydrodynamic barriers between aquifers as shown by the SGR and permeability modeling results and backed by well pump tests performed by the Company.

3.9.2 Lisbon Valley Fault Gouge and Morrison Shale Column Studies

The following section documents two column studies conducted to characterize changes in fault gouge and aquitard material in the presence of acidic water. The results of the testing identified reduced permeabilities during both tests

Aquitard Testing Summary

The Company has completed column testing of Morrison Shale and Lisbon Valley Fault gouge in support of BC aquifer confinement. The testing was conducted to evaluate any permeability changes of the BC Aquifer as a function of contact with lower pH lixiviant which will occur as part of the ISR project.

Morrison Shale was selected since it is the confining unit below the BC aquifer and will therefore come into contact with low pH lixiviant at the bottom of the aquifer. Lisbon Valley Fault gouge was selected since it is representative of the illite-rich fault gouge known to laterally confine the BC Aquifer in Lower Lisbon Valley (LLV) and will therefore come into contact with low pH lixiviant at the perimeter of the BC aquifer. Both samples were collected from the one of the Company's current active open pits. Samples were collected at the locations in Figure 3.30.

Figure 3.30 Fault Gouge and Morrison Brushy Basin Column Sample Locations

Morrison Column Test Summary

The Morrison Shale sample was pulled from a prolific outcrop that divides the pit along strike. The sample was loaded into a 10 ft tall, 12 in diameter column designated column 103. This material was not wet nor under lithostatic load as it occurs below the BC aquifer and is therefore considered a conservative sample for testing since these conditions provide the optimal permeable conditions for this material. The test column was fed with water for 11 days then switch to process facility lixiviant.

Column 103 started rinse with water for almost two weeks followed by a rest period after which the Department started a raffinate rinse which contained between 2.5 and 3.4 g/l free acid at a pH between 1.6 and 1.8. Initially this column flowed at the LVMC standard column application rate of 0.0035 gpm/ft2. This flow continued until the column material reached about 45% of the acid consumption at which point the flow became restricted to an equivalent of 0.0007 gpm/ft2 (almost no test solution was able to pass through the sample). The test was discontinued after flows diminished to the point where column testing was no longer practical. The test ran for approximately nine months.

Figure 3.31 Brushy Basin Column Flow Rate

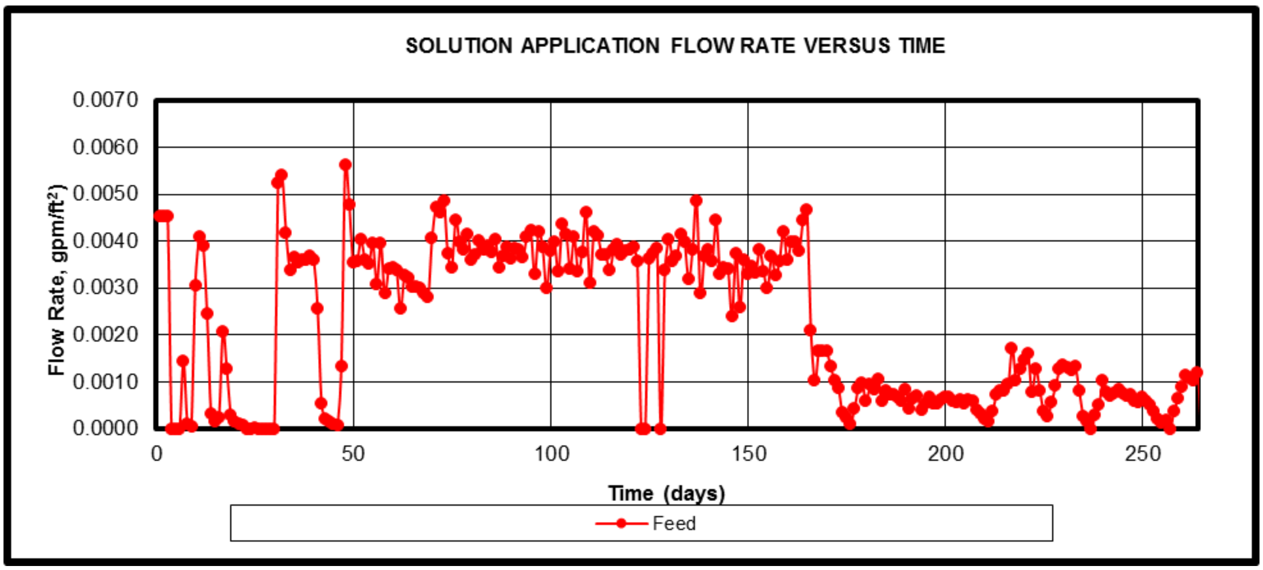
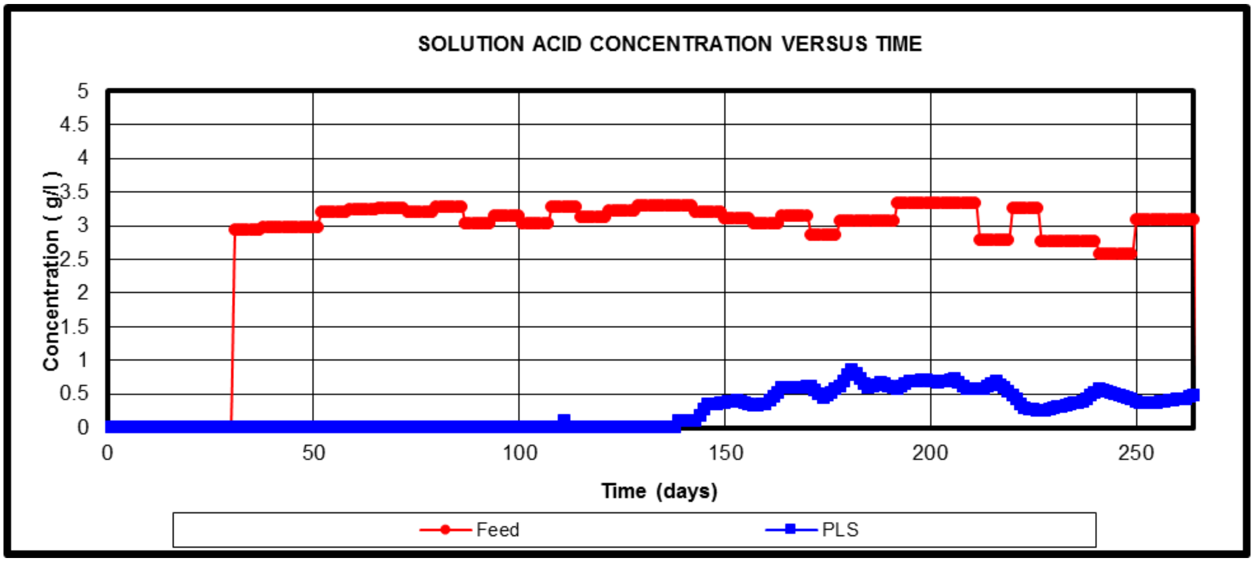


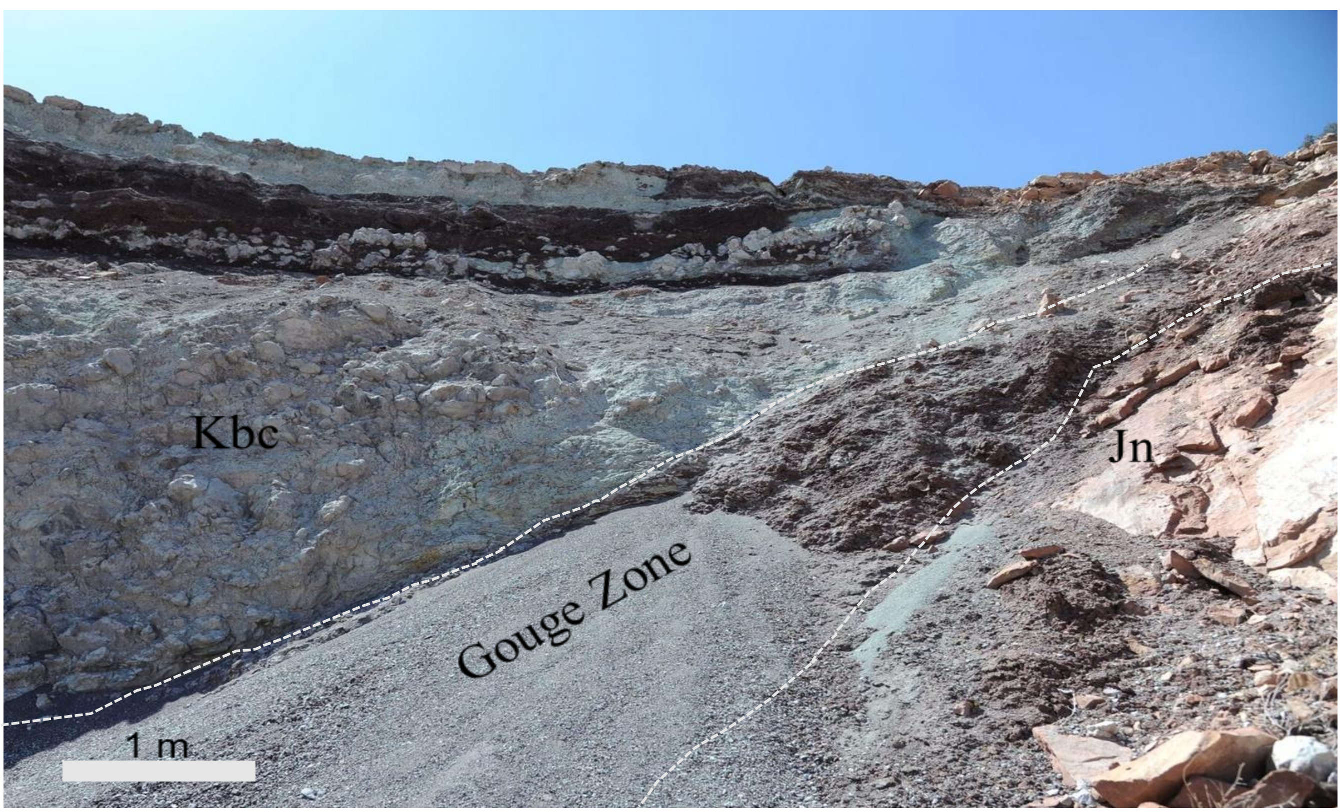
Figure 3.32 Brushy Basin Column Feed vs Effluent Acid Concentration



Fault Gouge Column Test Summary

The Lisbon Valley Fault sample was pulled from thick fault gouge in the southern corner of the open pit near a location of previous fault gouge sampling and analyses including SGR (Broaddus, Krantz; 2019). Figure 3.33 below, excerpted from the Broaddus study, shows the characteristics of fault gouge in this location along the Lisbon Valley Fault.

Figure 3.33 Lisbon Valley Fault Gouge Sampling Location



The sample was loaded into a 10 ft tall, 12 in diameter column designated column 126. The column was only rinsed with process facility lixiviant.

Column 126 was wetted upon loading to make handling the material easier. This likely caused some compaction which is should be considered minimal compared to an intact saturated fault under lithostatic load. This column immediately plugged upon being fed raffinate solution. Solution built to about 2 ft of head over the material and had to be evaporated off because it would not penetrate the 10 ft of material.

Conclusion

The application of lixiviant to Morrison Shale and Lisbon Valley Fault gouge decreases permeability under conventional column testing procedures. This is presumed to be caused when the lixiviant pH rises in contact with the acid consuming units. Without a sufficiently low pH to hold dissolved solids in solution, the solids precipitate in the limited pore space further restricting flow. The degree of permeability reduction was not quantified during this testing however, it is safe to conclude that if ISR lixiviant comes in contact with Morrison shale and fault gouge material in the Project Area that it become even less permeable.

3.9.3 Geochemical Contrast Study (C. Noyes, University of Arizona 2018-2019)

In 2018 and 2019 University of Arizona Masters Candidate Chandler Noyes conducted an advanced groundwater study for LVMC. The study focused on the assessment of aquifer connectivity as a function of groundwater chemistry and age. The results of his study are excerpted in the following section. The section begins a with a summary statement. Chandler's full thesis is included in Appendix C.

"Understanding regional groundwater flow and assessing aquifer connectivity is an important water resource management practice to mitigate migration of contaminants in multiple industries, including the oil and gas and mining sectors. This study focuses on the metal-rich Lisbon Valley of the Paradox Basin in southeastern Utah, where numerous faults may act as conduits or barriers to cross-formational flow. All geochemical and isotopic results show that these distinct aquifers are not strongly hydrologically connected under current natural hydrologic conditions." – C. Noyes, Geochemical and Isotopic Assessment of Regional Groundwater Flow and Aquifer Connectivity in the Lisbon Valley, Utah, 2019

As his project for his Master of Science with a Major in Hydrology, C. Noyes analyzed the geochemical and age contrasts of the BC and N aquifers of the Project Area. In addition to major ion chemistry and trace metals, eight environmental isotopes were collected: stable water isotopes $\delta^{18}O$ and δD, tritium (^{3}H), $\delta^{13}C$ of dissolved inorganic carbon ($\delta^{13}C$-DIC), $\delta^{18}O$ and $\delta^{34}S$ of sulfate ($\delta^{18}O$-SO_4 and $\delta^{34}S$-SO_4) $^{87}Sr/^{86}Sr$, and radiocarbon (^{14}C). Isotopes were collected from 21 wells, with 11 wells receiving a full suite of isotopic analyses. Well locations are shown on Figures 3.34, 3.35, 3.36, and tabulated in Table 3.3. This multi-tracer approach offered insight into solute chemistry, groundwater residence time, and water-rock reactions, providing the most thorough characterization of groundwater in the BC and N aquifers possible. All geochemical and isotopic analyses indicated that these distinct aquifers have minimal hydrologic communication.

Figure 3.34 Wells Selected for Geochemical and Age Contrast Study

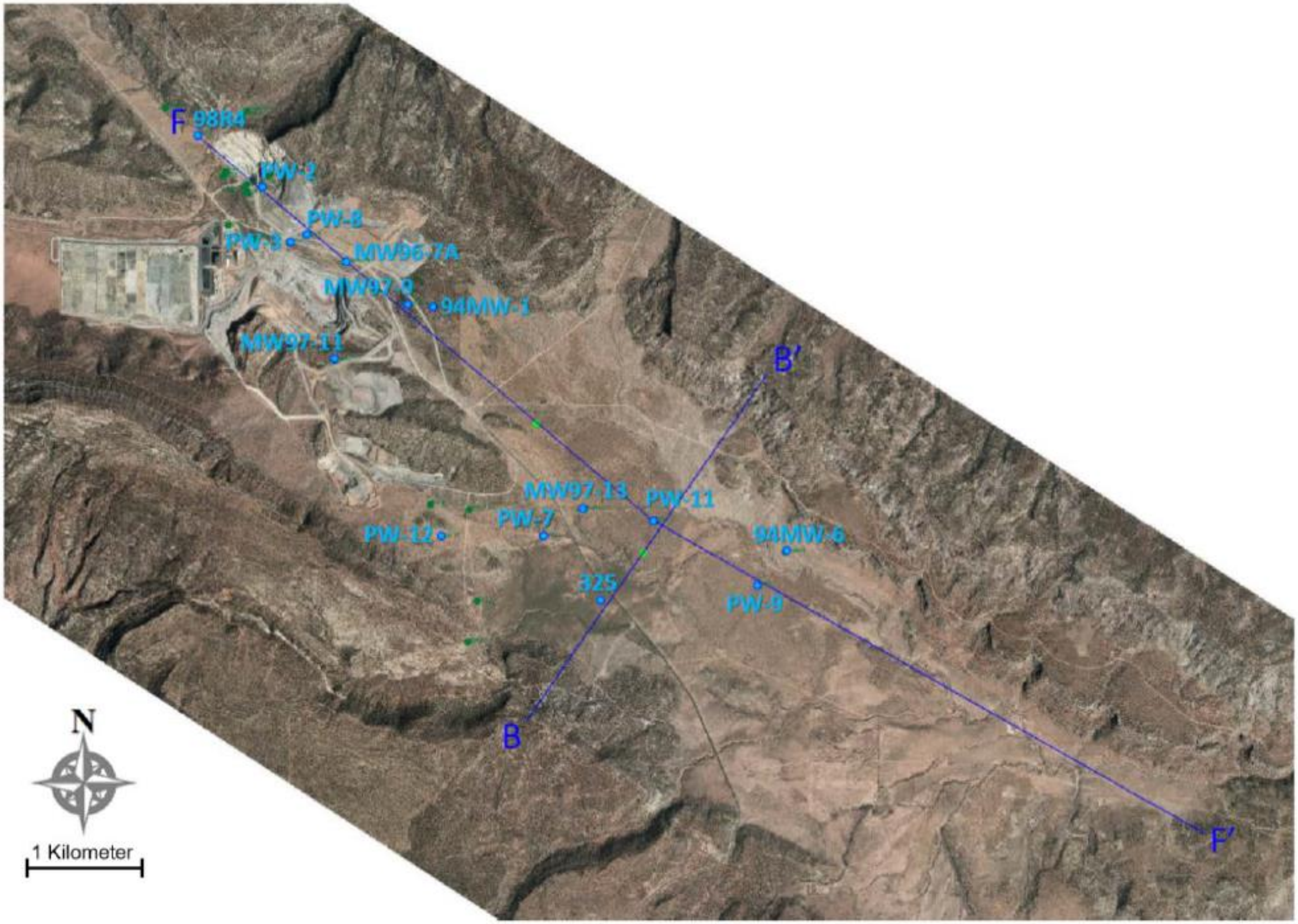


Figure 3.35 Geochemical and Age Contrast Study Cross-section B-B’

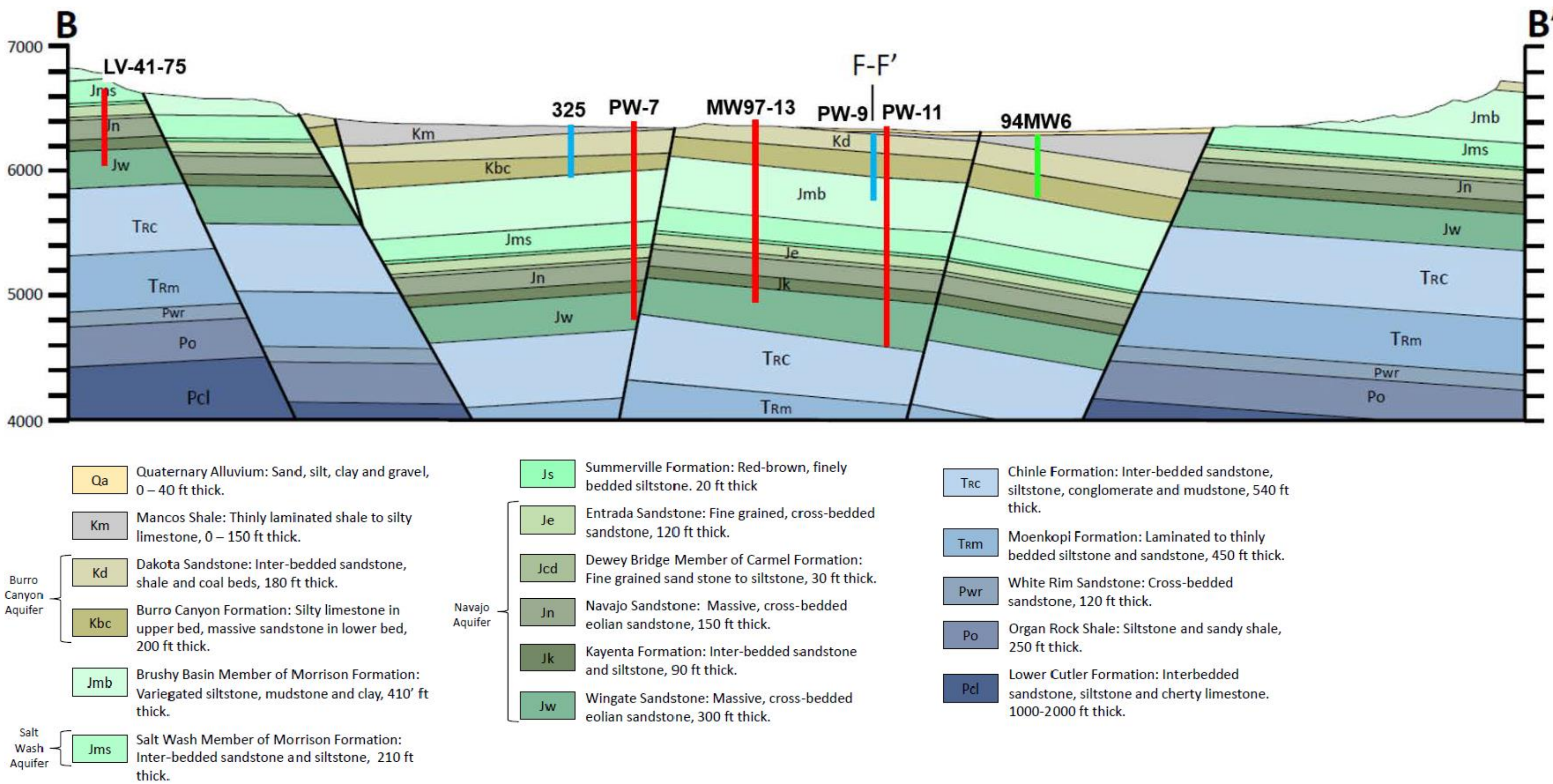
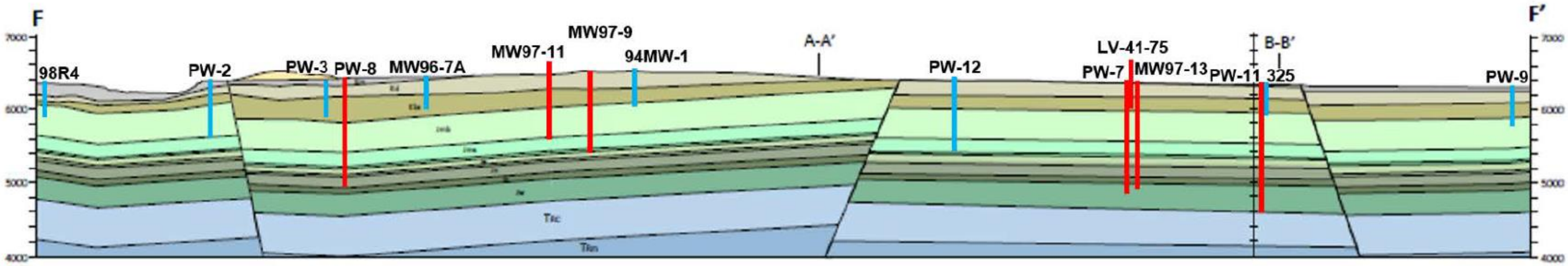


Figure 3.36 Geochemical and Age Contrast Study Cross-section F-F’

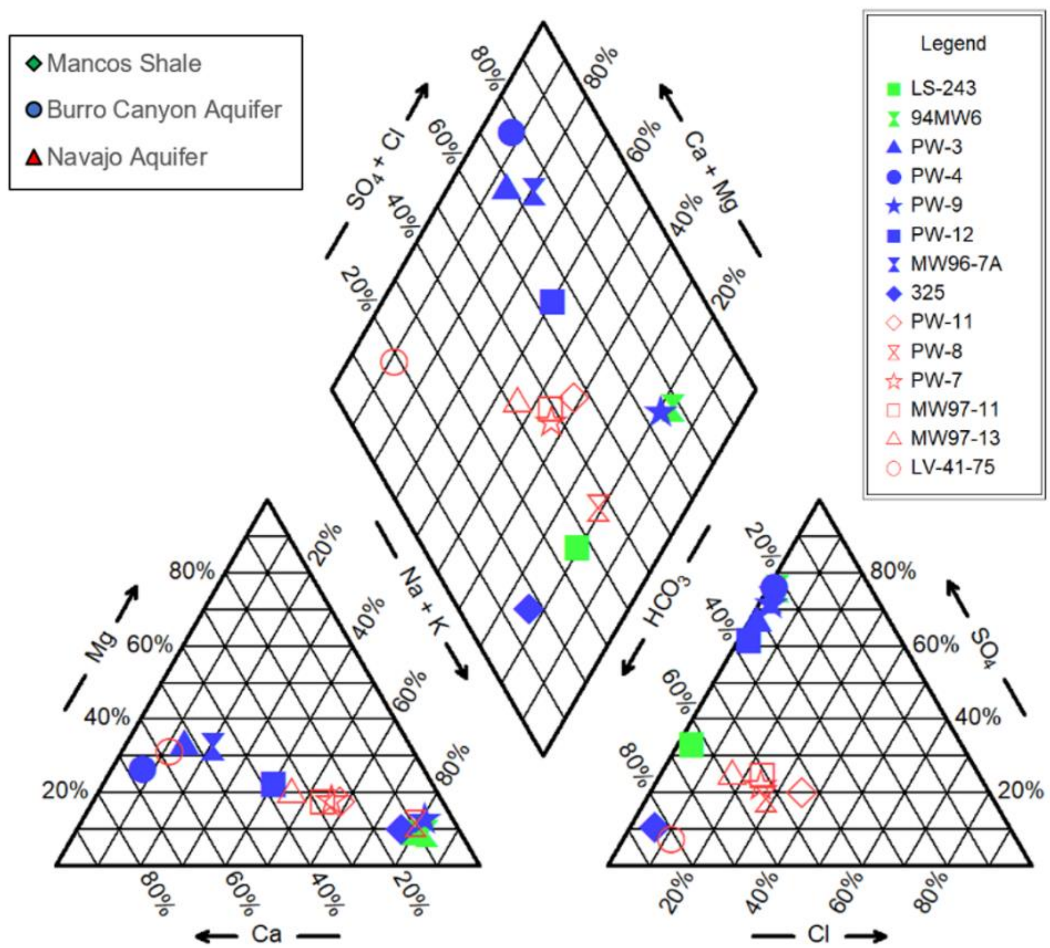


	Qa	Quaternary Alluvium: Sand, silt, clay and gravel, 0 – 40 ft thick.
	Km	Mancos Shale: Thinly laminated shale to silty limestone, 0 – 150 ft thick.
Burro Canyon Aquifer	Kd	Dakota Sandstone: Inter-bedded sandstone, shale and coal beds, 180 ft thick.
Burro Canyon Aquifer	Kbc	Burro Canyon Formation: Silty limestone in upper bed, massive sandstone in lower bed, 200 ft thick.
	Jmb	Brushy Basin Member of Morrison Formation: Variegated siltstone, mudstone and clay, 410’ ft thick.
Salt Wash Aquifer	Jms	Salt Wash Member of Morrison Formation: Inter-bedded sandstone and siltstone, 210 ft thick.
	Js	Summerville Formation: Red-brown, finely bedded siltstone. 20 ft thick
Navajo Aquifer	Je	Entrada Sandstone: Fine grained, cross-bedded sandstone, 120 ft thick.
Navajo Aquifer	Jcd	Dewey Bridge Member of Carmel Formation: Fine grained sand stone to siltstone, 30 ft thick.
Navajo Aquifer	Jn	Navajo Sandstone: Massive, cross-bedded eolian sandstone, 150 ft thick.
Navajo Aquifer	Jk	Kayenta Formation: Inter-bedded sandstone and siltstone, 90 ft thick.
Navajo Aquifer	Jw	Wingate Sandstone: Massive, cross-bedded eolian sandstone, 300 ft thick.
	TRC	Chinle Formation: Inter-bedded sandstone, siltstone, conglomerate and mudstone, 540 ft thick.
	TRM	Moenkopi Formation: Laminated to thinly bedded siltstone and sandstone, 450 ft thick.
	Pwr	White Rim Sandstone: Cross-bedded sandstone, 120 ft thick.
	Po	Organ Rock Shale: Siltstone and sandy shale, 250 ft thick.
	Pcl	Lower Cutler Formation: Interbedded sandstone, siltstone and cherty limestone. 1000-2000 ft thick.

Solute Chemistry

Groundwater in the BC aquifer is a Ca-Mg-SO_4 type water, while N aquifer wells generally plot as an Na-HCO_3 type water in the Piper Plot below (Figure CN-5). Principal Component Analysis (PCA) was conducted on 12 major ions (SO_4^{2-}, HCO_3^-, Na^+, Ca^{2+}, Mg^{2+}, K^+, Sr^{2+}, Cl^-, F^-), isotopes ($\delta^{18}O$, $\delta^{34}S$-SO_4), and corrected radiocarbon ages of groundwater samples from the BC and N aquifers, and further highlighted the distinct groupings of the BC and N aquifers found at the Project. In addition, BC aquifer wells, on average had higher concentrations ore-forming trace elements, such as Cu, Fe, Co, Mn, and U than the N aquifer wells.

Figure 3.37 Piper plot of Mancos, BC and N Aquifer wells



Groundwater Residence Time

Stable isotopes of water ($\delta^{18}O$ and δD) were measured at 19 wells (Table 3.4). All samples generally plotted along the Utah Meteoric Water Line (UT MWL) where $\delta D = (\delta 18O * 6.7) - 12.6$. As such, further presentation of results will be limited to $\delta^{18}O$, since δD is proportionally related to $\delta^{18}O$. In the BC aquifer, $\delta^{18}O$ values ranged from -16.5 to -10.2‰ with an average of -14.1‰, while in the N aquifer, $\delta^{18}O$ values ranged from -17.4 to -13.5‰; excluding the sample with a value of -13.5‰ as it was an anomalous sample $\delta^{18}O$ in the N aquifer ranged from -17.4 to -16.6‰ with an average of -17.0‰. Distinct groupings between BC aquifer and N aquifer wells are observed in the stable water isotope data suggesting that recharge to the aquifers occurred at different times.

Table 3.3 Wells Sampled for Isotopic Geochemistry and Age

Well ID	Sampling Date	Latitude	Longitude	TOC Elevation (m)	Depth (m)	Formation
SLV2	11/2/2017	38.14856	-109.14183	1944.6	unknown	Mancos
94MW6	11/2/2017	38.12372	-109.08806	1916.6	unknown	Mancos
LS-243	3/14/2018	38.10688	-109.09547	1937.6	121.9	Mancos
WILCOX	10/31/2017	38.10526	-109.05534	1889.8	46.0	Dakota
PW-1	10/31/2017	38.15100	-109.13995	1940.6	109.7	Burro Canyon
PW-2	11/1/2017	38.15148	-109.13867	1950.1	228.6	Burro Canyon
PW-3	11/1/2017*	38.14729	-109.13597	1948.3	147.8	Burro Canyon
PW-4	8/1/2018	38.15263	-109.14210	1936.0	129.5	Burro Canyon
PW-9	11/1/2017	38.12116	-109.09063	1920.3	157.0	Burro Canyon
PW-12	11/1/2017*	38.12490	-109.12121	1968.7	304.8	Burro Canyon
MW96-7A	11/1/2017	38.14576	-109.13056	1965.9	364.2	Burro Canyon
98R4	11/1/2017	38.15541	-109.14478	1937.9	138.7	Burro Canyon
98R7	11/2/2017	38.15165	-109.14013	1940.2	102.1	Burro Canyon
325	8/23/2018	38.12001	-109.10598	1940.9	158.5	Burro Canyon
PW-7	8/21/2018	38.12493	-109.11143	1943.2	462.7	Navajo
PW-8	10/31/2017*	38.14782	-109.13432	1954.3	474.0	Navajo
PW-11	11/1/2017*	38.12608	-109.10066	1929.8	457.2	Navajo
MW97-11	8/22/2018	38.13831	-109.13161	2014.0	338.3	Navajo
MW97-13	8/21/2018	38.12695	-109.10746	1950.3	438.9	Navajo
MW06-15	11/2/2017	38.15727	-109.14010	1941.3	274.3	Navajo
LV-41-75	8/23/2018	38.11587	-109.11999	2026.2	176.2	Navajo

Notes: TOC = top of casing; *samples had $^{87}Sr/^{86}Sr$ and trace metals collected on 8/1/2018

Stable water isotope data was then compared with corrected radiocarbon ages to identify the timing of recharge. In the BC aquifer, corrected radiocarbon ages ranged from 3,300 to 11,000 before present (BP) and coupled with the less negative $\delta^{18}O$ values suggests that recharge occurred during the Holocene. In the N aquifer, corrected radiocarbon ages ranged from 15,000 to 36,000 BP and coupled with more negative $\delta^{18}O$ values suggests that recharge occurred during the Late Pleistocene (Figure CN-6). Both the BC and N aquifers each had a single sample with a corrected radiocarbon age of "modern". In the case of the BC aquifer, this was likely due methanogenesis occurring at the well. In the N aquifer, this sample location was an uncased borehole in an unconfined portion of the aquifer, subject to atmospheric contamination. Refer to Noyes [2019 (Appendix C)] for detailed explanations of these pertinent geochemical processes.

Table 3.4 Isotopic Geochemisty and Age Results

Well ID	Formation	$\delta^{18}O$	δD	$\delta^{13}C$-DIC	$\delta^{34}S$-SO_4	$\delta^{18}O$-SO_4	$^{87}Sr/^{86}Sr$	^{3}H	^{14}C		
Unit		‰	‰	‰	‰	‰	--	TU	pmc	Uncorrected Age BP	Corrected Age BP
SLV2	MS	-14.2	-108	-8.9							
94MW6	MS	-13.4	-107	-3.3							
LS-243	MS				-1.2	-0.3					
WILCOX	BCA	-13.0	-97	-8.9							
PW-1	BCA	-15.6	-119	-8.7							
PW-2	BCA	-10.2	-82	-2.9							
PW-3	BCA	-12.6	-95	-4.3	-8.1	-5.8	0.70946	*< 0.8*	13.6	16,000	3,300
PW-4	BCA						0.70947				
PW-9	BCA	-14.6	-110	-8.2	15.9	7.6	0.70924	1.5	12.7	17,000	8,900
PW-12	BCA	-14.8	-111	-7.0	0.1	-2.3	0.70932	1.0	8.4	20,000	11,000
MW96-7A	BCA	-12.9	-97	-1.6	-1.7	-3.2	0.70936	< 0.5	7.7	21,000	4,000
98R4	BCA	-15.3	-114	-7.4							
98R7	BCA	-16.5	-124	-9.5							
325	BCA	-15.9	-119	7.9	*	*	0.70926	< 0.6	1.7	33,000	modern
PW-7	NA	-17.0	-128	-8.4	6.3	4.0	0.70963	*0.5*	3.6	27,000	19,000
PW-8	NA	-17.0	-128	-10.0	4.0	3.2	0.70920	< 0.6	0.5	42,000	36,000
PW-11	NA	-17.0	-128	-8.8	8.9	5.7	0.70970	< 0.5	1.9	32,000	25,000
MW97-11	NA	-17.2	-129	-6.1	3.8	4.0	0.70935	*0.5*	2.4	30,000	21,000
MW97-13	NA	-17.4	-130	-6.7	4.0	2.5	0.70958	< 0.5	5.0	24,000	15,000
MW06-15	NA	-16.6	-126	-17.1							
LV-41-75	NA	-13.5	-102	-7.0	4.2851	-2.04	0.70960	< 0.8	54	4,900	modern

Notes: ND = non-detect; < = less than detection limit; italicized values at the detection limit, considered non-detect

* = insufficient precipitate formed, analysis could not be run; MS = Mancos Shale, BCA = Burro Canyon Aquifer, NA = Navajo Aquifer

Figure 3.38 Plot of corrected radiocarbon age vs. $\delta^{18}O$ of BC and N Aquifer wells.

