

# **Limon Sand & Gravel Resource**

## **Groundwater Monitoring Plan**

**December 2024**

By:

**Mid-State Materials, LLC**

Represented by:



**Lewicki & Associates**

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# Introduction

This groundwater quality monitoring plan will be implemented at the Limon Sand & Gravel Resource located in just southeast of Limon, CO. This plan outlines the methods that the mine operator, Mid-States Materials, LLC, will follow to protect and monitor the integrity of the local groundwater quality and quantity. This plan is intended to meet the requirements of the Division of Reclamation, Mining, and Safety (DRMS) Mineral Rules and Regulations Rule 3.1.7(7)(b) and the Colorado Department of Public Health & Environment (CDPHE) Regulation No. 41. The Limon Sand & Gravel site is not located on any classified areas regarding groundwater; therefore, the statewide regulations (CDPHE Regulation 41) will be followed.

This monitoring plan requires the collection of pre-operational groundwater data that will be used as the baseline data to compare to the results of continued long-term groundwater monitoring. At least five quarters of monitoring data will be collected prior to operations commencing onsite. Continued monitoring will take place during mining operations. Results of this monitoring will be used to evaluate if any adverse impacts on groundwater have taken place as a result of the Limon Sand & Gravel mining operations.

The mining operation will directly interact with groundwater as it infiltrates freely into the pit. Groundwater will be pumped out for mining to an approved CDPHE discharge point. The interaction of groundwater by mining is not anticipated to cause any adverse impacts to groundwater as the pit itself acts as a gravel filter keeping sediments and other pollution from entering the local groundwater aquifer. Based on these conditions, sampling of water chemistry at the Limon Sand & Gravel resource will be conducted on a quarterly basis.

# 1. Background Information

## 1.1. Site Description

The Limon Sand & Gravel site is located roughly 2 miles southeast of Limon in Lincoln County, Colorado. The site is located at 39.2352, -103.6406. The site is a total of 1,094.5 acres.

The Limon Sand & Gravel site is composed of upland and terrace areas divided by the Big Sandy Creek through the center. Surrounding the property is mostly undeveloped, agricultural, or oil and gas uses. The site is currently dry rangeland used by cattle for grazing, with some stock structures and wells present. The site is hilly with a gradient towards the Big Sandy Creek.

The site location is shown in the vicinity map in Figure 1 below.



**Figure 1 – Vicinity Map**

The geology of the site is composed of a sand and gravel alluvial deposit created by the Big Sandy Creek. The deposit is overlain by approximately 6 inches of topsoil and a varying thickness of overburden ranging from 10 feet towards the creek, and 35 feet on the terraces further from the creek. The deposit itself is composed of sand and gravel, and is approximately

10 feet thick. The bedrock below the alluvial deposit is shale at approximately 20-45 feet below the surface.

The aquifer present at the site is the Upper Big Sandy Groundwater Basin. This aquifer is approximately four feet below the surface. The alluvial aquifer is unconfined and is part of the greater Colorado River Basin. The aquifer is approximately 25 feet thick at the site. The hydraulic conductivity of the aquifer, based on pump tests in Rifle, CO, range from 55 to 275 feet/day<sup>1</sup>. The aquifer is recharged in various ponds and canals throughout the basin. Underlying the Colorado River aquifer is the Piceance bedrock aquifer which will not be interacted with as it is between 100-500 feet below the surface.

There is not enough groundwater level data near the site to develop a potentiometric surface. However, the location and flow of the Colorado River, as well as the topography of the site indicate that groundwater is moving west, or possibly northwest. There is conflicting data from local groundwater wells that suggests water is flowing to the southwest. Groundwater direction will be confirmed during baseline water quantity testing. After which, a potentiometric model will be developed.

A baseline map showing proposed wells and existing hydrologic conditions of the site is attached in Appendix 1.

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<sup>1</sup> *Groundwater Compliance Action Plan for the New Rifle, Colorado, Processing Site*, U.S. Department of Energy, 2016.



## 1.2. Baseline Groundwater Characterization

Water quality and quantity sampling will take place at four locations for five quarters prior to mining operations in order to establish the baseline groundwater characterization. Quality sampling will take place at the three groundwater wells (GW-1, GW-2, GW-3, and GW-4) to define the baseline water quality for the entire site. Compliance monitoring will be taken downstream during mining at GW-4 throughout the life of the mine.

