Plan revision number: 5
Plan revision date: 07/15/2025

QUALITY ASSURANCE AND SURVEILLANCE PLAN

Brown Pelican CO_2 Sequestration Project

TITLE AND APPROVAL SHEET

The Quality Assurance and Surveillance Plan (QASP) is approved for use and implementation at the Brown Pelican CO_2 Sequestration Project (BRP Project or Project) including wells BRP CCS1, BRP CCS2, BRP CCS3. The signatures below denote the approval of this document and intent to abide by the procedures outline within it.

[redacted]

DISTRIBUTION LIST

The following Project participants will receive the completed QASP and all future updates for the duration of their involvement in the Project.

[redacted]

1.0 Project Management

1.1 Project

Characterization of the Injection Zone, Upper Confining System, Upper Confining Zone, and Lower Confining Zone was conducted by experienced geoscience and engineering professionals using industry-recognized software and techniques. Characteristics of the AoR were confirmed during construction of the BRP CCS1, BRP CCS2, and BRP CCS3 wells. Further characterization will be conducted using operation data after commencement of CO_2 injection at the BRP Project.

Pipeline, surface equipment, and well designs comply with industry standards for CO_2 material selection and operating conditions to promote mechanical integrity of the system during the life of the Project.

Monitoring programs for leak detection, corrosion, and surveillance have been tailored for the Project to ensure protection of Underground Sources of Drinking Water (USDWs) and the environment, to maintain mechanical integrity during operations, and to maximize the storage life of the asset. These plans incorporate best practices and recommendations for Carbon Capture and Storage projects worldwide as well as decades of experience by Occidental Petroleum (Oxy), parent company of Oxy Low Carbon Ventures (OLCV), in the development and operation of CO_2 Enhanced Oil Recovery (EOR) fields.

As part of the quality control process during testing and surveillance, most of the samples collected and the data gathered will be analyzed, processed, validated, or witnessed by third parties independent of the operations staff. For specialized data such as seismic acquisition, seismicity monitoring, and distributed temperature sensing (DTS), the Project will have additional support from the providers of the selected technologies in quality control, verification of the data, and system calibration.

Sensors, transducers, and controllers will be connected to a central platform to allow for monitoring of operating conditions, system upset alarming, and safety protocol initiation. System data interfaces will be created and integrated in a unique surveillance platform. The operating parameters, monitoring values, laboratory results, and surveillance documents for the Project will be stored in a central database to provide support for Area of Review (AoR) reviews, monitoring, quality assurance programs, and reporting.

1.1 Project Organization

The BRP Project includes participation of multidisciplinary teams from Oxy, OLCV, consultants, and subcontractors. Together, the BRP Project team will provide technical and operational expertise to ensure a safe, successful, and efficient project.

The Project will establish key staffing positions that will ensure a reliable operation with the highest standards of quality, surveillance procedures, storage evaluation, and reporting. Some of the staff will be dedicated full time to the operation, while others will be assigned as needed during AoR reviews, maintenance activities, and other Project activities.

Once the Project is in operation, OLCV can provide a detailed contact list with the names of the individuals in each position.

1.1.1 Key Individuals and Responsibilities

A brief description of key management and supervision roles and responsibilities is below:

- **Project Manager:** The Project Manager is responsible for Project coordination and implementation, including obtaining required permits, ensuring compliance with reporting requirements and meeting Project technical objectives.
- **Production Engineer:** The Production Engineer is responsible for designing and executing subsurface operations related to well mechanical integrity, performance, and monitoring. The Production Engineer supervises the activities of the Surface Lead and the Well Performance Analyst and coordinates activities with other departments, such as facilities engineering. The Production Engineer is responsible for verifying that surveillance is being performed appropriately and results are properly communicated, ensuring personnel comply with the safety policies, and is the point of contact in the event that Emergency Response and Remedial Plan is activated.
- **Surface Lead:** The Surface Lead is responsible for ensuring operating procedures are followed and any deviation from set parameters is corrected. The Surface Lead role is field-based, and this person is responsible for coordinating on-site maintenance and monitoring activities.
- **Well Analyst:** The Well Analyst is responsible for conducting digital surveillance to monitor alarms and troubleshoot any deviations from normal operation. The Well Analyst

will be in close communication with the Surface Lead, Production Engineer, and operations team at Stratos Direct Air Capture Facility (Stratos) to ensure mechanical integrity and safe operation of wells and surface facilities.

Additional to the key administrative positions identified in the above section, the BRP Project will be fully supported by Oxy technical staff and/or contractors. Below are examples of technical roles:

- **Geologist:** The role of the Geologist is to characterize the subsurface storage complex, to create and update the geologic model by integrating offset regional information, site-specific log and core data, and seismic and other geophysical data.
- **Petrophysicist:** The role of the Petrophysicist is to analyze the available logs and generate porosity and permeability models to be used in the geologic model of the area.
- **Geochemist:** The role of the Geochemist is to evaluate fluid and gas data obtained from wells and integrate the information with the geologic, petrophysical and reservoir engineering information to characterize fluid and gas compositional changes in the subsurface.
- **Geophysicist:** The role of the Geophysicist is to evaluate seismic and other geophysical data to help define and monitor the subsurface storage complex.
- **Drilling, Completions and Production Engineers:** The role of the Drilling Engineer is to develop cost estimates, design the wellbores and execute drilling programs. The Completions Engineer develops a cost estimate for dynamic testing, completes and tests the well. Production engineers develop monitoring plans for wellbore mechanical integrity, optimal well operation, and plugging plans.
- **Reservoir Engineer:** The role of the Reservoir Engineer is to simulate fluid flow in the Injection Zone using the geologic model, designate the AoR, and optimize well placement and number of wells.
- **Facilities Engineer:** The role of the Facilities Engineer is to ensure quality assurance and monitor compliance with Project requirements.

- **Well Automation Technician:** The Automation Technician is responsible for maintaining the instrumentation and control system at the wellhead, and the communications to the system used for remote surveillance and operation.
- **Measurement Technician:** The measurement technician is responsible for maintaining and periodic verification of performance of the flow measurement devices at the site.
- **Subject Matter Experts/Task Leads:** Subject Matter Experts (SMEs) and Task Leads include both internal (Oxy) and external (subcontractors) personnel such as geologists, hydrologists, chemists, atmospheric scientists, ecologists, and others. These SMEs help develop testing and monitoring plans, collect environmental data specified in those plans using best practices, and maintain and update those plans as needed.

1.1.2 Independence from Project QA and Data Gathering

The majority of physical samples and data gathered as part of the monitoring program will be analyzed, processed, or witnessed by third parties independent and outside of the Project management structure.

1.1.3 QASP Responsibility

OLCV will be responsible for maintaining and distributing official, approved QASPs. OLCV will periodically review the QASP and consult with the Environmental Protection Agency Underground Injection Control (EPA UIC) Program Director if changes are recommended.

1.2 Problem Definition and Background

1.2.1 Reasons for Initiating the Project

The purpose of the BRP Project is to safely and securely inject and store CO_2 derived from the Stratos Direct Air Capture (Stratos) facility. The purpose of this document is to support the Testing and Monitoring Plan for the BRP CCS1, BRP CCS2, and BRP CCS3 wells.

1.2.2 Background Information

OLCV will test and monitor the BRP Project site using both direct and indirect methods. The purpose of testing and monitoring is to promote safe CO_2 injection, determine the response of the Injection Zone, and evaluate the movement of the pressure front and CO_2 plume with the ultimate goal of demonstrating non-endangerment of USDWs.

1.2.3 Regulatory Information

Class VI well regulations in 40 CFR §146 Subpart H require owners or operators of Class VI wells to demonstrate that injection wells maintain mechanical integrity, that fluid migration and the extent of the pressure elevation are within the limits described in the permit application, and that

USDWs are not endangered. To demonstrate integrity of the wellbore, the operator will conduct continuous monitoring of pressure and temperature, and mechanical integrity tests (MITs). To demonstrate the extent of the CO_2 plume and pressure front, OLCV will obtain pressure, temperature and fluid samples in monitoring wells and geophysical data of the injection site. In addition, shallow groundwater and soil gas will also be monitored for changes that could indicate movement of CO_2 from the Injection Zone. Well data, geophysical data, and surface data, along with safe operating practices, will ensure non-endangerment of USDWs.