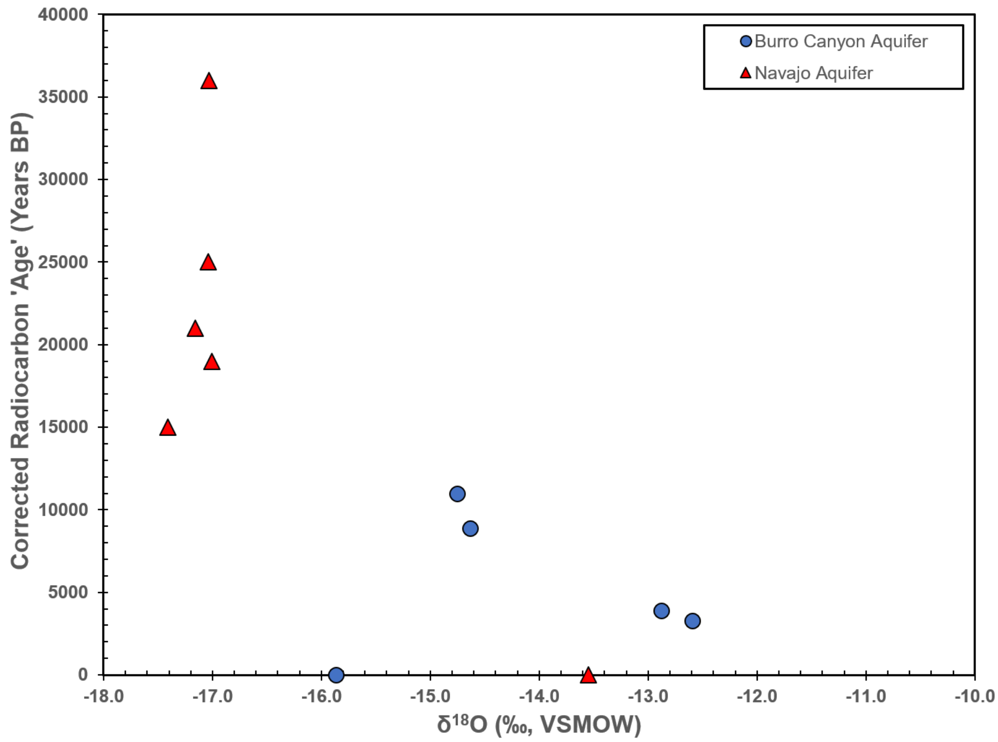
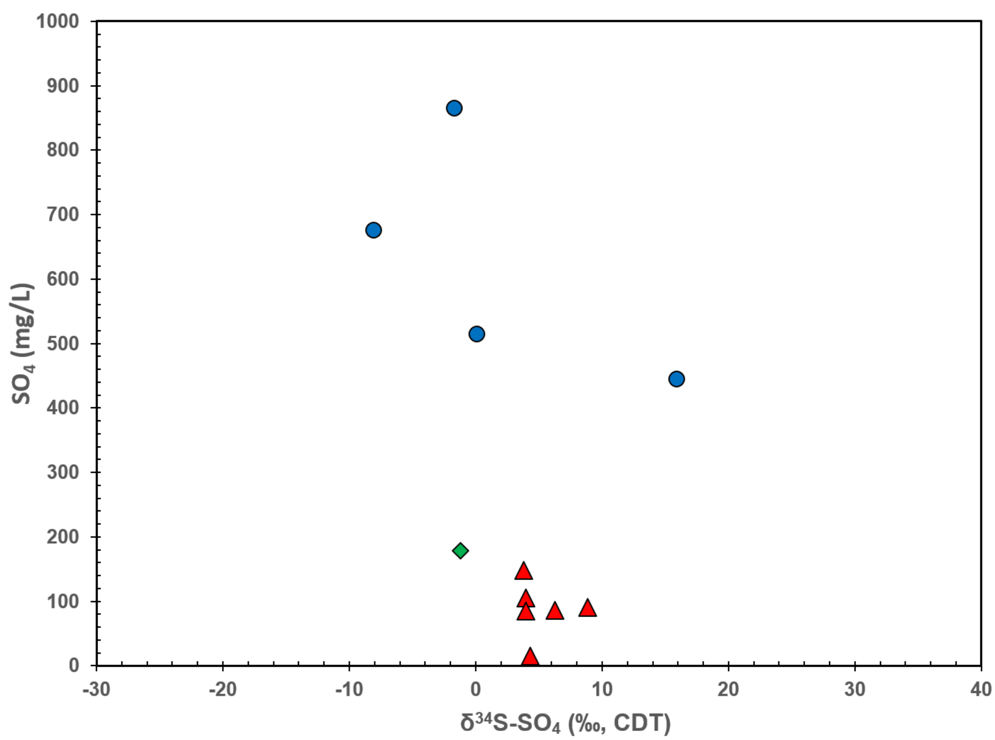


Figure 3.39 Plot of $[SO_4^{2-}]$ vs. $\delta^{34}S$-SO_4.



Stable carbon isotopes of dissolved inorganic carbon ($\delta^{13}C$-DIC) were measured at 19 wells (Table 3.4). In the Mancos Shale, $\delta^{13}C$-DIC values ranged from -8.9 to -3.3‰. In the BC aquifer, $\delta^{13}C$-DIC values ranged from -9.5 to +7.9‰, with the observed value of +7.9‰ being the only positive $\delta^{13}C$-DIC value measured in the study area. In the N aquifer, $\delta^{13}C$-DIC values ranged from -17.1 to -6.1‰. To note, $\delta^{13}C$-DIC is only used in the determination of corrected radiocarbon ages.

Tritium was generally non-detect, detected at the minimum detection limit (MDL) [and thus considered non-detect], or at a low-level detection attributable to contamination. As such, tritium results were inconsequential.

Water-Rock Interactions

Stable sulfur and oxygen isotopes of sulfate ($\delta^{34}S$-SO_4 and $\delta^{18}O$-SO_4) were measured at 12 wells (Table 3.4). In the BC aquifer, values of $\delta^{34}S$-SO_4 and $\delta^{18}O$-SO_4 ranged from -8.1 to +15.9‰ and -5.8 to +7.64‰, respectively. One sample from the BC aquifer, borehole 325, formed an insufficient amount of $BaSO_4$ precipitate during laboratory preparations, and thus was unable to be analyzed. In the NA, $\delta^{34}S$-SO_4 and $\delta^{18}O$-SO_4 ranged from +3.8 to +8.9‰ and -2.0 to +5.7‰, respectively. These results highlight different redox conditions in the BC and N aquifers. The BC aquifer has sulfate isotope values characteristic of sulfide oxidation, which is consistent with the presence of chalcocite found within this aquifer. On the other hand, the N aquifer has sulfate isotope values that fall within the range of atmospheric deposition and/or soil sulfate, characteristic of eolian sandstones which the N aquifer is primarily composed of. A plot of [SO_4^{2-}] vs. $\delta^{34}S$-SO_4 (Figure CN-7) shows that groundwater in the BC aquifer generally has near-zero to negative $\delta^{34}S$-SO_4 values and high concentrations of [SO_4^{2-}], while groundwater in the N aquifer has positive values of $\delta^{34}S$-SO_4 and much lower concentrations of [SO_4^{2-}]. Sulfate isotopes thus further distinguish the unique isotopic compositions of the BC and N aquifers.

The ratio of $^{87}Sr/^{86}Sr$ was measured at 12 wells (Table 3.4). In the BC aquifer, the strontium isotope ratio ranged from 0.70924 to 0.70947, with an average of 0.70935. In the N aquifer, strontium isotope ratios were slightly more radiogenic than the BC and ranged from 0.70920 to 0.70970, with an average of 0.70951. Further, in the BC aquifer [Sr^{2+}] ranged from 1.91 to 14.03 mg/L with an average of 6.67 mg/L, while in the N aquifer [Sr^{2+}] ranged from 0.31 to 2.72 mg/L with an average of 1.87 mg/L. The less radiogenic $^{87}Sr/^{86}Sr$ ratio and higher concentrations of [Sr^{2+}] in the BC aquifer are characteristic of the carbonate formations that make up this aquifer, while the more radiogenic $^{87}Sr/^{86}Sr$ ratio and lower concentrations of [Sr^{2+}] are typical of eolian sandstones, a rock type that the N aquifer is primarily composed of. Thus, strontium isotopes add another layer to the unique isotopic signatures found within the BC and N aquifer.

Summary

- Major ion chemistry indicates that the BC and N aquifers have distinct geochemical signatures.
- All isotopic analyses indicated that the BC and N aquifers have distinct water compositions.
- The water in the BC aquifer has an age range of 3,300 to 11,000 years BP, while the water in the N aquifer has an age range of 15,000 to 36,000 years BP.

- All aforementioned conclusions suggest that minimal communication is occurring between the BC and N aquifers.

3.9.4 Summary of a 20-year Review of the Hydrogeologic System (Whetstone Associates 2019)

In December 2018, Whetstone Associates provided the Company with a 20-year summary report of the water quality monitoring data that had been collected by Whetstone from water wells throughout the Project Area from a period ranging from 1998 through to 2018. As part of the summary report, Whetstone performed an evaluation of the ground water flow direction and the communications (or lack thereof) between the aquifers that exist within the Project Area.

According to the report, there is a large unsaturated zone that exists between the BC and N aquifers. Moreover, both the BC and N aquifers are highly segmented, with faults generally acting as barriers to flow across faults. The barriers to horizontal flow across faults are a result of fault gouge along the fault planes and the juxtaposition of permeable units against low-permeability units. The apparent flow direction in the N aquifer below the Project Area appears to flow to the northeast. The flow in this deeper N aquifer is also controlled by the relative complex geologic structures.

Of note, active mining has been performed within the Lisbon Valley Active Mine Area, with open pits being deepened yearly. Over the twenty-year monitoring event, there has been no indication of communication between the BC and N aquifers, as would have resulted in change in water quality and overall water chemistry of the distinct aquifers.

3.9.4.1 Confining Features of the AEB

For the purpose of this Technical Report, each boundary (North, South, East, and West) is discussed in the context of confinement and rationale as an AEB (see figure 3.23 for fault locations).

North Boundary:

The North Boundary is confined in the following ways:

- Impermeable to very low permeability faults
- Faulting resulting in the juxtaposition of the BC aquifer against confining clay units
- Influent gradient coming from the La Sal Mountains
- Vertical confinement above and below the BC aquifer by impermeable shale
- The Company will drill an additional observation well to further analyze and confirm North Boundary confinement.

South Boundary:

The South Boundary is confined in the following ways:

- Impermeable to very low permeability faults
- Faulting resulting in the juxtaposition of the BC aquifer against confining clay units

- Geochemical contrast and age dating of the water within the BC aquifer of the Project Area and the N aquifer outside of the Project Area
- Vertical confinement above and below the BC aquifer by impermeable shale

East Boundary:

The East Boundary is confined in the following ways:

- Geologic structure which elevates the Burro Canyon formation above the piezometric surface, effectively pinching out the aquifer
- Dry holes drilled within Colorado
- Vertical confinement below the BC aquifer by impermeable shale

West Boundary:

The West Boundary is confined in the following ways:

- Geologic structure which elevates the BC formation above the piezometric surface, effectively pinching out the aquifer
- Vertical confinement above and below the BC aquifer by impermeable shale

3.9.5 Project Area Mineralization

The Project Area is mineralized with commercial grades of copper for ISR. This interpretation is supported by 68,363 ft of 2 D seismic surveys, 44,000 ft of dipole-dipole resistivity and induced polarization (IP) surveys, surface geochemical sampling, and over 170,000 ft of drilling since 2005. The results of this activity identify deposits that extend across the Project Area along the geologic strike from northwest to southeast. The north portion of the Project Area includes Lone Wolf Flying Diamond, and deposits. These deposits extend approximately 3.4 miles from northwest to southeast along the north edge of LLV. The south portion of the Project Area includes the GTO deposit and, Lucky Strike Prospect, and Little Indian Prospect. These deposits extend approximately 4 miles from northwest to southeast along the south edge of LLV. These deposits and exploration activity are summarized on Figure 3.40

The Lone Wolf, Flying Diamond, Stateline, and GTO, Deposits are supported by conventional drilling and assay. The Lucky Strike and Little Indian areas are supported by geochemical sampling and resistivity surveys. Geochemical sampling is supported by the correlation of copper and copper pathfinder elements at the Lisbon Valley Mine (Adkins, A. R., Thorson, J. P., and Geiger, F.2009). Figure 3.41 and 3.42 depict the results of geochemical sampling in the Project Area. A description of the geochemical sampling and results is expanded in Appendix D.

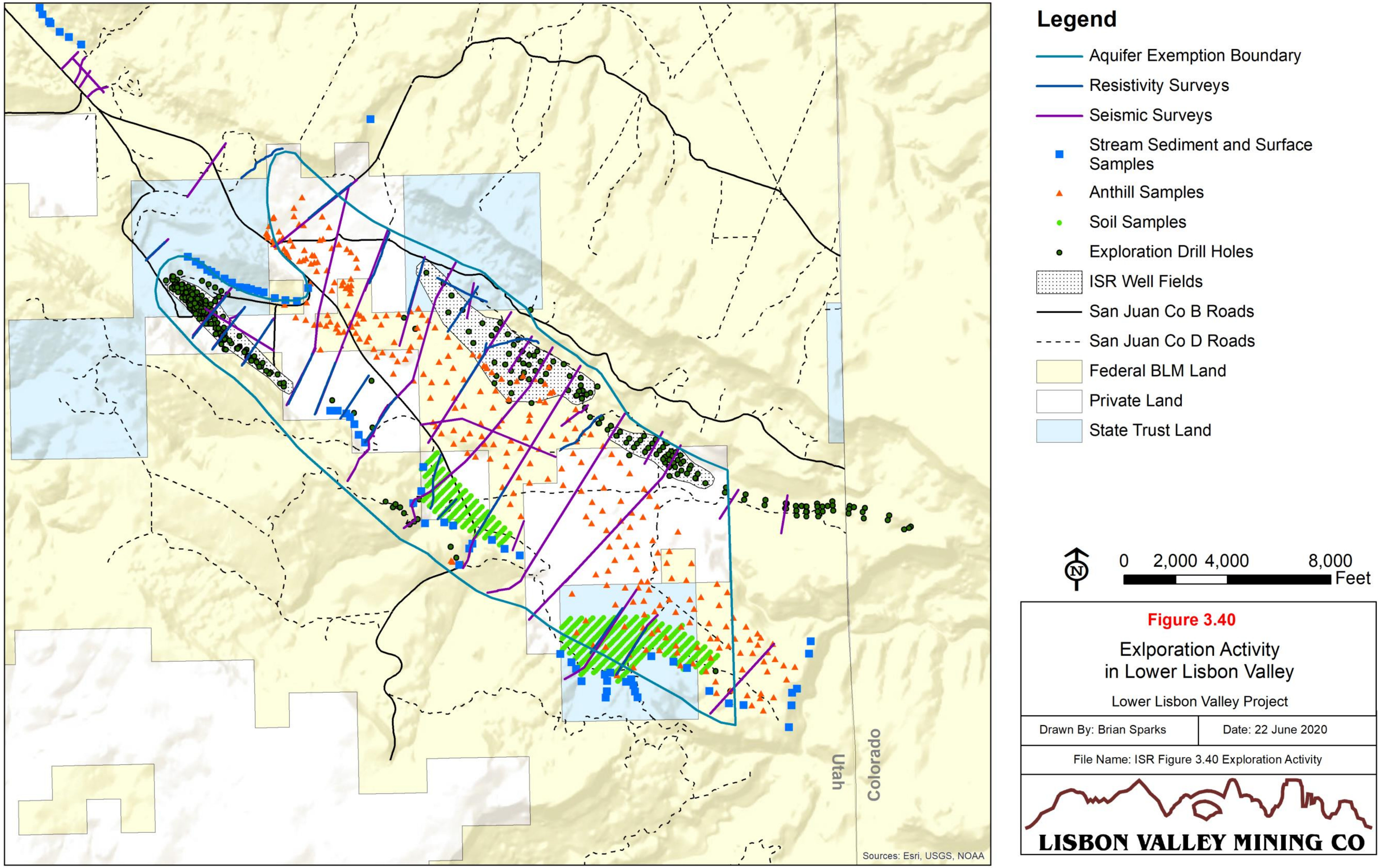


Figure 3.40
Exlporation Activity in Lower Lisbon Valley
Lower Lisbon Valley Project

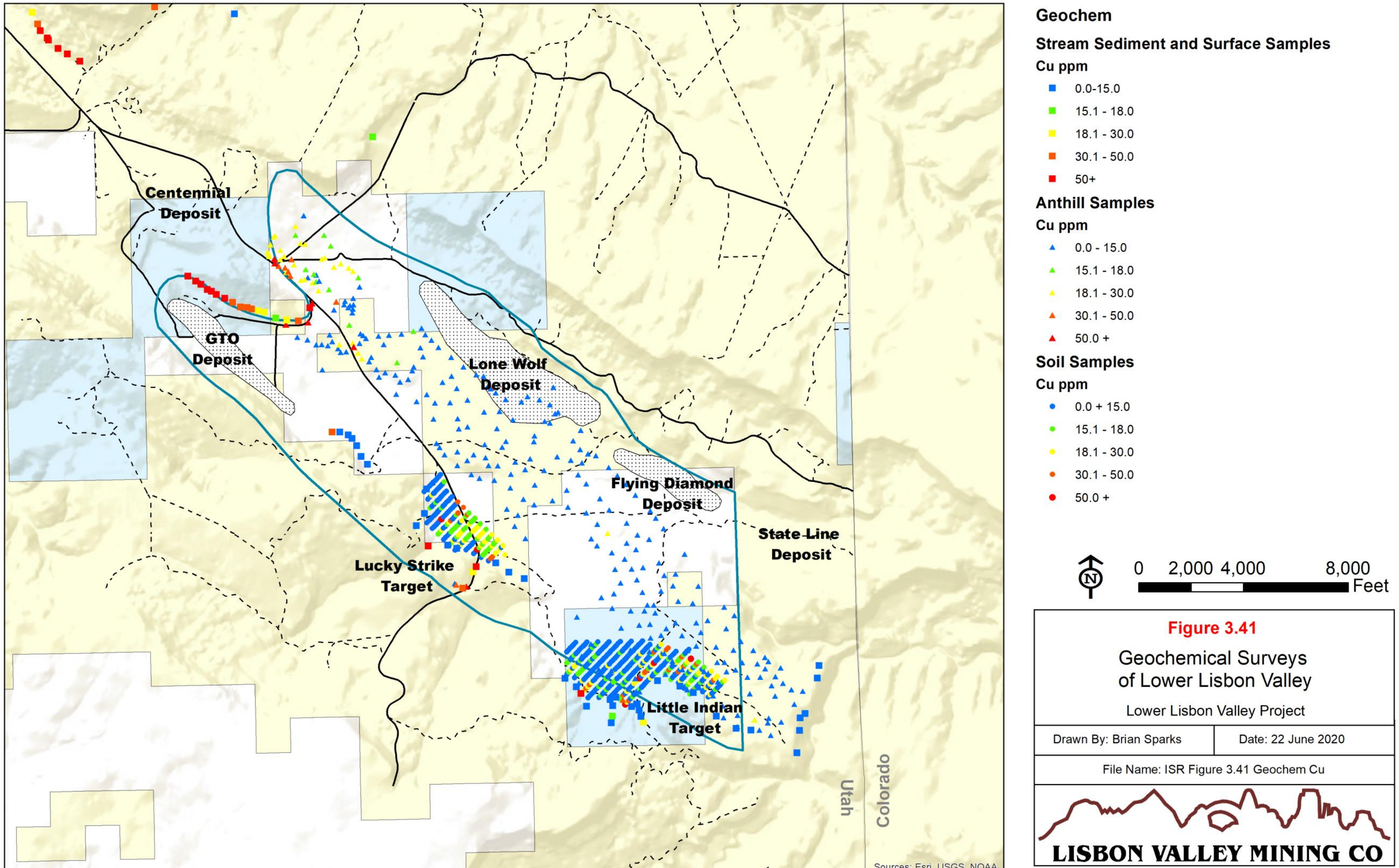


Figure 3.41

Geochemical Surveys of Lower Lisbon Valley

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 22 June 2020

File Name: ISR Figure 3.41 Geochem Cu

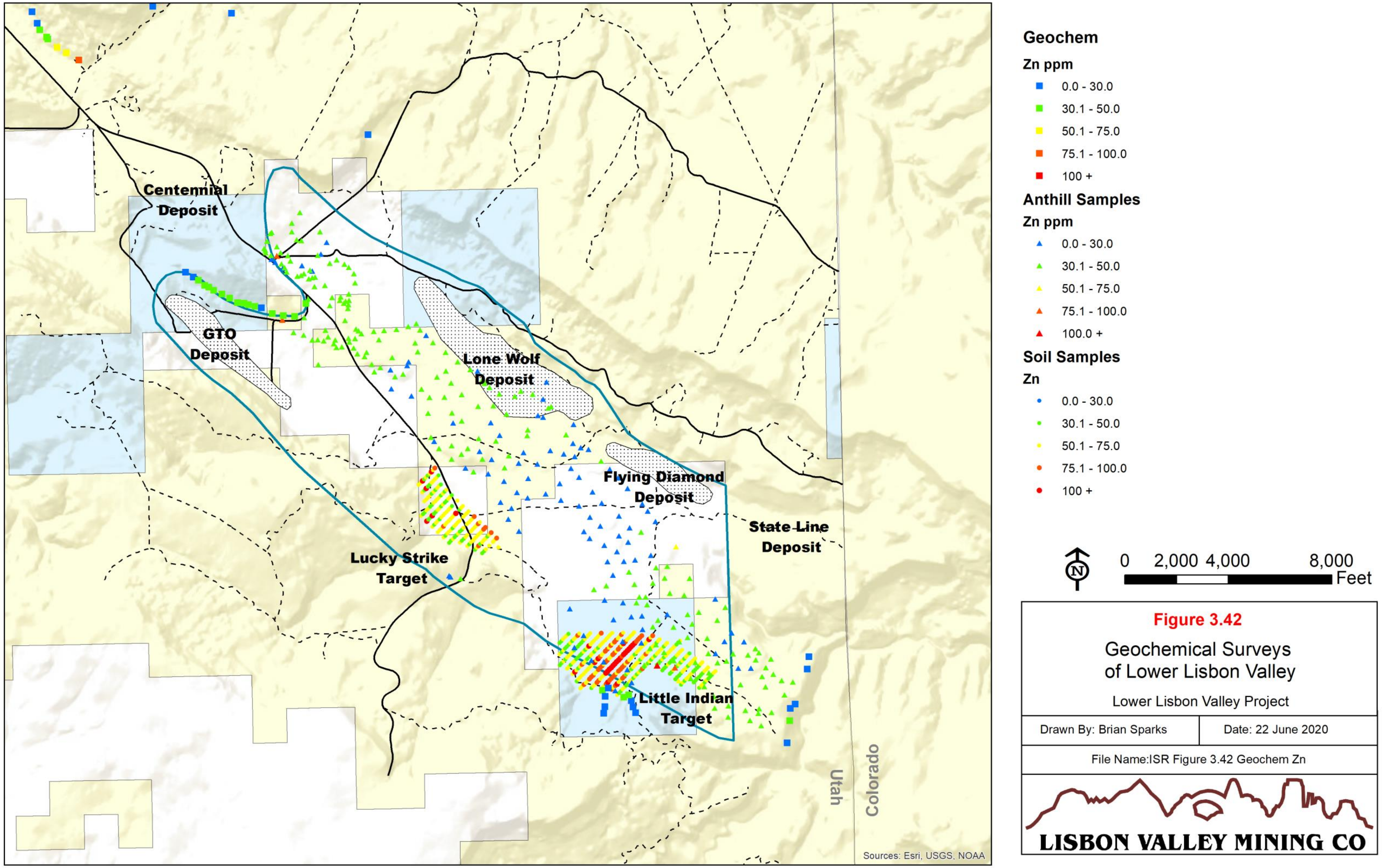


Figure 3.42

Geochemical Surveys of Lower Lisbon Valley

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 22 June 2020
File Name:ISR Figure 3.42 Geochem Zn	

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3.9.6 Project Area Groundwater Occurrence

As described in previous sections, groundwater occurs in the BC Aquifer as the uppermost aquifer in the Project Area. The aquifer is vertically confined by the underlying Morrison Formation and overlying Mancos Shale. The aquifer is laterally confined by sealed faulting along the valley margins, and by elevated geologic structure on its southeast boundary.

The occurrence of groundwater in the Project Area is supported by over 170,000 feet of exploration drilling, 7 groundwater production wells, 3 monitoring wells, one livestock water well, one abandoned domestic well, and 2 open hole piezometers. Exploration drilling identifies groundwater as a function of water flows during drilling. Exploration locations were shown in Figure 3.4. The wells and piezometers are shown in Figure 4.3..

Most of the Company's existing water wells are concentrated in the northwest portion of Project Area. Groundwater occurrence in the southeast Project Area is supported by pump testing, abandoned domestic wells, a livestock well, and electrical resistivity surveys. Locations are shown on Figure 3.43

The electrical resistivity of the subsurface is related to various geological parameters such as the mineral and fluid content, porosity and degree of water saturation in the rock. Surface electrical resistivity surveys have been used for many decades in hydrogeological, mining and geotechnical investigations. LVMC utilizes the dipole-dipole array as part of mineral exploration using induced polarization (IP). Resistivity interpretations related to the occurrence of groundwater are expanded in Appendix D.

LVMC has characterized the hydrogeologic conditions of the SE Project Area using available well, open hole, and surface geophysical methods:

- Pump test
- Drill hole logs
- Borehole resistivity logging
- Surface resistivity mapping and correlation to drill hole logs

The combined information supports the occurrence of BC Aquifer groundwater along an approximate 2.5 mile transect in the southeast LLV. The Company's hydrologic data to date indicates BC groundwater elevation ranges from 6150-6175 feet amsl in LLV. This head is consistent with observations in the SE Project Area.

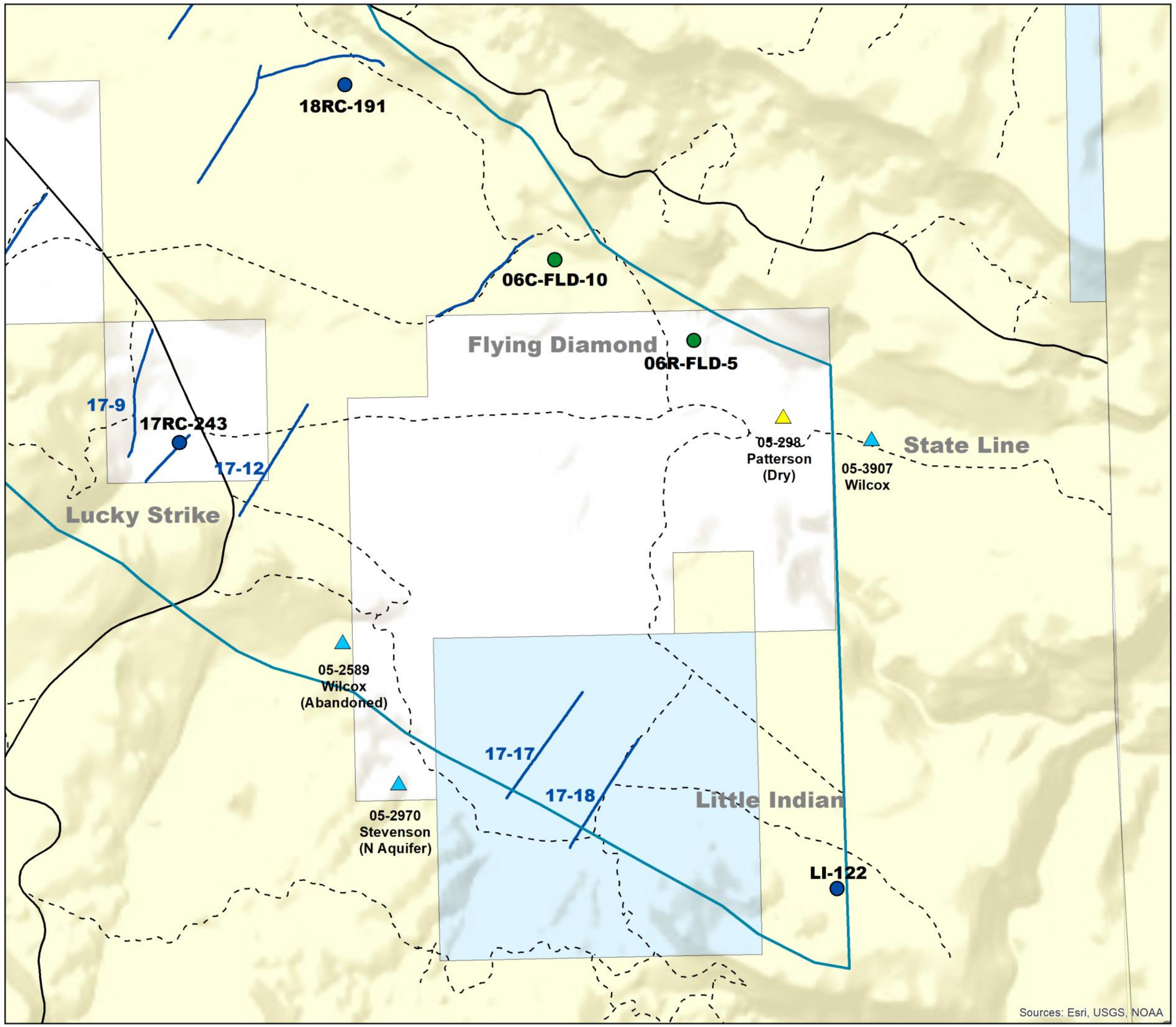

Figure 3.43

Southeast Area Wells and Resistivity Surveys

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 22 June 2020
File Name: ISR Figure 3.43 SE Area Wells and Resistivity	

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4.0 PART C- Tabulation of Artificial Penetration Data

This attachment details the inventory of water wells, monitor wells, exploration drill holes, and oil and gas wells located within the AOR. It also describes the Company's corrective action plan to prevent movement of ISR fluids into USDWs.

4.1 Well Inventory

There are no domestic, residential, municipal, or other commercial users in the Project Area's BC Aquifer. The closest municipal water well is 14 miles from the Project Area in the upgradient direction.

Historical records and field investigations conducted within the AOR were used to develop the well inventory. A total of 50 wells have been identified within the AOR. 41 of these wells belong to the Company. There are an additional five domestic wells, two livestock well and two monitoring wells in the AOR. Well locations are tabulated in Appendix E and shown in Figure 4.3. Well logs, well completion records and associated documentation is tabulated in Appendix F.

The well inventory is divided into the following uses:

- Groundwater Production Wells (PW prefix): 13 wells currently used by the Company for mining water supply (non-drinking water wells) or available for mining water supply.
- Groundwater Monitoring Wells (MW prefix): 30 wells currently used for groundwater quality and water level monitoring. 28 of the monitoring wells are owned and operated by the Company and two are owned by a uranium mining company.
- Domestic: Of the 6 registered domestic water wells in the AOR, three are in use (e.g., drinking, washing, sanitary use, etc.) and are outside the Project Area. The other 3 registered domestic wells identified in the AOR are recorded as being dry and/or out of use.
- Stock: One stock well is located in the AOR and Project Area. It is recorded as a shallow dry hole and out of use.

4.2 Oil and Gas Well Inventory

A total of eight oil and gas wells are located in the AOR. Four are located in the Project Area. All wells in the Project area have been plugged and abandoned. Available well records, including plugging and abandonment, are publicly available by the Utah Department of Natural Resources, and the Moab Field Office of the BLM. All locations of oil and gas wells drilled within the AOR are shown on Figure 4.1. Permitting and completion reports are compiled in Appendix G

4.3 Exploration Drill Hole Inventory

A total of 1,430 exploration holes are located in the AOR. 369 exploration holes are located in the Project Area. All exploration holes in the Project area have been plugged and abandoned in accordance with Utah Administrative Code (UAC) R647-4-108. An inventory of exploration holes is shown on Figure 4.2. Exploration locations are tabulated in Appendix H. Available exploration hole plug and abandonment records are publicly available by the Utah Department of Natural Resources, and the Moab Field Office of the BLM. All exploration holes terminate in the Morrison Formation Brushy Basin Unit (Jmb).

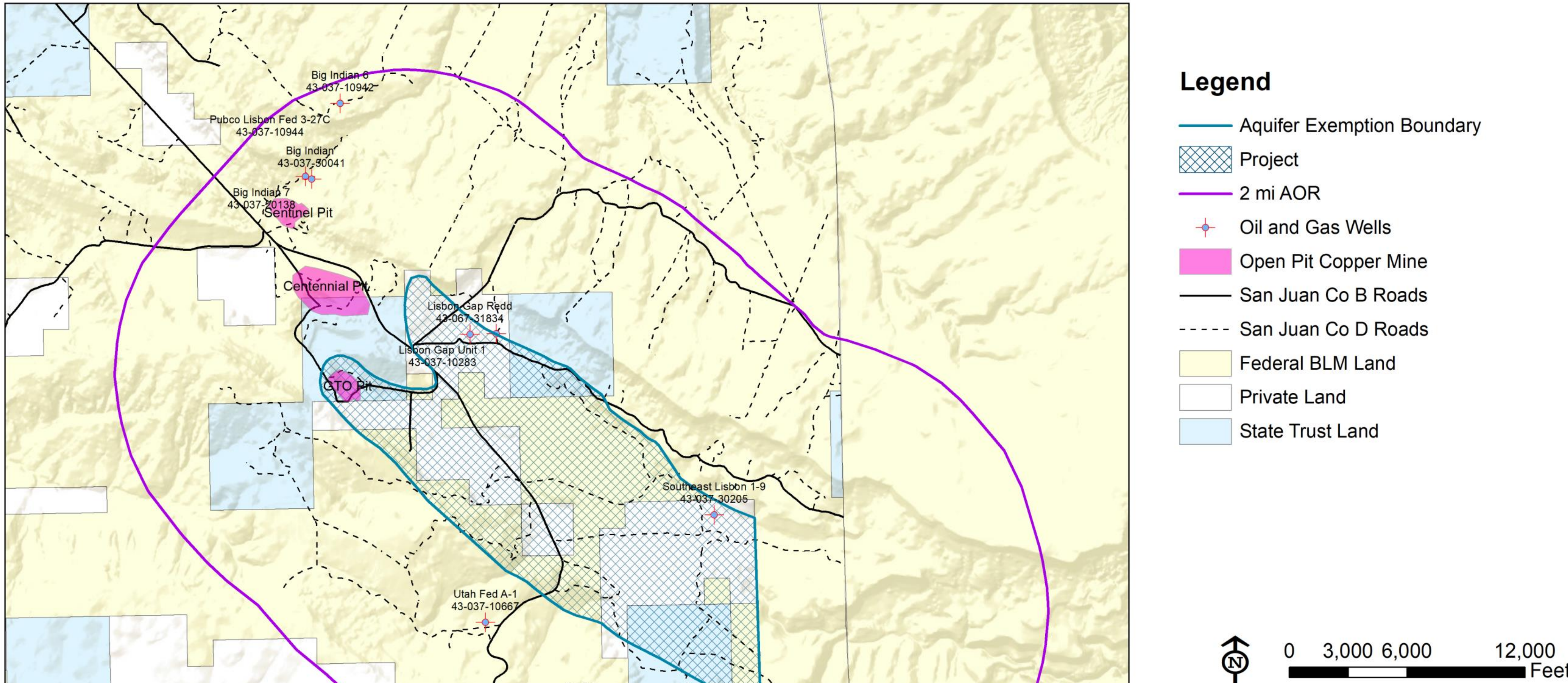

Figure 4.1

Historic Oil and Gas Wells

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 22 June 2020
File Name: ISR Figure 4.1 Oil and Gas Wells	

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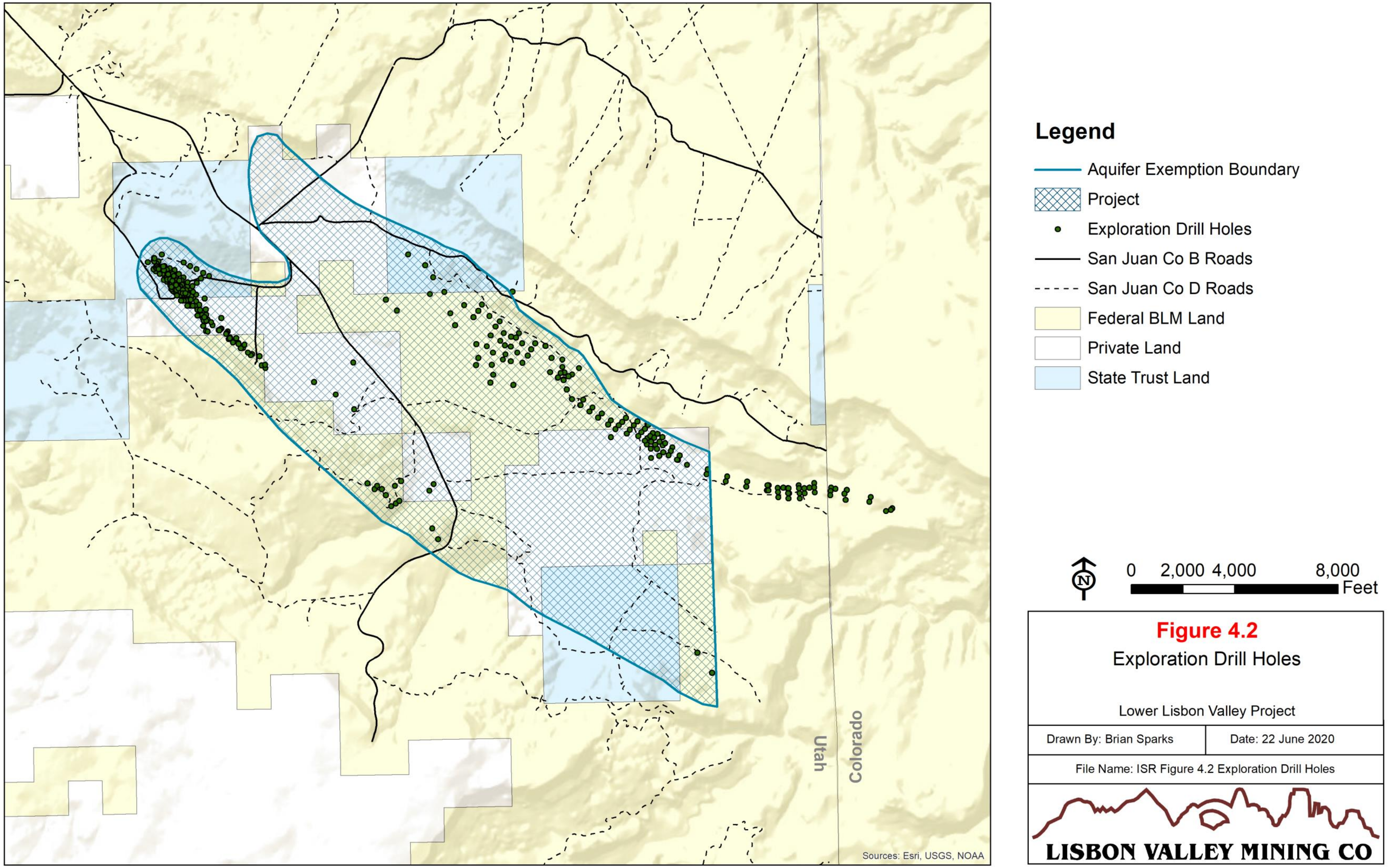


Figure 4.2

Exploration Drill Holes

Lower Lisbon Valley Project

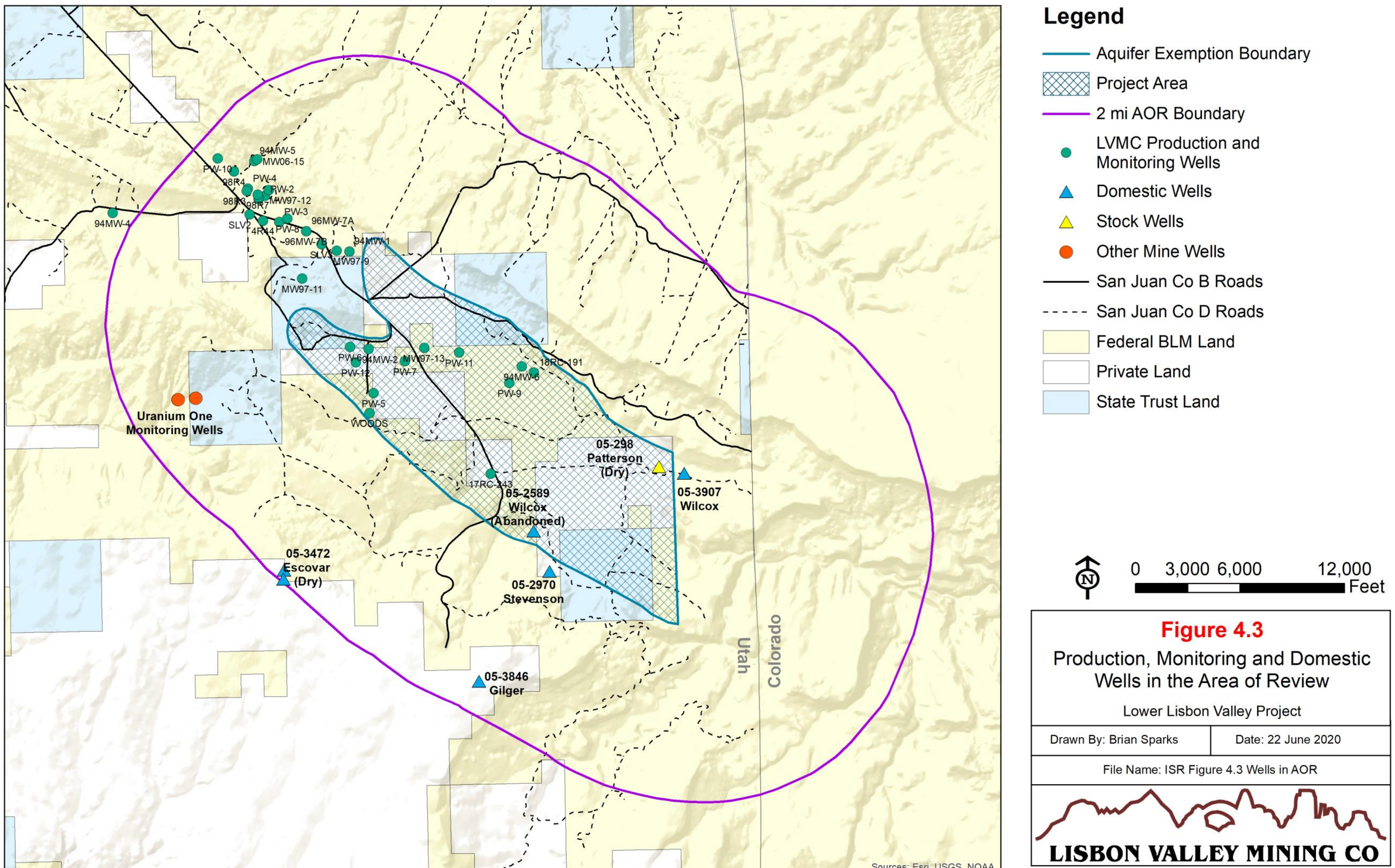


Figure 4.3
Production, Monitoring and Domestic Wells in the Area of Review

4.3.1 Evaluation of Potential Discharges to USDW

The Company has performed an extensive evaluation of ore deposit geologic confinement in LLV and based on this evaluation has been able to demonstrate that the risk of potential discharges to USDW (only USDW in AOR is the N aquifer) is very low because of geologic and hydraulic confinement of the BC aquifer all of which will be augmented by a comprehensive well monitoring program. Reference Sections 3, 10, 11, 12, 16 for detail.