Each sample point can be seen on the map in Appendix 1 and on Figure 2. Details on the sampling locations are provided in Table 1.

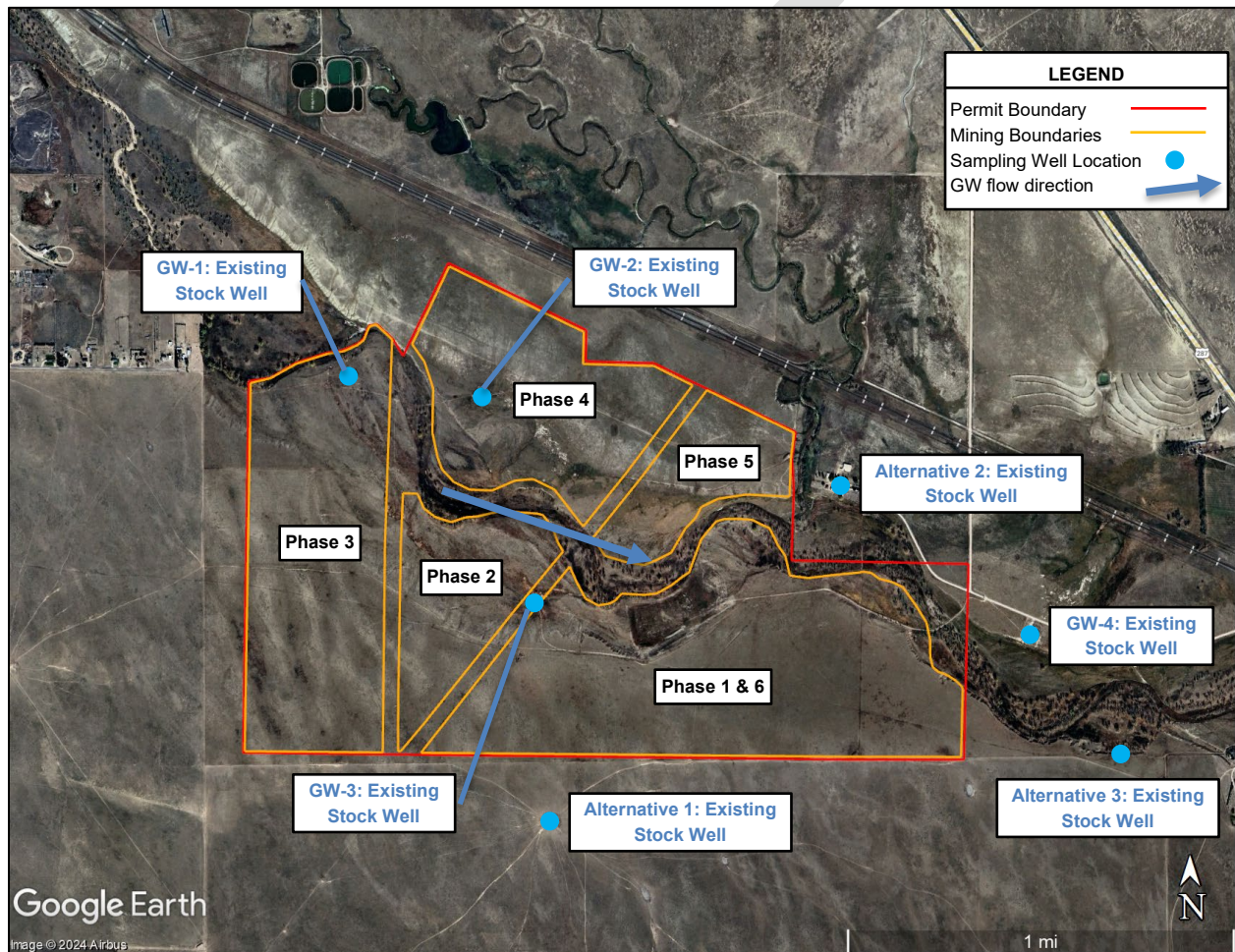


Figure 2 – Groundwater Sampling Locations

**Table 1 – Groundwater Sampling Location Data**

<b>ID</b>	<b>Location Description</b>	<b>Lat</b>	<b>Long</b>	<b>Surface Elev. (ft)</b>	<b>Top of Casing Elev. (ft)</b>	<b>Total Depth (ft)</b>	<b>Depth to Water (ft)</b>	<b>Completion Date</b>
<b>GW-1</b>	Northwestern edge of site – south of Big Sandy Creek	39.24324	-103.67186	5254'	TBD	30	10	7-19-95
<b>GW-2</b>	Northwestern portion of site – north of Big Sandy Creek	39.24314	-103.66117	5249'	TBD	33	12	12-22-61
<b>GW-3</b>	Center of site – south of Big Sandy Creek	39.23260	-103.66033	5241'	TBD	34	10	12-24-61
<b>GW-4</b>	East and downstream of site – slightly north of Big Sandy Creek	39.23373	-103.63815	5215'	TBD	60	8	3-17-15
<b>Alt-1</b>	South of site	39.22769	-103.66087	5256'	TBD	67	28	4-8-64
<b>Alt-2</b>	Northeast of site	39.24024	-103.64440	5231'	TBD	40	20	7-1-65
<b>Alt-3</b>	Southeast and downstream of site – slightly south of Big Sandy Creek	39.22939	-103.63415	5231'	TBD	38	16	10-18-66

### 1.2.1. Monitoring Well Installation

All wells being used for monitoring were constructed by a licensed contractor following the State Engineer's Office (SEO) guidelines. Construction information and lithology for each well are provided in Appendix 3 under the associated CDWR permit documents. Other characteristics of the wells are provided in Table 1 above. Table 2 below lists the permit CDWR permit numbers for each of these wells.

**Table 2 – CDWR Well Permits**

ID	CDWR Permit No.	Use
GW-1	187207-	Stock
GW-2	62846-	Stock
GW-3	62847-	Stock
GW-4	296990-	Stock
Alternative-1	19131-	Stock
Alternative-2	62844-	Stock
Alternative-3	29107-	Stock