1.3 Project / Task Description

1.3.1 Summary of Work to be Performed

OLCV has performed a characterization of the site prior to injection operations to confirm that the site can safely accommodate the volume of anticipated CO_2 injection and ensure non-endangerment of USDWs. The site will be monitored before injection operations to characterize natural background variability, and during and after injection to confirm operational parameters and describe CO_2 plume and pressure movement. The AoR and determination of site closure will be routinely updated based on testing and monitoring data, along with computational modelling results. Table 1 below summarizes the testing and monitoring plans. Table 2 describes the planned frequency of monitoring activities. Table 3 lists the geographic locations of wells used for monitoring.

Table 1--Summary of monitoring and testing plans

Objective	Method	Location	Analytical Technique	Lab / Custody
CO_2 injectate stream analysis	On-line gas analyzers and chromatograph; and physical sampling for laboratory analyses	Analyzers and sample ports are located on the pipeline transporting CO_2 from Stratos to BRP Project	Chemical and isotopic analysis	Third-party contractor (e.g., Pantech)
Continuous recording of operational parameters in UIC Class VI injection wells: injection rate, volume, pressure, and temperature	P/T at surface and downhole; DTS fiber, and injection line flowmeter	P/T gauges at surface and downhole in UIC Class VI injectors, and flowmeter on the flowlines directly upstream of UIC Class VI injector wellheads	Direct measurement	P/T gauges, DTS, and flowmeter will be monitored by Well Analyst and interpreted by Production Engineer
Corrosion monitoring in UIC Class VI injection wells, brine withdrawal wells and in SLR monitoring wells;	Corrosion coupons, surface sensors surface visual inspection including OGI; DTS fiber, downhole P/T	Corrosion coupons, surface sensors, and visual inspection including OGI at wellhead and flowlines; Downhole and surface P/T in	Physical analysis, observation, and direct measurement	Retrieval and analysis of coupons will be carried out by third-party certified lab; surface inspections and OGI will be conducted by

Objective	Method	Location	Analytical Technique	Lab / Custody
and surface leak detection	gauges, and surface P/T gauges	UIC Class VI injectors and SLR2 and SLR3 (expected); Downhole P/T and surface P in WW; Surface P at SLR1 and ACZ1; DTS in UIC Class VI injectors, SLR2 and SLR1		Surface Lead, gauges and DTS will be monitored by Well Analyst and interpreted by Production Engineer
Internal mechanical integrity	Downhole and surface P/T gauges and/or DTS	Downhole and surface P/T in UIC Class VI injectors and SLR2 and SLR3 (expected); Downhole P/T and surface P in WW; Surface P at SLR1 and ACZ1; DTS in UIC Class VI injectors, SLR2 and SLR1	Direct measurement	P/T gauges and DTS will be monitored by Well Analyst and interpreted by Production Engineer
External mechanical integrity testing	Downhole and surface P/T gauges and/or DTS, and MIT	Downhole and surface P/T in UIC Class VI injectors and SLR2 and SLR3 (expected); Downhole P/T and surface P in WW; Surface P at SLR1 and ACZ1; DTS in UIC Class VI injectors, SLR2 and SLR1; MIT in all wells penetrating Injection or Confining Zones	Direct measurement, log analysis	P/T gauges and DTS will be monitored by Well Analyst and interpreted by Production Engineer; logs will be analyzed by Cement and Casing SMEs
Near well-bore formation properties testing (Pressure fall-off testing)	Pressure fall-off test	UIC Class VI wells	Direct measurement and interpretation of results	Results will be interpreted by Reservoir Engineer and Production Engineer
Injection Zone pressure, temperature, and geochemistry	P/T gauges and/or DTS; saturation logging, and fluid and dissolved gas sampling	Downhole and surface P/T in UIC Class VI injectors and SLR2 and SLR3 (expected); Downhole P/T and surface P in WW; Surface P at SLR1 and ACZ1; DTS in	Direct measurement of P/T; saturation logging; chemical and isotopic analysis of fluids and dissolved gases	Gauges and DTS will be monitored by Well Analyst and interpreted by Production Engineer; third-party contractor will conduct fluid and dissolved gas

Objective	Method	Location	Analytical Technique	Lab / Custody
		UIC Class VI injectors, SLR2 and SLR1; fluid and dissolved gas sampling in WW and SLR (and SLR3, expected); saturation logging in SLR wells and ACZ1		sampling and send samples to certified lab for analyses
Geochemistry of lowermost USDW coincident with the first permeable zone above the Confining Zone (Dockum group)	Fluid and dissolved gas sampling and analysis	Dockum fluids and gases produced with a downhole pump at the USDW1 well	Chemical and isotopic analysis of groundwater and dissolved gases	Third-party contractor will conduct fluid and dissolved gas sampling and send samples to certified lab for analyses
Soil and soil gas analysis (vadose zone; near surface)	Isotopic analysis and chemical evaluation	20 discreet soil gas monitoring stations within and adjacent to the AoR	Chemical and isotopic analyses of soil gas and soils	Third-party contractor will conduct fluid and dissolved gas sampling and send samples to certified lab for analyses
CO_2 plume and pressure movement within the Injection Zone	P/T gauges and/or DTS, and event-driven* fluid sampling	Downhole and surface P/T in SLR2 and SLR3 (expected); Downhole P/T and surface P in WW; Surface P at SLR1 and ACZ1; DTS SLR2 and SLR1; sampling of fluids and dissolved gases at WW and SLR2 (and expected at SLR3)	Direct measurement of P/T; chemical and isotopic analysis of fluids and dissolved gases	Third-party contractor will conduct fluid and dissolved gas sampling and send samples to certified lab for analyses
Indirect geophysical monitoring of plume and pressure	2D VSP utilizing DAS or wireline conveyed geophones; 2D surface seismic; saturation logging; DInSAR	VSP and surface seismic at UIC Class VI injectors and SLR2; saturation logging at SLR wells and ACZ1, DInSAR/GPS at AoR	Field-based seismic acquisition and GPS recording; satellite-based DInSAR; wellbore logging	Third-party acquisition and processing of seismic, DInSAR data and logging operator; interpretation by Geologist, Geophysicist and Petrophysicist
Presence or absence of seismicity	Seismometers	Regional and site-specific seismometer network	Field-based data digitally transmitted to third party contractor and Geophysicist	Data processing, monitoring, and interpretation by Geophysicist and

Objective	Method	Location	Analytical Technique	Lab / Custody
				third-party contractor

Notes:

- *OLCV will monitor pressure and temperature data obtained from downhole gauges and/or DTS fiber daily, and also routinely evaluate long-term data trends to detect deviations from the reference temperature or pressure gradient. If persistent deviations in temperature or pressure are detected, OLCV will obtain reservoir fluid samples and analyze fluid and dissolved gas chemistry to determine the presence or absence of increased CO_2. In addition, fluid and dissolved gas chemistry data from the lowermost USDW and soil gas chemistry from shallow soils will be monitored for trends to detect deviations from reference chemistry. If persistent and/or abrupt anomalies in chemistry are detected additional fluid or soil gas samples will be obtained to confirm the presence or absence of increased CO_2.
- DTS/DAS fiber installed in SLR1, SLR2, BRP CCS1, BRP CCS2, and BRP CCS3
- Pressure and Temperature (P/T) downhole gauges installed in BRP CCS1, BRP CCS2, BRP CCS3, WW1, WW2, WW3, WW4, and SLR2
- Pressure and Temperature (P/T) surface gauges installed at BRP CCS1, BRP CCS2, BRP CCS3, and SLR2
- Pressure (P) surface gauges installed at SLR1, ACZ1, WW1, WW2, WW3, and WW4
- Acronyms:
    - DInSAR = Differential Interferometric Synthetic Aperture Radar
    - DAS = Distributed Acoustic Sensing
    - DTS = Distributed Temperature Sensing
    - GPS = Global Positioning System
    - MIT = Mechanical Integrity Test
    - OGI= Optical Gas Imaging
    - PISC = Post-Injection Site Care period
    - P/T = Pressure and Temperature
    - UIC = Underground Injection Control
    - USDW = Underground Source of Drinking Water
    - VSP = Vertical Seismic Profile