5.0 PART D - Corrective Action Plan

This section describes the necessary steps or modifications to prevent movement of fluid into USDW through any artificial penetrations into the injection zone. There are no USDW above the injection zone. Artificial penetrations into the N Aquifer below the injection is limited to improperly abandoned boreholes and/or wells.

The Company will use the best available information and best professional practices to locate boreholes or wells in the vicinity of potential well field areas. This will include historical records, aerial surveys, pump tests, and field investigations. Consistent with standard industry operating practices and experience, the following describes the procedures the Company will implement to detect and mitigate any unplugged holes or wells that have the potential to impact the control and containment of well field solutions.

The Company has committed to UDWQ to properly plugging and abandoning or mitigating any of the following should they pose the potential to impact the control and containment of well field solutions within the Project Area.

1. Historical wells and exploration holes
2. Holes drilled by the Company for the purposes of delineation and exploration
3. Any well failing mechanical testing integrity including wells drilled by the Company and well drilled by the Company's predecessors

The Company will attempt to locate with best professional practices any presently unknown boreholes or wells in the vicinity of every potential well field. Historical records will be used to determine the presence of previous boreholes and wells.

Should any drill hole or well at or near potential well fields be suspected of being improperly plugged and abandoned, the Company will use best professional practices to precisely locate and re- enter the suspected problem hole with a drill rig or tremie pipe. The Company will evaluate mitigation alternatives including plugging and abandoning the hole or well with grout as described below. The Company may enter the well with logging equipment prior to plugging and abandoning the well to confirm that the well poses a potential problem.

5.1 Plugging and Abandonment Procedures

The Company's standard operating procedures will include plugging and abandoning all boreholes completed during the process of exploration and delineation drilling. Any wells installed by the Company which fail a mechanical integrity test (MIT) and cannot be repaired also will be plugged and abandoned. Plugging and abandonment procedures are discussed in Section 15.

5.2 Mitigation and Avoidance

Boreholes or wells which may potentially impact control of well field operations will be evaluated using pump test data and groundwater modeling. Should it be determined that it is not possible to mitigate potential adverse impacts from any unplugged borehole or well that is discovered, the affected well field will be designed to minimize any potential impacts. The monitoring system will be designed to demonstrate well field control. This may include monitor wells in addition to those provided for normal well field operations.

6.0 PART E Injection Zone Formation Testing Plan

This attachment discusses the operating data for the injection wells, including the typical and anticipated maximum injection rate, injection pressure range, and range in concentrations of the injected fluids.

6.1 Injection Flow Rate

The injection flow rates for individual Class III injection wells are anticipated to range from approximately 50 to 100gpm. The project-wide injection flow rate will fluctuate depending on the number of well fields undergoing copper recovery and aquifer restoration. The project-wide injection flow rate is expected to increase from the onset of copper recovery in the first well field through the period of concurrent copper recovery and aquifer restoration. The Company estimates that individual well field copper recovery times will be about 5 years, with multiple well fields typically in copper recovery at any given time. Aquifer restoration will be completed following copper recovery in each well field. Therefore, concurrent copper recovery and aquifer restoration is anticipated to begin approximately five years after initial well field operation.

Figure 10.2 in Section 10 depicts the anticipated project schedule. Table 6.1 summarizes the maximum project-wide flow rates during concurrent copper recovery and aquifer restoration. The maximum gross pumping rate from producing well fields is anticipated to range from 5,000 gallons per minute (gpm) (GTO deposit) to 20,000 gpm (Lone Wolf/Fling Diamond deposit). To maintain an inward hydraulic gradient, the injection flow is estimated to range from 0.5% to 5% less than the extraction flow. This demonstrates that the vast majority of water pumped from the production zone will be reinjected, such that the net withdrawal rate will be only a small fraction of the gross pumping rate. The maximum anticipated gross pumping rate from well fields undergoing aquifer restoration will range from 1,000 gpm (GTO deposit) to 4,000 gpm (Lone Wolf/Flying Diamond deposit). The estimates of production flow rates are used for information purposes only; LVMC is not requesting that the proposed Class III UIC permit include flow limits.

Table 6.1 Operational Flow Rates

Deposit	**Operation Phase**	**Injection Flow Rate gpm**	**Production Flow Rate gpm**
GTO	Copper recovery (5 year)	4,975	5,000
	Aquifer restoration (1 year)	950	1,000
Lone Wolf / FD	Copper recovery (5 year)	19,900	20,000
	Aquifer restoration (1 year)	3,800	4,000

6.2 Injection Pressure

The Company will specify the maximum injection pressure for each well. The designated maximum pressure will be posted near the injection trunk line gauge used to monitor injection pressure. The maximum injection pressure will be calculated as the lowest value of the following:

- The lowest value of maximum allowable wellhead pressure for all injection wells based on fracture pressure calculations presented in Section 8.1.
- The manufacturer-specified maximum operating pressure for the well casing.

- The manufacturer-specified maximum operating pressure of the injection piping and fittings.

This pressure will not initiate new fractures or propagate existing fractures in the injection or confining zone or cause the migration of lixiviant into any USDW in accordance with 40 CFR § 144.28(f)(6)(i).

6.3 Injection Fluid Composition

Two different types of fluid will be injected into the well fields. During copper recovery, a lixiviant consisting of production zone groundwater fortified with sulfuric acid and oxygen will be injected into the well fields and recirculated from new and/or existing process collection ponds. Injection solution temperatures are expected to range from 40° F during the winter to 70° F in the summer months. The temperature range results from the temporary residence time in above-grade process ponds. During aquifer restoration, fresh makeup water from the adjacent BC or underlying N Aquifer will be injected into well fields. The BC aquifer may not contain enough water supply to support the ISR project since it does not re-charge or have influent flow. Table 6.2 describes the anticipated range of concentrations for various constituents in the lixiviant injected during copper recovery. The lixiviant formulation illustrated in Table 6.2 is a reflection of metals dissolution in the ore body as a result of the addition of sulfuric acid. This formulation will circulate through the ore body during the mining phase. The formulation will change during restoration when acid is no longer added to the circulation, causing analytes to precipitate.

Table 6.2 Injection Fluid Composition

As	Ba	Cd	Cr	Pb	Hg	Se	Ag	Cu	U	S	Ca	Mg
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
< 1	< 1	23	< 1	2	< 1	< 1	< 1	637	3		639	2224
< 1	< 1	24	< 1	3	< 1	< 1	< 1	655	3		626	2369

7.0 PART E – Formation Testing Program

This attachment provides a description of the formation testing program for the Project. The formation testing program description includes information about geohydrologic properties of the ore zone and the confining zones from previous tests and information about the pump testing program that will be performed for each well field.

7.1 Fracture Pressure

The Company will not use hydraulic fracturing as part of the ISR process, and no fracture pressure testing is planned. Fracture testing could increase the probability of creating a pathway for loss of fluid control in the immediate vicinity of the tested well. The Company will operate its injection wells below the estimated fracture pressure of the injection zone. Maintaining the native hydraulic properties of the host sand is important to copper recovery and control of well field solutions. Instead of fracture testing the Company will rely on conservative and accepted methods of estimating fracture pressure as described below.

Fracture pressure varies with well depth, strength of formation rock and overburden pressure. Hydraulic pressure is the sum of the overburden pressure and the hydrostatic pressure of fluids within the wellbore. The hydrostatic pressure can be calculated based on the pressure gradient of the fluid multiplied by the fluid depth. The total hydraulic pressure or downhole pressure is calculated as follows:

> total hydraulic pressure (psi) =overburden pressure (psi) + [(fluid pressure gradient (psi/ft) x depth (ft)]

To prevent formation fracturing, the total hydraulic pressure or downhole pressure must not exceed the formation fracture pressure. Since the hydrostatic pressure is calculated as the fluid pressure gradient multiplied by the depth, the maximum surface pressure or maximum allowable well head pressure (max WHP) can be calculated as follows:

> max WHP = formation fracture pressure (psi) – hydrostatic pressure (psi)

The formation fracture pressure can be calculated based on the fracture gradient multiplied by the depth.

Fracture gradient is defined by the EPA (2012) as follows:

> The fracture gradient is a measure of how the pressure required to fracture rock in the earth changes with depth. It is usually measured in units of "pounds per square inch per foot" (psi/ft) and varies with the type of rock and the stress history of the rock. The default value used by Region 8 in Utah is 0.8 psi/ft. This means, for example, that at a depth of 100 ft, a pressure of 80 psi would be required to fracture the rock, while at a depth of 500 ft, the required pressure would be 400 psi; at 1,000 ft, 800 psi

LVMC will use a fracture gradient value of 0.6 psi/ft as a conservative value for the overlying shale in either the Mancos layer or bed 14. Therefore, the max WHP will be calculated based on the following equation, which uses a fluid pressure gradient of 0.433 psi/ft for the injected fluid:

max WHP = [0.6 psi/ft – 0.433 psi/ft] x [depth to top of bed 15 (ft)]

Based on a range of depths to the target mineralization of approximately 125 to 800 feet, the max WHP will range from approximately 20 to 133 psi. The maximum allowable WHP will be calculated on a well-by-well basis, and operational controls will be put in place to prevent exceeding designated pressures. The maximum injection pressure will be designated for each header house as described in Section 6.2. The designated maximum injection pressure will be posted near the injection trunk line gauge used to monitor injection pressure. This practice will ensure the formation fracture pressure is not exceeded according to 40 CFR § 144.28(f)(6)(i).

7.2 Project Area Pumping Tests

7.2.1 Pump Test Summary

Comprehensive aquifer tests have been conducted on seven groundwater production wells in the Project Area. This includes five BC aquifer tests and two N aquifer tests. The Company uses pump tests to determine well yields and aquifer hydraulic conductivities. Step-drawdown tests were conducted to determine well hydraulics. Constant discharge tests were conducted to determine aquifer properties. The pump tests support good permeability of the BC aquifer which supports flow criteria required for successful ISR operations. Additionally, one of the pump tests illustrates geologic confinement of the BC aquifer. Appendix I provides reports documenting pumping tests that have been conducted in the Project Area. A summary of the reports in these appendices is provided below.

7.2.1.1 BC Aquifer

PW-5. Two pumping tests were conducted at well PW-5 shortly after well completion and development in 2004: a step-drawdown test and a constant discharge test. The 4-hour step-drawdown test was conducted at rates of 194, 259, and 307 gpm for 45-60 minutes per step. Water levels did not stabilize at each step, but were continuing to drop at rates of 0.13 ft/min, 0.20 ft/m, and 0.26 ft/min for the three steps, respectively. The non-linear well loss constant (C) was calculated from Jacob (1950) to be 1.8×10^{-4} ft/gpm2 and the linear well loss coefficient was calculated at 0.15 ft/gpm.

A 24-hour constant-discharge pumping test was conducted in PW-5 starting on June 7, 2004 using a 60 hp Grundfos 230S submersible pump (rated for 160 to 320 gpm) which was set at 512 ft bgs on 4-inch drop pipe in PW-5. The test was initially conducted at 315 gpm, but the insulation burned through on one lead wire and the pump kicked off after 1 hour and 10 minutes. The test was re-started after 2.5 hours, and the well was pumped for 24 hours at an average rate of 220 gpm.

Maximum drawdown at the end of 24 hours was 84 feet, which equated to a specific capacity of 2.6 gpm/ft. The 84-ft drawdown was small, relative to the available drawdown of approximately 240 ft. The constant discharge test results were analyzed using the Theis, Theis recovery, Cooper-Jacob, Cooper-Papadapalous, Jacob recovery, and Moench methods. The analysis of drawdown at the pumping well produced higher hydraulic conductivity results during pumping (2.56×10^{-4} to 3.98×10^{-4} cm/sec) than during recovery (1.72×10^{-4} to 1.74×10^{-4} cm/sec). Given an aquifer saturated thickness of 333 ft, the hydraulic conductivity is 1.69x10-4 cm/sec. In conclusion, the hydraulic conductivity of the Burro Canyon aquifer at PW-5 ranges from a low of 1.73×10^{-4} cm/sec (the geometric mean of two recovery test analyses) to a high of 3.98×10^{-4} cm/sec (the Theis analysis) with a best estimate of 3.48×10^{-4} cm/sec.

PW-6. Two pumping tests were conducted at well PW-6 shortly after well completion and development: a 2-hour step-drawdown test on June 5 and a 24-hour constant discharge test on June 6 - 7, 2005. The step-drawdown test in PW-6 was conducted on May 19, 2005 using a 50 hp Grundfos 230S submersible pump was set at 435 ft bgs on 3-inch drop pipe. Step tests were conducted at 245, 260, 272, and 282 gpm. Each step was run for approximately 30 minutes, and water levels stabilized quickly at each flow rate. The maximum drawdown was 59.5 ft at a flow rate of 282 gpm .

The non-linear well loss constant (C) was calculated from Jacob (1950) to be 1.86×10^{-4} ft/gpm^2 and the linear well loss coefficient was calculated at 0.16 ft/gpm, as summarized in 7.1. These constants can be used to calculate the expected drawdown for any pumping rate. For example, the expected drawdown resulting from aquifer loss and well loss at a pumping rate of 400 gpm is 92.4 ft

PW-9. An 18.25-hour pumping test was conducted in well PW-9, from September 13 - 14, 2007 using a 15 HP Grundfos 150S submersible pump to accommodate the low flow rates. The pump intake was set at 298 ft below ground surface, and the water level was drawn down to the pump intake with an average pumping rate of 33.9 gpm. Water levels were measured throughout the 18.25-hour pumping test and for 28 hours after the pump was shut off, at which time the water level had recovered to within 2.7 feet of the static, pre-test water level. The pumping and water level recovery data from the 18.25-hour pumping test was analyzed using unconfined and leaky solutions. Analysis of the drawdown data yielded higher hydraulic conductivities (geometric mean = 4.06×10^{-5} cm/sec) than recovery data (geometric mean = 1.57×10^{-5} cm/sec). The best estimate of aquifer hydraulic conductivity at PW-9 is 2.52×10^{-5} cm/sec.

PW-12. An aquifer pumping test was conducted at well PW-12 shortly after well development in October, 2012. The well was pumped at three different flow rates (steps) leading into a constant discharge test and a recovery test. The stepped flow rates of 46 gpm, 62.2 gpm, and 99.5 gpm were selected based on the characteristics of the aquifer and the limitations of the test pump. For the constant discharge test, PW-12 was pumped at an average flow rate of 96 gpm for 24 hours, resulting in 155.7 ft of drawdown. Water levels recovered to within 4 feet of static in less than two hours.

The hydraulic conductivity analysis was conducted using a Theis solution for the step test in a confined aquifer, and was solved as both fully penetrating (where thickness b = 200 ft) and partially penetrating (where b= 400 ft and screen length L = 200 ft). The fully penetrating solution provided more realistic results, as the well efficiency was more reasonable (63% FP vs. 111.3% PP). The fully penetrating solution is plausible since the well is completed with filter pack sand to the top of the aquifer. Storage was fixed at 0.00005 in the analysis, however the solutions are insensitive to this parameter. The best estimate of Burro Canyon aquifer properties at PW-12, based on the fully penetrating analysis, is transmissivity (T) =235 ft^2/day, b = 200 ft, and hydraulic conductivity K= 1.2 ft/d (4.2×10^{-4} cm/sec). Note, however, that aquifer boundary conditions have a more significant effect on actual drawdowns observed during longer-term pumping in Lisbon Valley.

PW-12 is equipped with a permanent submersible pump, and is plumbed into the raw water system. Static water level prior to pumping was 5,830.8 ft amsl (500.6 ft btoc). Well PW-12 currently yields approximately 150 gpm with drawdown of 700 ft. Specific capacity ranges from 0.63 to 0.84 gpm/ft with an average of 0.70 gpm/ft.

17RC-243. An aquifer pumping test was performed in open borehole 17RC-243 on March 13, 2018. The bore hole was pumped for 175 minutes at an average rate of 6.64 gpm (ranging from 0.8 to 25 gpm). Flow rate during the test was highly variable, as valve adjustments were made to achieve a relatively constant discharge rate under changing head conditions. A total of 1,162 gallons were pumped, resulting in a drawdown of 28.55 ft. Plots of residual drawdown showed a change in slope at about t/t' = 2.6 to 2.7, indicating that recovery data were affected by a boundary condition at about 103 to 110 minutes after the pump was shut off, with the water level recovery prior to 103 minutes being affected by higher hydraulic conductivity of the formation closer to the well and recovery after 110 minutes being affected by lower hydraulic conductivity of the formation farther away from the well. The Theis analyses for confined and unconfined conditions considered the entire recovery dataset and provided identical estimates of transmissivity and hydraulic conductivity of 68 ft2/day and $2.3x10^{-4}$ cm/sec, respectively. The results of the Theis analyses fell between the high and low estimates from the residual drawdown analyses.

7.2.1.2 N Aquifer

PW-7. Two pumping tests were conducted in well PW7 shortly after the well was deepened and cased in June 2006: a 2.5-hour step-drawdown test and a 24-hour constant discharge test. Four steps were conducted for approximately 30 minutes each, at pumping rates of 160, 145, 132, and 130.4 gpm. Drawdown stabilized at 39.2, 37.8, 34.4, and 33.9 for each step, respectively, resulting in a non-linear well loss constant (C) of $5.3x10^{-4}$ ft/gpm2 and a linear well loss coefficient of 0.18 ft/gpm.

The 24-hour constant-discharge pumping test in PW-7 was conducted at an average flow rate of 147.2 gpm, and a total of 206,700 gallons were pumped. Maximum drawdown at the end of 24 hours was 51 feet, equating to a specific capacity of 2.9 gpm/ft. The results were analyzed using the Theis, Theis recovery, Cooper-Jacob, Cooper-Papadapalous, and Jacob recovery methods, and indicated higher hydraulic conductivity results during pumping ($2.56x10^{-4}$ to $3.98x10^{-4}$ cm/sec) than during recovery ($1.72x10^{-4}$ to $1.74x10^{-4}$ cm/sec). The analysis concluded that the hydraulic conductivity of the N-aquifer at PW-7 ranges from a low of $1.19x10^{-4}$ cm/sec (the Jacob early-time recovery test analyses) to a high of $6.43x10^{-4}$ cm/sec (the Theis analysis) with a best estimate of $2.89x10^{-4}$ cm/sec

Water levels were measured in monitoring well MW97-13, which is completed in the N-aquifer 1,358 feet from well PW-7. The monitoring well showed no response to pumping at PW-7.

PW-11. An aquifer pumping test was conducted on well PW-11 in July 2013. The well was pumped at an average rate of approximately 30 gpm for 8.5 hours, for a total of 16,260 gallons discharged. The pump was shut off when the water level drawdown approached the pump intake.

PW-11 was equipped with a permanent submersible pump, and is plumbed into the raw water system. Static water level prior to pumping was 5,183.4 ft amsl (1,148 ft btoc). The well yields approximately 50 gpm with drawdown of 500 – 550 ft. Specific capacity ranges from 0.06 to 0.12 gpm/ft with an average of 0.09 gpm/ft.

7.3 LVMC Pump Test Conclusions

LVMC pump testing supports anticipated hydraulic conductivity in the BC aquifer from 10^{-4} to 10^{-3} cm/sec range. This range is suitable for ISR at the head pressures that will be induced from gravity flow from surface ponds.

Table 7.1 Summary of Hydraulic Conductivity Results

Well	Pump Intake Depth (ft)	Aquifer	Final Drawdown (ft)	Hydraulic Conductivity Low Range (cm/sec)	Hydraulic Conductivity High Range (cm/sec)	Hydraulic Conductivity Best Estimate (cm/sec)	Hydraulic Conductivity Best Estimate (ft/day)
PW-5	512	Burro Canyon	61.54	---	---	---	---
PW-5	512	Burro Canyon	83.57	1.71E-04	3.98E-04	3.48E-04	0.99
PW-6	435	Burro Canyon	59.47	---	---	---	---
PW-6	435	Burro Canyon	65.96	2.23E-03	6.21E-03	2.66E-03	7.53
PW-12	794.6	Burro Canyon	155.71	4.20E-04	4.20E-04	4.20E-04	1.19
LS-243	295.3	Burro Canyon	28.55	1.10E-04	4.50E-04	2.30E-04	0.65
PW-7	1,000	N-aquifer	39.18	---	---	---	---
PW-7	1,000	N-aquifer	51.49	1.19E-04	6.43E-04	2.89E-04	0.82
PW-11	---	N-aquifer	---	---	---	---	---
PW-12		Burro Canyon		---	---	---	---
PW-12		Burro Canyon	155.71	4.20E-04	4.20E-04	4.20E-04	1.19

7.3.1 LVMC Pump Testing 1995-2013

In addition to the tests described above, Adrian Brown Consultants and Whetstone Associates conducted numerous aquifer tests in wells and boreholes, with and without observations wells, from 1995 to the present at the Lisbon Valley site. These tests included constant discharge pumping tests, variable-discharge pumping tests, step-drawdown tests, and slug tests in wells SLV3, PW-1, PW-2, PW-3, PW-4, 95R1, and MW96-7B, and in piezometers 98R3, 98R4, 98R7, 98R8, and PW97-1A.

Based on review of the testing results by LVMC, significant conclusions from the testing indicate:

- Transmissivity of the BC aquifer based on the analysis of late time data averaged about 122 ft^2/day, with a geomean hydraulic conductivity of 0.61 ft/day ($2.1x10^{-4}$ cm/sec). The specific storage of the BC aquifer is estimated at $3x10^{-5}$ (dimensionless).

- The best estimate of transmissivity for the N aquifer is about 400 ft^2/day, with a hydraulic conductivity of 2.9x10-4 cm/sec. The specific storage of the N aquifer is estimated at $1x10^{-5}$ (dimensionless).

- The vertical hydraulic conductivity of the Morrison aquitard calculated using the Field Determination of the Hydraulic Properties of Leaky Multiple Aquifer Systems method (Neuman and Witherspoon, 1972). Vertical conductivities ranged from $5.0x10^{-8}$ to $5.25x10^{-7}$ cm/sec.

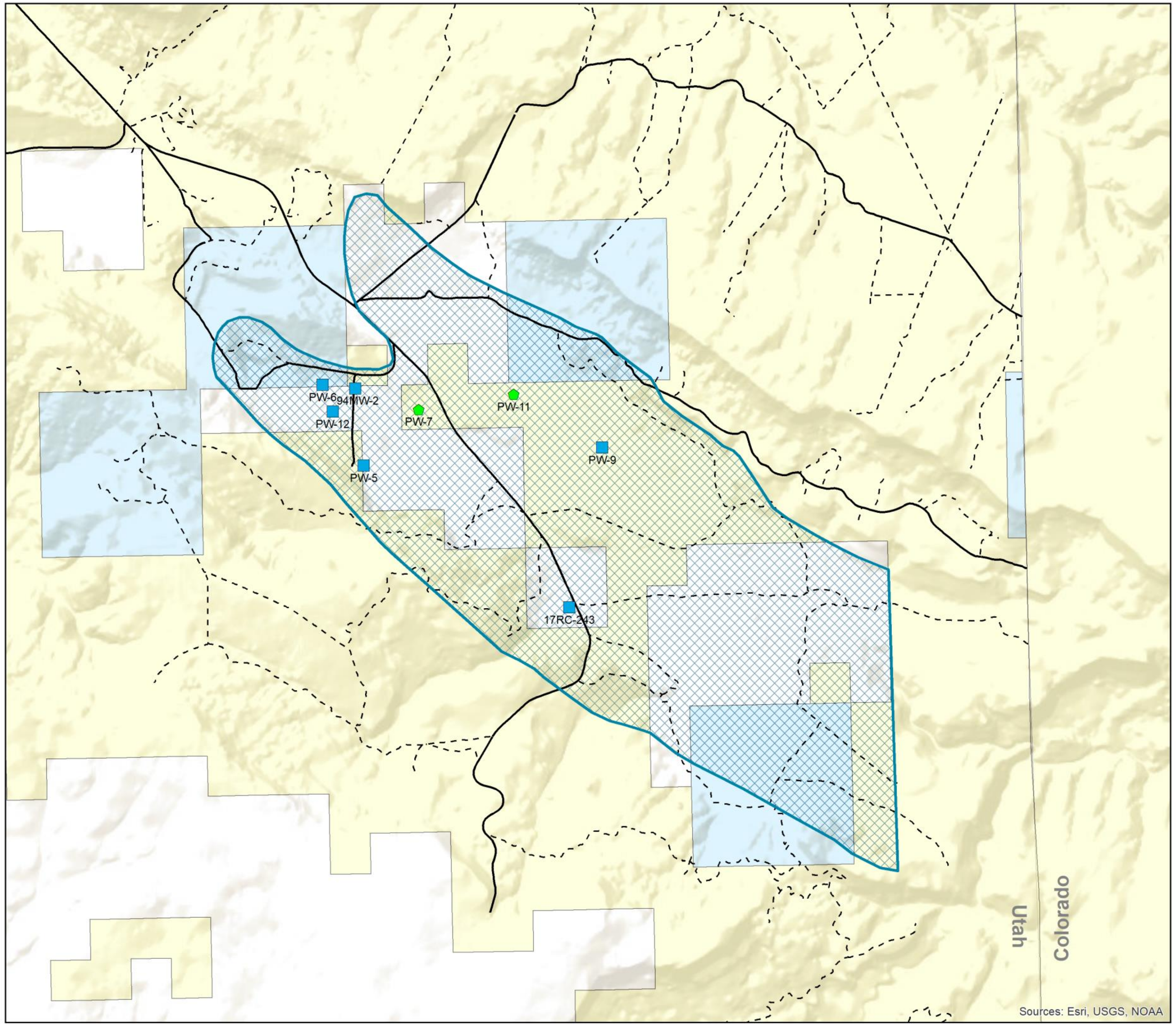


Figure 7.1

Aquifer Test Locations

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 22 June 2020

File Name: ISR Figure 7.1 Aquifer Test Locations

LISBON VALLEY MINING CO

7.4 PW-5 Transducer Test & Study

LVMC conducted a groundwater elevation study in the summer of 2019 as part of well rehabilitation work on BC aquifer production well PW-12. The study involved intermittent groundwater pumpage from on both sides of the GTO fault. This fault isolates the BC and N aquifers along the 3 Step footwall. The study focused on groundwater monitoring at the fault (PW-5) during intermittent pumpage from the hanging wall (PW-12) and footwall (Woods well). Groundwater elevation monitoring at the GTO fault was accomplished using a pressure transducer in PW-5.

7.4.1 Background

PW-12 is an important supply well located in LLV near the GTO deposit in the BC aquifer. Since installation in 2012, pumpage from PW-12 has locally dewatered the BC aquifer including water levels in former BC production well PW-5. This well is currently used as a piezometer with insufficient water for pumping. The Woods well is located on the 3 Step footwall and pumps groundwater from the N aquifer. The N aquifer head at the Woods wells is >200 feet higher than the BC aquifer head at PW-5. Therefore an influent head gradient occurs across the GTO fault. Both PW-12 and Woods well are aggressively pumped in the summer due to high process water demands at the Lisbon Valley Mine. Well locations and GTO fault are shown on Figure 7.6.

PW-5 terminates in the GTO fault separating the BC aquifer from N aquifer along the 3 Step footwall. It's location and design are ideally located for groundwater elevation changes from PW-12 pumping. It is equally well suited for monitoring potential groundwater elevation changes from water leakage across the GTO fault from the 3 Step footwall.

The summer of 2019 was highly problematic with well pump failures at PW-12 and pump cavitation issues at the Woods well. This resulted in both wells being pumped intermittently and at separate times. The aggressive, yet intermittent pumpage from both aquifers located on separate sides of the GTO fault provided an ideal opportunity to implement transducer monitoring in PW-5.

Figure 7.7 shows the PW-5 pressure hydrograph and 5-week time period extending from July 8 to August 13. Woods well began its seasonal pumpage on July 8 at a rate of 150 gpm. At this time, PW-12 was pumping at a rate of 120 gpm. On July 14, the column pipe failed on PW-12 damaging the pump and taking the well out of service. This resulted in an immediate head inflection at PW-5 (Inflection #1). The pump was reinstalled in in PW-12 on July 17 without knowledge that the pump was damaged. This resulted in a second inflection as PW-12 pumpage decreased PW-5 groundwater elevation (transducer pressure). Near the end of July the flow rate from the damaged pump in PW-12 began to decline. This resulted in 3rd inflection as the pressure head at PW-5 increased. PW-12 was taken out of service at 3rd time on July 31 and the pump replaced on August 11. This resulted in a 4th inflection as pumpage reduced pressure at PW-5.

The Company is continuing PW 5 study and analysis.

Figure 7.2 PW-5 Transducer Study Location Map

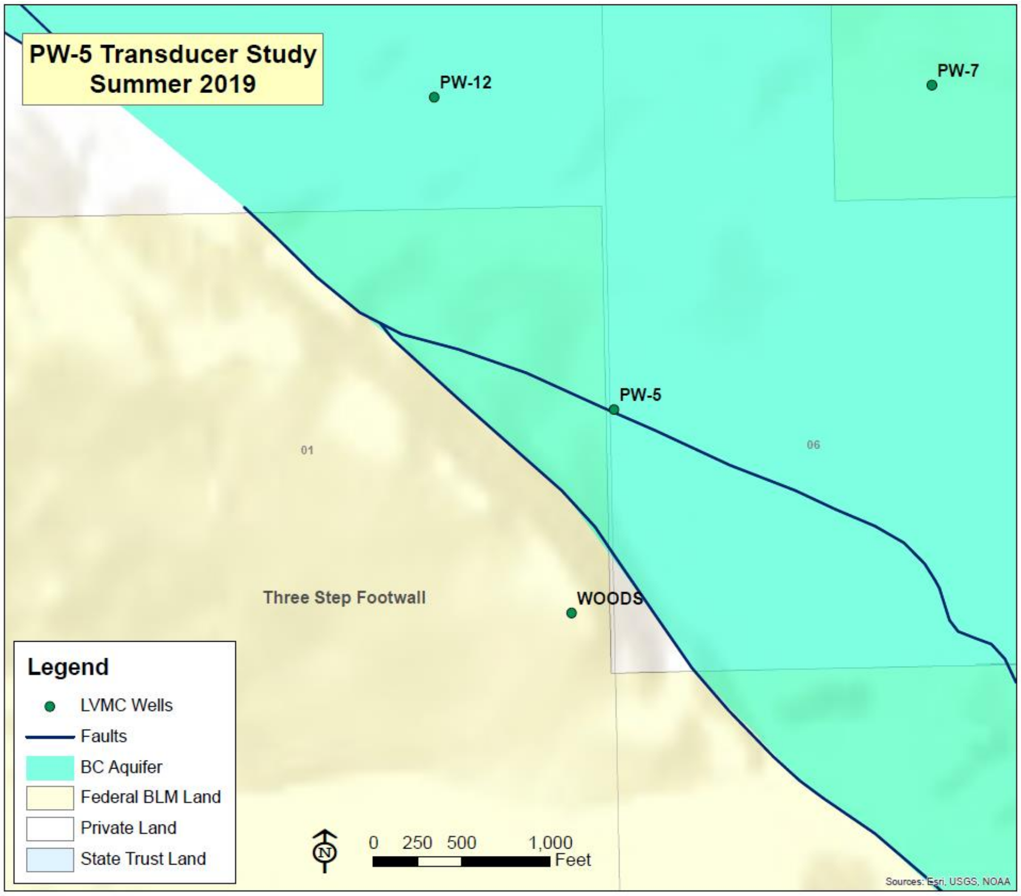
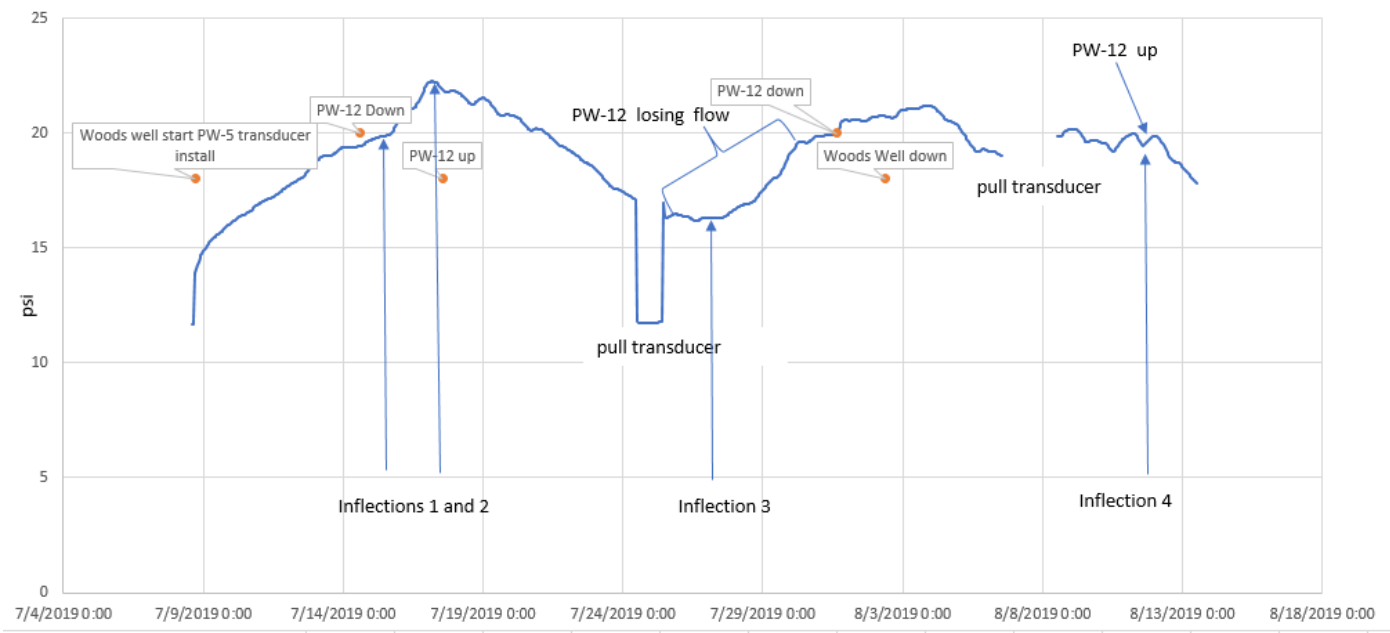


Figure 7.3 PW-5 Transducer Pressure



7.4.2 Summary and Conclusions

The BC and N aquifers occur juxtaposed along the GTO fault near PW-5. The aquifers were both pumped intermittently over a 5-week period at flow rates greater than 100 gpm. Pumpage from the BC aquifer at PW-12 influences the BC aquifer head at PW-5. The pressure influence is almost immediate reflecting hydraulic connection and confined groundwater conditions. Pumpage from the Woods well does not appear to influence the pressure head at PW-5. The GTO fault appears to behave as a hydraulic seal reflecting the occurrence of high SGR material.