### 1.2.2. Baseline Groundwater Quantity

The baseline water level will be quantified with at least 15 months (once a month for five quarters) of static water level measurements at all sampling locations. It will be taken monthly at wells GW-1, GW-2, GW-3, GW-4, Alt-1, Alt-2, and Alt-3 for baseline characterization. The water level will be measured using depth measuring equipment such as a sounder from the top of the well casing, using the sampling methods outlined later in this plan. Data will be recorded in table and graph format in Appendix 1. This data will be analyzed to show the water level against time in graph format. A potentiometric groundwater model will be developed from this quantity data to ensure that POC monitoring is in the correct location to characterize downstream water qualities.

Quantity sampling will continue following the start of mining on a monthly basis. Results will be reported to the DRMS in table and graph format with the annual report.

### 1.2.3. Baseline Groundwater Quality

The baseline water quality will be quantified with at least five quarters of water quality sampling at the four sampling locations. Field and laboratory samples will be taken quarterly at groundwater wells GW-1, GW-2, GW-3, and GW-4. Quality sampling will meet Regulation 41 standards and parameters using the sampling methods described in this plan. Data will be recorded in a table and reported in Appendix 1.



## 2. Predicted Impacts to Hydrologic Balance

Predicted impacts to the hydrologic balance are not anticipated to occur at the Limon Sand & Gravel site. Groundwater will be able to flow freely through the pit so quantity should not be affected. The other potential impact could be to the groundwater quality, however, this is unlikely as the pit acts as a gravel filter preventing pollution from travelling in the aquifer. Additionally, all discharges from the pit will be permitted and sampled for quality.

The sampling and monitoring methods in this plan will work to identify any impacts to the hydrologic balance once mining starts. Also, outlined in this plan are actions to take in the case that adverse impacts to the groundwater are encountered.

## 3. Groundwater Monitoring Plan

This groundwater monitoring plan will be enacted at the Limon Sand and Gravel site to identify and quantify any potential impacts of mining to the local groundwater aquifer.