Table 2—Summary of testing and monitoring frequency

Objective	Method	Pre-injection	During injection	Post-injection
CO_2 injectate stream analysis	On-line gas analyzers and physical sampling for laboratory analyses	Chemical and isotopic characterization prior to injection	Continuous monitoring of selected components using gas analyzers; quarterly sampling for full compositional analyses; and isotopic analysis if capture process materially changes source stream; and event-driven[1]	N/A
Continuous recording of operational parameters in UIC Class VI injection wells: injection rate, volume, pressure, and temperature	P/T at surface and downhole; DTS fiber, and injection line flowmeter	Measurement and recording prior to injection	Continuous measurement and recording	N/A

Objective	Method	Pre-injection	During injection	Post-injection
Corrosion monitoring in UIC Class VI injection wells, brine withdrawal wells and in SLR monitoring wells; and surface leak detection	Corrosion coupons, surface sensors, surface visual inspection including OGI; DTS fiber, downhole P/T gauges, and surface P/T gauges	Inspection prior to injection	Quarterly coupon testing, weekly visual inspection, quarterly OGI inspection; continuous surface sensors; and continuous monitoring using P/T gauges and DTS	Continuous surface monitoring and quarterly visual inspection until site closure
Internal mechanical integrity	Downhole and surface P/T gauges and/or DTS; and annular pressure test	Measurement prior to injection	Continuous measurement and recording of P/T and annular pressure test after well interventions	N/A
External mechanical integrity testing	Downhole and surface P/T gauges and/or DTS, and MIT	Measurement prior to injection	Continuous measurement and recording of P/T; and annual MIT	N/A
Near well-bore formation properties testing (Pressure fall-off testing) in UIC Class VI wells	Pressure fall-off test	Measurement prior to injection	Once during every five-year period until plugging	N/A
Injection Zone pressure, temperature, and geochemistry	P/T gauges and/or DTS; saturation logging, and fluid and dissolved gas sampling	Characterization prior to injection, including quarterly fluid and dissolved gas sampling for approximately one year in WW wells; cased hole saturation logging WW wells and SLR2 (and SLR3, expected); Downhole and surface P/T in UIC Class VI injectors and SLR2 and SLR3 (expected); Downhole P/T and surface P in WW; DTS in UIC Class VI injectors, SLR2 and SLR1	Continuous measurement and recording of P/T gauges; annual saturation profile in SLR2 (and in SLR3 once constructed); saturation profile in WW once every five-year period; event-driven* fluid sampling, triggered by changes in P/T	Continuous measurement and recording of P/T for the first 10 years pending an approved PISC plan, then annually until plugging; saturation profile annually; event-driven* fluid and dissolved gas sampling, triggered by P/T data
Geochemistry of lowermost USDW coincident with the first permeable zone above the Confining Zone (Dockum group)	Fluid and dissolved gas sampling and analysis	Characterization prior to injection, including quarterly fluid and dissolved gas sampling for	Quarterly fluid and dissolved gas sampling in years 1-3 and annually starting in year 4; and, event-driven*, triggered by	Annual fluid and dissolved gas sampling for first 10 years post injection pending an approved PISC plan;

Objective	Method	Pre-injection	During injection	Post-injection
		approximately one year	P/T data in SLR2 or SLR3 wells	then event-driven* fluid and dissolved gas sampling, triggered by P/T data in SLR2 or SLR3 wells thereafter
Soil and soil gas analysis (vadose zone; near surface)	Isotopic analysis and chemical evaluation	One soil sampling and analysis event; soil gas sampling and analysis prior to injection, including quarterly sampling for approximately one year prior to commencement of injection	Quarterly soil gas sampling in years 1-3, then annually starting in year 4 for subset of stations, and event-driven*, triggered by P/T data in SLR2, SLR3 or USDW1 monitor wells and fluid sample results	Event-driven*, triggered by P/T data in SLR2, SLR3 or USDW1 monitor wells and fluids sample results
Containment of CO_2 in Injection Zone	P/T gauges and/or DTS; saturation logging, and event-driven* fluid and dissolved gas sampling	Characterization prior to injection, including quarterly sampling and analysis for approximately one year in WW wells; saturation logging in the Upper Confining Zone in SLR1 and ACZ1; Downhole and surface P/T in UIC Class VI injectors and SLR2 and SLR3 (expected); Downhole P/T and surface P in WW; DTS in UIC Class VI injectors, SLR2 and SLR1	Continuous measurement and recording of P/T (SLR1 and WWs); event-driven* fluid sampling in WWs; saturation logging once every five-year period in SLR1 and ACZ1 wells	P/T or DTS: continuously for the first 10 years pending an approved PISC plan in SLR1 well or until plugging; Saturation logging will be event-driven* in the SLR1 or ACZ1
Non-endangerment of shallow groundwater and soil	Geochemical and isotopic monitoring to detect deviations from expected groundwater and soil gas chemistry	Characterization prior to injection: quarterly	Groundwater and soil gas sampling: Quarterly analysis in years 1-3, then annually after that; and, event-driven*, triggered by P/T data in SLR wells	Event-driven*
CO_2 plume and pressure movement within the Injection Zone	P/T gauges and/or DTS; and event-driven* fluid sampling	P/T measurements and fluid sampling prior to injection in the SLR2 and WW wells	Continuous P/T measurement in SLR2 and SLR3 (once constructed) wells; event-driven*	P/T recording bimonthly for the first five years post-injection, then annually until well

Objective	Method	Pre-injection	During injection	Post-injection
			fluid sampling in SLR or WW wells	is plugged or plume stabilizes in SLR2 or SLR3 wells
Indirect geophysical monitoring of plume and pressure	2D VSP utilizing DAS or wireline conveyed geophones; 2D surface seismic; saturation logging; DInSAR and GPS	2D VSP and 2D surface acquisition prior to injection in UIC Class VI injectors and SLR2; baseline saturation logging; baseline DInSAR and GPS acquisition	Annual saturation logging in SLR2 and SLR3 (once constructed) wells; 2D VSP after 1, 2, 5 and 10 years; 2D surface seismic at year 10 and approximately every five years thereafter; Quarterly DInSAR and GPS	Annual saturation logging in SLR2 and SLR3 wells; surface 2D VSP once every approximately five-year period until plugging; 2D surface seismic once every approximately five years until plume stabilization Annual DInSAR and GPS for first five years post-injection
Presence or absence of seismicity	Seismometers	Prior to injection	Continuous monitoring and recording	Continuous monitoring and recording until site closure

Notes:

[1] Event-driven sampling of CO_2 injectate stream will be triggered if there are changes in the DAC process that may arise from facility upgrades or after facility shut-in periods.

*OLCV will monitor pressure and temperature data obtained from downhole and surface gauges and downhole temperature from DTS fiber daily, and routinely evaluate long-term data trends to detect deviations from the reference temperature or pressure gradient. If persistent deviations in temperature or pressure are detected, OLCV will obtain reservoir fluid samples and analyze fluid and dissolved gas chemistry to determine the presence or absence of increased CO_2. In addition, fluid and dissolved gas chemistry data from the lowermost USDW and soil gas chemistry from shallow soils will be monitored for trends to detect deviations from reference chemistry. If persistent and/or abrupt anomalies in chemistry are detected additional fluid or soil gas samples will be obtained to confirm the presence or absence of increased CO_2.

- DTS/DAS fiber installed in SLR1, SLR2, BRP CCS1, BRP CCS2, and BRP CCS3
- Pressure and Temperature (P/T) downhole gauges installed in BRP CCS1, BRP CCS2, BRP CCS3, WW1, WW2, WW3, WW4, and SLR2
- Pressure and Temperature (P/T) surface gauges installed at BRP CCS1, BRP CCS2, BRP CCS3, and SLR2
- Pressure (P) surface gauges installed at SLR1, ACZ1, WW1, WW2, WW3, and WW4
- Acronyms:
    - DInSAR = Differential Interferometric Synthetic Aperture Radar
    - DAS = Distributed Acoustic Sensing
    - DTS = Distributed Temperature Sensing
    - GPS = Global Positioning System
    - MIT = Mechanical Integrity Test
    - OGI= Optical Gas Imaging
    - PISC = Post-Injection Site Care period
    - P/T = Pressure and Temperature
    - UIC = Underground Injection Control
    - USDW = Underground Source of Drinking Water
    - VSP = Vertical Seismic Profile

Table 3—List of Project wells.