7.5 Pre-Operational Pump Testing for Each Well Field

The following pump testing procedures will be used to establish that the production and injection wells are hydraulically connected to the perimeter production zone monitor wells, that the production and injection wells are hydraulically isolated from non-production zone vertical monitor wells, and to detect potentially improperly plugged wells or exploration holes. Pump testing results will be included in the well field hydrogeologic data packages.

7.6 Pump Testing Design

An extensive pump test program will be designed and implemented prior to operation of each well field to evaluate the hydrogeology and assess the ability to operate the well field. Prior to pump testing several important well field development steps will be completed:

1) Delineation drilling at spacing sufficient to finalize well field design. As standard procedure, all delineation holes will be plugged and abandoned after drilling.

2) Detailed mapping of the ore bodies targeted for ISR operations and the lithology of overlying and underlying confining units.

3) Revision of the conceptual geology and hydrogeology including definition of aquitards and ore zone units to be produced or monitored.

4) Design of the production and injection wells including well locations and screened intervals.

5) Design of the monitor well system based on production and injection well locations and refined conceptual geology and hydrogeology.

6) Specification of all monitor well locations and screened intervals.

7) Installation of all monitor wells and production wells to be used during pump testing.

7.7 Pump Test Procedures

Appropriate wells as needed for characterization and regulatory purposes will be monitored during the pumping test, including but not necessarily limited to the following wells:

1) Pumping wells,

2) Monitor wells within the production zone,

3) Perimeter production zone monitor wells,

4) Monitor wells in the immediately overlying non-production zone sand unit,

5) Monitor wells in each subsequently overlying non-production zone sand unit,

6) Monitor wells in the alluvium, if present,

7) Monitor wells in the immediately underlying non-production zone sand unit, if the production zone does not occur immediately above the Morrison,

8) Any additional wells installed for investigating other hydrogeologic features, and

9) Any other wells within proximity to the well field that have been identified as having the potential to impact or be impacted by ISR operations

In general, the monitoring system wells will be monitored using downhole data logging pressure transducers, which will be corrected for variations in barometric pressure. Some manual measurements with electronic meters also may be made.

Prior to testing, static potentiometric water levels will be measured in every well in the monitoring system. Where a sufficient number of data points exist, these data will be used to map the pre-operational potentiometric surface for each unit including alluvium, where present. Because of the high density of wells and, any leakage across aquitards due to improperly plugged boreholes or wells typically will become apparent while preparing potentiometric surface maps. Water samples will be collected from selected N aquifer monitor wells and analyzed for baseline parameters. The N aquifer water quality will be evaluated to identify any potential areas of leakage across aquitards due to improperly plugged boreholes or wells.

Pump testing will involve inducing stress on the production zone ore zone by operating pumping wells. The goal of the test will be to demonstrate suitable conditions for ISR operations. This will be done by causing drawdown in the production zone extending to all perimeter monitor wells, creating a cone of depression across the well field area to test the confinement between the ore zone and the overlying and underlying confining units, if present, and addressing potential leakage through confining units via improperly sealed or unplugged exploration boreholes, or associated with naturally occurring geologic features. The presence or lack of response in vertical monitor wells will be used for evaluation of confinement between these units and for identification of leakage due to anomalies such as improperly plugged boreholes. If leakage is present, the relative responses in the overlying, underlying, and/or alluvial monitor wells will indicate the proximity and direction toward the source of leakage.

The pumping test duration will be sufficient to create a suitable response in the perimeter monitor wells, typically a minimum drawdown of 1 foot. If hydrogeologic conditions dictate, less response may be adequate to show a direct cause and effect from pumping.

The flow rate of the pumping test will be based on well capacity and design requirements. More than one pumping well may be required to create drawdown in all perimeter wells.

Measurements during pump testing will include instantaneous and totalized flow, periodic pressure transducer measurements, barometric pressure, and time. A step rate test will be performed initially. There will be an initial stabilization phase with no flow, a stress period of constant flow, and a recovery period with no flow

7.8 Pump Test Evaluation

Evaluation of pump test data will address the following:

1) Demonstration of hydraulic connection between the production and injection wells and all perimeter monitor wells and across the ore zone.
2) Verification of the geologic and hydrologic conceptual model for the well field.
3) Evaluation of the vertical confinement and hydraulic isolation between the production zone and overlying and underlying units.
4) Calculation of the hydraulic conductivity, storativity, and transmissivity of the ore zone.
5) Evaluation of anisotropy within the ore zone.

7.9 Well Field Hydrologic Data Packages

Pump testing data and results will be included in the well field hydrogeologic data packages, which will be prepared in accordance with UDWQ permit requirements. This section describes the contents and evaluation of the well field hydrogeologic data packages. These will be reviewed by the UDWQ.

Upon completion of field data collection and laboratory analysis, the well field hydrogeologic data packages will be assembled and submitted for review by the UDWQ UIC Program for evaluation. The UDWQ UIC Program evaluation will determine whether the results of the hydrologic testing and the planned ISR operations are consistent with standard operating procedures and technical requirements stated in the UDWQ permit. The evaluation will include review of the potential impacts to human health and environment. Relevant portions also will be included in the injection authorization data packages. If anomalous conditions are present or the evaluation indicates potential to impact human health or the environment, the well field hydrogeologic data package will be submitted to UDWQ for review and approval. The well field hydrogeologic data package and written evaluation will be maintained at the site and available for regulatory agency review.

Each well field hydrogeologic data package will contain the following:

1) A description of the proposed well field (location, extent, etc.).
2) Map(s) showing the proposed production and injection well patterns and locations of all monitor wells.
3) Geologic cross sections and cross section location maps.
4) Isopach maps of the production ore zone and overlying and underlying confining units.
5) Discussion of how pump testing was performed, including well completion reports.
6) Discussion of the results and conclusions of the pump testing, including pump testing raw data, drawdown match curves, potentiometric surface maps, water level graphs, drawdown maps and, when appropriate, directional transmissivity data and graphs.
7) Baseline water quality information including proposed upper control limits (UCLs) for monitor wells and target restoration goals (TRGs).
8) Any other information pertinent to the proposed well field area tested will be included and discussed.

7.10 Injection Authorization Data Packages

Injection authorization data packages will be prepared and presented to UDWQ for each well field. Each injection authorization data package will contain the following: A description of the proposed well field (location, extent, etc.).

1) Map(s) showing the proposed production and injection well patterns and locations of all monitor wells.
2) Geologic cross sections and cross section location maps.
3) Discussion of how pump testing was performed, including well completion reports and MIT results.
4) Discussion of the results and conclusions of the pump testing, including pump testing raw data, drawdown match curves, potentiometric surface maps, water level graphs, drawdown maps and, when appropriate, directional transmissivity data and graphs.
5) The calculated formation fracture pressure for each well and the designated maximum injection pressure for each well.
6) Commitment to completing MIT and preparing well completion reports for all injection wells prior to initiating injection into the well field.
7) Schedule for proceeding with operation of the well field.

8.0 PART F - Well Stimulation Plan

A stimulation program is not proposed for the Project injection wells.

Well development (described in Section 11.4), which will include swabbing, will be used to improve well yield by enhancing hydraulic communication between the aquifer and the well.

9.0 PART G - Injection Well Construction Plan

The Company will install all wells using a downhole hammer and compressed air or reverse circulation. Hole sizes will range from 6 ½ to 9 7/8". Limited additives will be used to form a wall cake in the Mancos Fm.

10.0 PART H - Injection Construction Details

This attachment details the construction procedures that will be utilized for injection, production and monitor wells at the Project. All injection and production wells will be completed in accordance with Utah well construction standards and EPA standards for Class III UIC wells.

10.1 Well Construction Materials

Well casing material will be polyvinyl chloride (PVC) and High Density Polyethylene (HDPE) with minimum SDR 17 wall thickness. Use of this casing material has been approved at other ISR sites, such as the Cameco Resources Smith Ranch Project in Wyoming, also known as the Crow Butte Site (Cameco, 2012; NRC, 2016). The construction of the wells within the AOR will mirror that of the Crow Butte Site, which states:

"The typical well casing used is rigid PVC Standard Dimension Ratio 17 (SDR-17) with a nominal 13 centimeters (5 inches) outside diameter (Certainteed or similar). However, should a larger pump size be required, larger diameter casing may be utilized."

The hole will be cased with 12-inch steel surface casing outside nominal 5 to 6 inches diameter SDR-17 PVC well casing. Fiberglass or steel casing may also be used. The casing will extend from the top of the top of the target zone to approximately 2 feet above ground level. Each joint of SDR-17 casing will be connected by a water tight O-ring seal which is locked with a high strength nylon spline. No glue or screws will be used with these types of well casing materials.

The wells typically will be 4.5 to 6-inch nominal diameter and will meet or exceed the specifications of ASTM Standard F480 and NSF Standard 14. In order to provide an adequate annular seal, the drill hole diameter will be at least 2 inches larger than the outside diameter of the well casing.

The annulus materials will be emplaced using a tremie pipe and sealed with neat cement grout composed of sulfate- resistant Portland cement in accordance with Utah wells construction standards. Water used to make the cement grout will not contain oil or other organic material. Cement grout could contain adequate bentonite to maintain the cement in suspension in accordance with Halliburton cement tables.

Casing will be joined using methods recommended by the casing manufacturer. PVC casing joints approximately 20 feet apart will be joined mechanically (with a watertight O-ring seal and a high strength nylon spline) to ensure watertight joints above the perforations or screens. Casings and annular material will be routinely inspected and maintained throughout the operating life of the wells.

10.1.1 Thermoplastic Well Casing Variance Request

The Company requests a variance from the requirement in 40 CFR § 147.2104(b)(1) that plastic well casing materials, including PVC, ABS or others, not be used in new injection wells deeper than 500 feet in the State of Utah. This variance is requested on the following basis:

1. Collapse pressure calculations and well casing manufacturer specifications indicate that PVC well casing can be used at depths greater than 500 feet considering the site-specific well construction methods (see Section 11.1.1.1).
2. PVC well casing has been used successfully for wells deeper than 500 feet at other

ISR facilities for many years (see Section 11.1.1.2).

3. PVC well casing is commonly used for other wells in Utah deeper than 500 feet (see Section 11.1.1.3).
4. Thermoplastic well casing is the preferred well casing material for ISR facilities due to corrosion resistance. The corrosion resistance of PVC compared to carbon steel well casing is well documented.
5. Each new injection, production and monitor well will be pressure tested to confirm the integrity of the casing prior to being used for ISR operations. MIT will be repeated every 5 years and after any repair where a downhole drill bit or under-reaming tool is used (see Section 11.5).
6. The injection pressure for each injection well will be maintained below the maximum pressure rating of the well casing (see Section 7.2).
7. An extensive excursion monitoring program will be implemented by installing and sampling monitor wells in the perimeter of the production zone and in overlying and underlying hydrogeologic units to detect potential excursions of ISR solutions into USDWs such as would occur with a leaking injection well (see Section 14.2).
8. Injection pressures will be monitored through automated control and data recording systems that will include alarms and automatic controls to detect and control a potential release such as would occur through an injection well casing failure (see Section 14.1).

The variance is requested pursuant to 40 CFR § 147.2104(d)(4), which states that the Regional Administrator may approve alternate casing provided that the owner or operator demonstrates that such practices will adequately protect USDWs.

10.1.2 Hydraulic Collapse Pressure Calculations

When specifying well casing and installation, the Company will adhere to the requirements in ASTM F480, Standard Specifications for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80. ASTM F480 requires that "the depth at which thermoplastic well casing can be used is a design judgment." There is no depth of installation limit in ASTM F480 except that PVC well casing should be "used under conditions that meet manufacturer's recommendations for its type" and that "the driller shall install the thermoplastic casing in a manner that does not exceed the casing hydraulic collapse resistance." In accordance with these requirements, the Company will ensure that all thermoplastic well casing meets the manufacturer's recommendations for its type and is installed in a manner that does not exceed the hydraulic collapse resistance.

The net hydrostatic pressure on the well casing is calculated as the difference between the exterior and interior hydrostatic pressure. The hydrostatic pressure is calculated as the fluid density multiplied by the fluid depth. The Company will use cement to grout the annulus on all injection, production and monitor wells. Using a typical cement grout density of 90 lb/ft3, and recognizing that the inside of the well casing will always be full of water before the cement cures (with a density of at least 62.4 lb/ft3 depending on whether additives are used), the pressure versus depth gradient will be about 27.6 lb/ft3 or about 0.2

psi/ft of depth. According to CertainTeed (2011), the hydraulic collapse pressure for SDR 17 PVC well casing is about 224 psi. Therefore, it would take an installation depth much greater than 1,000 ft to exceed this pressure as long as cement grout is used and the well casing remains full until the cement hardens. Both of these conditions will be met in all injection, production and monitor well casing installations using the installation procedures described in Section 11.2. Water will be used to displace the cement and force it upward into the annulus; therefore, the well casing will always be full of water while the cement cures.

When designing and installing injection, production and monitor wells, the Company will adhere to the requirements of ASTM F480 and manufacturer's criteria to ensure that the installation does not exceed the casing hydraulic collapse resistance.

10.1.3 Use of PVC Well Casing at Other ISR Facilities

There are numerous successful applications of PVC well casing at other ISR projects where the well depths are in excess of 500 feet. For example, at the Crow Butte project, where the average ore depth is 650 feet, 4.5-inch ID PVC well casing has been successfully used for many years. Both Taseko Mines Ltd. and Excelsior Mining Corp.'s copper ISR projects are projected to use either PVC, FRP or fiberglass well casing as part of well design for wells ranging up to 600 feet deep or more (Gunnison NI 43-101, 2017 and Florence NI 43-101, 2017). Both copper ISR projects are located in Arizona.

10.1.4 Utah Well Construction Standards

UAC R317-7-10 provides the Utah State guidelines for the construction of Class III wells as would be installed for the Project. Specifically, the Utah well construction standards state:

> All new Class III wells shall be cased and cemented to prevent the migration of fluids into or between underground sources of drinking water. The Director may waive the cementing requirement for new wells in existing projects or portions of existing projects where he has substantial evidence that no contamination of underground sources or drinking water would result. The casing and cement used in the construction of each newly drilled well shall be designed for the life expectancy of the well. In determining and specifying casing and cementing requirements, the following factors shall be considered:
>
> a. depth to the injection zone;
>
> b. injection pressure, external pressure, internal pressure, and axial loading;
>
> c. hole size;
>
> d. size and grade of all casing strings (wall thickness, diameter, nominal weight, length, joint specification, and construction material);
>
> e. corrosiveness of injected fluids and formation fluids;
>
> f. lithology of injection and confining zones; and
>
> g. type and grade of cement.

The Company will ensure that the Utah well construction standards are met during the engineering and installation of wells associated with the Project and will comply with UAC R317-7-10 monitoring requirements.

10.1.5 Compliance with 40 CFR § 146.32

The injection wells will comply with the 40 CFR § 146.32 regulations for protection of USDWs in Utah. The language stated in 40 CFR § 146.32 is a duplication of that found in the State of Utah R317-7-10.

10.2 Well Construction Methods

10.2.1 Injection Wells

Typical production and injection well installation will begin by drilling a bore hole through the ore zone to obtain a measurement of the copper grade and thickness. The ore depth is anticipated to range from approximately 200 to 900 feet. For all wells, the bore hole will be sampled and geologically logged. Samples will be collected at 5-10 ft intervals.

Injection wells will be constructed for use with packers. This will require a discontinuous screened interval and gravel pack separated by bentonite seals. A typical well is planned to have 4 to 8 20ft screened intervals separated by 5 ft intervals of blank casing. Casing centralizers will be installed as appropriate to allow uniform annular space. Gravel and bentonite will be tremied from the surface using separate gravel and bentonite tanks. The uppermost bentonite seal will extend a minimum of 10 feet above the uppermost screen. Following this the remaining annular space will be grouted to the surface using tremie pipe. Injection well design is shown on Figure 10.1. Injection wells

10.2.2 Extraction Wells

Extraction wells will be constructed with a continuous screened interval extending from the bottom of the well to a depth 10-20 feet below the top of the BC (Bed 15). The gravel pack will be tremied to a depth 10 feet above the top of screen. This will be followed with a minimum 10ft bentonite seal. The bentonite seal will be allowed to hydrate before grouting the well to surface. Extraction well design is shown on Figure 10.2.

10.3 Well Development

The primary goals of well development will be to allow formation water to enter the well screen, flush out drilling fluids, and remove the finer clays and silts to maximize flow from the formation through the well screen. This process is necessary to allow representative samples of groundwater to be collected, if applicable, and to ensure efficient injection and production operations. Wells will be developed immediately after construction using air lifting, swabbing, pumping or other accepted development techniques which will remove water and drilling fluids from the casing and borehole walls along the screened interval. Prior to obtaining baseline samples from monitor wells, additional well development will be conducted to ensure that representative formation water is sampled. The water will be pumped sufficiently to show stabilization of pH and conductivity values prior to sampling to indicate that development activities have been effective.

10.4 Well Rehabilitation

Extraction wells and injection wells may be rehabilitated over the course of mining in the event chemical precipitates affect yields. This will be conducted by acid-washing the screened intervals and reversing flows, and/or utilizing a work over drilling rig to surge and swab the wells using a surge block. Both injection and extraction wells are suitable submersible pump installation, acid washing and flows reversal. The primary goals of well rehabilitation will be to gently dissolve precipitates to open screened intervals and gravel pack.

Figure 10.1 Injection Well Construction Diagram

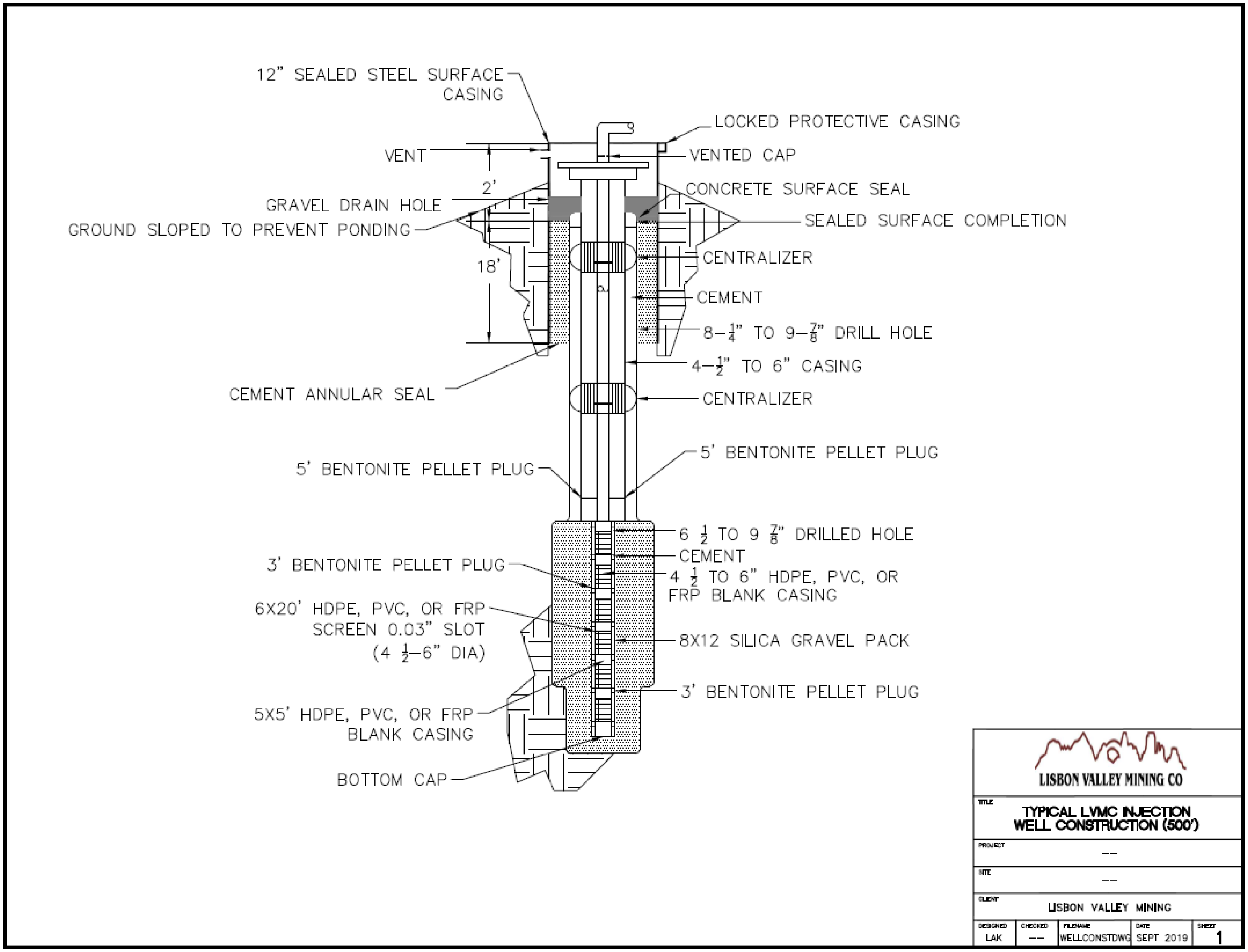


Figure 10.2 Production Well Construction Diagram

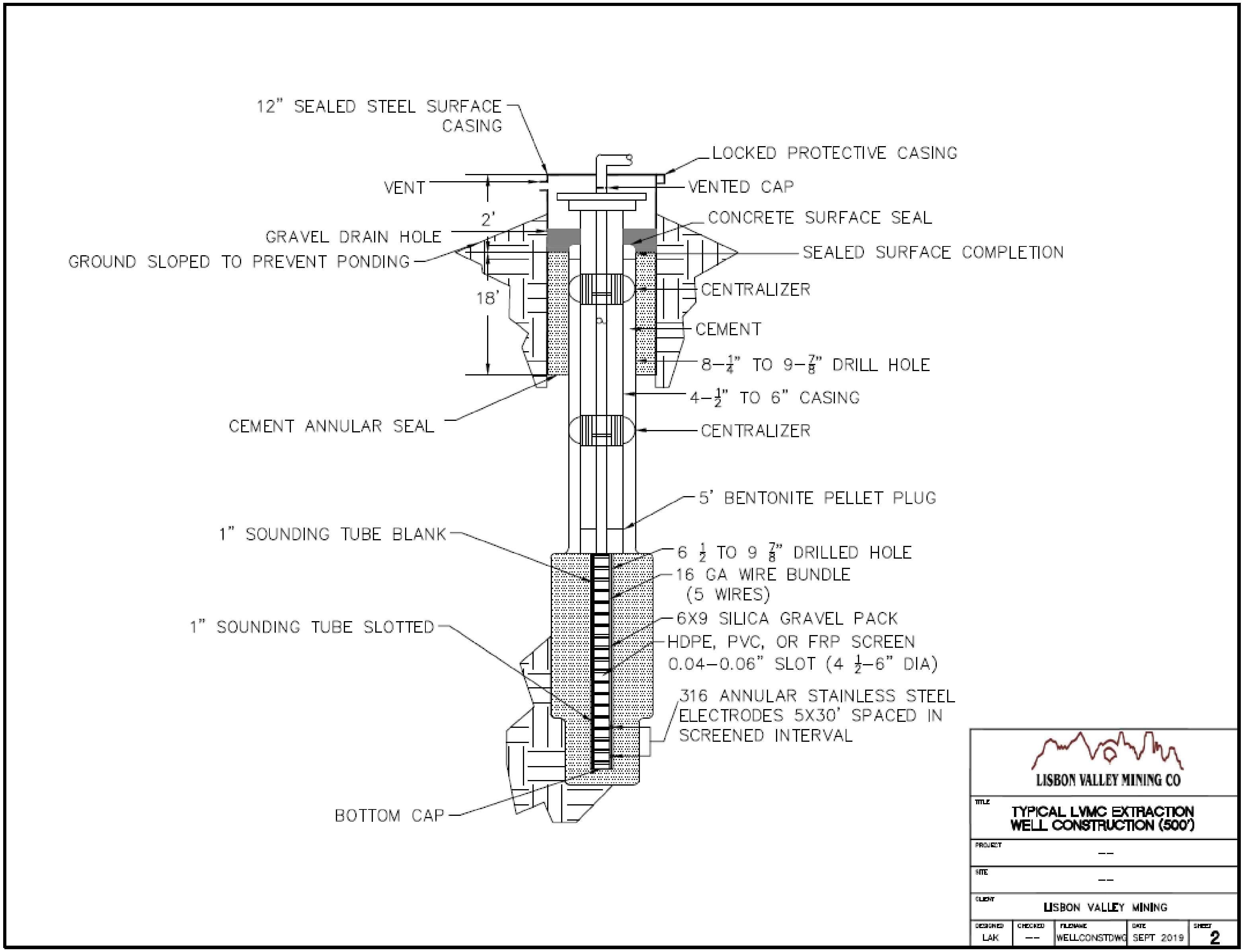


Figure 10.3 Injection Wellhead Construction Diagram

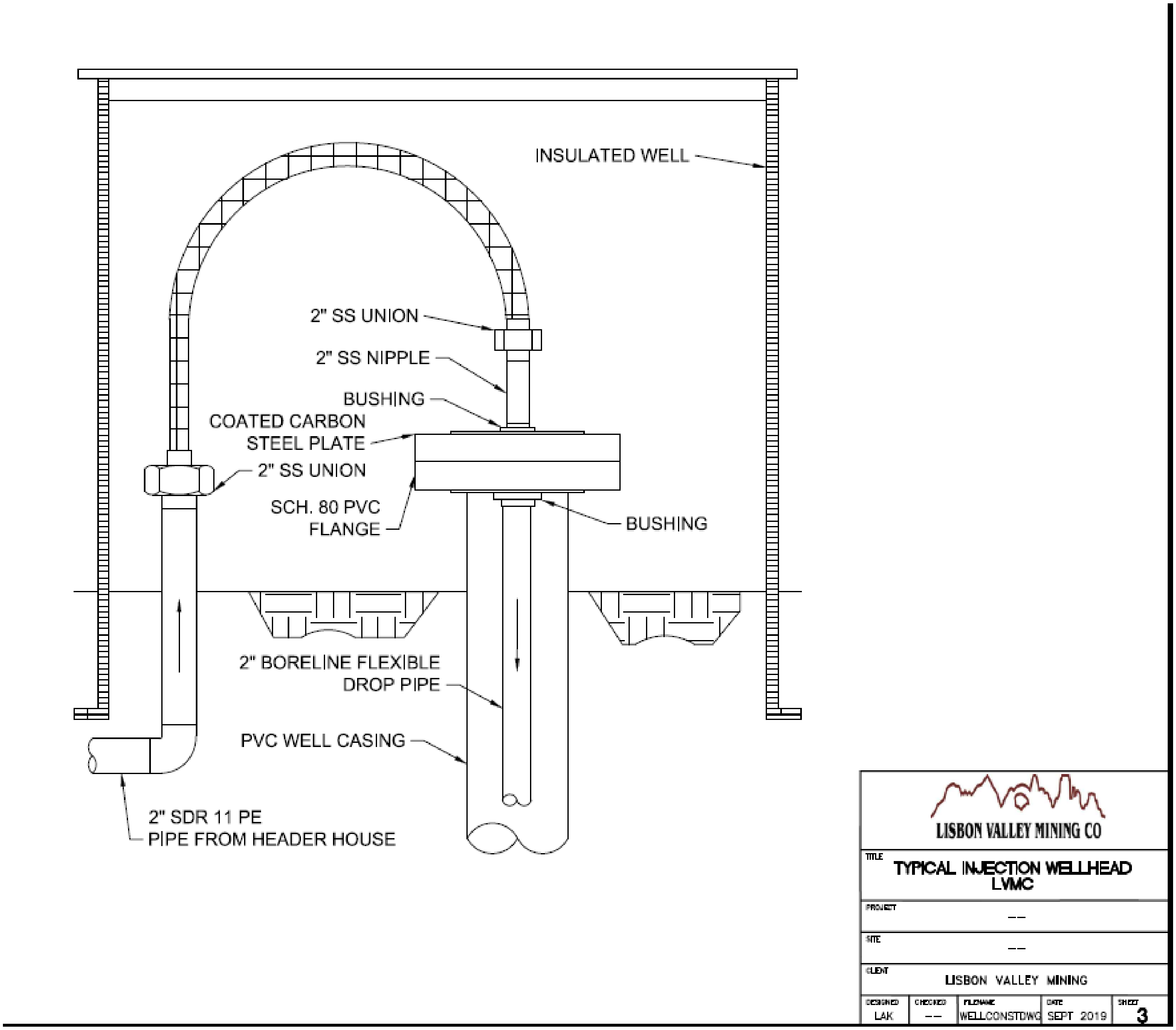
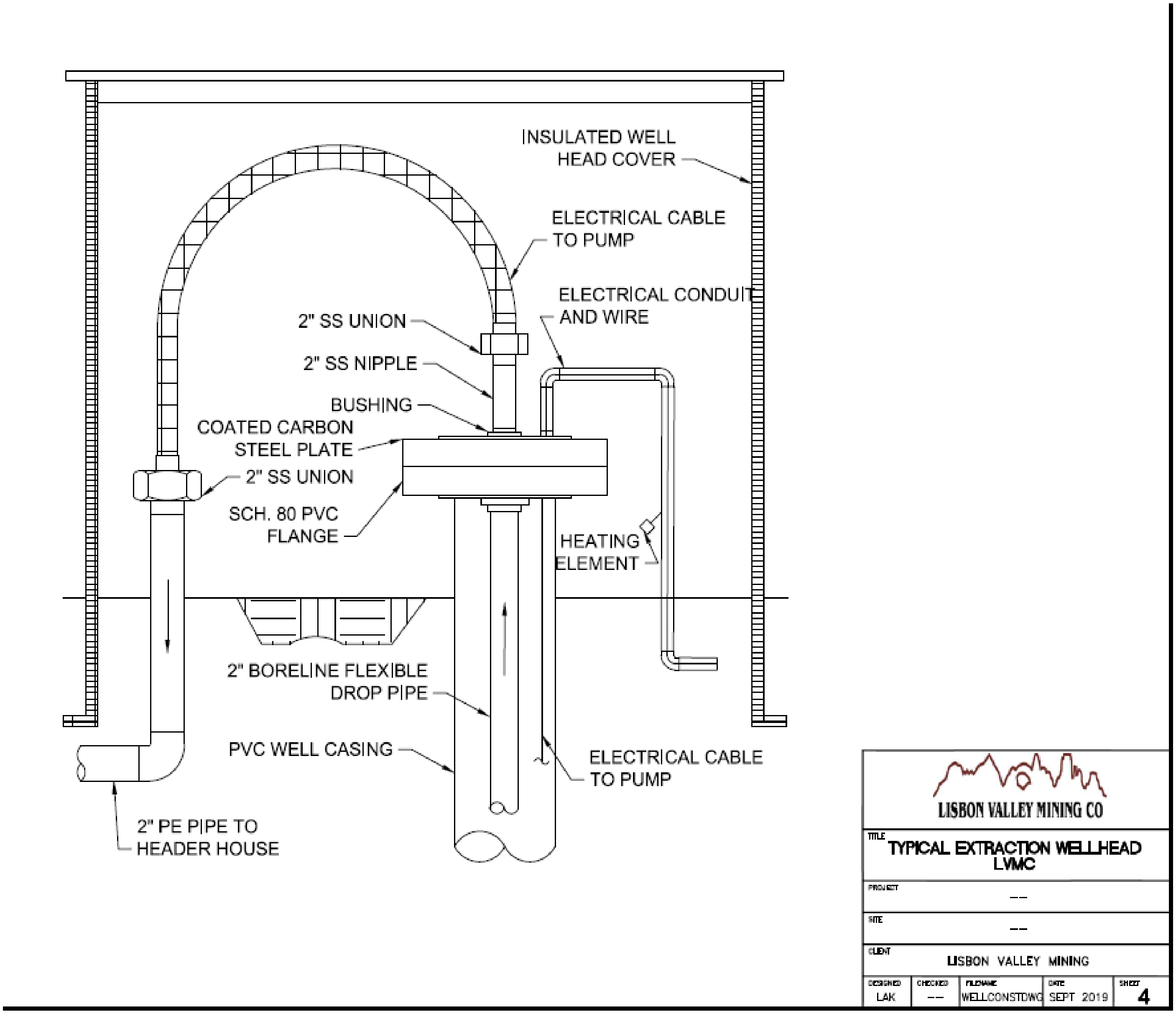


Figure 10.4 Production Wellhead Construction Diagram



10.5 Mechanical Integrity Testing

All injection, production, and monitor wells will be field tested to demonstrate the mechanical integrity of the well casing. The MIT will be performed using pressure-packer tests. The bottom of the casing will be sealed with a plug, downhole inflatable packer, or other suitable device. The casing will be filled with water and the top of the casing will be sealed with a threaded cap, mechanical seal or downhole inflatable packer. The well casing then will be pressurized with water or air and monitored with a calibrated pressure gauge. Internal casing pressure will be increased to 125 percent of the maximum operating pressure of the well field, 125 percent of the maximum operating pressure rating of the well casing (which is always less than the maximum pressure rating of the pipe), or 90 percent of the formation fracture pressure (see Section 8.1), whichever is less. A well must maintain 90 percent of this pressure for a minimum of 10 minutes to pass the test.

If there are obvious leaks, or the pressure drops by more than 10 percent during the 10-minute period, the seals and fittings on the packer system will be checked and/or reset and another test will be conducted. If the pressure drops less than 10 percent the well casing will have demonstrated acceptable mechanical integrity.

10.5.1 Loss of Mechanical Integrity

If a well casing does not meet the MIT criteria, the well will be removed from service. The casing may be repaired and the well re-tested, or the well may be plugged and abandoned. Well plugging procedures are described in Section 15. EPA will be notified of any well that fails MIT following the reporting procedures described in Section 14.5. If a repaired well passes MIT, it will be employed in its intended service following demonstration that the well meets MIT criteria. If an acceptable test cannot be demonstrated following repairs, the well will be plugged and abandoned.

10.5.2 Subsequent Mechanical Integrity Testing

In addition to the initial testing after well construction, MIT will be conducted on any well following any repair where a downhole drill bit or under-reaming tool is used. Any well with evidence of subsurface damage will require new MIT prior to the well being returned to service. MIT also will be repeated once every 5 years for all active wells.