### 3.1. Groundwater Points of Compliance

The point of compliance (POC) at the Limon Sand & Gravel site will be used to monitor quality and quantity of groundwater during mining operations to ensure compliance with Regulation 41. This point of compliance will be downstream of mining. GW-4 and Alternative Well-3 are both potential POC's, one of which will be used for POC monitoring during mining operations. The POC will be chosen after baseline water level testing confirms which direction groundwater is flowing, following a technical revision. The POC will be whichever point is downstream of a southwest (GW-2) or southeast (GW-3) groundwater direction.

Monitoring will begin quarterly at the designated POC for the first 12 months after mining begins. If monitoring shows no adverse effects of mining at the POC, monitoring frequency may be decreased through a technical revision (TR) with the DRMS. With the division's approval, sampling frequency will be decreased to twice a year (every 6 months), or to a schedule recommended by the DRMS. Results of the quality and quantity sampling at the POC will be provided to the DRMS with the annual report. If adverse effects are identified, the DRMS will be notified immediately and the operator will start a water quality mitigation plan to be approved by the DRMS.

## 4. Sampling Methods

This section identifies the sampling methods that will be used to quantify the groundwater conditions at the Limon Sand & Gravel site.

### 4.1. Sampling Location

The sampling locations, including frequency and sampling type, are detailed in the table below.

**Table 3 – Sampling Type and Frequency**

Baseline Sampling (5 Quarters Total)			POC Sampling (Life of Mine)	
ID	Quantity Sampling Frequency	Quality Sampling Frequency	Quantity Sampling Frequency	Quality Sampling Frequency*
GW-1	Monthly	Quarterly	TBD**	None**
GW-2	Monthly	Quarterly	Monthly	None
GW-3	Monthly	Quarterly	Monthly	None
GW-4	Monthly	Quarterly	Monthly	Quarterly*
Alt-1	Monthly	TBD	TBD	None
Alt-2	Monthly	TBD	TBD	None
Alt-3	Monthly	TBD	TBD	None

\*Quarterly sampling will take place at the POC after the first 12 months of mining. After 12 months, it may be decreased through a TR with the DRMS.

\*\*GW-1 can be left in place during mining for POC sampling if sampling at this well is deemed necessary.

### 4.2. Sampling Frequency

Baseline groundwater sampling will begin at least five quarters in advance of mining at the Limon Sand & Gravel Resource. One sample per quarter will be taken at each of the groundwater sampling locations to define the baseline conditions of groundwater (GW-1, GW-2, GW-3, and GW-4).

Point of compliance sampling will begin after mining has started. It will start out as quarterly sampling for the initial 12 months after the beginning of mining. If adverse impacts have not been encountered after five quarters of sampling, the frequency may be decreased with approval from the DRMS.

### 4.3. Sampling Parameters

The operator or qualified person will perform field and laboratory analysis of their samples for the water quality parameters identified in Table 4. These parameters are consistent with those required by the DRMS for Construction Material Sites, derived from Regulation 41 Tables 1-4. All laboratory analysis of the groundwater samples will be performed by a State of Colorado certified laboratory that follows industry standards and quality assurance/quality control (QA/QC) procedures.

**Table 4 – Water Quality Parameters**

Analyte		Table Value Standard (mg/L unless stated otherwise)	Reg.41 Table Reference (1-4)
1	pH (Field)	6.5-8.5 units	2 & 3
2	TDS	400, or 1.25 x Background	4
3	Chloride - Dissolved	250	2
4	Fluoride - Dissolved	2	3
5	Nitrate (NO <sub>3</sub> )	10	1
6	Nitrite (NO <sub>2</sub> )	1.0	1
7	Nitrite + Nitrate as Nitrogen	10	1
8	Sulfate - Dissolved	250	2
9	Aluminum - Dissolved	5	3
10	Antimony - Dissolved	0.006	1
11	Arsenic - Dissolved	0.01	1
12	Barium - Dissolved	2	1
13	Beryllium - Dissolved	0.004	1
14	Boron - Dissolved	0.75	3
15	Cadmium - Dissolved	0.005	1
16	Chromium - Dissolved	0.1	1 & 3
17	Cobalt - Dissolved	0.05	3
18	Copper - Dissolved	0.2	3
19	Iron - Dissolved	0.3	2
20	Lead - Dissolved	0.05	1
21	Lithium - Dissolved	2.5	3
22	Manganese - Dissolved	0.05	2
23	Mercury - Dissolved	0.002	1
24	Molybdenum - Dissolved	0.21	1
25	Nickel - Dissolved	0.1	1
26	Selenium - Dissolved	0.02	3
27	Silver - Dissolved	0.05	1
28	Thallium - Dissolved	0.002	1
29	Uranium - Dissolved	0.0168-0.03	1
30	Vanadium - Dissolved	0.1	3
31	Zinc - Dissolved	2	3