API or State well number	Project Well Name	Regulatory Well Name	Purpose	Drill Date	Anticipated Plug Date	Latitude (NAD 27)	Longitude (NAD 27)
4213544040	BRP CCS1	Shoe Bar Ranch 1CS	CO_2 injector	2024	End of Injection Period	31.76481926	-102.72891895
4213544041	BRP CCS2	Shoe Bar Ranch 2CS	CO_2 injector	2024	End of Injection Period	31.76994887	-102.73320589
4213544062	BRP CCS3	Shoe Bar Ranch 3CS	CO_2 injector	2024	End of Injection Period	31.76024766	-102.71013484
4213544065	SLR2	Shoe Bar Ranch 2SL	Injection Zone monitor	2025	~20 years post Injection Period	31.74657954	-102.72586378
4213543920	SLR1 or Shoe Bar 1	Shoe Bar Ranch 1	Stratigraphic test, Confining Zone monitor	2023	2025[1] and ~10 years post Injection Period	31.76343592	-102.70349808
4213543977	ACZ1 or Shoe Bar 1AZ	Shoe Bar Ranch 1AZ	Stratigraphic test, Confining Zone monitor	2023	2025[1] and ~10 years post Injection Period	31.76448867	-102.73053251
657173	USDW1	ShoeBar Monitor Well #1	USDW monitor	2024	~20 years post Injection Period	31.76411900	-102.7316750
4213544035	WW1	Shoe Bar Ranch 1WW	Brine withdrawal, Injection Zone monitor	2024	End of Injection Period	31.76289537	-102.69592320
4213544036	WW2	Shoe Bar Ranch 2WW	Brine withdrawal, Injection Zone monitor	2024	After ~seven years of injection[2] End of Injection Period	31.78419970	-102.72758691
4213544037	WW3	Shoe Bar Ranch 3WW	Brine withdrawal, Injection Zone monitor	2024	End of Injection Period	31.75008559	-102.71022070
4213544034	WW4	Shoe Bar Ranch 4WW	Brine withdrawal, Injection Zone monitor	2024	End of Injection Period	31.76384466	-102.75395043
NA	SLR3	Shoe Bar Ranch 3SL	Injection Zone monitor	~2030; ~5 years after commencement of CO_2 injection	~10 years post Injection Period	31.78023685	-102.7418093

[1] Conversion from stratigraphic test well to monitor well

[2] Plugging of Holt

1.3.2 Anticipated Evolution of Project Tasks

The methodology and frequency of testing and monitoring methods is expected to change throughout the life of the Project. Pre-injection monitoring and testing will focus on establishing baselines and ensuring that the site is ready to receive injected CO_2. Injection period monitoring will be focused on collecting data that will be used to calibrate models and ensure containment of CO_2. Post-injection period monitoring and testing is designed to demonstrate CO_2 plume stabilization and ensure containment. The testing and monitoring plan will be reviewed at least once every five years and will be amended, if necessary, to ensure monitoring and storage performance is achieved and new technologies are appropriately incorporated.

Data obtained from the Testing and Monitoring Plan will be used to inform operational decisions on the quantity and rate of CO_2 injected and potential containment actions. Data will be used to improve computational model forecasts. Data that is interpreted to be inconsistent with model predictions will trigger additional testing, monitoring and evaluation.

1.4 Quality Objectives and Criteria for Measurement Data

1.4.1 Measurement and Performance Criteria

The overall objective of quality assurance for monitoring is to develop and implement procedures to provide results that meet and/or exceed the requirements for the Class VI permit.

The key testing and monitoring components of the BRP Project that involve analysis of physical samples are:

- CO_2 injectate stream, Table 4a and 4b
- Material corrosion, Table 5
- Fluid and dissolved gas in the Injection Zone during well construction, Table 6a
- Fluid and dissolved gas in the Injection Zone following construction, Tables 6b and 6c
- Fluid and dissolved gas in the USDW (also the first permeable zone above the Confining Zone), after well construction, Tables 6d and 6e
- Soil and soil gas, Table 7

Other data measurement sources listed below do not involve analysis of physical samples. The specifications of these tools are found in Section 1.4.7 of this document:

- Gauge measurements, Tables, 9a-9h
- On-line gas analyzers, Table 10
- DTS and DAS measurements, Table 11a and 11b
- Log measurements, Tables 12a-12c
- Seismometers, Table 13
- Vertical Seismic Profiles (VSP), Table 14
- DInSAR and GPS data, Table 15
- Surface monitoring optical cameras and surface sensors, Table 16a and 16b

The following tables provide details on analytical and field parameters and the actionable testing and monitoring outputs.

Table 4a--Summary of analytical parameters for CO_2 injectate stream at surface for laboratory analyses

Parameters	Analytical Methods[1]	Detection Limit / Range[2]	Typical Precision[2]	QC Requirements
CO_2 content	GPA 2177-20[3]	>95 mol%	GPA 2177-20	GPA 2177-20
Water	GPA 2177-20	<30 lbm/MMscf	GPA 2177-20	GPA 2177-20
Nitrogen	GPA 2177-20	<4 mol%	GPA 2177-20	GPA 2177-20
Sulphur	GPA 2177-20	<35 ppm by weight	GPA 2177-20	GPA 2177-20
Oxygen	GPA 2177-20	<5 mol%	GPA 2177-20	GPA 2177-20
Glycol	GPA 2177-20	<0.3 gal/MMscf	GPA 2177-20	GPA 2177-20
Carbon Monoxide	GPA 2177-20	<4,250 ppm by weight	GPA 2177-20	GPA 2177-20
NOx	GPA 2177-20	<6 ppm by weight	GPA 2177-20	GPA 2177-20
SOx	GPA 2177-20	<1 ppm by weight	GPA 2177-20	GPA 2177-20
Particulates ($CaCO_3$)	GPA 2177-20	<1 ppm by weight	GPA 2177-20	GPA 2177-20
Argon	GPA 2177-20	<1 mol%	GPA 2177-20	GPA 2177-20
Surface pressure	GPA 2177-20	>1,600 psig	GPA 2177-20	GPA 2177-20
Surface temperature	GPA 2177-20	>65°F and <120°F	GPA 2177-20	GPA 2177-20
Isotopes	Isotope ratio mass spectrometry and accelerator mass spectrometry	$\delta^{13}C$ and ^{14}C of CO_2	±0.15 – 0.03‰	10% duplicates, 4 samples per batch

[1] An equivalent method may be employed with the prior approval of the UIC Program Director.

[2] Detection limits and precision (laboratory control limits) are typical for these analytical methods.

[3] GPA Midstream Standard licensed to OLCV.

Table 4b--Summary of analytical parameters for CO_2 injectate stream at surface in on-line analyzers

Parameters	Analytical Methods[1]	Detection Limit / Range[2]	Typical Precision[2]	QC Requirements
CO_2 content	On-line chromatograph	>95 mol%	±0.25% of reading	Daily calibration runs automatically QC performance reviewed monthly
Water	Aluminum oxide sensor	<30 lbm/MMscf	±1% full scale	Clean and calibrate per schedule recommended by manufacturer
Oxygen	Galvanic fuel cell	<5 mol%	±1% of range	Calibrate per schedule recommended by manufacturer

Table 5--Summary of analytical parameters for corrosion coupons

Parameters	Analytical Methods[1]	Detection Limit / Range[2]	Typical Precision[2]	QC Requirements

Mass	NACE SP0775-2018-SC	0.05 mg	2%	N/A
Thickness	NACE SP0775-2018-SC	0.01 mm	± 0.05 mm	N/A

[1] An equivalent method may be employed with the prior approval of the UIC Program Director.

[2] Detection limits and precision (laboratory control limits) are typical for these analytical methods.

Table 6a--Summary of analytical parameters for fluid and dissolved gas samples in the Injection Zone (Lower San Andres) during well construction.