10.5.3 Reporting

MIT documentation will include the well designation, test date, test duration, beginning and ending pressures, and the signature of the individual responsible for conducting each test. MIT documentation will be available for inspection by the EPA. MIT results will be reported on a quarterly basis as described in Section 14.5 (Attachment P).

11.0 PART I - Injection Well Operating Plan and Procedures

This attachment presents an overview of ISR operations, including injection procedures. It describes the general design of ISR well fields and specific design considerations It also discusses hydraulic well field control, lined process ponds, groundwater restoration, and the project schedule.

11.1 Overview of Operations

The Project will implement ISR methods for copper extraction using existing process facilities and collection ponds and associated well fields for the first three deposits identified within the Project Area. These include GTO, Lone Wolf Deposits and Flying Diamond Deposits.

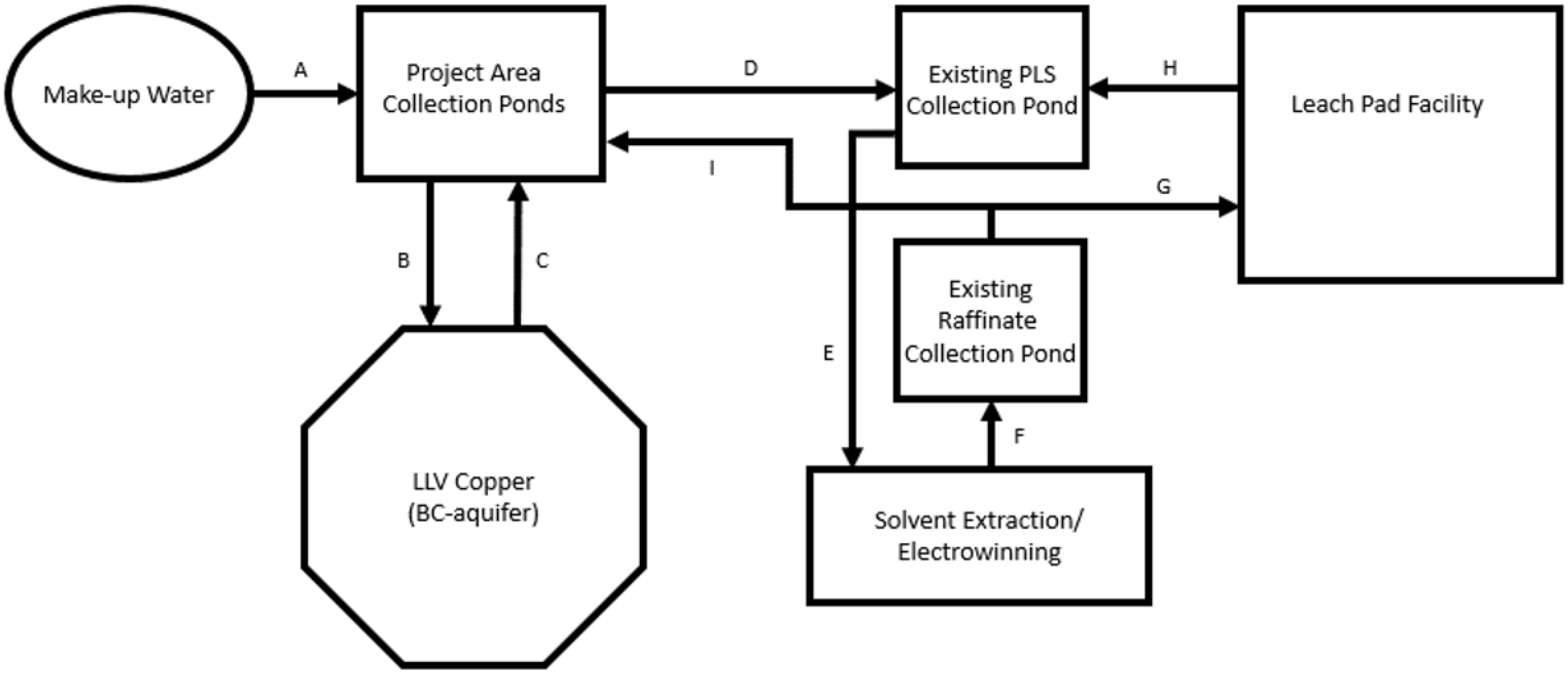
Copper will be recovered by injecting lixiviant fortified with oxygen into injection wells and recovering the resulting solution (pregnant lixiviant) from production wellfields. Copper solutions will be collected into three process collection ponds, a low copper grade solution collection pond (LLS), an intermediate copper grade solution collection pond (ILS), and high copper grade solution collection pond (PLS). The ILS collection pond will be used to recirculate ILS back though the deposit through injection to increase grade. When the ILS injection circuit reaches PLS concentration it will be redirected to the PLS collection pond. PLS will be piped to the Lisbon Valley Copper Mine and recovered via the Company's existing process facilities and solution will be returned to the well fields from the process facility collection ponds.

A fourth collection pond will be used for groundwater restoration at each deposit. It will be used to facilitate recirculation of groundwater from the mined-out areas of the wellfields. Restoration ponds will be plumbed to land application and/or wetland treatment cells. In addition, these ponds may be equipped with evaporation systems to concentrate TDS for deep well disposal.

The vast majority of water withdrawn from the production wells will be reinjected as part of the ISR process, such that the net withdrawal rate will be only a small fraction of the gross circulation rate. A small portion of the production and restoration streams will not be reinjected to maintain an inward hydraulic gradient within each well field for the duration of ISR mining and aquifer restoration activities.

Water for the ISR supply will be supplied from the BC aquifer to the extent possible. The BC aquifer is projected to be able to support ISR operations as well field operations are staged over time despite inconsistent productivity and presence throughout the Project Area. To the extent required, N aquifer water will be used to support ISR operations and also for BC aquifer restoration activity. Below is a schematic of the process flow.

Figure 11.1 Illustrative Flow diagram of the fluid flow associated with the ISR activities.



Stream ID	Description
A	Make-up water for leach operations
B	LLV injection
C	LLV extraction
D	Pregnant leach solution from ISR
E	Process plant feed
F	Copper barren solution to existing raffinate pond
G	Raffinate flow to existing heap leach operations
H	Pregnant leach solution from heap leach
I	Raffinate flow to ISR retention pond (Optional)

Monitoring systems will be implemented to ensure mining activities and changes in aquifer chemistry are contained to minimize potential impacts to the environment and public health. Monitoring systems will include both production wells and non-production wells along with related equipment to monitor groundwater chemistry in and surrounding the wellfields. Non-production monitoring wells will be equipped with pressure transducers prior to production. This will provide baseline information with which to correlate with ISR mining withdrawals, to further verify adequate confinement of mining fluids. Alert levels will be identified after production begins in accordance with pump testing at each wellfield for each monitoring well.

Aquifer restoration will be completed following copper recovery in each well field. During aquifer restoration, the groundwater in the well field will be restored in accordance with UDWQ requirements. Restoration will involve recirculation and rinsing the respective aquifers to restore a neutral pH and precipitate total dissolved solids (TDS). Final restoration may involve evaporation, land application, wetlands, and deep well injection.

A reclamation plan will be implemented in accordance with UDWQ permit and UDOGM large scale mine permit conditions to abandon wells, piping, wellfield controls, ancillary equipment, reclaim disturbed areas, and ensure that the Project Area meets all postmining land uses following ISR activities. See Section 14 for additional information.

11.2 Chemistry and Hydraulics of copper ISR

There are three primary components of successful copper ISR: i) mineral receptiveness to leaching or chemistry, ii) permeability of the host rock and iii) maintaining appropriate leaching conditions in the target ore zone.

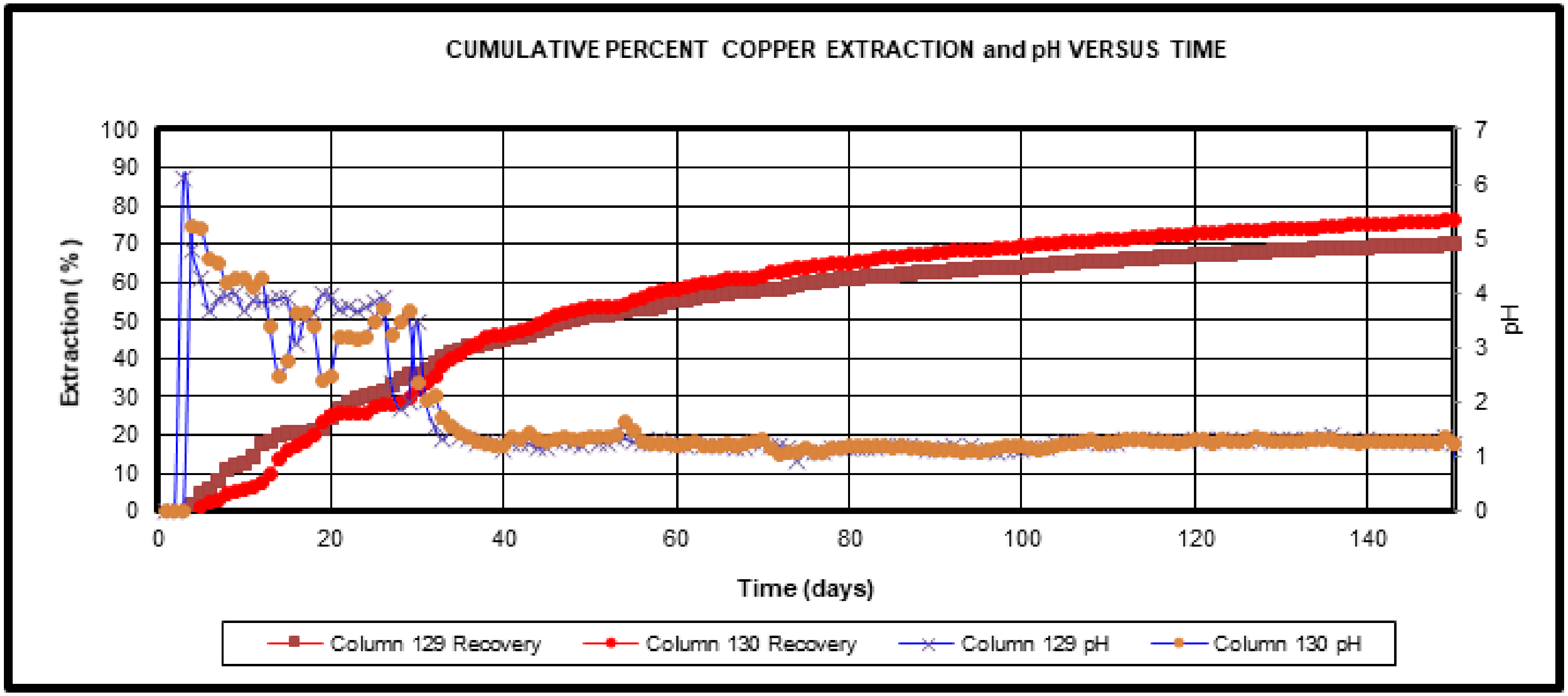
The ISR process involves the oxidation and solubilization of copper sulfide minerals in-situ, meaning “in-place” using a leaching solution (lixiviant). The lixiviant will consist of groundwater, dilute sulfuric acid gaseous oxygen. The lixiviant will be circulated through the ore deposit to oxidize and dissolve copper minerals into a copper-bearing solution consistent with leaching chemistry used to leach ore from open pit mining. The chemistry of copper sulfide oxidation and dissolution is described below:

$$Cu_2S + 10Fe^{3+} + 15SO_4^{2-} + 4H_2O = 2Cu^{2+} + 10\ Fe^{2+} + 12SO_4^{2-} + 4H_2SO_4$$

The Company will employ the iron based lixiviant where total iron and ferric iron levels are increased from baseline water level by lowering pH and adding dissolved air or oxygen. Ferric iron is the key leaching agent for copper mineralization at the LVMC and air or oxygen helps promote the amount of ferric iron in the leaching lixiviant. Copper recovery at Lisbon Valley has been approximately 65 – 75% using the same leaching chemistry over thirteen years in its open pit mining operations (this copper recovery chemistry is used throughout the copper industry).

Additionally, the Company has performed substantial column test work analyzing ISR copper chemistry in its laboratory which has confirmed 70% plus copper recovery which is commercially economic, an example of a set of column tests is show below in Figure 11.2. The Company has also performed confirmatory bench-scale core testing focused on copper recovery and rock permeability under anticipated operational pressures.

Figure 11.2 ISR Column Test Copper Recovery Relative to pH



ISR requires permeable ore bodies to facilitate introduction and extraction of lixiviant. The Company has performed multiple comprehensive aquifer tests in addition to collection of thirteen years of groundwater quality data from the BC aquifer, all of which indicate permeability and chemistry supportive of the ISR. The Company projects ISR operational flow rates (Section 6.10) based on the Company's pump test as well as planned well and pump design. The fine dissemination of copper mineralization in the host sandstone is ideal for ISR which utilizes the sandstone's permeability to access fine copper mineralization with lixiviant for recovery.

The Company projects using a well packer system in order to control and monitor lixiviant sweep through the aquifer and related target zones. The Company has substantial operational and test data the support copper recovery when appropriate chemistry conditions are maintained under hydraulic pressure and flow. The Company projects using water from throughout the BC aquifer in the Project Area in order to support ISR required hydraulics and flow rates and may augment water usage with water from the N aquifer.

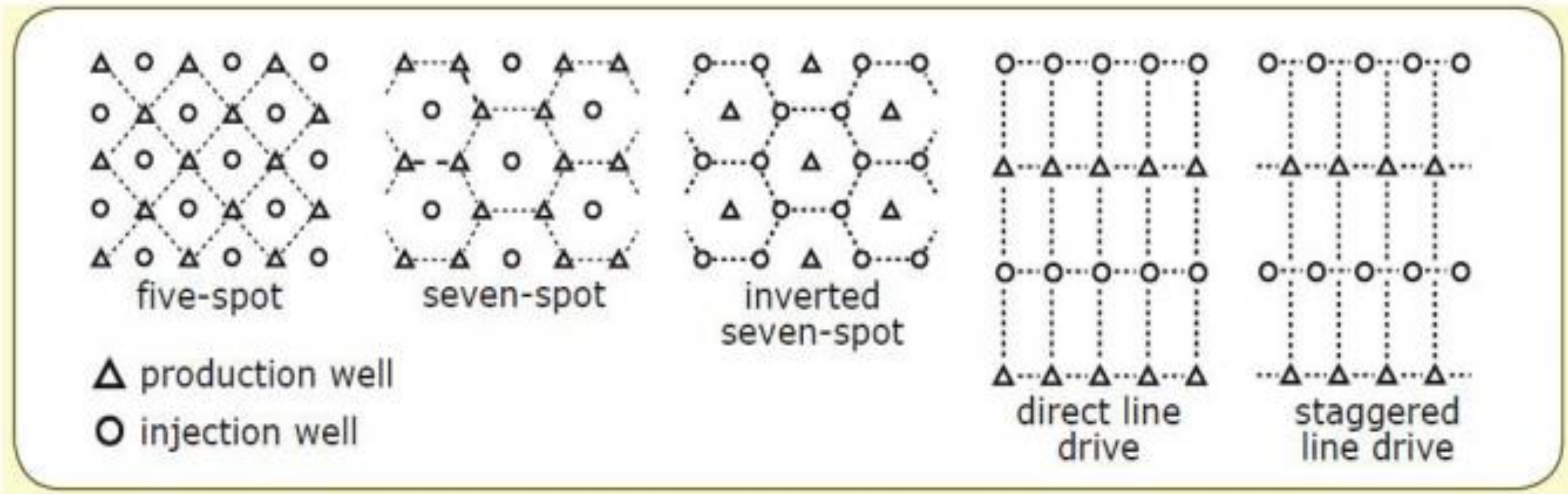
Finally, The Company already owns and operates an SX/EW processing facility and infrastructure that will be used to process copper bearing lixiviant from the ISR project into pure copper cathode identical to the Company's current finished copper product from open pit mining operations. The Company projects its ISR project to be commercially viable for approximately 28 years based on development of existing 508 million pounds of measured, indicated and inferred resources contained in three copper deposits, GTO, Lone Wolf and Flying Diamond plus additional resource potential associated with these deposits (LVMC, 2019).The Company maintains its copper resources in compliance with US and International Resource reporting standards.

11.3 Well Field Design

Each ISR well field will consist of a series of injection and production wells completed within the target mineralization zone. Prior to design and layout of the wells, the ore bodies will be delineated with exploration holes. These holes will be geologically logged and sampled. Before drilling, each injection and production well will be assigned lateral coordinates, a ground surface elevation, depth to top of screened interval, and length of screened interval.

Conventional ISR wellfield operation utilizes vertical injection wells and extraction wells in roughly orthogonal patterns. Figure 11.3 shows variations of ISR wellfield patterns. The Company intends to begin production using a conventional 5-spot pattern with wells spaced 150-ft. Other patterns will be considered and potentially implemented after the sweep efficiency of the initial 5-spot pattern is measured and evaluated.

Figure 11.3 Conventional ISR Patterns



11.3.1 Injection and Production Wells

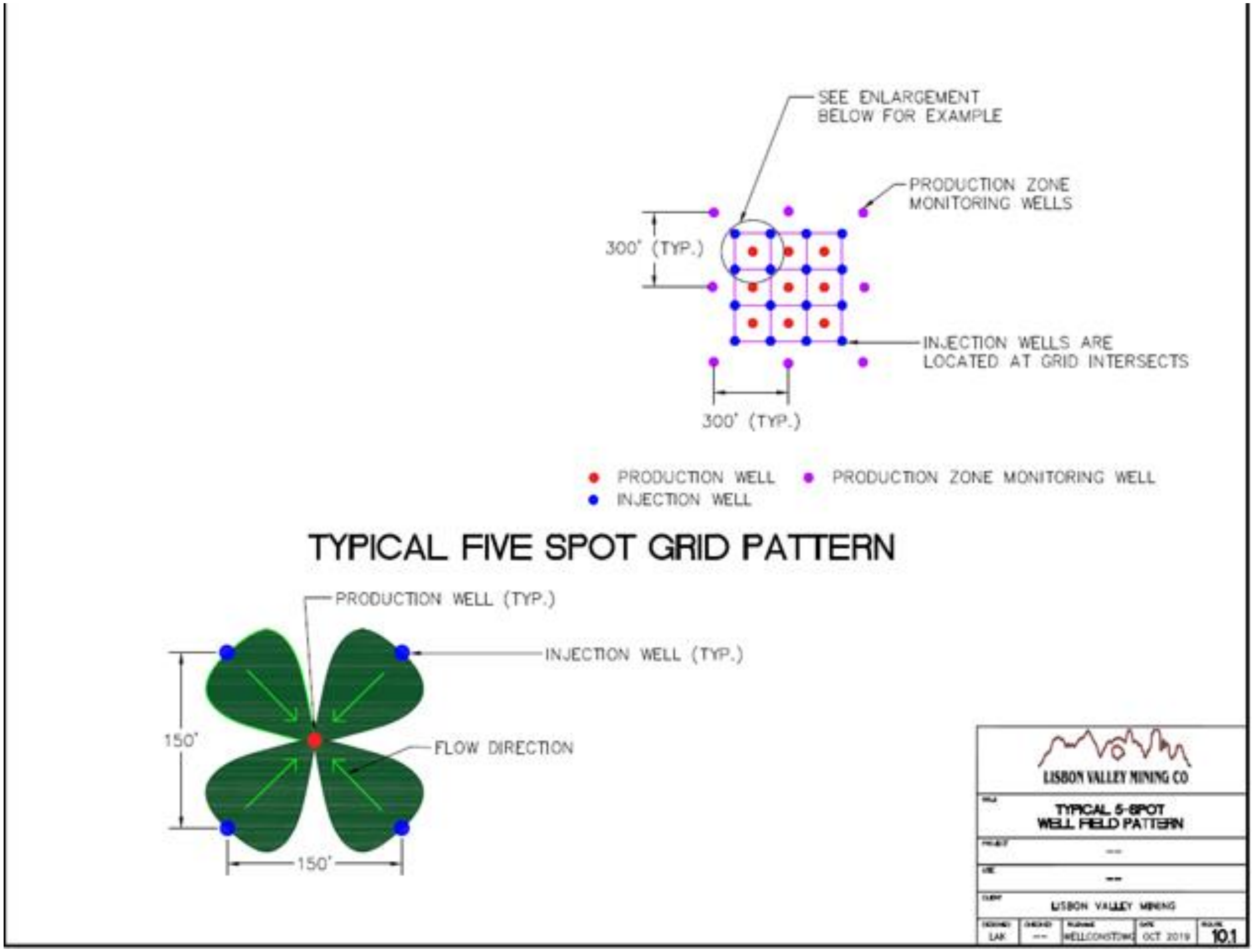
For all injection and production wells, the top of the screened interval will be at or below the base of the confining unit overlying the mineralized zone. The screened interval will be completed only across the targeted ore zone.

A typical (150 x 150 ft grid) well field layout is illustrated on 10.1. This typical layout is based on the lateral distribution and grade of the GTO copper deposit.

The well patterns and spacing may differ from well field to well field, but a typical pattern will consist of five wells, with one well in the center and four wells surrounding it oriented in four corners of a square. Typically, a production well will be located in the center of the pattern, and the four corner wells will be injection wells. Injection wells are further surrounded with monitoring wells. These wells are sequentially converted to extraction wells as the wellfield expands. This allows the configuration to support injection, extraction, and monitoring. Figure 11.4 depicts the proposed typical 5-spot well field pattern. It is important to note that the spacing and configuration can and will change in response to geologic structure and hydraulic continuity.

All wells will be completed for use as either injection or production wells, so that flow patterns can be changed as needed to recover copper and restore groundwater quality in the most efficient manner.

Figure 11.4 Proposed 5-Spot Wellfield Pattern and Production Zone Monitoring Wells



11.4 Wellfield Installation and Operation Sequence

ISR wellfields will be installed and sequenced along the long axis of each deposit in the Project Area. At each of the current deposits this will expand the wellfield in the NW/SE directions. The operation sequence will begin with mining and convert to restoration as well field rolls out. The Company intends to add approximately 200-250 wells/per year. Individual wells are intended to operate as mining wells for 5 years, or until they are no longer commercial. Following completion of copper recovery, a subset of the extraction wells will be converted to restoration and used to recirculate groundwater within the wellfield. This operational sequence allows for concurrent restoration of the aquifer. No well fields will interact with any domestic water wells.

11.4.1 Process Ponds

Each wellfield will be plumbed to the process ponds through a series of headers and common valving. The headers will direct wellfield flow to one of three ponds. All process and reclamation ponds are designed to contain 6MM gallons.

- Intermediate leachate solution (ILS)
- Pregnant leach solution (PLS)
- Reclamation pond
- Contingency pond(s)

Wellfield circulation will begin through the ILS pond. Here the ILS pond will serve to recirculate acid, water, and metals dissolved from the deposit through the respective wellfield until the copper grade approaches a commercial level (PLS). ILS pond solutions will be maintained at a prescribed pH through the addition of makeup acid. This process will continue for the duration of the commercial mining sequence.

As the copper concentration in the extraction wells approaches a commercial level, a fraction of the wellfield flow will be re-directed to the PLS pond. The PLS pond will be further concentrated through continued circulation of ILS through the wellfield. The PLS will be pumped to the Company's SX/EW plant at the Lisbon Valley Copper Mine though the ISR pipeline corridor. Here the SX/EW will extract the copper and recirculate the barren solution through the mine's raffinate pond. The raffinate from the beneficiation process will be pumped back to the ILS pond through the ISR wellfield corridor back to each wellfield for continued recirculation.

Aquifer restoration will begin after portions of the wellfield no longer produce commercial levels of copper. Barren wellfield flow will be redirected to the reclamation pond. Here the reclamation pond will be used to rinse and reclaim the water by continued circulation through barren portions of the wellfield without makeup acid. The absence of makeup acid will quickly consume the remaining acid and solids will precipitate back into the aquifer. Recirculation will continue until restoration standards are obtained, either through continued recirculation, land application, deep well disposal or combination of all.

11.4.2 Monitor Wells

Monitor wells will be installed in and around each well field to detect the potential migration of ISR solutions away from the target production zone. Perimeter monitor wells will be completed in the production zone around the perimeter of each well field. Non-production zone monitoring wells will be completed within each well field in the adjacent and overlying and underlying aquifers. A detailed description of the monitor well design and sampling procedures is contained in Section 12.

11.4.3 Hydraulic Well Field Control

The Company will maintain hydraulic control of each well field from the first injection of lixiviant through the end of aquifer restoration. During copper recovery, the groundwater removal rate in each well field will exceed the lixiviant injection rate, creating an inward hydraulic gradient within each well field. During aquifer restoration, the groundwater removal rate in each well field will exceed the injection rate of permeate and clean makeup water from the BC or N aquifers. If there are any delays between copper recovery and aquifer restoration, production wells will continue to be operated as needed to maintain water levels within the perimeter monitor rings below baseline water levels. This activity may be intermittent or continuous.

Inward hydraulic gradients will be maintained and monitored through use of flow meters and wireless dataloggers at each wellfield. Flow meters will be installed at all extraction and injection wells to ensure extraction rates exceeds injection. Wireless pressure and conductivity dataloggers will be installed and operated in each perimeter production monitoring well surrounding each wellfield (see Fig 11.4). Pressure dataloggers will be monitored to verify an inward hydraulic gradient. Conductivity dataloggers will be monitored to detect any changes in conductivity indicative of lixiviant excursion. Both water levels and conductivity measurements will be conducted at a frequency appropriate to confirm hydraulic well field control as described in Section 14.2.3. In the event an excursion is detected, corrective action measures will be taken in accordance with Section 13.1.

Verification of hydraulic control will be performed through water level measurements in perimeter monitor wells and non-production monitoring wells Water levels will be measured using pressure transducers or manual electronic meters and recorded at a frequency appropriate to confirm hydraulic well field control as described in Section 14.2.3.

11.5 Approach to Wellfield Control with Respect to Partially Saturated Conditions

Refer to Section 5.2.2.5 for a description of partially saturated conditions. The only instance where hydrologically unconfined (partially saturated) conditions exist within an area proposed for ISR operations occurs at the GTO deposit. The GTO deposit will be treated like a conventional saturated deposit however extraction wells will be located in the saturated portion of the deposit. Lixiviant injection will report to the saturated portion of the deposit as a function of geologic control features such as faults and impermeable layers.

11.6 Approach to Wellfield Control with Respect to Historical Mine Workings

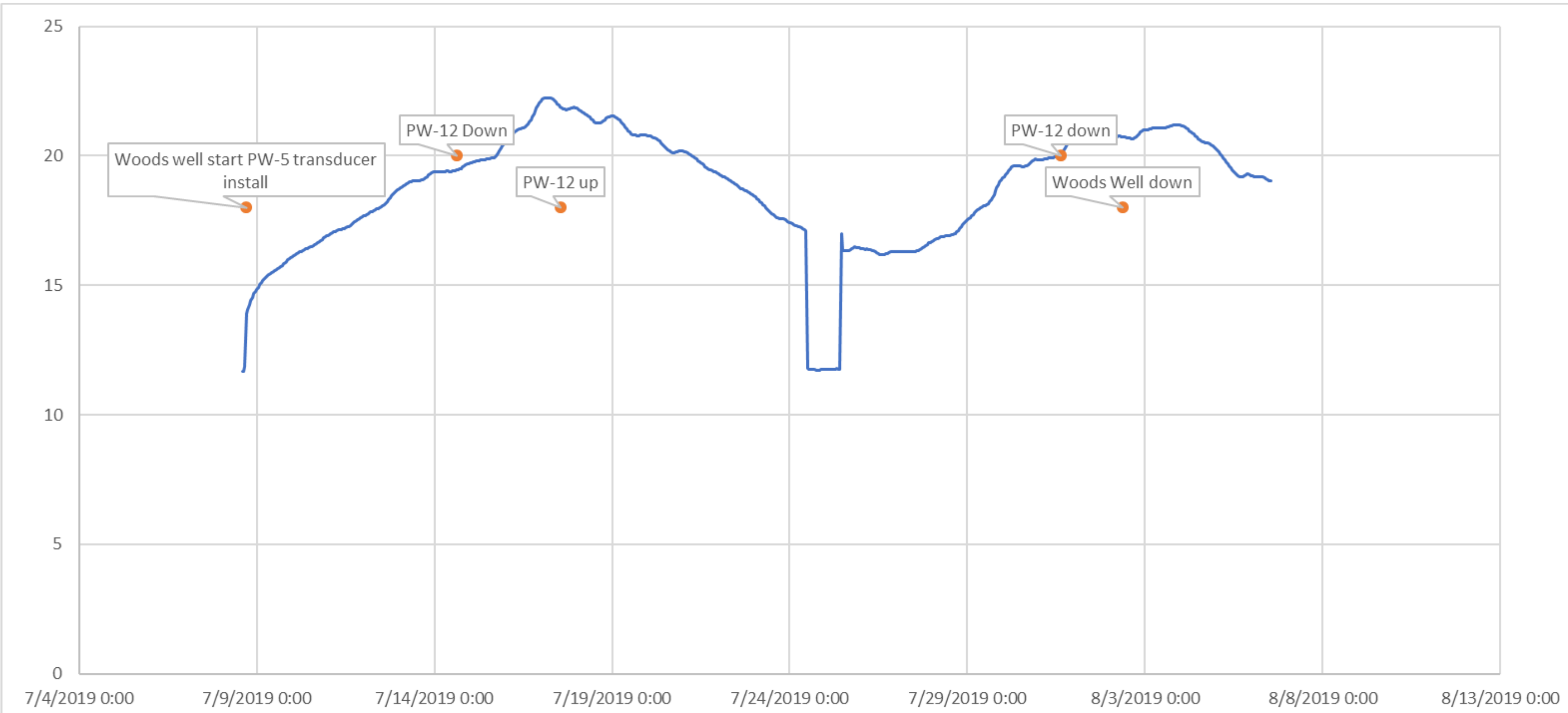
As described in Section 3.2 the former Woods mine extracted ore from the Chinle Formation which borders the GTO deposit. All mining was done in the footwall and therefore remains hydraulically isolated from any potential ISR activities by the Flying Diamond Fault. A map of the historical Woods mine workings was shown on Figure 3.4. Hydraulic isolation of the historical mine workings has been demonstrated by pressure transducer monitoring in the workings (footwall) and in the Project Area (hanging wall). This was described previously in Section 7.2.3. Figure 11.5 shows the transducer testing results showing isolation of the historical mine workings.

There is one small existing open pit, GTO, in the Project Area. ISR operations target GTO ore will not have any operational relationship with the GTO pit or existing open pit operations.

If any additional open pits are mined in the Project Area, ISR may be used a complimentary copper recovery strategy however ISR solution will not interfere with any open pits. An open at a similar depth as the ore zone in the Project Area would create an influent hydraulic gradient toward the pit which would only further increase the control of the fluid flow in addition to well field hydraulic control. After open pit mining, open pits are backfilled eliminating the existence of pit pools so in addition to restoration of the BC aquifer, no BC aquifer water will pool anywhere in the Project Area.

Figure 11.5 Transducer Testing Woods Mine Area

Figure 11.5 shows the response of transducer testing across the Woods mine area. The transducer response supports the hydraulic isolation of the BC aquifer from the adjacent historical mine workings as a function of the Lisbon Valley fault dividing the two areas.



11.7 Groundwater Restoration

Groundwater restoration in each well field will be conducted in accordance with UDWQ Class III permit requirements. Per the UDWQ UIC Guidelines, the purpose of the Class III UIC Permit for which the Company is proposing, is to "inject fluids for the in situ extraction of minerals or metals from ore bodies that have not been previously mined by conventional methods." (deq.utah.gov, 2020). As stated on the UDWQ UIC program, the purpose of a Class 5B6 well or wellfield is: "Subsurface Environmental Remediation – Used to clean up, treat, or prevent contamination of groundwater."

Before and during the ongoing ISR operations, the Company will collect data in regard to baseline ground water quality, natural acid neutralization as a function of sweep, and other pertinent information that will be used to prepare a comprehensive Groundwater Restoration Plan.

11.7.1 Target Restoration Goals

Groundwater restoration, or aquifer restoration, will be performed pursuant to UDWQ requirements to protect USDWs. The groundwater restoration program for all well fields will be conducted pursuant to UAC R317-7.

Prior to operation, the baseline groundwater quality will be determined through the sampling and analysis of water quality indicator constituents in wells screened in the mineralized zone(s) across each well field. Section 12.2 describes the methods used to select baseline wells, sample the wells, and calculate baseline water quality statistics. The target restoration goals (TRGs) will be established as a function of the average baseline water quality and the variability in each parameter according to statistical methods approved by UDEQ.

11.7.2 Groundwater Restoration Process

Groundwater restoration will be conducted in accordance with UDWQ permit requirements in a manner that will protect USDWs, human health and the environment. The methods for achieving this objective are discussed in the following sections.

11.7.4 Groundwater Rinse and Neutralization

Closure of the wellfield will begin with include the elimination of make-up acid to the ILS pond. This will be followed by recirculation of the groundwater inside each wellfield. In general, recirculation will involve perimeter wells pumping to the interior of the wellfield. This approach recirculates groundwater within the wellfield and brings in fresh groundwater from the perimeter, effectively recirculating and rinsing the former copper deposit. Neutralization and TDS reduction will occur as a function of the highly calcic aquifer characteristics combined with the fact no additional acid is added. This water will be used for land application and evapo-concentrated or for deep well disposal, if either is necessary. Land application will include conventional irrigation of salt-tolerant plant species and/or wetland species. Figure 11.6 shows planned locations of land application. Rinsing, deep well disposal and land application will be continued until asymptotic TDS concentrations are identified, or as long as technically and economically feasible.

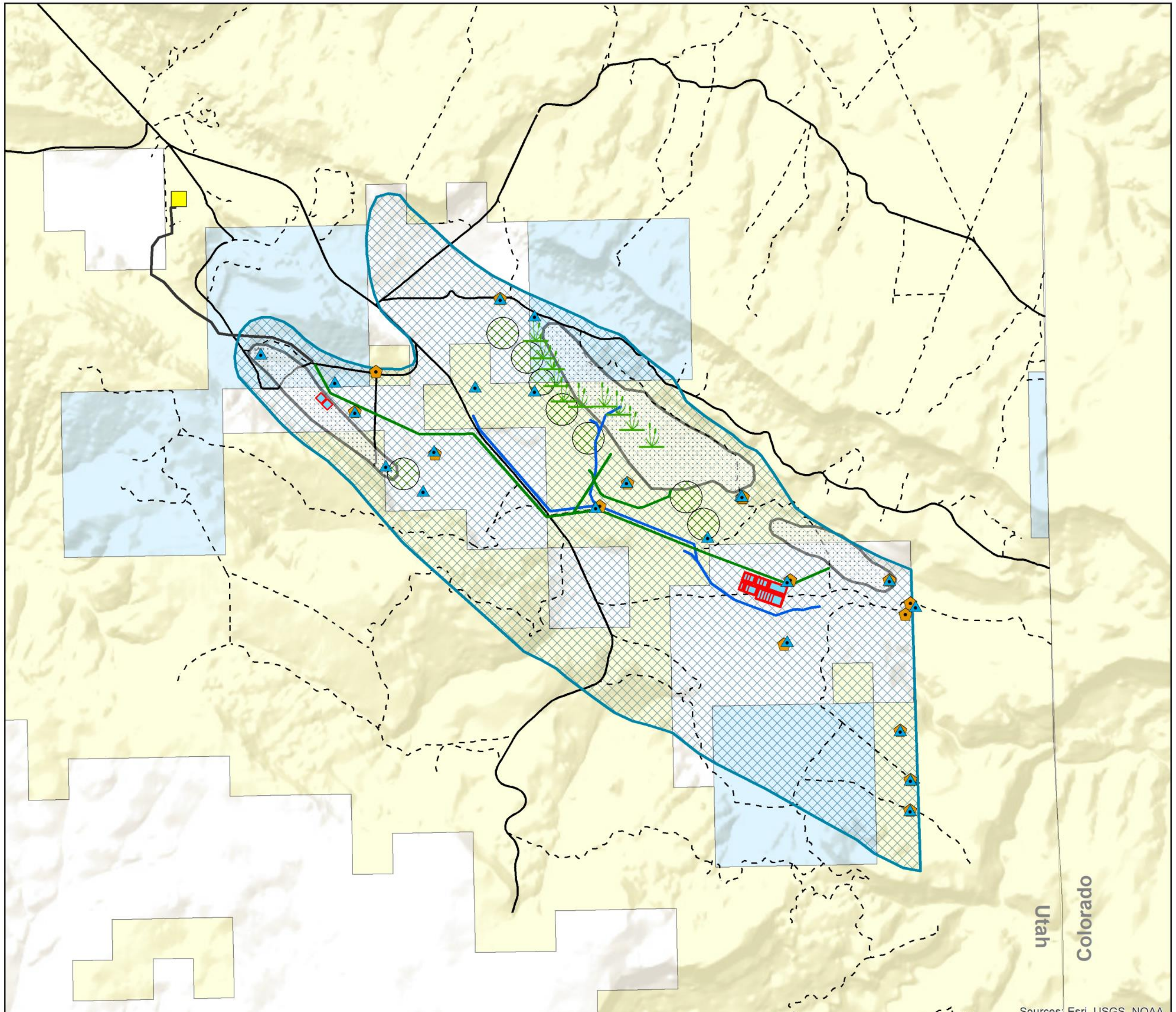
The Company shall monitor the rinsing progress by analyzing fluids recovered from all recovery wells in the first mine block after rinsing. This data will then be used to determine the minimum number of sampled wells needed to confirm that rinsing has been successful in the rinsing and closure of subsequent mine blocks. The results of that evaluation shall be submitted for UDWQ review and approval. The wells to be retained for sampling during rinsing operations in subsequent mine blocks shall be identified and the locations of those wells shall be provided before closure of other wells in a mine block is approved by UDWQ.