#### 4.4. Sampling Procedure

The following protocol will be used for the collection and testing of water samples by field personnel. This procedure was developed using the *SESCPROC-301-R3: Groundwater Sampling Operating Procedure* published by the United States Environmental Protection Agency (EPA).

##### General Precautions

- 1) Proper safety precautions must be observed when collecting groundwater sampling. This procedure should be enacted in tandem with the judgement of a competent and experienced professional. Proper Personal Protective Equipment (PPE) should be worn depending on the conditions of the site and materials/chemicals being handled. Potential hazards of the site should be identified prior to sampling, particularly when sampling is occurring on an active mine site. All chemicals will be provided with Material Safety Data Sheets.

##### Prior to Sampling

- 1) **Laboratory Selection & Bottle Procurement:** Specific bottles will be ordered from an appropriate and certified analytical laboratory which will be used for collecting water samples. The bottles are retrieved from the lab cleaned and preconditioned. The bottles will either already be prepared with the preservative(s), or the preservatives will be provided from the laboratory.
- 2) **Decontamination:** Field sampling equipment will be cleaned and calibrated prior to sampling. This is important to get accurate data and prevent contamination of samples. The calibration of the equipment will be performed as described in the equipment manual. Decontamination of equipment will be achieved in accordance with the *SESDPROC-205 Field Equipment Cleaning and Decontamination* procedure published by the EPA. The procedures for the equipment to be used are as follows:
  - a. **Well Sounder or Tape:**
    - i. Wash with Liquinox or other appropriate equipment detergent and tap water.
    - ii. Rinse with tap water.
    - iii. Rinse with deionized water.
  - b. **Pump and Wetted Portion of Tubing or Hose:**
    - i. Disconnect power and wash exterior of pump and hose with Liquinox or other appropriate equipment detergent and tap water.
    - ii. Rinse with tap water.
    - iii. Rinse with deionized water.
    - iv. Keep clean between uses.

## Sampling

- 1) **Depth Measurement:** The static water level of the groundwater well will be measured and recorded using a water level well sounder prior to pumping of the well. The measurement location at the top edge of the well casing will be marked with a permanent ink pen. This mark will be touched up with fresh ink each time a sample is taken.
- 2) **Purging the well:** The contents of the well will be purged prior to sample collection using a low-flow, submersible pump. This pump will be cleaned prior to being placed in the well. Sampling will not occur until conditions of the water have stabilized AND at least three well volumes have been removed from the well. If the required volume has been purged, and the water appears to not be stabilized, then additional purging must occur until stabilization. Stabilization of the groundwater can be determined based on the following:
  - a. Water is running clear with little to no sediment for a prolonged period of time.
  - b. Field measurements, such as those listed below, have stabilized.
- 3) **Field Measurements:** Water will be collected in a clean and empty container for various field measurements. Between sampling locations, the container must be cleaned or rinsed thoroughly, preferably with water from the source to be sampled next. The following field measurements will be taken with cleaned and calibrated meters. Field measurements will be reported in a manner that is consistent with industry standards for field sampling logbooks. An example of the logbook to be used is shown in Appendix 4.
  - a. pH
  - b. Temperature
  - c. Dissolved Oxygen
  - d. Conductivity
- 4) **Collecting Samples:** Water will be pumped from the well into a clean pitcher or bottle which will be used to fill the bottles from the laboratory. The bottles will be marked with the date, time, and site location of the sample as well as the person who collected the sample. If a pump controller system is used, the sample bottles may be filled directly from the well. Samples will be preserved and shipped in accordance with the method requirements. Filled sample bottles will then be placed in a cooler with ice for transport to the lab.
- 5) **Contamination Prevention:** Special care must be exercised to prevent contamination of samples. Samples must be stored in a secure location to prevent alteration of the sample properties. The chain of custody procedure must be followed. Sampling shall occur from the least contaminated, to the most contaminated location.
- 6) **Chain of Custody:** A chain of custody will be completed for the sample which indicates what analyses need to be performed, the date and time of sampling, sample identification, and who assembled the sample. The samples will be delivered to the lab the day of collection. Samples shall be custody sealed during shipment or long term storage. Samples must remain in the custody of the sampler sample custodian until the samples are relinquished to the laboratory.