Parameters	Analytical Methods	Detection Limit / Range	Typical Precision	QC Requirements
Total and Dissolved Metals: Al, Ba, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sr, T V, and Zn	ICP - Section 1.28-2	0.00004 to 0.003 mg/L	±20	Daily calibration, Initial QC checks, method blank, lab control samples, sample duplicate
Total and Dissolved Metals Add-Ons: Ag, As, Sb, Se, Th, Ti, Tl, U	EPA SW6010B	0.00004 to 0.003 mg/L	±20	Daily calibration, Initial QC checks, method blank, lab control samples,
Total and Dissolved Metals: B, Ca, Fe, K, Mg, Li, Na, Si, Sr,	ICP - Section 1.28-2	0.003 to 0.254 mg/L	±20	Daily calibration, Initial QC checks, method blank, lab control samples
Hg	USEPA Method 245.1	19.6 ng/L	±20	Calibration as needed, daily QC checks; ICV, ICB, RL, method blank, lab control samples, matrix spike and matrix spike dup; CCV/CCB every 10 samples or part thereof
Total Inorganic Carbon (TIC);	Standard Method 5310B	0.198 to 0.290 mg/L	±20	Calibration as needed, daily QC checks; method blank, lab control samples
Total Organic Carbon (TOC)	SM-2320 B	0.01-2,000 mg/L	±1 mg/L	Matrix spikes
Dissolved CO_2	ASTM D 513-82	8 mg/L	±20	Frequent calibration, method blank, lab control samples
Alkalinity: Total, Bicarbonate, Carbonate, and Hydroxide	Standard Method 2320B	8 mg/L	±20	method blank, lab control samples
Major Anions: Br, Cl, F, and SO_4, NO_2 and NO_3 as N	IC – Section 1.27-2 Chlorides Determination – Section 1.22-3	0.003 to 0.563 mg/L	±20	Calibration as needed, daily QC checks; method blank, lab control samples,
PO_4 as P	IC – Section 1.27-2	0.0215 mg/L	±20	Daily calibration, Initial QC checks method blank, lab control samples
Dissolved H_2S (Sulfide)	Standard Method 4500S2-D	0.026 mg/L	±20	Calibration as needed, daily QC checks; method blank, lab control samples

Total Dissolved Solids (TDS)	USEPA Method 160.1	10 mg/L	±20	Method blank, lab control samples, and sample duplicate
Conductivity	ASTM D 1125	0 to 200 mS/cm	±1%	Calibration as needed, daily QC checks
pH and Temperature	ASTM D 1293	0.1 to 14 pH units	±0.1 pH units	Daily calibration
Specific Gravity	ASTM D 1429 / ASTM D 1480	NA	To the nearest thousandths decimal	Duplicates
Cation Anion Balance	Calculation	NA	±10	Calculation
$^{228}Ra/^{226}Ra$	USEPA Method 903 / 904	50 pCi/L (RL)	± 25%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.

Table 6b--Summary of analytical parameters for fluid and dissolved gas samples in the Injection Zone (Lower San Andres) after construction of the WW1, WW2, WW3, and WW4

Laboratory Analyte	Analytical Methods[1]	Detection Limit / Range[2]	Typical Precision[2]	QC Requirements
Total and Dissolved Metals: Ag, Al, As, Ba, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Sr, Th, Tl, U, V, and Zn	USEPA Method 200.8	0.00004 to 0.003 mg/L	±20	Daily calibration, Initial QC checks (ICV, ICB, RL) method blank, lab control samples, matrix spikes and sample duplicate, CCV/CCB every 10 samples or part thereof
Total and Dissolved Metals: B, Ca, Fe, K, Mg, Li, Na, Si, Sr, Ti	USEPA Method 200.7	0.003 to 0.254 mg/L	±20	Daily calibration, Initial QC checks (IPC, ICV, ICB, RL) method blank, lab control samples, matrix spike and matrix spike dup; CCV/CCB every 10 samples or part thereof
Total and Dissolved Hg	USEPA Method 245.7	19.6 ng/L	±20	Calibration as needed, daily QC checks; ICV, ICB, RL, method blank, lab control samples, matrix spike and matrix spike dup; CCV/CCB every 10 samples or part thereof
Dissolved Inorganic Carbon (DIC); Dissolved Organic Carbon (DOC)	Standard Method 5310C	0.198 to 0.290 mg/L	±20	Calibration as needed, daily QC checks; ICV, ICB, RL, method blank, lab control samples, matrix spike and matrix spike dup; CCV/CCB every 10 samples or part thereof
Dissolved CO_2	Standard Method 4500 CO_2 D	8 mg/L	±20	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.

Alkalinity: Total, Bicarbonate, Carbonate, and Hydroxide	Standard Method 2320B	8 mg/L	±20	Method blank, lab control samples, matrix spikes
Major Anions: Br, Cl, F, SO_4, NO_2, NO_3 as N, and PO_4 as P	USEPA Method 300.0	0.003 to 0.563 mg/L	±20	Calibration as needed, daily QC checks; ICV, ICB, RL, method blank, lab control samples, matrix spike and matrix spike dup; CCV/CCB every 10 samples or part thereof
Total and Dissolved P	USEPA Method 365.1	0.0215 mg/L	±20	Daily calibration, Initial QC checks (ICV, ICB, RL) method blank, lab control samples, matrix spikes and sample duplicate, CCV/CCB every 10 samples or part thereof
Dissolved H_2S (Sulfide)	Standard Method 4500S2-D	0.026 mg/L	±20	Calibration as needed, daily QC checks; ICV, ICB, RL, method blank, lab control samples, matrix spike and matrix spike dup
Total Dissolved Solids (TDS)	USEPA Method 160.1	10 mg/L	±20	Method blank, lab control samples, and sample duplicate
Conductivity	Standard Method 2510B	0 to 200 mS/cm	±1%	Calibration as needed, daily QC checks (1413, 14130 and second source SRM), CCV every 10 samples or part thereof
pH and Temperature	USEPA Method 150.1	0.1 to 14 pH units	±0.1 pH units	Daily calibration, second source SRM, CCV's every 10 samples or part thereof
Specific Gravity	ASTM Method D1429-03	NA	To the nearest thousandths decimal	Duplicates
Cation Anion Balance	Calculation	NA	±10	Calculation
Organics: Benzene, Toluene, Ethylbenzene, and Xylenes	USEPA Method 8260	0.001 to 0.003 mg/L	±20	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Dissolved Gas Abundances: CO_2, CO, N_2, Ar, He, H_2, O_2, C1-C6+	In-house Lab SOP, similar to RSK-175	1 to 100 ppm, varies by component	C1-C4: ± 5%; C5-C6+: ± 10%	20% of all analyses are check/reference standards.
Dissolved Gas Isotopes: $\delta^{13}C$ of C1-C5 and CO_2, $\delta^{2}H$ of C1	High precision (offline) analysis via Dual Inlet IRMS	Varies by component	$\delta^{13}C$: 0.1 per mil; $\delta^{2}H$: 3.5 per mil	20% of all analyses are check/reference standards.
^{14}C of C1	AMS - subcontracted to Beta Analytic	0.44 pMC	± 1 to 2 pMC	Daily monitoring of instrumentation and chemical purity in additional to extensive computer and human cross-checks.