11.7.5 Land Application Option

In the land application liquid waste disposal option, the primary method of aquifer restoration will be incremental groundwater circulation and rinse followed by land application. Land application will include surface irrigation via 300-1000ft pivots and/or engineered wetlands. Wetlands will require permitting through US Corp of Engineers. Land application targets are shown on Figure 11.6.

11.7.6 Deep Disposal Well Option

In the deep disposal well option the primary method of aquifer restoration will be incremental groundwater circulation and rinse followed by deep well disposal in an existing Class III Disposal Well. Deep well disposal is shown on Figure 11.7.



Legend

- Aquifer Exemption Boundary
- Project Area
- BC Aquifer Monitoring Wells
- Morrison Fm and N Aquifer Monitoring Wells
- Wetland Engineering Target
- Mine Area Pipeline Corridor
- Access Roads, Pipelines, Overhead Power
- Drainage Channel
- ISR Process Ponds
- Processing Plant SXEW
- Land Application
- San Juan Co B Roads
- San Juan Co D Roads
- Federal BLM Land
- Private Land
- State Trust Land

N

0 2,000 4,000 8,000 Feet

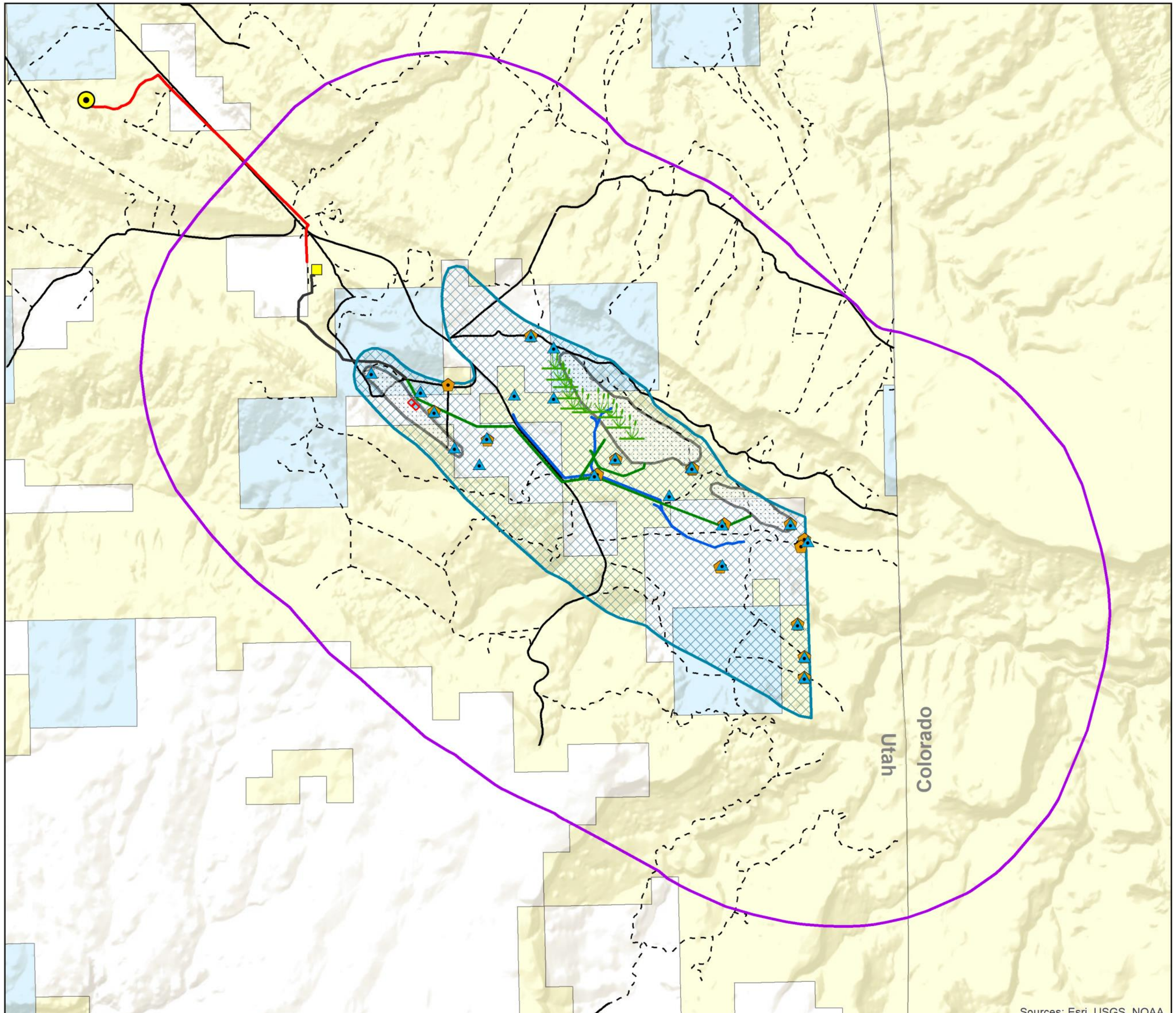
Figure 11.6

Proposed Facilities and Initail Well Areas
Land Applocation Option

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 24 June 2020
File Name: ISR Figure 11.6 Proposed Facilities Land Application	

LISBON VALLEY MINING CO



Legend

- Aquifer Exemption Boundary
- 2 mi AOR
- BC Aquifer Monitoring
- Morrison Fm and N Aquifer Monitoring Wells
- Wetland Engineering Target
- Mine Area Pipeline
- Access Roads, Pipelines, Overhead Power
- Deep Disposal Well
- Deep Well Disposal Piping
- Drainage Channel
- ISR Process Ponds
- Processing Plant SXEW
- Federal BLM Land
- Private Land
- State Trust Land
- Project Area

0 3,000 6,000 12,000 Feet

Figure 11.7

Proposed Facilities and Initail Well Areas
Deep Disposal Well Option

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 24 June 2020

File Name: ISR Figure 11.7 Proposed Facilities Deep Disposal Well

LISBON VALLEY MINING CO

11.7.7 Groundwater Restoration Monitoring

Groundwater restoration monitoring will be conducted quarterly during the restoration process and continue for 2 years after restoration is complete (post-rinse monitoring) in accordance with UDWQ requirements. Post-rinse monitoring may be extended to a longer term dependent on monitoring results and UDWQ interpretation.

The Company will submit a post-rinsing notification and report, with documentation, to UDWQ within thirty (30) days following completion of the post rinsing monitoring program.

11.8 Stormwater Control and Mitigation

The Company has evaluated flood inundation boundaries and will construct ISR facilities outside of these boundaries to avoid potential impacts to facilities from flooding and potential impacts to the surface in the event of any potential spills or leaks.

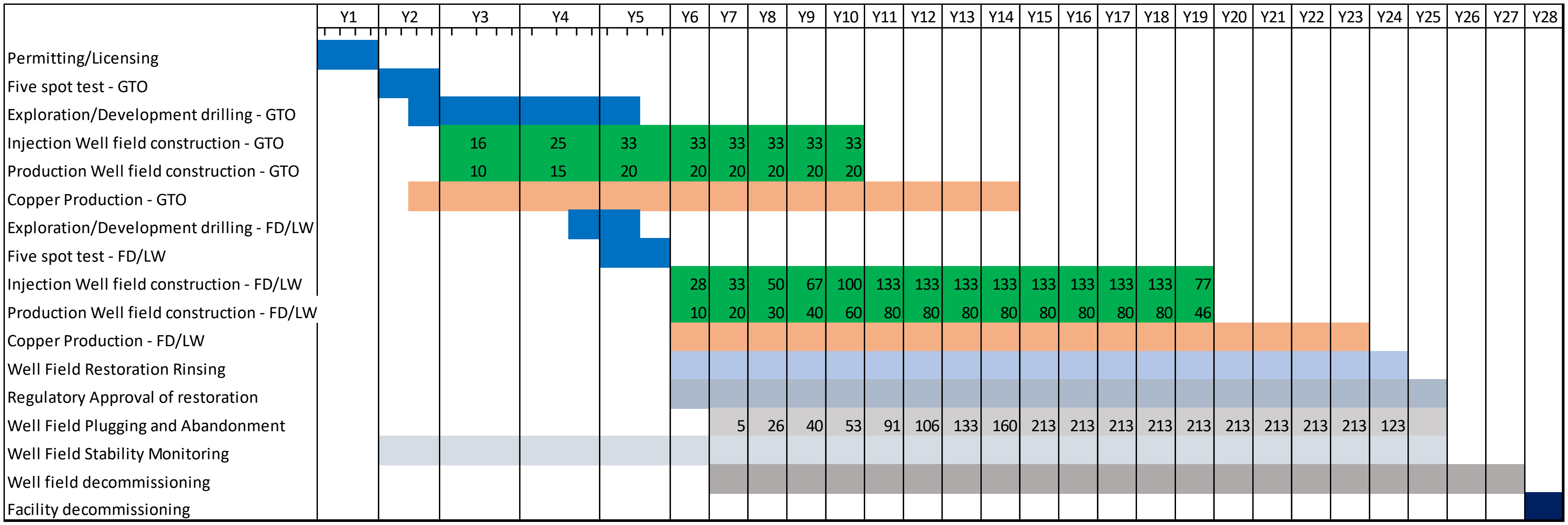
The Company has completed surface flow modeling to calculate peak discharges, and HEC-RAS models were used to compute water-surface profiles and inundated areas during runoff events. The results of this modeling were used to engineer drainage around all LLV mining facilities including ISR and open pit. All facilities will be located out of the 100-year flood inundation boundaries. Final design is subject to federal jurisdiction under Section 404 of the Clean Water Act (CWA). The drainage design concept is depicted in Figures 11.7 and 11.8 and detailed in Appendix J.

11.9 Schedule

Construction of ISR wellfields and facilities will begin at the GTO followed by Lone Wolf Deposit following the issuance of an UDOGM ISR mine permit, UDWQ Class III UIC permit, EPA aquifer exemption permit and other relevant permits. It is anticipated that construction of the second well field, GTO, and ancillary facilities will occur at the same time or follow shortly thereafter. Alternately, the Company may develop either the GTO or Lone Wolf area well fields first, followed by the well fields in the other area. Copper recovery operations within the permit area will continue for approximately 7 to 20 years during which additional well fields will be completed. Each well field will be decommissioned and plugged and abandoned when copper recovery is complete.

LVMC projects plugging and abandonment activity to begin approximately five years after ISR operations commence and continue annually until all well fields have completed copper recovery and been decommissioned. This will have the effect of keeping total wells requiring plugging and abandonment at a relatively static level after five years as new ISR wells are drilled and older ISR wells are decommissioned. It is likely that the process facilities will continue to operate for several years following decommissioning of the well fields. The entire Project will then be decommissioned and reclaimed in accordance with UDEQ, EPA, BLM and requirements. The projected construction, operation, restoration and decommissioning schedule is provided in Figure 11.8.

Figure 11.8 LVMC ISR Project Schedule



12.0 PART J - Monitoring, Recording and Reporting Plan

This attachment describes the monitoring programs directly related to the proposed Class III UIC permit, including monitoring the pressure, flow rate and chemical characteristics of the injection fluid. It also describes monitoring programs that will be conducted in accordance with UDWQ permit requirements designed to protect groundwater quality outside of the exempted aquifer. These programs include excursion monitoring at POC wells surrounding each ISR wellfield. These programs are a supplement to the natural hydrologic confinement of the BC aquifer to LLV and from the N aquifer.

12.1 ISR FacilityMonitoring

The Company will implement control and data recording systems at the ISR facilities which will provide centralized monitoring and control of the process variables including the flow rate and pressure of the injection stream at each wellfield. Pressure gauges installed at each injection wellhead or in the injection manifold also will be manually recorded at least daily.

The volumetric flow rate of oxygen will be measured at the point of injection into the barren lixiviant using calibrated gas flow meters. The flow meters will be routinely calibrated according to manufacturer recommendations.

The injection fluid in each operating well field will be sampled monthly. Samples will be collected from the ILS process pond and analyzed for copper, sulfuric acid, pH, total iron, ferrous iron, ferric iron, and Eh.

ISR facility monitoring will include subsidence monitoring of selected extraction wells in each wellfield. In addition to visual wellhead observations, this will include installation of a continuous GPS (CGPS) system at each of the three deposits, GTO, Lone Wolf, and Flying Diamond. CGPS sub-centimeter capabilities will be correlated with groundwater elevation measurements to evaluate any changes in surface subsidence.

12.2 Point of Compliance Monitoring

Following is a brief summary of the point of compliance monitoring program that will be conducted in accordance with UDWQ permit requirements to detect potential horizontal or vertical exceedance of two or more control limits of N aquifer water and BC aquifer water outside the well fields.

As is currently implemented by the Company for the Active Mine Area, the Company will monitor point of compliance (POC) wells associated with ISR activities. As described above, prior to commencement of ISR activities, baseline water quality data for the BC and N aquifers in the areas surrounding the proposed ISR wellfields will be determined. The baseline water quality data will be used to build a ground water protection level database. The ground water protection level to which the Company will monitor will consist of a mixture of Utah Drinking Water Quality Standards and site-specific standards. The higher of the two standards will be used as the ground water protection level.

The Company will monitor ground water on a quarterly basis during active ISR operations. While performing monitoring activities, the ground water chemistry will be tracked and measured against the ground water protection levels. Exceedance of the ground water protection limit shall occur if:

1. For parameters that have been defined as detectable in the background and for which protection levels have been established based on 1.5 times the mean background concentration,

exceedance shall be defined as two consecutive samples exceeding the protection level and the mean background concentration by two standard deviations.

2. For parameters that have been defined as detectable in the background and for which protection levels have been established based on 0.5 times the ground water quality standard, exceedance shall be defined as 2 consecutive samples exceeding the protection level and the mean background concentration by two standard deviations.

3. For parameters that have background data set between 50-85% non-detectable analyses, exceedance shall be defined as 2 consecutive samples from a compliance monitoring point exceeding the established protection level.

4. For parameters that have been defined non-detectable in the background and for which protection levels have been determined based on 0.5 times the ground water quality standard or the limit of detection exceedance shall be defined as 2 consecutive samples from a compliance monitoring point exceeding the established protection limit.

Upon determination of an exceedance ground water quality standards, the Company shall:

1. Verbally notify the Director of the exceedance within 24 hours of receipt of data, and

2. Provide written notice within 5 days of determination, and

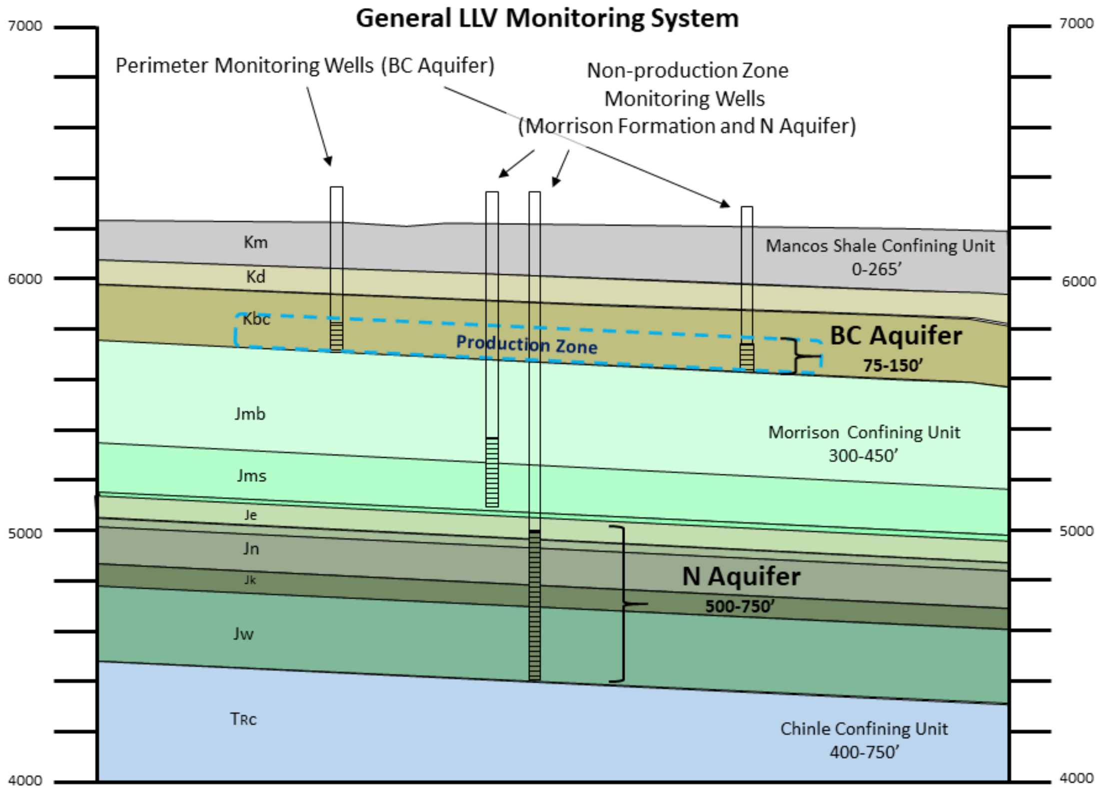
3. Continue an accelerated schedule of monthly ground water monitoring for at least two months and continue monthly monitoring until the operation is brought into compliance.

12.2.1 Monitoring Network Design

The monitoring network will consist of production and non-production monitoring wells. Production monitor wells are part of each ISR wellfield as shown on Figure 11.2. These wells will be monitored to support to ensure inward hydraulic gradients at each wellfield and to detect lixiviant excursion. Water levels will be measured using downhole pressure transducers or manual electronic meters. These measurements will alert operators to any significant change in the water levels that would affect hydraulic control of lixiviants.

POC wells are located outside each wellfield and are monitored to detect changes in groundwater chemistry in the BC, M and N aquifers outside and below the respective wellfields, as well as outside the Project Area. A schematic of this plan is shown on Figure 12.1.

Figure 12.1 Point of Compliance Monitor Well Network Design



12.2.2 Point of Compliance Monitoring Wells

A total of 40 POC monitoring well locations have been identified. Six of the proposed monitoring wells already exist. The monitoring wells are configured in two perimeters, and will be monitored in two phases as necessary. The perimeter 1 (phase 1) are located approximately 1,000 ft outside each well field. The perimeter 1 monitor well configuration will be drilled and an enhanced baseline water quality monitoring program implemented prior to commencement of any ISR activities within the corresponding well field. The enhanced baseline water quality monitoring will provide the baseline data for the purposes of monitoring potential changes in ground water quality, as lined out in Section 12.2 above.

Perimeter 2 (phase 2) wells are located an additional 1,000 feet laterally. Perimeter 2 wells will be drilled (if not already in place) upon indication of an exceedance in any Perimeter 1 monitor well. Each active monitoring well will be sampled quarterly.

In accordance with Section 12.2, if an exceedance is detected in a phase 1 monitoring well, phase 2 wells in the same area will be installed or activated. Figure 12.2 shows proposed locations of all POC monitoring wells. Locations, depths, and formationsare tabulated in Table 12.1.

Table 12.1 Proposed Monitoring Wells

Phase 1 Well	Easting	Northing	Depth	Well Type	Formation
FD BC P1-1	668,990	4,219,650	600	Piezo	BC
FD BC P1-2	670,270	4,219,400	600	Piezo	BC
GTO BC P1-1	663,740	4,221,920	700	Piezo	BC
GTO BC P1-2	664,480	4,221,640	700	Piezo	BC
LW BC P1-1	666,470	4,222,300	600	Piezo	BC
LW BC P1-2	666,470	4,221,550	600	Piezo	BC
LW BC P1-3	667,390	4,220,640	600	Piezo	BC
LW BC P1-4	668,540	4,220,500	600	Piezo	BC
PW-12	664,680	4,221,340	1000	Production	BC
PW-5	664,989	4,220,802	650	Production	BC
FD N P1-1	668,540	4,220,480	800	Piezo	N
FD M P1-1	668,540	4,220,480	600	Piezo	M
FD N P1-2	669,020	4,219,660	1500	Piezo	N
FD M P1-2	669,020	4,219,660	1300	Piezo	M
FD N P1-3	670,220	4,219,430	800	Piezo	N
FD M P1-3	670,220	4,219,430	600	Piezo	M
FD N P1-4	669,530	4,220,140	800	Piezo	N
GTO N P1-1	664,680	4,221,340	1500	Piezo	N
GTO M P1-1	664,680	4,221,340	1300	Piezo	M
LV 463-79	664,710	4,220,620	750	Piezo	N
LW N P1-1	666,470	4,222,300	800	Piezo	N
LW N P1-2	667,400	4,220,630	1500	Piezo	N
LW M P1-2	667,400	4,220,630	1300	Piezo	M
LW N P1-3	668,550	4,220,490	800	Piezo	N
LW M P1-3	668,550	4,220,490	600	Piezo	M
LW N P1-4	668,290	4,221,080	800	Piezo	N
LW N P1-5	667,280	4,221,880	800	Piezo	N
MW97-11	663,738	4,222,810	1500	Piezo	N
PW-11	666,487	4,221,512	1800	Production	N

Phase 2 Well	Easting	Northing	Depth	Well Type	Formation
GTO BC P2-1	665,360	4220 550	700	Piezo	BC
GTO BC P2-2	665,470	4,220,950	700	Piezo	BC
LW BC P2-1	666,130	4,220,470	700	Piezo	BC
LW BC P2-2	667,080	4,220,390	700	Piezo	BC
LW BC P2-3	668,530	4,220,510	700	Piezo	BC
LW BC P2-4	668,200	4,220,090	700	Piezo	BC
LW BC P2-5	665,880	4,221,592	700	Piezo	BC
FD BC P2-1	668,990	4,219,050	700	Piezo	BC
FD BC P2-2	670,500	4,219,280	702	Piezo	BC
LV41-75	664,810	4,220,340	750	Open Hole	N
GTO N P2-1	665,480	4,220,920	1500	Piezo	N
GTO M P2-1	665,480	4,220,920	1300	Piezo	M
GTO N P2-2	664,890	4,221,740	1500	Piezo	N
GTO M P2-2	664,890	4,221,740	1300	Piezo	M
PW-7	665,537	4,221,361	1501	Production	N
LW N P2-1	666,130	4,222,470	800	Piezo	N
LW M P2-1	666,130	4,222,470	600	Piezo	M
LW N P2-2	667,120	4,220,400	1500	Piezo	N
LW M P2-2	667,120	4,220,400	1300	Piezo	M
LW N P2-3	668,010	4,221,860	1000	Piezo	N
MW97-13	665,880	4,221,592	1500	Piezo	N
FD N P2-1	668,960	4,219,020	1500	Piezo	N
FD M P2-1	668,960	4,219,020	1300	Piezo	M
FD N P2-2	670,590	4,219,340	800	Piezo	N
FD M P2-2	670,590	4,219,340	600	Piezo	M
FD N P2-3	670,000	4,220,530	1200	Piezo	N

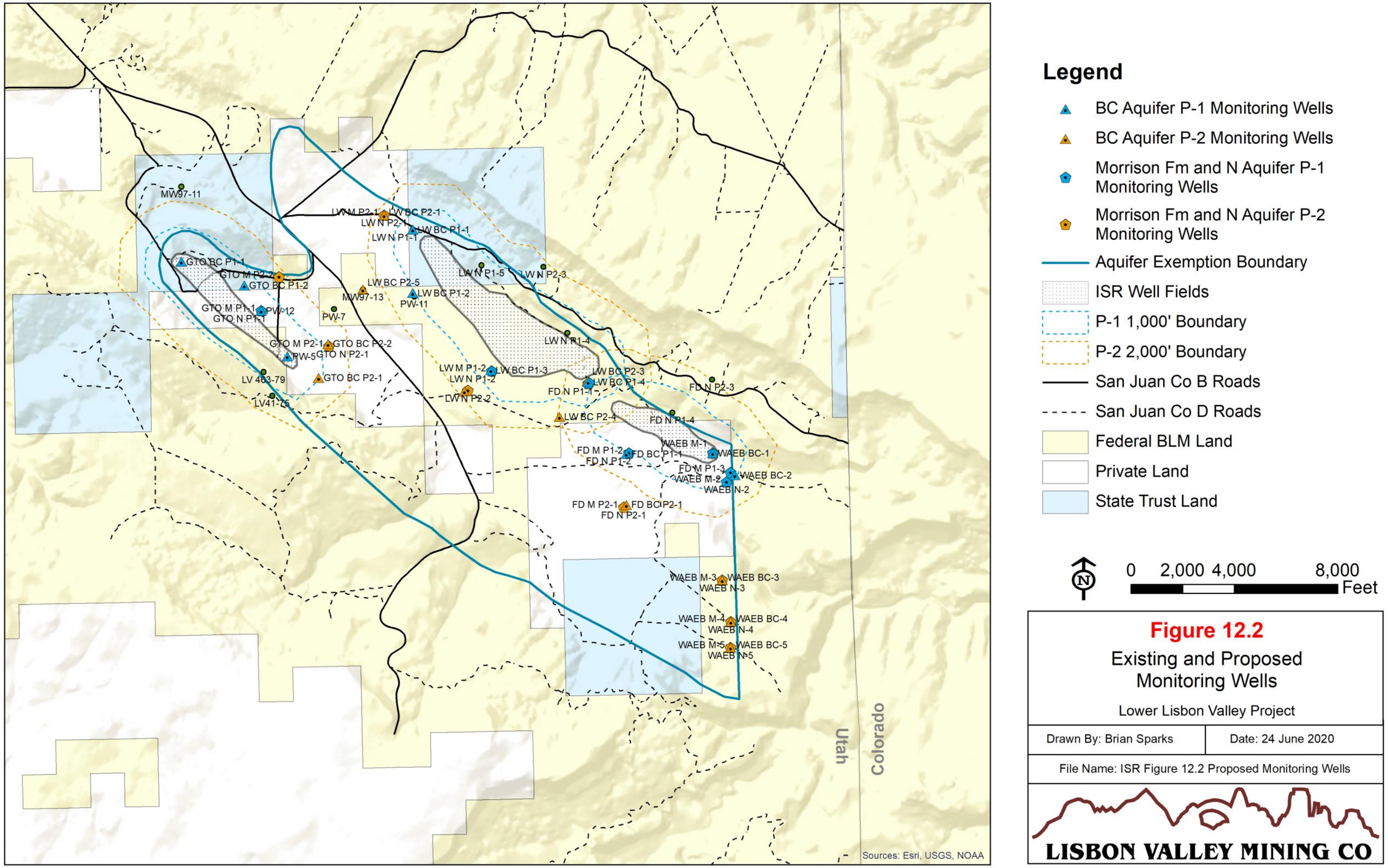
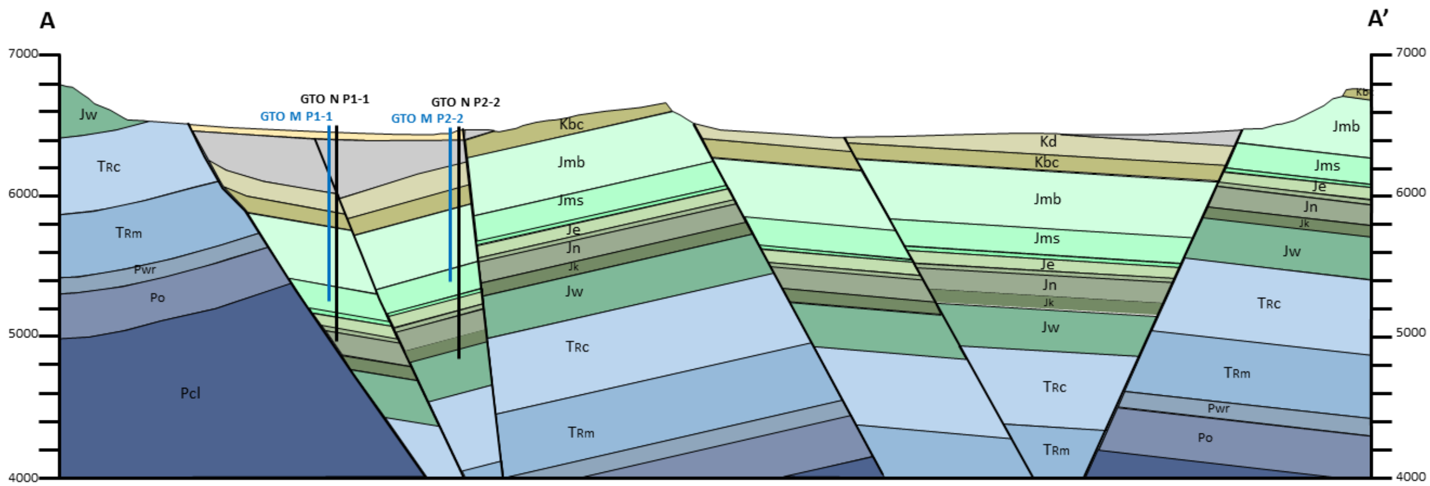


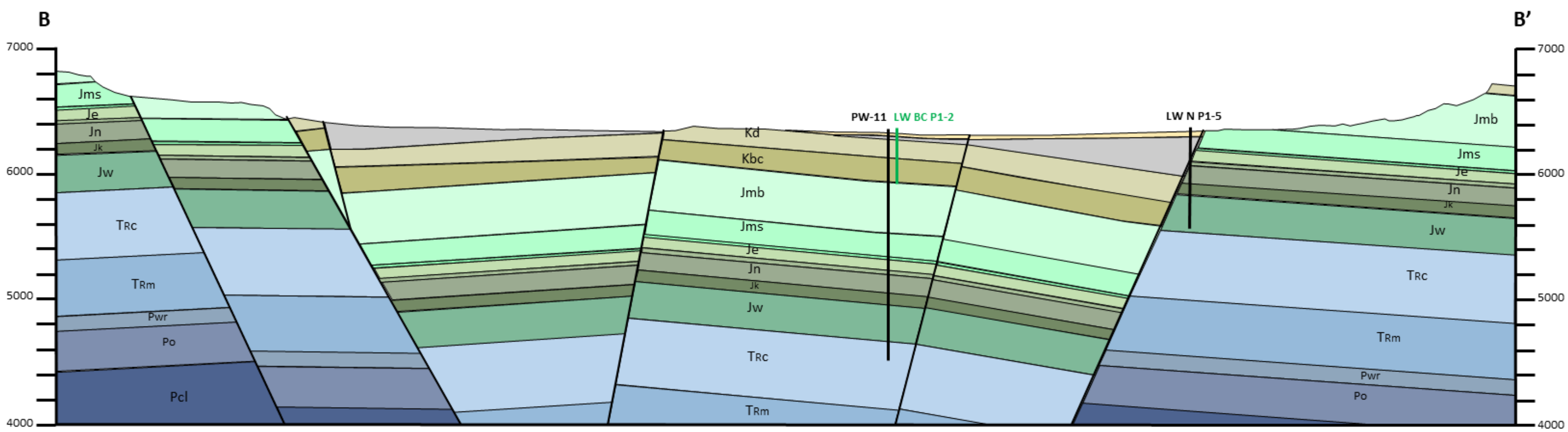
Figure 12.2
Existing and Proposed Monitoring Wells

12.2.3 POC Monitor Well Concept

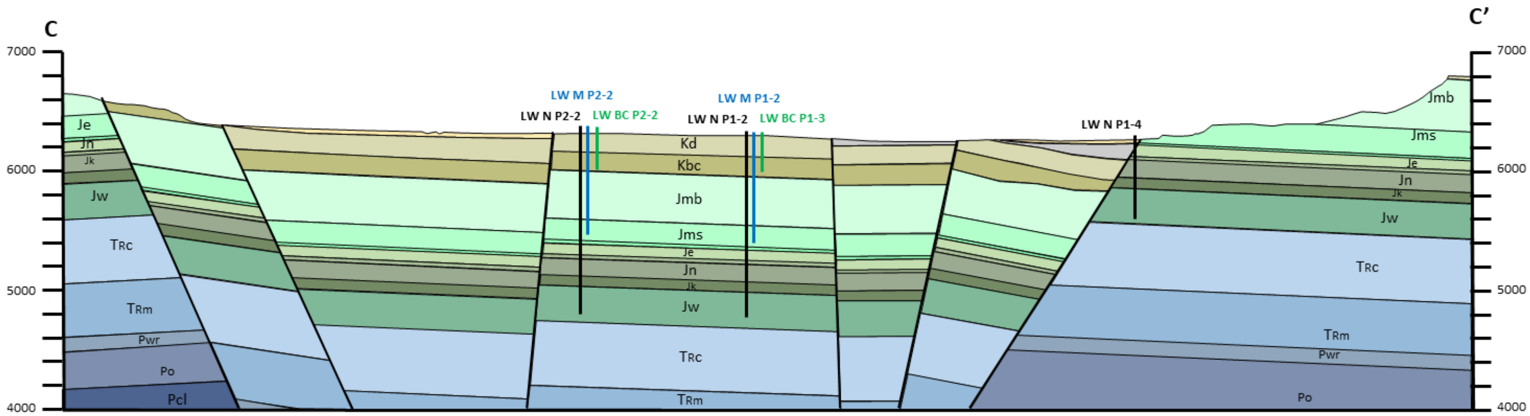
As introduced in Section 12.1, POC monitoring wells will be located outside each wellfield in both BC and N Aquifers. The BC Aquifer will be monitored by BC wells surrounding each wellfield. The N Aquifer will be monitored by N Aquifer wells which both surround and underly each wellfield. Section-view examples of N Aquifer POC monitor wells around each copper deposit are shown on Figures 12.3-12.6.

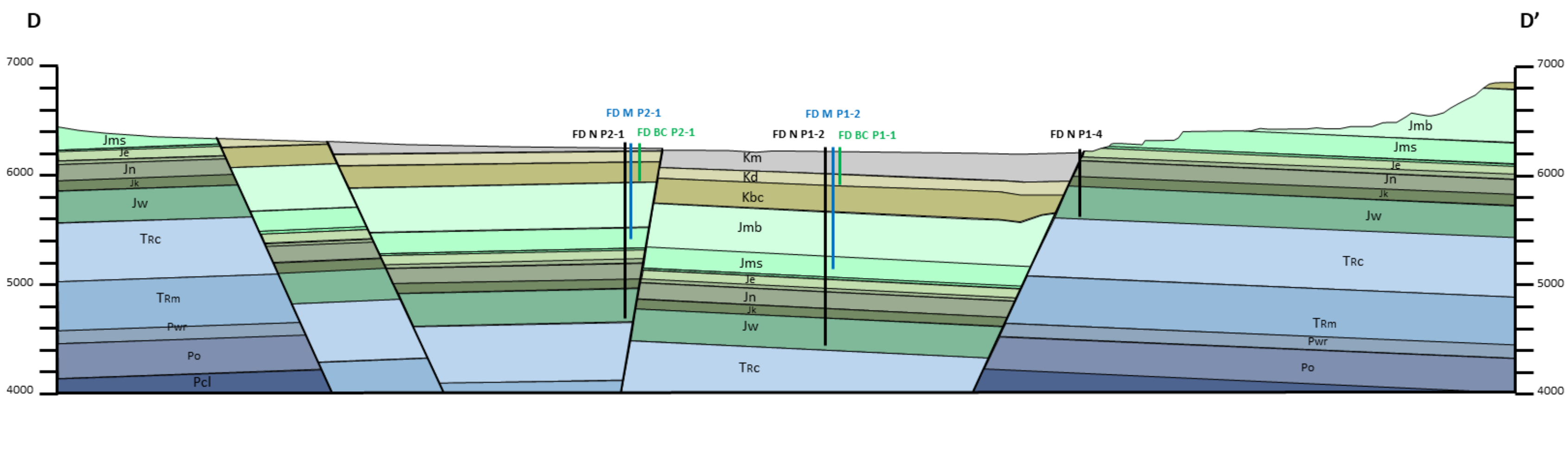
Figures 12.3 and 12.4 Monitoring Well Cross-Sectional Layout at GTO Deposit and Lone Wolf Deposit
NW





Figures 12.5 and 12.6 Monitoring Well Cross-Sectional Layout Lone Wolf Deposit SE and Flying Diamond Deposit





12.2.4 Point of Compliance Monitoring

POC monitoring will be conducted quarterly in accordance with UDWQ permit requirements. This will include water level measurements and groundwater sampling for constituents detailed in Table 12.2 Groundwater sampling will be conducted using low-flow submersible pumps.