#### 4.5. Analytical Procedures

The results from the analytical water quality testing will be evaluated through comparison with the State groundwater quality standards. The Limon Sand & Gravel Resource is not within any WQCC specified areas that would require conformance with anything other than statewide water quality standards. Baseline groundwater data can be found in Appendix 2.

#### 4.6. Site-Specific Numeric Protection Levels

Baseline water quality data gathering may show ambient levels of a regulated parameter at a level higher than that specified in Regulation 41. In such a case, the operator will propose a Site-Specific Numeric Protection Level through a TR. Site-Specific Numeric Protection Levels at the Limon Sand & Gravel site will be proposed after the five quarters of baseline sampling. They will be determined by the results of baseline water quality data. The Site-Specific Numeric Protection Levels will be based on the two-sigma (95-percentile) statistical value for the parameter sampled.

#### 4.7. State Water Quality Standards

The analytical results of water quality testing during mining will be compared to the regulatory limits established by Water Quality Control Commission (WQCC) and those otherwise defined by the DRMS. The groundwater of the Limon Sand & Gravel site is subject to the statewide groundwater quality standards as defined in Tables 1-4 of the WQCC Regulation 41. The site is not within any specified areas identified by the WQCC to have specific groundwater quality standards. If any exceedance of applicable water quality standards is detected during mining at the mine, the DRMS will be notified in accordance with Rule 3.1.7(9) and the operator will initiate a water quality mitigation plan as proposed by the DRMS.

If any exceedances of the WQCC Regulation 41 basic groundwater standards are encountered, the operator will implement the following reporting and mitigation procedures:

- Notify the DRMS of the exceedance within five (5) working days of receiving the analytical report from the laboratory.
- Implement DRMS proposed corrective actions, as defined in a subsequent TR, such as the following:
- Identify the potential cause or source of the exceedance.
- Implement supplemental water quality sampling. Sampling and testing of the groundwater well will be increased until the parameter(s) drop below the allowable limit. Only parameter(s) that were in exceedance will be measured as part of this supplemental sampling.
- Consult with the Garfield County Department of Environmental Health on appropriate mitigation methods of the exceedance.

- Provide a report to Garfield County staff and the DRMS with details of the exceedance, mitigation measures, and results.

#### 4.8. Reporting

Baseline water quality and quantity data for the initial five quarters will be reported to the CDRMS prior to operations. Reporting of POC data will be included with the mine's annual report. Data reporting will be in table format and graph format when necessary.

#### 4.9. Sampling Quality Assurance Project Plan (QAPP)

The operator's quality assurance methods for water sampling includes only using Colorado State certified laboratories with an industry standard Quality Assurance/Quality Control plan in place. On-site quality assurance for field sampling is included in the Sampling Procedure described in Section 1.4. Certain steps of the procedure such as clearing three well volumes before sampling and using cleaned and calibrated testing equipment help to ensure that the testing results are accurate and free of altering contaminants. Any samples that are collected will include information on who took the sample, when it was taken, sample identification, and the chain of custody. A sample data collection sheet from previous baseline monitoring at the site is provided in Appendix 5.

## Appendix 1 - Map

## Appendix 2 - Baseline Groundwater Quality Data

Will be provided once complete.

## Appendix 3 – CDWR Permits

Documents provided in the following order:

<u>ID</u>	<u>CDWR Permit No.</u>
GW-1	TBD
GW-2	TBD
GW-3	TBD



## Appendix 4 – Industry Standard Field Sampling Sheet

## Appendix 5 – Chain of Custody Sample