^{14}C of DIC	AMS - subcontracted to Beta Analytic	Depends on available sample volume	± 1 to 2 pMC	Daily monitoring of instrumentation and chemical purity in additional to extensive computer and human cross-checks.
$\delta^{13}C$ of DIC	Gas Bench/CF-IRMS	Depends on available sample volume, minimum of 50mg/L required	0.20 per mil	20% of all analyses are either check/reference standards or duplicate analyses.
$\delta^{18}O$ and $\delta^{2}H$ of H_2O	Analyzed via CRDS	N/A	$\delta^{18}O$: 0.10 per mil; $\delta^{2}H$: 2.0 per mil	20% of all analyses are either check/reference standards or duplicate analyses.
$^{87}Sr/^{86}Sr$	TIMS - subcontracted to the University of AZ	Approximately 40 ppm	± 0.00002	SRM 987 Sr standard within the long-term precision (external precision) of +/- 0.00002 accepted value of 0.71025
$^{228}Ra/^{226}Ra$	USEPA Method 901.1	50 pCi/L (RL)	± 25%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Field Parameters				
pH (Field)	Standard Method2 4500-H+ B-2000	2 to 12 pH units	±0.2 pH units	User calibration per manufacturer recommendation
Specific conductance (Field)	EPA Method 120.1	0 to 200 mS/cm	±1%	User calibration per manufacturer recommendation
Temperature (Field)	Standard Method 2550 B-2000	-5 to 50 ºC	±0.2 ºC	Factory calibration
Oxidation-Reduction Potential (Field)	Standard Method 2580	-1999 to +1999 mV	±20 mV	User calibration per manufacturer recommendation
Dissolved Oxygen (Field)	ASTM Method D888-09 (C)	0 to 50 mg/L	0 to 20 mg/L: ±0.1 mg/L or 1% of reading, whichever is greater; 20 – 50 mg/L: ±8% of reading	User calibration per manufacturer recommendation
Turbidity (Field)	USEPA Method 180.1	0 to 1000 NTU	± 1% of reading or 0.01 NTU, whichever is greater	User calibration per manufacturer recommendation

[1] An equivalent method may be employed with the prior approval of the UIC Program Director.

[2] Detection limits and precision (laboratory control limits) are typical for these analytical methods.

*Analytical parameters to be included during the pre-injection phase, and only as needed during the injection and post-injection phases of the Project.

Table 6c. Summary of analytical parameters for fluid and dissolved gas samples in the Injection Zone (Lower San Andres) following construction for SLR2 and SLR3.

Parameters	Analytical Methods[1]	Detection Limit / Range[2]	Typical Precision[2]	QC Requirements
Cations/metals: Al, Ba, Cd, Ca, Cr, Co, Cu, Fe, Fe, Fe, Pb, Li, Mg, Mn, Hg, Mo, Ni, P, K, Si, Na, Sr, V, and Zn	ICP, Fe^{3+} is calculated	<0.002 to <5.96 mg/L (each component has a different detection limit)	±20 %	Daily calibration, Initial QC checks, method blank, lab control samples, sample duplicate
Cation/metal: As	EPA Method 200.7	<0.01 mg/L	±20 %	Daily calibration, Initial QC checks, method blank, lab control samples
Cation/metal: Hg	USEPA Method 245.1	<0.0002 mg/L	±20 %	Calibration as needed, daily QC checks method blank, lab control samples
Anion: Borate	ICP	<0.004	±20 %	Calibration as needed, daily QC checks; method blank, lab control samples
Anions: Br, Cl, and I	Titration / IC	<1.0 mg/l	±20 %	Calibration as needed, daily QC checks; method blank, lab control samples
Anions: F, NO_2, NO_3, PO_4, and SO_4	IC	<1.0 mg/l	±20 %	Calibration as needed, daily QC checks; method blank, lab control samples,
Anion: S	Methylene Blue	<0.1 mg/l	±0.75 mg/L	Calibration as needed, daily QC checks; method blank, lab control samples
Alkalinity: total bicarbonate and carbonate	Titration	<1.0 mg/l	±20 %	Daily calibration, Initial QC checks, method blank, lab control samples
Total Dissolved Solids (TDS)	EPA Method 160.1 or equivalent	10 mg/L	±20 %	Method blank, lab control samples, and sample duplicate
Organic Acids: Acetate, Butyrate Formate, Glycolate, Propionate, Valerate	IC	<1.0 mg/l	±20 %	Calibration as needed, daily QC checks; method blank, lab control samples
Total Organic Carbon	SM 5310B	<1.0 mg/L	±20 %	Calibration as needed, daily QC checks; method blank, lab control samples
Cation Anion Balance	Calculated	N/A	N/A	N/A
Gas-Water Ratio	Calculated	N/A	N/A	N/A
Water density / Specific Gravity (lab)	ASTM D 5002[3]	See Method	See Method	See Method
Salinity (from Conductivity)	Calculated	N/A	N/A	N/A
pH (lab)	SM-4500H+	0.1 to 14 pH units	±20 %	Daily calibration
Dissolved Gas Abundances: N_2, CO_2, H_2S, C1, C2, C3, iC4, nC4, iC5, nC5, C6, C7, C8, C9, C10, C11, C12, C13,	Modified GPA 2286[4]	See Method	See Method	Calibration as needed, daily QC checks; method blank, lab control samples

C14, C15, C16, C17, C18, C19, C20+				
Field Parameters				
Water density (field)	N/A	N/A	N/A	N/A
pH (field)	SM-4500H+	0-14	±0.02 pH unit	Daily calibration
Specific conductance (field)	SM-2510	100 uS/cm-10 mS/cm	±0.5%	Daily calibration
Temperature (field)	SM-2550B	-35 - +120°F	±0.20°F	Verified against ISO Certified and Calibrated thermometer
Turbidity (field)	SM-2130 B	0-1000 NTU	±2%	Daily calibration
Oxidation-Reduction potential (field)	SM-2580	-300 - +300 mV	±10 mV	Daily calibration
Dissolved oxygen (field)	ASTM D 888-87	0.1-12ppm	±0.01 ppm	Environmental/temperature controls

[1] An equivalent method may be employed with the prior approval of the UIC Program Director.

[2] Detection limits and precision (laboratory control limits) are typical for these analytical methods.

[3] See reference for ASTM Standard D 5002 – 99 (2005)

[4] See reference for GPA 2286-95

* Analytical parameters to be included during the pre-injection phase, and only as needed during the injection and post-injection phases of the Project.

Table 6d--Summary of analytical parameters for fluid and dissolved gas samples during March 2024 in the first permeable zone above the confining zone / lowermost USDW (Dockum Group).

Laboratory Analyte (Eurofins for water geochemical analyses)	**Analytical Methods[1]**	**Detection Limit / Range[2]**	**Typical Precision[2]**	**QC Requirements**
Total Metals/Metalloids: Ca, Fe, Li, Mg, P, K, and Na	EPA Method 6010D	Detection limits range from 0.005 - 0.5 mg/L	± 20%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Dissolved Metals/Metalloids: Ca, Fe, Li, Mg, P, K, and Na	EPA Method 6010D	Detection limits range from 0.005 - 0.5 mg/L	± 20%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Total Metals/Metalloids: Al, As, Ba, B, Cd, Co, Cu, Cr, Pb, Mn, Ni, Sb, Se, Si, Sr, Th, Tl, U, V, and Z	EPA Method 6020B	Detection limits range from 0.001 - 0.5 mg/L	± 20%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Dissolved Metals/Metalloids: Al, As, Ba, B, Cd, Co, Cu, Cr, Pb, Mn, Ni, Sb, Se, Sr, Th, Tl, U, V, and Z	EPA Method 6020B	0.001 mg/L	± 20%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Total Metals/Metalloids: Hg	EPA Method 7470A	0.0002 mg/L	± 20%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.

Dissolved Metals/Metalloids: Hg	EPA Method 7470A	0.0002 mg/L	± 20%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Anions: Br, Cl, F, NO_2, NO_3 and SO_4	EPA Method 300.0	Detection limits range from 0.1 - 0.5 mg/L	± 10% ± 20% (NO_3)	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Anions: PO_4^{3-}	EPA Method 365.1	0.0613 mg/L	N/A	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Organics: Benzene, Toluene, Ethylbenzene, and Xylenes	USEPA Method 8260	0.001 to 0.003 mg/L	±20	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Cation-Anion balance	SM 1030E	N/A	N/A	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Conductivity/Specific Conductance	SM 2510B	10 umhos/cm @ 25C	N/A	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Total, Bicarbonate, and Carbonate	SM 2320B	4 mg/L	± 15%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
pH and Temperature	EPA Method 9040C	0.1 S.U.	± 0.1 S.U.	Frequent calibration and sample duplicate.
Total dissolved solids (TDS)	SM 2540C	20 mg/L	± 20%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Wate density / Specific Gravity (lab)	ASTM D1429	0.1	N/A	Frequent calibration and sample duplicate.
Dissolved Inorganic Carbon (DIC); Dissolved Organic Carbon (DOC)	Standard Method 5310C	0.198 to 0.290 mg/L	±20	Calibration as needed, daily QC checks; ICV, ICB, RL, method blank, lab control samples, matrix spike and matrix spike dup; CCV/CCB every 10 samples or part thereof
*$^{228}Ra/^{226}Ra$	EPA Method 901.1	50 pCi/L (RL)	± 25%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.