Table 12.2 Groundwater Analyte List and Methods

Test Analyte/Parameter	Units	Analytical Method
Physical Properties		
pH ǂ	pH units	A4500-H B
Total Dissolved Solids (TDS) +	mg/L	A2540 C
Conductivity	µmhos/cm	A2510 B
Common Elements and Ions		
Alkalinity (as $CaCO_3$)	mg/L	A2320 B
Bicarbonate Alkalinity (as $CaCO_3$)	mg/L	A2320 B (as HCO_3)
Calcium	mg/L	E200.7
Carbonate Alkalinity (as $CaCO_3$)	mg/L	A2320 B
Chloride, Cl	mg/L	A4500-Cl B; E300.0
Magnesium, Mg	mg/L	E200.7
Nitrate, NO_3^- (as Nitrogen)	mg/L	E300.0
Potassium, K	mg/L	E200.7
Sodium, Na	mg/L	E200.7
Sulfate, SO_4	mg/L	A4500-SO4 E; E300.0
Trace and Minor Elements		
Arsenic, As	mg/L	E200.8
Barium, Ba	mg/L	E200.8
Boron, B	mg/L	E200.7
Cadmium, Cd	mg/L	E200.8
Chromium, Cr	mg/L	E200.8
Copper, Cu	mg/L	E200.8
Fluoride, F	mg/L	E300.0
Iron, Fe	mg/L	E200.7
Lead, Pb	mg/L	E200.8
Manganese, Mn	mg/L	E200.8
Mercury, Hg	mg/L	E200.8
Molybdenum, Mo	mg/L	E200.8
Nickel, Ni	mg/L	E200.8
Selenium, Se	mg/L	E200.8, A3114 B
Silver, Ag	mg/L	E200.8
Uranium, U	mg/L	E200.7, E200.8
Vanadium, V	mg/L	E200.7, E200.8
Zinc, Zn	mg/L	E200.8
Radiological Parameters		
Gross Alpha††	pCi/L	E900.0
Gross Beta	pCi/L	E900.0
Radium, Ra-226§	pCi/L	E903.0

ǂ Field and Laboratory

+ Laboratory only

††Excluding radon, radium, and uranium

§ If initial analysis indicates presence of Th-232, then Ra-228 will be considered within the baseline sampling program or an alternative may be proposed.

12.3 Groundwater Restoration Monitoring

During all phases of groundwater restoration, including active restoration and stability monitoring, POC monitoring will continue in accordance with UDWQ permit conditions. The following additional monitoring associated with groundwater restoration will be conducted in accordance with UDWQ permit requirements.

12.3.1 Establishing Production Zone Baseline Water Quality

Production zone baseline water quality and TRGs will be established according to UDWQ permit requirements. Prior to copper ISR, a subset of wells within each well field to be utilized as production wells will be identified for baseline water quality sampling. Baseline water quality and TRGs will be established according to statistical methods approved by UDWQ.

The Company has identified up to 55 wells in the Project Area for water quality monitoring. This would include 19 BC monitoring wells, 12 Morrison Formation wells, and 24 N Aquifer wells (Table 12.1). The expected sample frequency is one sample per monitoring well per quarter, with samples analyzed for the constituents listed in Table 12.2.

The Company has a comprehensive understanding of aquifer water quality, both at the Lisbon Valley Mine and the Project Area. Current baseline water quality for groundwater monitoring wells is shown in Table 12.3. MCL exceedances are shaded gray. Historic cumulative water quality for LVMC is compiled in Appendix K.

Table 12.3 LLV Baseline Groundwater Quality BC and N Aquifers

		Water Quality Range Lower Lisbon Valley BC Aquifer	Water Quality Range Lower Lisbon Valley N-Aquifer
Major Ions + Indicator Parameters			
Alkalinity, dissolved (as $CaCO_3$)	mg/l	105 - 163.2	185.4 - 328.1
Alkalinity (as $CaCO_3$)	mg/l	125 - 1,517	179 - 430
Bicarbonate (as $CaCO_3$)	mg/l	125 - 1,517.3	179 - 429.8
Carbonate (as $CaCO_3$)	mg/l	<1.7 - 31	<1 - 19
Hydroxide (as $CaCO_3$)	mg/l	<2 - <14.7	<1 - 5.9
Hardness (as $CaCO_3$)	mg/l	109 - 748	64 - 556
Calcium	mg/l	16.2 - 184	16.7 - 141
Magnesium	mg/l	11.4 - 108	5.3 - 46.1
Potassium	mg/l	7.7 - 17	3.72 - 12.6
Sodium	mg/l	71.6 - 1,540	50.1 - 248
Chloride	mg/l	9.3 - 81.9	4.9 - 310
Fluoride	mg/l	0.09 - 1.30	<0.1 - 1
Silica	mg/l	1.5 - 24.8	8.3 - 25.9
Sulfate	mg/l	131 - 2,800	6 - 533
Sodium Absorption Ratio (SAR)	%	1.61 - 1.79	3 - 4.7
Total Dissolved Solids	mg/l	542 - 5,340	260 - 1,440
Total Suspended Solids	mg/l	<5 - 11,700	<5 - 6,280
pH, Lab	s.u.	6.3 - 8.8	6.4 - 8.5
E.C. Lab	µS/cm	861 - 6,680	267 - 1,715
Nutrients			
Phosphorus, total as P	mg/l	<0.01 - 0.26	0.01 - 2.3
Nitrate as N, dissolved	mg/l	<0.02 - 1.59	0 - 0.5
Nitrite as N, dissolved	mg/l	0 - <0.05	0 - 0.094
Nitrate/Nitrite as N, dissolved	mg/l	<0.02 - 1.59	0 - 0.5
Nitrogen, ammonia	mg/l	<0.05 - 8.85	<0.05 - 1.7
Metals			
Aluminum, dissolved	mg/l	0.01 - 0.98	<0.03 - 1.12
Antimony, dissolved	mg/l	0.0004 - 0.012	<0.0002 - <0.02
Arsenic, dissolved	mg/l	<0.0002 - <0.04	<0.0002 - 0.0476
Barium, dissolved	mg/l	0.006 - 0.715	0.031 - 1.29
Beryllium, dissolved	mg/l	<0.00005 - <0.01	<0.00005 - <0.005
Cadmium, dissolved	mg/l	<0.00005 - 0.0597	<0.00005 - <0.003
Chromium, dissolved	mg/l	<0.0001 - 0.014	0.0001 - 0.1055
Copper, dissolved	mg/l	<0.002 - <0.05	<0.01 - 0.04
Iron, dissolved	mg/l	<0.01 - 39.3	0.01 - 15.7
Lead, dissolved	mg/l	<0.0001 - 0.069	<0.0001 - 0.0152
Manganese, dissolved	mg/l	0.008 - 1.18	0.017 - 5.4
Mercury, dissolved	mg/l	<0.0002 - 0.0003	<0.0002 - 0.00079
Molybdenum, dissolved	mg/l	<0.01 - 0.566	0.01 - 0.84
Nickel, dissolved	mg/l	<0.008 - 0.109	<0.008 - 17.3
Selenium, dissolved	mg/l	<0.0001 - 0.027	0.0001 - 0.012
Silver, dissolved	mg/l	<0.00005 - 0.526	<0.00005 - <0.5
Strontium, dissolved	mg/l	2.39 - 4.48	1.62 - 5.75
Thallium, dissolved	mg/l	<0.00005 - 0.014	<0.00005 - 0.009
Uranium, total	mg/l	0.0002 - 0.293	0.0000846 - 0.138
Vanadium, dissolved	mg/l	<0.002 - <0.04	<0.005 - 0.014
Zinc, dissolved	mg/l	0.01 - 1.7	<0.01 - 20.8
Radiological			
Gross Alpha, total	pCi/l	0.3 - 888	-0.73 - 277
Gross Beta, total	pCi/l	9 - 678	2.5 - 310
Radium 226, total	pCi/l	0.91 - 14	0.2 - 5.3
Radium 228, total	pCi/l	0.7 - 6	0 - 13.2
Thorium 228, total	pCi/l	0.32 - 1.27	-0.29 - 2.7
Thorium 230, total	pCi/l	0.4 - 7.5	-0.88 - 4
Thorium 232, total	pCi/l	0.2 - 1.8	-1.2 - 1.75

Table 12.4 Statistics of LLV MCL Exceedance BC and N Aquifers

		Burro Canyon Aquifer Summary Statistics						N-Aquifer Summary Statistics					
		Range						Range					
		Min.	Max.	Mean	Median	# Samples	# Non-Detects	Min.	Max.	Mean	Median	# Samples	# Non-Detects
Major Ions + Indicator Parameters													
Alkalinity, dissolved (as $CaCO_3$)	mg/l	105	163	144	162	3	0	185	328	259	254	9	0
Alkalinity (as $CaCO_3$)	mg/l	125	1,517.0	282.6	258.0	101	0	179.0	430.0	265.3	254.0	129	0
Bicarbonate (as $CaCO_3$)	mg/l	125	1,517.3	279	258	101	0	179	429.8	261	248	129	0
Carbonate (as $CaCO_3$)	mg/l	<1.7	31	5	<2	97	77	<1	19	3	<2	129	91
Hydroxide (as $CaCO_3$)	mg/l	<2	<14.7	3	<2	97	96	<1	5.9	2	<2	129	123
Hardness (as $CaCO_3$)	mg/l	109	748	433	473	101	0	64	556	219	188	129	0
Calcium	mg/l	16.2	184	103	117	101	0	16.7	141	53.3	45.2	129	0
Magnesium	mg/l	11.4	108	42.4	43.9	101	0	5.3	46.1	20.6	18.9	129	0
Potassium	mg/l	7.7	17	9.5	9.21	101	0	3.72	12.6	7.2	6.8	129	0
Sodium	mg/l	71.6	1,540	146	124	101	0	50.1	248	121	119	129	0
Chloride	mg/l	9.3	81.9	23	22	101	0	4.9	310	64	43	129	0
Fluoride	mg/l	0.09	1.30	0.5	0.40	101	5	<0.1	1	0.6	0.6	129	1
Silica	mg/l	1.5	24.8	10.9	11.8	101	1	8.3	25.9	14.4	13.9	129	0
Sulfate	mg/l	131	2,800	463	480	101	0	6	533	150	110	129	0
Sodium Absorption Ratio (SAR)	%	1.61	1.79	1.70	1.70	2	0	3	4.7	3.66	3.38	6	0
Total Dissolved Solids	mg/l	542	5,340	986	1,010	101	0	260	1,440	605	540	129	0
Total Suspended Solids	mg/l	<5	11,700	832	9.0	101	38	<5	6,280	509	83	129	21
pH, Lab	s.u.	6.3	8.8	7.8	8	101	0	6.4	8.5	7.8	8.2	129	0
E.C. Lab	µS/cm	861	6,680	1,358	1,370	101	0	267	1,715	951	936	129	0
Nutrients													
Phosphorus, total as P	mg/l	<0.01	0.26	0.03	<0.02	43	24	0.01	2.3	0.33	0.10	42	16
Nitrate as N, dissolved	mg/l	<0.02	1.59	0.16	0.04	101	49	0	0.5	0.07	0.02	129	79
Nitrite as N, dissolved	mg/l	0	<0.05	0.01	<0.01	100	79	0	0.094	0.01	<0.01	129	113
Nitrate/Nitrite as N, dissolved	mg/l	<0.02	1.59	0.16	0.05	101	49	0	0.5	0.08	0.03	129	75
Nitrogen, ammonia	mg/l	<0.05	8.85	0.24	0.050	100	68	<0.05	1.7	0.15	0.08	129	62
Metals													
Aluminum, dissolved	mg/l	0.01	0.98	0.06	<0.03	101	80	<0.03	1.12	0.05	<0.03	129	91
Antimony, dissolved	mg/l	0.0004	0.012	0.0014	<0.0004	100	82	<0.0002	<0.02	0.0024	0.0005	129	94
Arsenic, dissolved	mg/l	<0.0002	<0.04	0.0035	0.002	101	33	<0.0002	0.0476	0.0091	0.0064	129	25
Barium, dissolved	mg/l	0.006	0.715	0.034	0.013	101	0	0.031	1.29	0.151	0.088	129	0
Beryllium, dissolved	mg/l	<0.00005	<0.01	0.0004	<0.0001	101	98	<0.00005	<0.005	0.0004	<0.0001	129	121
Cadmium, dissolved	mg/l	<0.00005	0.0597	0.0076	0.0034	101	29	<0.00005	<0.003	0.0005	<0.0001	129	112
Chromium, dissolved	mg/l	<0.0001	0.014	0.0015	<0.0005	101	88	0.0001	0.1055	0.0046	<0.0005	129	85
Copper, dissolved	mg/l	<0.002	<0.05	0.01	<0.01	101	93	<0.01	0.04	0.01	<0.01	129	117
Iron, dissolved	mg/l	<0.01	39.3	1.37	0.35	101	7	0.01	15.7	0.85	0.31	129	14
Lead, dissolved	mg/l	<0.0001	0.069	0.0019	0.0002	100	58	<0.0001	0.0152	0.0018	0.0005	129	96
Manganese, dissolved	mg/l	0.008	1.18	0.153	0.12	101	1	0.017	5.4	0.349	0.12	129	6
Mercury, dissolved	mg/l	<0.0002	0.0003	0.0002	<0.0002	101	98	<0.0002	0.00079	0.0002	<0.0002	129	119
Molybdenum, dissolved	mg/l	<0.01	0.566	0.04	0.02	101	36	0.01	0.84	0.08	<0.02	129	58
Nickel, dissolved	mg/l	<0.008	0.109	0.01	<0.01	101	71	<0.008	17.3	0.44	<0.01	129	73
Selenium, dissolved	mg/l	<0.0001	0.027	0.002	<0.001	100	60	0.0001	0.012	0.002	<0.001	129	107
Silver, dissolved	mg/l	<0.00005	0.526	0.01772	<0.00005	101	94	<0.00005	<0.5	0.01191	<0.00005	129	117
Strontium, dissolved	mg/l	2.39	4.48	3.13	2.53	3	0	1.62	4.81	2.93	2.645	4	0
Thallium, dissolved	mg/l	<0.00005	0.014	0.0005	0.0002	100	55	<0.00005	0.009	0.0006	<0.0001	129	118
Uranium, total	mg/l	0.0002	0.293	0.0395	0.0288	94	0	0.000085	0.138	0.0113	0.0041	129	23
Vanadium, dissolved	mg/l	<0.002	<0.04	0.007	<0.005	101	98	<0.005	0.014	0.007	<0.005	129	119
Zinc, dissolved	mg/l	0.01	1.7	0.15	0.03	101	22	<0.01	20.8	0.50	0.02	129	52
Radiological													
Gross Alpha, total	pCi/l	0.3	888	73	22	104	0	-0.73	277	24	13	130	0
Gross Beta, total	pCi/l	9	678	63	20	104	0	2.5	310	34	15	130	0
Radium 226, total	pCi/l	0.91	14	7	6.05	20	0	0.2	5.3	1	1.0	64	0
Radium 228, total	pCi/l	0.7	6	3	2.4	19	0	0	13.2	2	1.5	55	0
Thorium 228, total	pCi/l	0.32	1.27	1	0.97	5	0	-0.29	2.7	0	0.03	18	0
Thorium 230, total	pCi/l	0.4	7.5	3	3.1	20	0	-0.88	4	1	0.675	56	0
Thorium 232, total	pCi/l	0.2	1.8	1	0.80	20	0	-1.2	1.75	0	0.30	52	0

12.4 Monitoring during Active Restoration

The Company will monitor the progress of aquifer restoration by sampling ore zone monitor wells in each well field at a frequency sufficient to determine the success of aquifer restoration, optimize the efficiency of aquifer restoration, and determine if any areas need additional attention.

12.5 Reporting

Prior to operation of each well field, the Company will prepare and submit an injection authorization data package. The data package will provide the planned locations of injection, production and monitor wells and the results of formation testing. The data packages will request authorization to initiate injection into each well field. The Company will complete MIT and a well completion report for each injection well prior to initiating injection into that well.

Quarterly monitoring reports will be submitted to UDWQ. At minimum, the quarterly monitoring reports will include the following information:

- Physical, chemical and other relevant characteristics of injection fluids
- Monthly average, maximum and minimum values for injection pressure, flow rate and volume
- Quarterly MIT results, a list of any wells failing MIT and corrective actions taken, and a list of wells anticipated to undergo MIT during the next quarter
- Any well maintenance activities

Signed quarterly reports will be submitted electronically unless otherwise directed by the UDWQ. If required, a signature letter from the Company Representative will accompany the electronic submission to certify the report. Reports will consist of monthly summary information for the project. Monitoring reports will include raw data and graphical analysis for the current reporting period to date. Each calendar quarter, the maximum, minimum, and average monthly values for each continuously monitored parameter specified for the injection wells will be tabulated. A narrative description of any deviations from permit limitations will be given. Maintenance activities, MIT activities, and other significant events that took place during the reporting period will be described. If an excursion has potential to impact a USDW, it will be reported verbally to UDEQ within 24 hours and followed up within 5 days in written form.

12.6 Record Keeping

Well completion records and all monitoring information, including calibration and maintenance records and data from the continuous monitoring instrumentation will be retained for at least three (3) years after all wells have been plugged and abandoned. This includes:

- Injection well completion reports.
- Information on the nature, volume, and composition of all injected fluids.
- MIT results, description and results of any other tests required by UDEQ, and any well work-overs completed.

The records discussed above (originals or copies) will be retained on site unless written approval to discard the records is provided by the UDWQ. Copies of these records (or originals) will be maintained for all observation records throughout the operating life of each well. The Company also will maintain an electronic database containing well completion and MIT records for all injection wells. The database will be provided for UDWQ use upon request.

12.7 Quality Assurance

After permit issuance but prior to operations, the Company will prepare and submit to UDWQ a Quality Assurance Project Plan (QAPP). The purpose of the QAPP is to ensure that all groundwater quality measurements are reasonably valid and of a defined quality. These programs are needed (1) to identify deficiencies in the sampling and measurement processes and report them to those responsible for these operations so that permittees may take corrective action and (2) to obtain some measure of confidence in the results of the monitoring programs to assure the regulatory agencies and the public that the results are valid.

13.0 PART K - Contingency Plan

This attachment outlines contingency plans to cope with system shut-ins or failures to prevent migration of fluids into any USDWs.

13.1 Introduction

The endangerment of USDWs may occur via any combination of at least three contamination pathways in which fluids can escape the injection zone and enter USDWs. These pathways include:

1) Migration of fluids vertically through a faulty N Aquifer monitoring well
2) Migration of fluids laterally into the N Aquifer
3) Migration of fluids vertically into the N Aquifer

The extent to which a USDW is threatened will depend on a number of factors including:

- The nature of the fluid being injected;
- The volume of the fluid being injected;
- The hydraulics of the flow system (pressure in the injection zone and overlying USDWs); and
- The amount of fluid that may enter the USDW via one or more of the pathways.

Proper construction and MIT of injection wells as outlined in Section 11 and effective monitoring as described in Section 14 will reduce the likelihood that any USDWs will be threatened.

13.2 Prevention Measures

13.2.1 Integrity Testing of Casing

Each new injection, production and monitor well will be logged using a cement bond log to determine the quality of cement bond on the exterior casing wall. This will be followed with pressure tested to confirm the integrity of the casing prior to being used for ISR operations. Mechanical integrity will be demonstrated after a well is constructed and before it is put into use. MIT procedures are discussed in Section 11.5. Wells that fail MIT criteria will be repaired or plugged and abandoned and replaced as necessary.

13.2.2 General Shutdown

All production, injection and monitor wells will be constructed of well casing that is cemented on the exterior to prevent vertical migration of ISR solutions up the annulus between the drill hole and the casing. Both production and injection wells will be piped into a collection header piping and collection ponds.

Each production well will have a submersible pump associated with a circuit breaker that will be labeled with the corresponding well number (e.g., GTO-50 or LW-100). Each circuit breaker will have a start and stop switch that can be used to energize or de-energize the pump motor. The circuit breaker will be the main source of electrical power and will be used to de- energize and lock out the pump motor as necessary for repairs or maintenance.

Each injection well will have a block valve between the header and the flow meter so that the injection well may be blocked off to service the meter and the well. There will be a manual flow control valve and a flow meter on each production and injection well to regulate the flow to and from each well and to balance the individual well patterns. The flow meters will be labeled with designated well identification numbers. The block valves will be closed for the appropriate injection or production well for shutdown and tag out.

13.2.3 Emergency Shutdown

The Company will install automated control and data recording systems at the GTO, Lone Wolf, and Flying Diamond facilities which will provide centralized monitoring and control of the process variables including the flows and pressures of production and injection streams. The systems will include alarms and automatic shutoffs to detect and control a potential release or spill.

Pressure and flow sensors will be installed, for the purpose of leak detection, on the main trunk lines that connect the process facilities to the well fields. In addition, the flow rate of each production and injection well will be measured automatically. Measurements will be collected and transmitted to both the process facilities control systems. Should pressures or flows fluctuate outside of normal operating ranges, alarms will provide immediate warning to operators which will result in a timely response and appropriate corrective action.

Both external and internal shutdown controls will be installed at well head to provide for operator safety and spill control. The external and internal shutdown controls will be designed for automatic and remote shutdown of each well head. In the event of a well shutdown, an alarm will occur and the flows of all injection and production to that well will be automatically stopped.

13.2.4 Point of Compliance Exceedance Control

During production operations, lixiviant will be injected into the production zone through the injection wells, and recovery solution will be withdrawn by the submersible pumps in the production wells. During aquifer restoration, permeate and/or clean makeup water from the N Aquifer will be injected into injection wells and recovery solution pumped from the production wells. Recovering more groundwater than is injected during production and restoration will maintain a localized cone of depression for each well field. This induced gradient from the surrounding area toward the well field will serve as a control over the movement of ISR solutions and minimize the potential for lateral excursions.

Pre-operational POC exceedance preventative measures will include, but will not be limited to:

1) Proper well construction cement bond log, and MIT of each well before use;
2) Monitor well design schema based upon delineation drilling to further characterize the zones of mineralization and to identify the target completion zones for all monitor wells; and
3) Pre-operational pumping tests with monitoring systems in place to obtain a detailed understanding of the local hydrogeology and to demonstrate the adequacy of the monitoring system.

Operational POC exceedance preventative measures will include but will not be limited to:

1) Regular monitoring of flow and pressure on each production and injection well;
2) Regular flow balancing and adjustment of all production and injection flows

appropriate for each production pattern;

3) Monitoring of hydrostatic water levels in monitor wells to verify the inward hydraulic gradient; and
4) Regular collection of samples from all monitor wells to determine the presence of any indicators of the migration of ISR solutions horizontally or vertically from the production zone.

Monitor wells will be positioned to detect any ISR solutions that may potentially migrate away from the production zone due to an imbalance in well field pressure. Prior to injecting lixiviant into each well field, pre-operational pump testing will be conducted to demonstrate hydraulic connection between the production and injection wells and all perimeter monitor wells. Sampling of monitor wells will occur according to the schedule described in Section 12.2.

Controls for preventing migration of ISR solutions to overlying and underlying aquifers consist of:

- Regular monitoring of hydrostatic water levels and sampling for analysis of indicator species;
- Routine MIT of all wells on a regular basis (at least every 5 years) to reduce any possibility of casing leakage;
- Completion of MIT on all wells before putting them into service or after work which involves drilling equipment inside of the casing;
- Proper plugging and abandonment of all wells which do not pass MIT or that become unnecessary for use;
- Proper plugging and abandonment of exploration holes with potential to impact ISR operations; and
- Sampling monitor wells located within the overlying and underlying hydrogeologic units on a quarterly schedule.

13.3 Point of Compliance Exceedance Corrective Action

The Company will implement the following corrective action plan for POC exceedances occurring during production or restoration operations. Corrective actions to correct and retrieve an POC exceedance will include but will not be limited to:

- Adjusting the flow rates of the production and injection wells to increase the aquifer bleed in the area of the excursion;
- Terminating injection into the portion of the well field affected by the excursion;
- Installing pumps in injection wells in the portion of the well field affected by the excursion to retrieve ISR solutions;
- Replacing injection or production wells; and
- Installing new pumping wells adjacent to the well on excursion status to recover ISR solutions.

13.4 Mitigation Measures for Other Potential Environmental Impacts

13.4.1 Spills and Leaks

Well field features such as header houses, well heads or pipelines could contribute to pollution in the unlikely event of a release of ISR solution due to pipeline or well failure. Potential impacts will be minimized by routine MIT of all injection, production and monitor wells and hydrostatic leak testing of all pipelines during construction; implementing an instrumentation and control system to monitor pressure and flow and immediately detect and correct an anomalous condition; and implementing a spill response and cleanup program in accordance with UDEQ and UDOGM permit conditions.

13.4.2 Potential Natural Disaster Risk

See Seismology Section 3.7.

13.4.3 Potential Fire and Explosion Risk

The design criteria for chemical storage and feeding systems include applicable sections of the MSHA regulations and RCRA regulations and the Company will expand any current training and protocols to include the ISR project. The Company will maintain firefighting equipment on site.

13.4.4 Potential Power Outage

Power outages in the Project area would not be likely to last more than a few days or weeks under most conceivable scenarios. The Company will use generators onsite and may also contract for temporary generators to operate well field pumps sufficiently to maintain an inward hydraulic gradient within each well field if unforeseen power outages occur with expected duration of more than two weeks. Backup generators will be installed to maintain continuous instrumentation monitoring and alarms in the process facilities and well fields. Backup power also will be provided for lights.

14.0 PART L - Wellfield Closure Plan

This attachment describes the wellfield closure plan for the Class III injection and extraction wells. This includes i) wellfield rinsing ii) plugging and abandonment, and iii) post-closure closure monitoring.

The Company has evaluated closure costs associated with one and three years of ISR operations (Table 14.1) . The Company does not believe modeling closure scenarios beyond year three years of ISR operations is practical given the Company will be reviewing projections vs. actual operations as part of ongoing review of closure costs. The Company plans to conduct concurrent closure of portions of the wellfields that have completed copper leaching as new areas of the wellfield come into production.. The Company projects installing a total of 71 ISR well including a small test well array over the first three years of ISR operations that the Company will bond, see figure 11.8 for preliminary well installation schedule. The Company plans to review the adequacy of its bond with UDWQ within three years of commencing ISR operations to adjust the amount as necessary based on project advancement and review of actual ISR operating data.

14.1 Wellfield Rinsing

If the proposed ISR wellfield needs to be closed at any time during the first three years of operation,, the Company will initiate an approximate two year closure plan. The closure plan will involve cessation of acid addition, rinsing with fresh water, aquifer rest/neutralization, and wellfield recirculation. The total projected rinsing and recirculation will comprise approximately five pore volumes. Rinse water will be pumped and extracted from the wellfield(s) and evaporated at the ISR collection ponds using forced and natural evaporation (750 gpm capacity).

The Company's closure plan is based on geochemical modeling and metallurgical test results that indicate neutralization and constituent concentration reduction to appropriate levels can be accomplished in approximately two years. The rate and capacity of pH neutralization is well-understood and projected as a function of 15 years of leach pad operation and monitoring which requires daily pH control and observation of the same ore host rock targeted by ISR operations.

The closure plan involves three primary steps. First, following cessation of acid addition, the acidified leaching solution is rested in place to take advantage of the well-documented neutralization capacity of the gangue remaining in the ore body. Sufficient extraction of the leach solution will be maintained to ensure an inward hydraulic gradient while also injecting fresh water using the Company's 300+ gpm wellfield capacity. The initial rest will extend approximately 7 months. Leaching solution extracted during the initial step will be piped to a forced evaporation system and evaporated. Following this, the wellfield will be recirculated for a period of 9 months. Recirculation during phase 2 will allow solution which has not been neutralized to sweep through the acid consuming host rock while continuing to dilute with fresh water. The pH changes during all phases will be measured using pH probes dedicated to selected wells. After five pore volumes of recirculation, the Company projects a third step of replacing one pore volume with fresh water. Rinse water is projected to be supplied by the Company's existing water well supply which will predominantly withdraw groundwater from the BC aquifer. Hydraulic control wells, located along the perimeter of the wellfields are projected to provide additional fresh water for rinsing as the wellfields expand. These wells may be augmented by a water treatment facility as needed to increase rinsing capacity. The final step is anticipated to extend over the balance of the second year of restoration, or sufficient time to normalize pH in the BC aquifer. As pH returns to the projected neutral level, the Company projects being able to meet a water quality standard protective of human health and USDWs.

The Company has projected its wellfield rinsing and evaporation costs based on actual operating data and information used for bonding open pit operations with DOGM. In addition, the Company currently operates infrastructure needed to support ISR. This includes overhead power, monitoring wells, piping, and process ponds.

14.1.1 Mobilization

In the event that the Company defaults on its obligations under the permit, it is assumed the State of Utah would likely hire a remediation contractor to conduct the necessary closure and post closure operations, using subcontractors where necessary to perform such services as rinsing, well abandonment and pump replacement. It is also assumed the contractor would need to assemble a team and mobilize to the site in order to begin rinsing and closure operations. A lump sum estimate of $[75,000] is assumed for preparation and planning and $[20,000] to mobilize and demobilize from site.

14.1.2 Labor

Labor costs for bonding assume manager-level, staff-level, and admin-level rates using RS Means. These costs are included in Table 14.1.

14.1.3 Power Consumption

The Company has estimated the number of gallons required to achieve five pore volumes of recirculation rinsing plus the cost of pumping water from fresh-water wells. This estimation multiplies the average pump horsepower by time using the Company's prevailing power cost of $0.06 per KWh. The Company has significant experience operating its existing water wells for over ten years which it has used as a basis for estimating rinsing power costs.

14.1.4 Well Rehabilitation and Maintenance

The Company has projected pump maintenance, spares, and replacement based on actual operating data from its existing portfolio of wells for the past ten years. Well rehabilitation is anticipated to include reverse flushing wells, swabbing, surging, and replacement as necessary to maintain hydraulic control and commercial sweep efficiency.

14.1.5 Rinse Verification Sampling

Rinsing verification consists of groundwater monitoring of injection/recovery wells after rinsing is completed. The cost is calculated based on the number of injection and recovery wells completed by year of operation. Rinse verification sampling will be conducted on 10% of extraction wells. Assuming three years of ISR operation the Company projects having approximately 71 extraction wells in operation. Sampling 10% of these wells equates to one well for every 2.8 acres. A sample size of 10% is considered statistically significant for quality assurance (QA) verification.

14.1.6 Quarterly Reporting

Closure employees will conduct quarterly sampling, rinse verification sampling, and provide quarterly reporting to UDWQ during the well field closure and well abandonment process. This process is estimated to take two years so eight quarterly reports are projected for submission.

14.1 Well Plugging and Abandonment Plan

The plugging and abandonment methods are designed to prevent movement of fluids through the well, out of the production zone, and into USDWs or the land surface. The same procedures will be followed for production and monitor wells. The rinsing method is designed to neutralize ISR leach solutions and restore water quality to a standard mutually agreed upon with UDWQ. The attachment also summarizes the surface reclamation, decontamination and decommissioning activities that will be carried out in accordance with UDWQ permit and UDOGM permit requirements, as well as requirements stipulated by the BLM for public lands within the Project Area.

The Company will plug all wells in accordance with UAC R317-7-10.5 (40 CFR 146.10). Plugging and abandoning will be performed with bentonite or cement grout and will be placed so as to not allow the movement of fluid either into or between underground sources of drinking water. The weight and composition of the grout will be sufficient to control artesian conditions and meet the well abandonment standards of the State of Utah. Cementing will be completed from total depth to surface using a drill pipe.

Cementing wells with damage to casing and/or formation may require additional cement. This will be recorded along with the following information:

- well ID, total depth, and location
- driller, company, or person doing the cementing work
- total volume of grout placed down hole
- viscosity and density of the grout

The Company will remove surface casing or cut off surface casing below ground and set a cement surface plug on each well plugged and abandoned.

The Company estimates well plugging and abandonment costs of approximately $5.00 per foot based on current pricing from a local drilling contractor plus a $200 per well capping charge. For the first three years of ISR operations, the Company projects drilling a total of approximately production 71 wells and 13 monitoring wells, all of which would require abandonment. The Company projects plugging and abandonment cost of these wells to be approximately $708,000.

14.2 Plugging and Abandonment Reporting

According to 40 CFR § 144.51(p) the operator is to notify the EPA within 60 days after plugging or at the time of the next quarterly report (whichever is less). In accordance with this requirement, a Plugging and Abandonment Report will be submitted to the EPA. The person that performs the plugging operation will certify the report as accurate. The report will contain either:

- A statement that the well was plugged in accordance with the approved Plugging and Abandonment Plan; or

- If the actual plugging differed from the Plugging and Abandonment Plan, a statement specifying the different procedures followed.

Documentation will be provided to verify that the quantity of sealing material placed in the well is at least equal to the volume of the empty hole.

The Plugging and Abandonment Reports will be retained for at least 3 years from the date of the submission unless the EPA requests an extension. If requested, at the conclusion of the retention period, the reports will be delivered to the EPA.

14.3.7 Post Closure Monitoring

Post closure monitoring will comprise of five years of annual monitoring at 16 monitor well locations; 9 at Lone Wolf and 7 at GTO. The wellfield will be considered closed once five consecutive annual rounds of monitoring meet TRGs for the N Aquifer. The Company conservatively projects post closure monitoring for ten years even though it projects only requiring five years to reach well field closure status.

14.4 Facility Decommissioning

Following regulatory approval of successful aquifer restoration in all well fields, the Company will decommission all well fields, processing facilities, ponds, and equipment within the Project Area. Decommissioning activities will be done in accordance with UDWQ permit and UDOGM large scale mine permit requirements. Surface reclamation and revegetation will be conducted in accordance with

UDOGM large scale mine permit requirements and requirements stipulated by the BLM. The decommissioning program will ensure that the Project Area is closed in a manner that permits release for unrestricted use.

14.5 Necessary Resources

The Company projects closing approximately the same number of wells that it drills annually beginning approximately five years after ISR operations commence (the Company estimates approximately five years to complete copper recovery of a respective ore block). This concurrent closure planning adheres to current Company operating practices employed for open pit mining operations and limits the closure costs from becoming excessively large at the end of the project.

Following review and approval of the closure plan, a financial assurance instrument will be submitted to UDWQ to assure the required activities will be completed to safeguard potential USDWs.

Each year the Company will submit a financial assurance update indicating the anticipated number of injection wells to be installed during the next year and wells to close as well as providing an updated financial assurance instrument to include closure costs for the net additional wells. During decommissioning, the financial assurance instrument will be updated annually to reflect the wells closed during the previous year.

During the ongoing ISR operations, the Company will evaluate sweep efficiency, well efficiencies, changes in groundwater quality, neutralization rates, and rinse/recirculation efficiencies. This data, and other pertinent information will be used to prepare a comprehensive Groundwater Restoration Plan and augment planning herein with actual operating data.

15.0 PART M - Financial Responsibility

The Company has maintained a $6million financial surety covering reclamation obligations for its open pit mining operation from 2009-2020. The Company performs concurrent reclamation as part of its ongoing mining operations including plugging and abandoning drill holes and has 13+ years of experience with reclamation requirements and obligations. As part of the Company's reclamation planning for ISR, it will complete reclamation activity already required for open pit operations and facilities, however, facilities reclamation including the SX/EW will not be completed until copper targeted by the ISR project has been recovered.

Following UDWQ review and approval of the Company's closure plan and cost estimate strictly focused on the ISR specific project facilities, and before any wellfield commercial operation, the Company will submit a financial assurance instrument to UDWQ to assure the required closure will be completed to safeguard USDWs. The Company will also expand its existing bond posted with DOGM to encompass any surface disturbance associated with ISR collection ponds, ISR related surface infrastructure, road and facilities or apply for a new surface disturbance bond. The Company preliminarily estimates its ISR specific bonding requirement for UDWQ to be approximately $4.5 million for the first three years of ISR operation.

Closure Summary		Closure after 3 years mining Y1	Y2
	Mining Area (tons)	7,521,429	7,521,429
	Wellfield Wells to Abandon		71
	Monitor Wells to Abandon		7
	Wells Rinsing	23	23
Mob		20,000	20,000
Preparation Planning		75,000	75,000
Labor			
	Project Manager	284,146	284,146
	Wellfield Supervisor	247,083	247,083
	Wellfield Operations (2)	368,368	368,368
	Wellfield Electrician	247,083	247,083
	Site Security	184,184	184,184
	Overhead, vehicles & expenses	10,000	10,000
	Total	1,340,864	1,340,864
Rinsing, Capital & Power			
	Rinse Recovery Pumping Power	75,091	59,246
	Evaporation Pumping Power	227,902	311,604
	Water Supply Power	54,872	54,872
	Total	357,865	425,722
Qtrly Monitoring, Rinse Verification Sampling, and Reporting		32,542	32,542
Well Rehabilitation and Maintenance		5,975	50,800
Well Abondonment			
	Wellfield	-	251,150
	Monitoring Wells	-	34,400
	Total	-	285,550
Post Closure Monitoring			40,435
Sub Total		1,832,246	2,270,913
	Contingency 10%	183,225	227,091
Total Closure Cost by Year of Operation		2,015,471	2,498,004
Total Closure Cost			4,513,475

Table 15.1-Wellfield Closure Cost Estimate

The Company plans to install an ISR test well array of 5-20 wells and it will review test planning with UDWQ for specific closure planning and financial assurance which will precede larger well field operations and bonding. This preliminary test will utilize existing infrastructure including overhead power, piping, process ponds and pumps.