*^{87}Sr/^{86}Sr	TIMS - subcontracted to the University of AZ	approximately 40 ppm	± 0.00002 ppm	SRM 987 Sr standard within the long term precision (external precision) of +/-0.00002 accepted value of 0.71025
*δ^{18}O and δ^{2}H of H_2O	Analyzed via CRDS	N/A	δ18O: 0.10 per mil, δ2H: 2.0 per mil	20% of all analyses are either check/reference standards or duplicate analyses.
δ^{13}C of DIC	Gas Bench/CF-IRMS	Depends on available sample volume, minimum of 50mg/L required	0.20 per mil	20% of all analyses are either check/reference standards or duplicate analyses.
*^{14}C of DIC	AMS - subcontracted to Beta Analytic	Depends on available sample volume	± 1 - 2 pMC	Daily monitoring of instrumentation and chemical purity in additional to extensive computer and human cross-checks.
*Dissolved Gas: N_2, CO_2, CO, O_2, Ar, H_2, He, CH_4, C_2H_6, C_3H_8, i-C_4H_{10}, n-C_4H_{10}, i-C_5H_{12}, n-C_5H_{12} and C6+	In-house Lab SOP, similar to RSK-175	Lowest quantifiable limits 1-100 ppm, varies by component	C1-C4: ± 5% C5-C6+: ± 10%	20% of all analyses are check/reference standards.
Dissolved CO_2	Standard Method 4500 CO_2 D	8 mg/L	±20	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
^{14}C of CH_4	High precision (offline) analysis via Dual Inlet IRMS	0.44pMC	± 1-2 pMC	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate. At least one secondary standard is measured with each sample batch and approx. 10% of samples submitted are prepared and measured a second time.
Dissolved Gas: H_2S (Sulfide)	SM 4500S F	1 mg/L	± 20%	Sample duplicates, method blanks and lab control samples.
*δ^{13}C of dissolved CO_2, C1-C5, δ^{2}H of CH_4	High precision (offline) analysis via Dual Inlet IRMS	Varies by component	δ13C: 0.1 per mil δ2H: 3.5 per mil	20% of all analyses are check/reference standards.
Field Parameters				
pH (field)	Standard Method2 4500-H+ B-2000	2 to 12 pH units	±0.2 pH unit	User calibration per manufacturer recommendation

Specific conductance (field)	EPA Method 120.1	0 to 200 mS/cm	±1% of reading	User calibration per manufacturer recommendation
Temperature (field)	Standard Method 2550 B-2000	-5 to 50 ºC	±0.2 ºC	Factory calibration
Oxidation-Reduction Potential (ORP) (field)	Standard Method 2580	-1999 to +1999 mV	±20 mV	User calibration per manufacturer recommendation
Dissolved oxygen (field)	ASTM Method D888-09 (C)	0 to 50 mg/L	0 to 20 mg/L (±0.1 mg/L or 1% of reading, whichever is greater) 20 – 50 mg/L (±8% of reading)	User calibration per manufacturer recommendation
Turbidity (field)	USEPA Method 180.1	0 – 1000 NTU	± 1% of reading or 0.01 NTU, whichever is greater	User calibration per manufacturer recommendation

[1] An equivalent method may be employed with the prior approval of the UIC Program Director.

[2] Detection limits and precision (laboratory control limits) are typical for these analytical methods.

* Analytical parameters to be included during the pre-injection phase, and only as needed during the injection and post-injection phases of the Project.

Table 6e--Summary of analytical parameters for fluid and dissolved gas samples during sampling events following March 2024 in the first permeable zone above the confining zone / lowermost USDW (Dockum Group).

Laboratory Analyte (Green Analytical for water geochemical analyses)	Analytical Methods[1]	Detection Limit / Range[2]	Typical Precision[2]	QC Requirements
<u>Total and Dissolved Metals</u>: Ag, Al, As, Ba, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Sr, Th, Tl, U, V, and Zn	USEPA Method 200.8	0.00004 to 0.003 mg/L	±20	Daily calibration, Initial QC checks (ICV, ICB, RL) method blank, lab control samples, matrix spikes and sample duplicate, CCV/CCB every 10 samples or part thereof
<u>Total and Dissolved Metals</u>: B, Ca, Fe, K, Mg, Li, Na, Si, Sr, Ti	USEPA Method 200.7	0.003 to 0.254 mg/L	±20	Daily calibration, Initial QC checks (IPC, ICV, ICB, RL) method blank, lab control samples, matrix spike and matrix spike dup; CCV/CCB every 10 samples or part thereof
Total and Dissolved Hg	USEPA Method 245.7	19.6 ng/L	±20	Calibration as needed, daily QC checks; ICV, ICB, RL, method blank, lab control samples, matrix spike and matrix spike dup; CCV/CCB

				every 10 samples or part thereof
Dissolved Inorganic Carbon (DIC); Dissolved Organic Carbon (DOC)	Standard Method 5310C	0.198 to 0.290 mg/L	±20	Calibration as needed, daily QC checks; ICV, ICB, RL, method blank, lab control samples, matrix spike and matrix spike dup; CCV/CCB every 10 samples or part thereof
Dissolved CO$_2$	Standard Method 4500 CO$_2$ D	8 mg/L	±20	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Alkalinity: Total, Bicarbonate, Carbonate, and Hydroxide	Standard Method 2320B	8 mg/L	±20	Method blank, lab control samples, matrix spikes
Major Anions: Br, Cl, F, SO$_4$, NO$_2$, NO$_3$ as N, and PO$_4$ as P	USEPA Method 300.0	0.003 to 0.563 mg/L	±20	Calibration as needed, daily QC checks; ICV, ICB, RL, method blank, lab control samples, matrix spike and matrix spike dup; CCV/CCB every 10 samples or part thereof
Total and Dissolved P	USEPA Method 365.1	0.0215 mg/L	±20	Daily calibration, Initial QC checks (ICV, ICB, RL) method blank, lab control samples, matrix spikes and sample duplicate, CCV/CCB every 10 samples or part thereof
Dissolved H$_2$S (Sulfide)	Standard Method 4500S2-D	0.026 mg/L	±20	Calibration as needed, daily QC checks; ICV, ICB, RL, method blank, lab control samples, matrix spike and matrix spike dup
Total Dissolved Solids (TDS)	USEPA Method 160.1	10 mg/L	±20	Method blank, lab control samples, and sample duplicate
Conductivity	Standard Method 2510B	0 to 200 mS/cm	±1%	Calibration as needed, daily QC checks (1413, 14130 and second source SRM), CCV every 10 samples or part thereof
pH and Temperature	USEPA Method 150.1	0.1 to 14 pH units	±0.1 pH units	Daily calibration, second source SRM, CCV's every 10 samples or part thereof
Specific Gravity	ASTM Method D1429-03	NA	To the nearest thousandths decimal	Duplicates
Cation Anion Balance	Calculation	NA	±10	Calculation
<u>Organics</u>: Benzene, Toluene, Ethylbenzene, and Xylenes	USEPA Method 8260	0.001 to 0.003 mg/L	±20	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.