16.0 PART N - Aquifer Exemption

This section summarizes data in support of an aquifer exemption request for the BC Aquifer in the Project Area. It is formatted to state 40 CFR requirements, identify how the Project meets these requirements, identify the horizontal and vertical AEB, and summarize information provided in previous sections for clarity.

16.1 Introduction

40 CFR § 146.4 allows EPA to exempt an aquifer or portion of an aquifer for the purpose of injection provided:

(a) It does not currently serve as a source of drinking water; and

(b) It cannot now and will not in the future serve as a source of drinking water because:

  (1) It is mineral, hydrocarbon or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quality and location are expected to be commercially producible.

  (2) It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical;

  (3) It is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption; or

  (4) It is located over a Class III well mining area subject to subsidence or catastrophic collapse; or

(c) The total dissolved solids content of the ground water is more than 3,000 and less than 10,000 mg/L and it is not reasonably expected to supply a public water system.

For Class III wells, the applicant must also submit data necessary to demonstrate that the aquifer is expected to be mineral or hydrocarbon producing. Relevant information as is contained in the mining plan for the proposed project, such as a map and general description of the mining zone, general information on the mineralogy and geochemistry of the mining zone, analysis of the amenability of the mining zone to the proposed mining method, and a time-table of planned development of the mining zone must be submitted.

16.2 Aquifer Serving as a Source of Drinking Water

Question: Does the aquifer serve as a source of drinking water?

Answer: No.

There are no domestic water wells in the Project Area. In addition, the BC Aquifer does not serve as a regional source of drinking water. Section 4.1 documents the AEB location 14 miles from the nearest public drinking water well.

Question: Can the aquifer now, or in the future, be used as a source of drinking water?

Answer: No.

The BC aquifer is mineralized with commercial grade copper in the Project Area with at least two deposits that have been drilled sufficiently to for the Company to declare measured and indicated resources consistent with NI 43-101 standards. The BC aquifer is also poor quality and is characterized by moderate TDS (500 to 5,000mg/L), consistent major ion chemistry, and high radionuclide concentrations. The BC water sampling from mine construction to date does not indicate that the BC water quality is consistent with drinking water standard (see Section 16.12).

Question: Is it is mineral, hydrocarbon or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quality and location are expected to be commercially producible?

Answer: Yes.

The LLV BC Aquifer is mineralized. Section 1 describes the current inventory (>800 MM lb) of copper deposits in the Project Area. Figure 1.3. shows the current extent and understanding of commercial copper deposits in the Project Area.

Question: Is the aquifer so contaminated that it would be economically or technologically impractical to render that water fit for human consumption?

Answer: Yes.

The LLV BC Aquifer is naturally contaminated by a subset of the brine metals that have heavily mineralized the greater Paradox Basin. Section 12.7.1. documents groundwater quality of the BC Aquifer in the Project Area. The BC Aquifer water quality is generally impacted with TDS, radionuclides, and crude oil, in addition to other analytes (Table 12.3). It's poor quality, natural confinement, lack of recharge, and proximity to larger sources of better quality groundwater from the N Aquifer eliminate the LLV BC Aquifer as a practical source of drinking water.

16.3 Mineralogy and Geochemistry of the Mining Zone

Question: is there adequate data to prove the amenability of the mining zone to the proposed mining method (ISR)?

Answer: Yes.

Sections 7, 11, and 16 described the mineralogy and geochemistry of the mining zone. Section 7 describes the measured hydraulic conductivity, and related permeability of the ore bodies. The permeability allows for greater control of lixiviant circulation, supporting commerciality. The location (depth) of the deposits is also important with regard to ISR head pressures and related flows through the ore bodies. Surface injection to the mineralized depths (200-900 feet) provides significant head pressure relative to shallow deposits. This also allows for greater control of lixiviant circulation further supporting commerciality. Section 11 describes the chemistry of copper sulfide ISR, and references the composition of injection fluids necessary to support ISR. Section 16 describes the mineralogy of the ore deposits in the context of fine dissemination of copper sulfide minerals in permeable sandstone. The fine dissemination provides greater surface area for ISR lixiviant contact and therefore greater commerciality.

16.4 Requested Aquifer Exemption Boundary

The rationale for the AEB is detailed in Section 3.9 and summarized in Appendix N. Summary justification for the horizontal and vertical extents of the requested AEB is provided below. When developing the requested AEB, the Company considered the following:

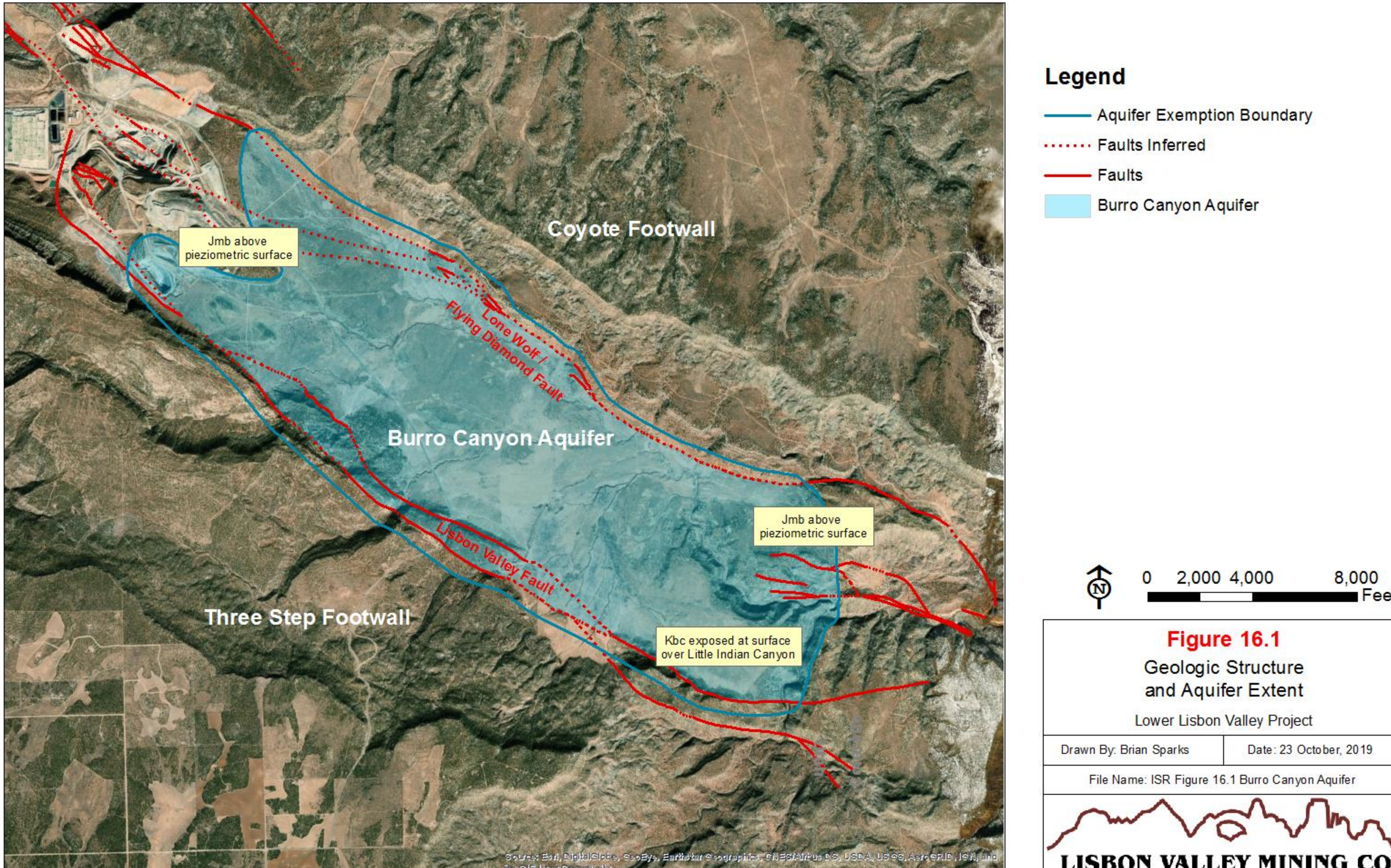
- The BC Aquifer within the Project Area meets 40CFR criteria for exemption.
- There are no domestic wells in the Project Area.
- The BC Aquifer within the Project Area water quality is poor, due to naturally occurring mineralization, crude oil, and lack of recharge. It cannot be economically developed due to the requirement for treatment prior to consumption. Its hydraulic confinement and lack of recharge prevents it from being developed as a sustainable source of drinking water. Finally, it cannot be practically developed as a public drinking water supply due to the local occurrence of better quality water.
- The closest public water supply is 14 miles
- The BC aquifer is vertically and laterally confined by geologic structure, aquitards, and non-transmissive faults
- BC Aquifer confinement is supported by physical, geologic, hydraulic, and geochemical data
- ISR operation will further confine the BC Aquifer by mining groundwater and reducing BC head pressures (i.e. well field hydraulic control)
- Internal Company confinement analysis is supported by research performed by a University of Arizona research team, specifically fault confinement and groundwater characterization

16.4.1 Horizontal Boundary Justification

The BC aquifer is confined laterally as a function of two bounding faults to the north (Lone Wolf/Flying Diamond Fault) and the south (Lisbon Valley Fault) and geologic structure which confines to the west and east. The faults are sealed with low permeability fault gouge that does not permit hydraulic flow. Geologic structure elevates the BC aquifer above the piezometric surface and to ground level effectively "pinching out" the aquifer on the east and west.

Figure 16.1 illustrates how these conditions support the horizontal boundary justification:

- North: The north boundary is defined by the Lone Wolf/Flying Diamond fault which terminates the BC Aquifer against the Coyote Footwall
- South: The south boundary is defined by the Lisbon Valley fault which terminates the BC aquifer against the Three Step footwall
- East: The east boundary is defined by the 670,300 easting. This is a hydraulic boundary that will supported and monitored by ISR operations.
- West: The west boundary is defined by geologic structure which elevates the Burro Canyon formation above the piezometric surface, effectively pinching out the aquifer.


Coyote Footwall
Jmb above piezometric surface
Lone Wolf / Flying Diamond Fault
Burro Canyon Aquifer
Jmb above piezometric surface
Lisbon Valley Fault
Three Step Footwall
Kbc exposed at surface over Little Indian Canyon
Legend
Aquifer Exemption Boundary
Faults Inferred
Faults
Burro Canyon Aquifer
0 2,000 4,000 8,000 Feet
Figure 16.1
Geologic Structure and Aquifer Extent
Lower Lisbon Valley Project
Drawn By: Brian Sparks
Date: 23 October, 2019
File Name: ISR Figure 16.1 Burro Canyon Aquifer
LISBON VALLEY MINING CO

16.4.2 Vertical Boundary Justification

The BC aquifer is confined vertically as a function of stratigraphy. This includes hundreds of feet of low-permeability shale above and below. The vertical AEB is a 500 ft distance into the underlying aquitard (Jmb), or top of N Aquifer and a 100 ft distance into the overlying aquitard (Km).

16.5 Commercial Producibility of the Ore Deposits

The commercial producibility of the Project is demonstrated by the LVMC ISR Resource Report (LVMC, 2019). This document is compliant with United States Security Exchange Commission and international reporting standards. The document was completed by the Company and a third party and confirms the resource calculations as well as the technical and economic viability of copper recovery by ISR methods at the Project. The report demonstrates the economic viability of the Project based on existing copper resource contained in three deposits within the Project Area.

16.6 Requested Exempted Aquifer Properties

The aquifer proposed for exemption is the BC Aquifer. This aquifer has the geologic and hydrologic features that make a copper deposit suitable for ISR as evidenced by aquifer properties, commercial copper occurrence, and hydraulic confinement.

- The deposit is sedimentary and generally is horizontal, tabular, and of sufficient size and lateral continuity to economically extract copper.
- The sandstone host rock is permeable enough to allow the ISR solutions to access and interact with the copper mineralization.
- The major confining units (Morrison Brushy Basin Member, Mancos Shale) will prevent ISR solution from migrating vertically into overlying or underlying aquifers.
- Geologic structure including low permeability fault gouge will prevent ISR solution from migrating laterally into adjacent aquifers.
- Influent head pressures will prevent ISR solution from migrating laterally into adjacent aquifers.
- ISR operation will prevent ISR solution from migrating laterally into adjacent aquifer as a function of groundwater withdrawals and increased isolation by head pressure.
- The mineralization targeted for ISR is located in a hydrologically saturated zone.

16.6.1 Aquifer Depth and Thickness

Within the Project Area, the depth of the BC Aquifer ranges from 200-900 feet from the surface and is approximately 450 feet thick. The ISR ore zone within the BC aquifer is approximately 75-100 feet in thickness.

16.6.2 Confining Formations

Section 6.2.2 describes the major confining units across the Project Area. The BC Aquifer is confined above by the Mancos Shale. The BC Aquifer is confined below by the Morrison Brushy Basin Unit.

Appendix M is a comprehensive report of the SGR concepts introduced in Section 3.9. It quantifies the permeability of fault gouge and further describes the geologic structures which laterally confine the AEB. The SGR of the confining fault gouge ranges in estimated permeability of .01-.05 md.

16.6.3 Hydraulic Properties

Hydraulic properties of the BC Aquifer have been determined through numerous pumping tests as described in Section 7.2. Table 7.8 summarizes the best estimates of hydraulic conductivity determined from these tests. The hydraulic properties of each well field will be determined prior to operations as described in Section 11.1

16.6.4 Geochemical Contrast BC/N Aquifers

Geochemical contrast analysis demonstrates the BC aquifer is confined laterally and vertically. Analysis performed encompasses geochemistry and age dating. Major ion chemistry indicates that the BC and N aquifers have distinct geochemical signatures. Additionally, all isotopic analyses indicated that the BC and N aquifers have distinct water compositions. Aged dating analysis indicates that the water in the BC aquifer has an age range of 3,300 to 11,000 years BP, while the water in the N aquifer has an age range of 15,000 to 36,000 years BP. All aforementioned conclusions suggest that minimal or no communication is occurring between the BC and N aquifers and that the BC aquifer is geologically and hydrologically confined.

16.7 ISR Process Considerations

16.7.1 Lixiviant Compatibility with Ore Body

The lixiviant will consist of groundwater pumped from the production zone and fortified with dilute sulfuric acid and oxygen.

The effectiveness of this type of lixiviant is demonstrated by leach amenability studies conducted on core samples collected within the Project Area using standard industry column testing as well as pressurized vessel testing which have demonstrated commercial copper recovery. All test work has been performed by the Company in its laboratory and additional confirmatory third-party laboratory test work is planned. LVMC has extensive experience leaching target mineralogy in its existing open pit heap leach operations since 2006 which has very comparable leaching metallurgy and chemistry and the necessary processing plant and infrastructure is already owned and operated by the Company.

16.7.2 Mineralogy of the Copper Ore

Copper within the Project Area occurs in sandstones of the Cretaceous Dakota and BC Formations. Copper minerals are finely disseminated within the interstices of the coarse and medium-grained sandstone units, and with less common occurrences in lenses and nodules along fractures, around organic matter, or replacing calcareous nodules or concretions, primarily within sandstone units. The fine dissemination of copper mineralization in the host sandstone is ideal for ISR which utilizes the sandstone's permeability to access fine copper mineralization with lixiviant for recovery.

The copper deposits are divided into oxide and sulfide mineralogical zones.

Oxide/Sulfide Interface – The oxide/sulfide interface is approximately 0-250 feet below the surface, although it varies according to lithology and permeability of the individual host beds. Oxide minerals include primarily malachite, azurite, tenorite, cuprite, and other unidentified oxidized copper minerals.

Sulfide Zone – The sulfide zone consists mainly of chalcocite or djurleite, with minor amounts of bornite and chalcopyrite on the fringes of the deposits. Chalcocite is fine-grained and "sooty" near the oxide/sulfide interface, where it might be secondary (supergene) in origin. Chalcocite disseminated in the BC Formation at depths greater than 250 feet is crystalline, steely and is primary (hypogene) in origin. Native copper is found only rarely at the oxide/sulfide interface at depth and is secondary in origin.

16.7.3 Well Field Construction and Completion

Section 11 describes the well construction materials and methods. Typical well casing will be 4.5 to 6-inch nominal diameter PVC with at least SDR 17 wall thickness. The Company will adhere to the requirements of ASTM F480 and manufacturer's criteria to ensure that the installations do not exceed the casing hydraulic collapse resistance. The drill holes will be at least 2 inches larger than the outside well casing diameters, and the annular spaces will be pressure-grouted with sufficient additional grout to achieve return to surface.

16.7.4 Mechanical Integrity Testing

Section 11.5 describes MIT that will be performed on all injection, production, and monitor wells prior to operation, at least every 5 years, and following any repair where a downhole drill bit or underreaming tool is used. For injection wells, MIT will be performed at 125 percent of the maximum operating pressure of the well field, 125 percent of the maximum operating pressure of the well casing, or 90 percent of the formation fracture pressure, whichever is less. A well must maintain 90 percent of the MIT hydrostatic test pressure for a minimum of 10 minutes to pass the test.

16.7.5 Hydraulic Well Field Control

Section 10.4 describes how the Company will maintain hydraulic control of each well field from the first injection of lixiviant through the end of aquifer restoration. This will be done by maintaining a production and restoration bleed, which will create a cone of depression within each well field. The typical production bleed is estimated at 1%, and the typical restoration bleed will range from about 1 to 17%. Verification of hydraulic control will be performed through water level measurements in perimeter monitor wells.

16.8 Groundwater Monitoring

Section 14.2 describes the excursion monitoring program that will be conducted to detect potential horizontal or vertical migration of ISR solutions outside the well field. POC monitor wells will consist of perimeter and underlying monitor wells that will be used to monitor any potential vertical migration of ISR solutions into the BC or N aquifers outside the well fields. Monitor wells will be sampled during copper recovery and aquifer restoration operations. Corrective actions will be initiated in the event of a POC exceedance to correct a potential well field balance and recover ISR solutions well before they can reach the AEB (refer to Section 13.3.1).

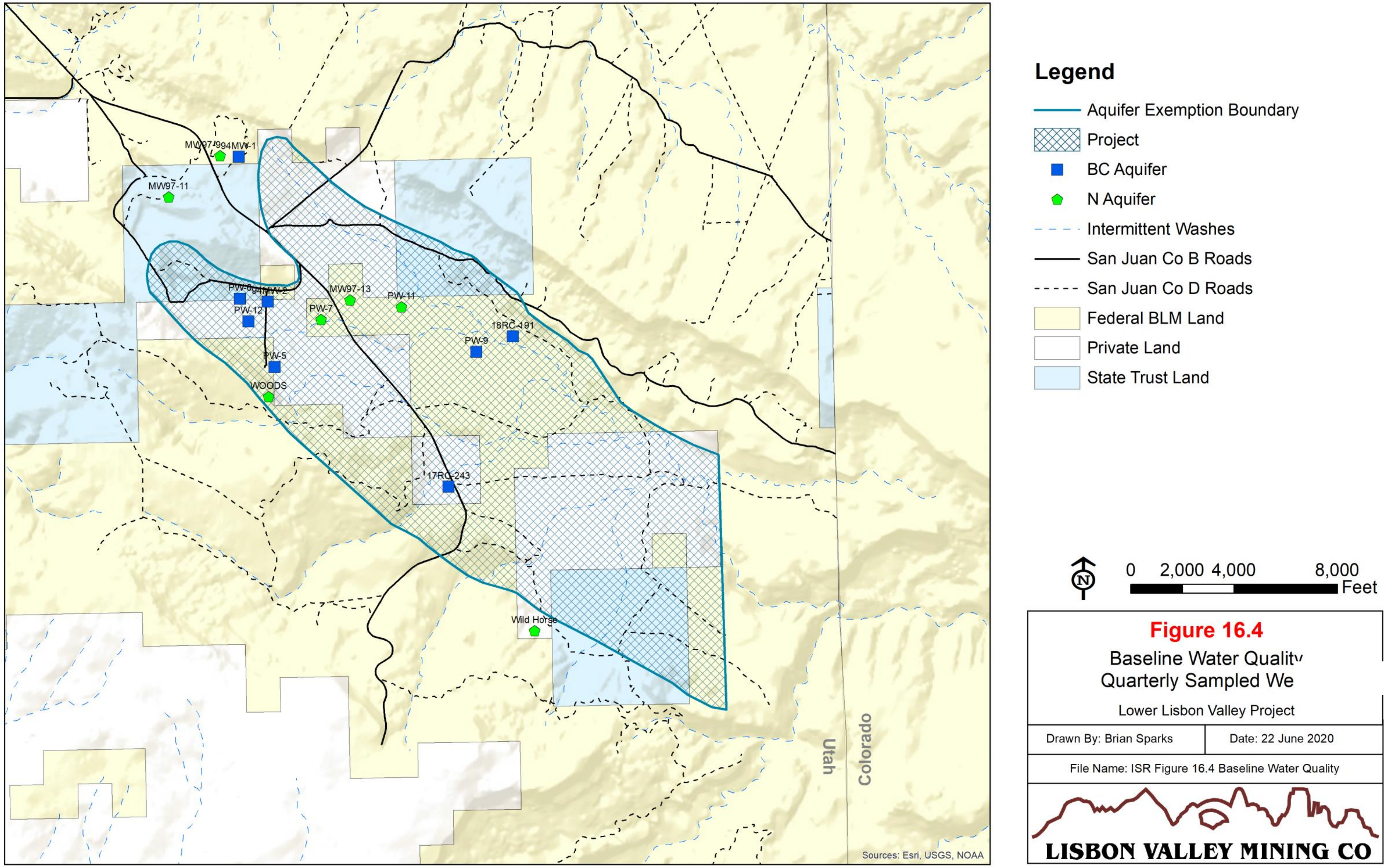
Section 14.3 describes the operational groundwater monitoring program that will be used to detect potential changes in groundwater quality in and around the Project Area as result of ISR operations. The operational groundwater monitoring program will include all POC monitoring wells located which are positioned vertically and horizontally from the ISR well fields.

16.9 Water Quality of the Requested Exempted Aquifer

This section describes the results of baseline water quality sampling in the BC aquifer. A summary of baseline water quality of BC as they occur within the Project Area is provided in Section 12 of this report. Additional baseline characterization of the requested exempted aquifer will occur as part of the development of the well field.

16.10 Groundwater Monitoring Network and Parameters

Baseline groundwater sampling was conducted quarterly in accordance with the Company's Groundwater Sampling Plan and pre-existing groundwater network as described in Section 12.2. This network is shown on Figure 16.2.



MW97-11
MW-1
PW-12
PW-7
MW97-13
PW-11
18RC-191
PW-9
PW-5
WOODS
17RC-243
Wild Horse
Utah
Colorado
Sources: Esri, USGS, NOAA
Legend
Aquifer Exemption Boundary
Project
BC Aquifer
N Aquifer
Intermittent Washes
San Juan Co B Roads
San Juan Co D Roads
Federal BLM Land
Private Land
State Trust Land
N
0 2,000 4,000 8,000
Feet
Figure 16.4
Baseline Water Qualit
Quarterly Sampled We
Lower Lisbon Valley Project
Drawn By: Brian Sparks
Date: 22 June 2020
File Name: ISR Figure 16.4 Baseline Water Quality
LISBON VALLEY MINING CO

16.11 Groundwater Quality Summary Statistics

The water quality in the BC Aquifer is characterized by moderate TDS (500 to 1,500mg/L), consistent major ion chemistry, and high radionuclide concentrations. Sulfate is the dominant cation. The BC aquifer is predominantly calcium sulfate water with a strong sulfate signature. The water quality in the N Aquifer is characterized by low TDS (200 to 500 mg/L) and consistent major ion chemistry, and often high radionuclide concentrations. The N aquifer water is predominantly sodium bicarbonate water.

16.12 Comparison with Drinking Water Standards

As stated in Section 12, and shown on Tables 12.3 and 12.4, the BC and N aquifers are geochemically distinct.

Table 16.1 below shows the comparison of the BC and N aquifers to the Utah Groundwater Quality Standards. The primary distinction between the BC and N aquifers is the level of TDS.

Table 16.1 Comparison of BC and N Aquifers with Utah Groundwater Quality Standards

Station Name Field Sample ID Lab Sample ID Sample Date	Units	Utah Groundwater Quality Standard (1)	BC Aquifer	N-Aquifer
Major Ions + Indicator Parameters				
Alkalinity (as $CaCO_3$)	mg/l	-----	105 - 163.2	185.4
Alkalinity, dissolved (as $CaCO_3$)	mg/l		125 - 1,517	179 - 430
Bicarbonate (as $CaCO_3$)	mg/l	-----	125 - 1,517.3	179 - 429.8
Carbonate (as $CaCO_3$)	mg/l	-----	<1.7 - 31	<1 - 19
Hydroxide (as $CaCO_3$)	mg/l	-----	<2 - <14.7	<1 - 5.9
Hardness (as $CaCO_3$)	mg/l	-----	109 - 748	64 - 556
Calcium, dissolved	mg/l	-----	16.2 - 184	16.7 - 141
Magnesium, dissolved	mg/l	-----	11.4 - 108	5.3-46.1
Potassium, dissolved	mg/l	-----	7.7 - 17	3.72-12.6
Sodium, dissolved	mg/l	-----	71.6 - 1,540	50.1 - 248
Chloride	mg/l	-----	9.3-81.9	4.9 - 310
Fluoride	mg/l	4.0	0.09-1.3	<0.1 - 1
Silica	mg/l	-----	1.5-24.8	8.3-25.9
Sulfate	mg/l	-----	131 - 2,800	6 - 533
Total Dissolved Solids	mg/l	10,000	542 - 5,340	260 - 1,440
Total Suspended Solids	mg/l	-----	<5 - 11,700	<5 - 6,280
pH, Lab	s.u.	6.5 - 8.5	6.3-8.8	6.4-8.5
E.C., Lab	µS/cm	-----	861 - 6,680	267 - 1,715
Nutrients				
Phosphorus, total as P	mg/l	0.05	<0.01 - 0.26	0.01-2.3
Nitrate as N, dissolved	mg/l	10.0	<0.02 - 1.59	0 - 0.5
Nitrite as N, dissolved	mg/l	1.0	0 - <0.05	0 - 0.094
Nitrate/Nitrite as N, dissolved	mg/l	10.0	<0.02 - 1.59	0 - 0.5
Nitrogen, ammonia	mg/l	-----	<0.05 - 8.85	<0.05 - 1.7
Metals				
Aluminum, dissolved	mg/l	-----	0.01-.98	<0.03 - 1.12
Antimony, dissolved	mg/l	0.006	0.0004	<0.0002 - <0.02
Arsenic, dissolved	mg/l	0.05	<0.0002 - <0.04	<0.0002 - 0.0476
Barium, dissolved	mg/l	2.0	0.005-0.715	0.031-1.29
Beryllium, dissolved	mg/l	0.004	<0.00005 - <0.01	<0.00005 - <0.005
Cadmium, dissolved	mg/l	0.005	<0.00005 - 0.0597	<0.00005 - <0.003
Chromium, dissolved	mg/l	0.1	<0.0001 - 0.014	0.0001-0.1055
Copper, dissolved	mg/l	1.3	<0.002 - <0.05	<0.01 - 0.04
Iron, dissolved	mg/l	-----	<0.01 - 39.3	0.01-15.7
Lead, dissolved	mg/l	0.015	<0.0001 - 0.069	<0.0001 - 0.0152
Manganese, dissolved	mg/l	-----	0.008-1.18	0.017-5.4
Mercury, dissolved	mg/l	0.002	<0.0002 - 0.0003	<0.0002 - 0.00079
Molybdenum, dissolved	mg/l	-----	<0.01 - 0.566	0.01-0.84
Nickel, dissolved	mg/l	-----	<0.008 - 0.109	<0.008 - 17.3
Selenium, dissolved	mg/l	0.05	<0.0001 - 0.027	0.0001-0.012
Silver, dissolved	mg/l	0.1	<0.00005 - 0.526	<0.00005 - <0.5
Strontium, dissolved	mg/l		2.39-4.48	1.62-5.75
Thallium, dissolved	mg/l	0.002	<0.00005 - 0.014	<0.00005 - 0.009
Uranium, total	mg/l	0.03	0.0002-0.293	0.0000846-0.138

Station Name Field Sample ID Lab Sample ID Sample Date	Units	Utah Groundwater Quality Standard [1]	BC Aquifer	N-Aquifer
Vanadium, dissolved	mg/l	-----	<0.002 - <0.04	<0.005 - 0.014
Zinc, dissolved	mg/l	5.0	0.01-1.7	<0.01 - 20.8
Radiological				
Gross Alpha, total	pCi/l	15	0.3 - 888	0.73 - 277
Gross Beta, total	pCi/l	8 [4]	9 - 678	2.5 - 310
Radium 226, total	pCi/l		0.91 - 14	0.2-5.3
Radium 228, total	pCi/l		0.7 - 6	0 - 13.2
Thorium 230, total	pCi/l		0.4-7.5	0.88 - 4
Thorium 232, total	pCi/l		0.2-1.8	1.2 - 1.75

16.13 Future Operations

With future exploration drilling, there is the potential of locating additional recoverable resources within the Project Area that are outside the currently requested AEB. A future amendment for a modified AEB might be requested by the Company if additional potential well field areas are delineated.

17.0 PART O - Expected Changes Due to Injection

Expected changes due to injection include changes in aquifer chemistry, head pressures, and local gradients. All changes are transient and will be restored after mining.

17.1 Chemistry Changes

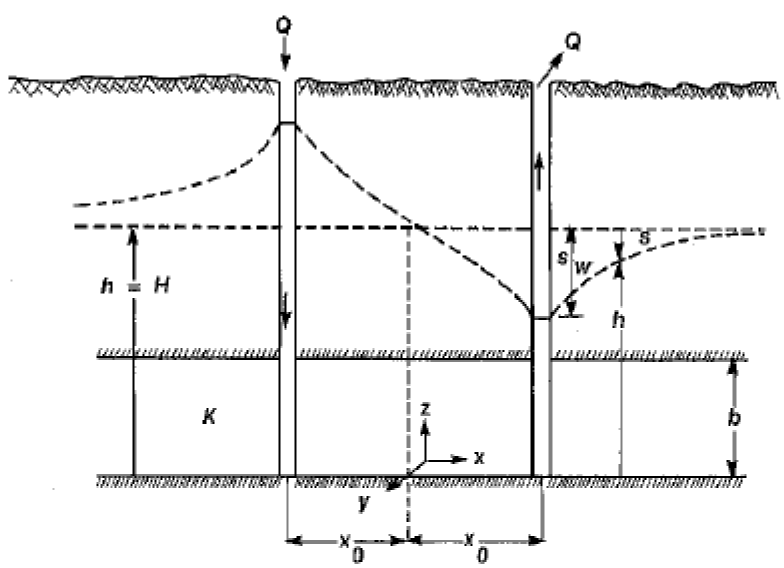
The LLV BC Aquifer chemistry and head levels will change during the ISR mining process. The anticipated groundwater chemistry within each wellfield is detailed in Section 6.3.

17.2 Head Changes

The head level changes will be the result of concurrent injection/extraction. A section is included below describing the dynamics of concurrent injection/extraction in the ISR wellfields.

17.2.1 Hydrology of ISR

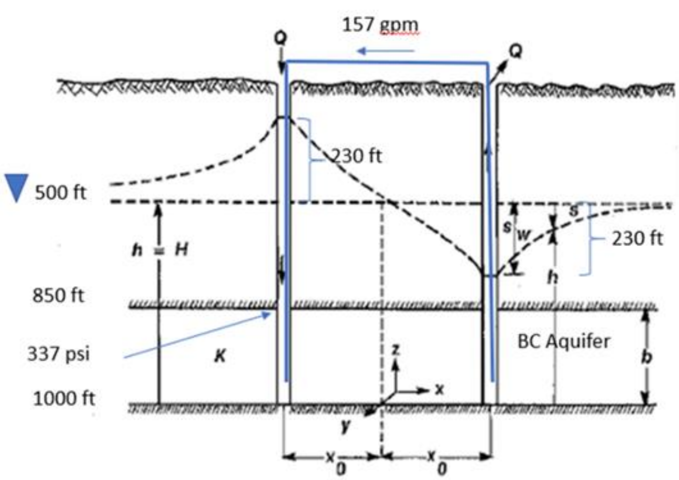
ISR operation involves injection and extraction wells operating in tandem which increases flow between wells as a function of increased pressure head. The inter-well pressure head between wells is a sum of injection pressure and drawdown pressure. Stated another way, the drawdown (Sw) is equal to the increase in head above the water table at the injection well. Sw between a single extraction and single injection well is shown below. The injection well can be pressured to heads above ground surface with a surface booster pump of sufficient pressure rating and capacity.



The GTO simulation is based on pump testing at PW-12, located near the deepest part of the GTO graben. Injection pressure w/o boost is simulated @ 337psi. This pressure can be boosted to 459 psi and stay 10% below 0.6 ft/ft frac gradient. The extended 5-Spot wellfield flow can be operated at flow rates greater than 50 gpm/well.

Depth Bed 15	hydrostatic ft	psi	frac psi	90% frac	delta
850	780	337.74	510	459	121.26

GTO Injection Pressure and Extended Wellfield Flow



The extended five spot flow equation expressed with the intrinsic permeability and SI units is:

$$Q = \frac{k_i \Delta P_{IP}}{\mu}\left[\frac{\pi b}{\ln(S_S/\sqrt{2}r_w) - 0.619}\right]. \quad (11.11)$$

Q=(k_iDP_IP/m)*[pb/(ln(S/(sqrt(2)r_w))-0.619)]

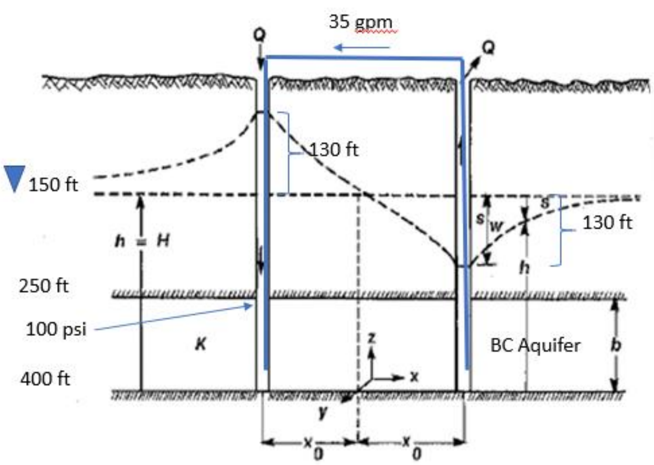
Q	gpm	**156.6877**
k_i	mD	400
DP_{IP}	psi	130.05
m	psi*s	1.45E-07
b	ft	150
S5	ft	150
S/sqrt(2)	ft	106.066
r_w	in	4

Bartlett R.W 2009 Solution Mining Leaching and Fluids Recovery of Materials Second Edition

The changes in head pressure at Lone Wolf is shown below and added to Section – of the report. The Lone Wolf simulation is based on pump testing at PW-9, a low permeability well located on the perimeter of the Lone Wolf depost. Injection pressure w/o boost is simulated @ 100 psi. This pressure can be boosted to 135 psi and stay 10% below 0.6 ft/ft frac gradient

Depth Bed 15	hydrostatic ft	psi	frac psi	90% frac	delta
250	230	99.59	150	135	35.41

Lone Wolf Pressure Injection Pressure and Extended Wellfield Flow



The extended five spot flow equation expressed with the intrinsic permeability and SI units is:

$$Q = \frac{k_i \Delta P_{IP}}{\mu}\left[\frac{\pi b}{\ln(S_5/\sqrt{2}r_w) - 0.619}\right]. \quad (11.11)$$

Q=(k$_i$DP$_{IP}$/m)*[pb/(ln(S/(sqrt(2)r$_w$))-0.619)]

Q	gpm	35.25472
k_i	mD	90
DP_{IP}	psi	130.05
m	psi*s	1.45E-07
b	ft	150
S5	ft	150
S/sqrt(2)	ft	106.066
r_w	in	4

Bartlett R.W 2009 Solution Mining Leaching and Fluids Recovery of Materials Second Edition

17.4 ISR Wellfield Design

Injection rates and extraction rates will be controlled during ISR operation to hydraulically capture all of the injected lixiviant and minimize excursion. The wellfield pattern, combined with flow rate controls, will capture the injected lixiviant by either operating more extraction wells than injection wells, or otherwise adjusting injection flow below extraction flow. This maintains an inwards hydraulic gradient for life of mining activities. Production monitoring wells, described in Section 12, ensure that head levels and chemistry changes are restricted to the wellfields for the life of the ISR mining process.

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