Dissolved Gas Abundances: CO_2, CO, N_2, Ar, He, H_2, O_2, C1-C6+	In-house Lab SOP, similar to RSK-175	1 to 100 ppm, varies by component	C1-C4: ± 5%; C5-C6+: ± 10%	20% of all analyses are check/reference standards.
Dissolved Gas Isotopes: $\delta^{13}C$ of C1-C5 and CO_2, $\delta^{2}H$ of C1	High precision (offline) analysis via Dual Inlet IRMS	Varies by component	$\delta^{13}C$: 0.1 per mil; $\delta^{2}H$: 3.5 per mil	20% of all analyses are check/reference standards.
^{14}C of C1	AMS - subcontracted to Beta Analytic	0.44 pMC	± 1 to 2 pMC	Daily monitoring of instrumentation and chemical purity in additional to extensive computer and human cross-checks.
^{14}C of DIC	AMS - subcontracted to Beta Analytic	Depends on available sample volume	± 1 to 2 pMC	Daily monitoring of instrumentation and chemical purity in additional to extensive computer and human cross-checks.
$\delta^{13}C$ of DIC	Gas Bench/CF-IRMS	Depends on available sample volume, minimum of 50mg/L required	0.20 per mil	20% of all analyses are either check/reference standards or duplicate analyses.
$\delta^{18}O$ and $\delta^{2}H$ of H_2O	Analyzed via CRDS	N/A	$\delta^{18}O$: 0.10 per mil; $\delta^{2}H$: 2.0 per mil	20% of all analyses are either check/reference standards or duplicate analyses.
$^{87}Sr/^{86}Sr$	TIMS - subcontracted to the University of AZ	Approximately 40 ppm	± 0.00002	SRM 987 Sr standard within the long-term precision (external precision) of +/- 0.00002 accepted value of 0.71025
$^{228}Ra/^{226}Ra$	USEPA Method 901.1	50 pCi/L (RL)	± 25%	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate.
Field Parameters				
pH (Field)	Standard Method2 4500-H+ B-2000	2 to 12 pH units	±0.2 pH units	User calibration per manufacturer recommendation
Specific conductance (Field)	EPA Method 120.1	0 to 200 mS/cm	±1%	User calibration per manufacturer recommendation
Temperature (Field)	Standard Method 2550 B-2000	-5 to 50 ºC	±0.2 ºC	Factory calibration
Oxidation-Reduction Potential (Field)	Standard Method 2580	-1999 to +1999 mV	±20 mV	User calibration per manufacturer recommendation
Dissolved Oxygen (Field)	ASTM Method D888-09 (C)	0 to 50 mg/L	0 to 20 mg/L: ±0.1 mg/L or 1% of reading, whichever is greater; 20 – 50 mg/L:	User calibration per manufacturer recommendation

			±8% of reading	
Turbidity (Field)	USEPA Method 180.1	0 to 1000 NTU	± 1% of reading or 0.01 NTU, whichever is greater	User calibration per manufacturer recommendation

[1] An equivalent method may be employed with the prior approval of the UIC Program Director.

[2] Detection limits and precision (laboratory control limits) are typical for these analytical methods.

* Analytical parameters to be included during the pre-injection phase, and only as needed during the injection and post-injection phases of the Project.

Table 7--Summary of analytical parameters for soil and soil gas

Parameters	Analytical Methods[1]	Detection Limit / Range[2]	Typical Precision[2]	QC Requirements
pH	EPA Method 9045D	0-14 pH Std Unit	±0.1	Lab Control/ Lab Control Duplicate, instrument calibration, field duplicates
Electrical conductivity (EC)	29B_EC	5 umhos/cm	20	Lab Control/ Lab Control Duplicate, Matrix Spike/ Matrix Spike Duplicate samples, Method Blank, instrument calibration, field duplicates
Sodium Adsorption Ratio (SAR)	29B SAR	0.01 meq/meq	±20%	Lab Control/ Lab Control Duplicate, Matrix Spike/ Matrix Spike Duplicate samples, Method Blank, instrument calibration, field duplicates
Moisture	SM 2540 B	0.1 - 100%	±20%	Lab Control/ Lab Control Duplicate, instrument calibration, field duplicates
Total Organic Carbon (TOC)	Walkley Black 9060A	0.02 wt%	±20%	Lab Control/ Lab Control Duplicate, Matrix Spike/ Matrix Spike Duplicate samples, instrument calibration, field duplicates
Soil Gas Samples				
Gas: H_2, He, O_2, N_2, CO_2, CH_4, CO, Ar, C2-C6+	Third party lab SOP, similar to RSK-175	CO_2: 50 ppm N_2 and O_2: 100 ppm CH4: 2 ppm C_2 - C_6+: 1ppm 50 ppm	for CO_2 (> 1.5%) ±0.6% (of measured value) for CO_2 (< 0.05%) ±1.7% (of measured value) for N2 and O2 (>10%) ±0.5% (of measured value) CH_4: ±0.4 to 1% (of measured value) C2 - C4: ±0.4 to 1% (of measured value)	At a rate of 20% of the samples analyzed: A lab check standard or sample duplicate is analyzed every 5th run with a lab standard being run first every day. Method based on ASTM D1945

			C5 - C6+: ±2 to 4% (of measured value) for He: ±2% (of measured value)	
*^{14}C of CO_2	AMS - subcontracted to Beta Analytic	0.44pMC	0.02 pMC - 0.5 pMC	At a rate of 20% of the samples analyzed: A lab check standard or sample duplicate is analyzed every 5th run with a lab standard being run first every day.
*$\delta^{13}C$ of CH_4 and CO_2, $\delta^{2}H$ of Methane	High precision (offline) analysis via Dual Inlet IRMS	Varies by component	δ13C: 0.1 per mil δ2H: 3.5 per mil	Frequent calibration, method blank, lab control samples, matrix spikes and sample duplicate. At least one secondary standard is measured with each sample batch and approx. 10% of samples submitted are prepared and measured a second time.
Soil Gas Field Analysis				
Hydrogen Sulfide (field)	EPA Method 21	0 to 100 ppm	±5% of reading or ±2 ppm	User calibration per manufacturer recommendation

[1] An equivalent method may be employed with the prior approval of the UIC Program Director.

[2] Detection limits and precision (laboratory control limits) are typical for these analytical methods.

* Analytical parameters to be included during the pre-injection period, and only as needed during the injection and post-injection periods of the Project.

Table 8--Actionable testing and monitoring outputs

Activity or Parameter	Project Action Limit	Anticipated Reading
External mechanical integrity: DTS fiber	Action taken when there is an anomaly in the temperature profile	Continuous temperature profiles that are within expected or modeled ranges
Internal mechanical integrity: Annulus pressure test	Pressure should not decrease more than 5% in 30 minutes	Pressure should not decrease more than 5% in 30 minutes
Surface and downhole gauges	Action taken when pressures are substantially outside of modeled or expected range	Within the Injection Zone, pressure should be <90% of fracture opening pressure
MIT – Pulse Neutron Logging	Action taken when CO_2 is measured outside of expected range	Brine saturated ~60 CO_2 saturated ~8
Corrosion coupons	Action taken to identify source of corrosion if coupons indicate a rate of more than 4 mm per year	Corrosion measured by coupons is < 4 mm per year
Pressure fall-off Testing	Action taken to identify source if outside of expected range	Fall-off v. pressure is as expected
Surface CO_2 sensors	CO_2 injectate leak detected	No CO_2 injectate leaking
Surface CO_2 cameras	CO_2 injectate leak detected	No CO_2 injectate leaking
Surface wellhead inspection	CO_2 injectate leak detected	No CO_2 injectate leaking
CO_2 stream analysis using continuous gas analysis	CO_2 in product stream is below minimum spec, notify operations.	<95% CO2 = low alarm
	O_2 above limit for pipeline integrity – notify operations	>10 ppmw = high alarm
	H_2O above limit for pipeline integrity – notify operations	>630 ppmv = high alarm

Shallow groundwater chemistry measured in the Dockum Group	A departure between observed measurements and baseline/seasonal parameter trends	Proposed methodology for detecting a departure from baseline/seasonal parameter trends is detailed in Section 5.1.4 of the Baseline Report.
Soil gas chemistry	A departure between observed measurements and baseline/seasonal parameter trends	Proposed methodology for detecting a departure from baseline/seasonal parameter trends is detailed in Section 5.1.4 of the Baseline Report.

1.4.2 Precision

Assessment of analytical precision can be made through the analysis of duplicate samples obtained in the field for testing in third-party laboratories or for testing by field instruments. Precision will be specific to each vendor or contractor selected to perform the work. Although the precision of measurement system can be affected by variations introduced in sampling and analysis, OLCV will ensure that the selected vendors and contractors follow their individual standard operating procedures (SOPs) to optimize the measurement precisions.

1.4.3 Accuracy and Bias

Laboratory accuracy is typically measured by conducting tests comparing standards of known concentrations and project samples. These tests may include the percent recovery on laboratory control samples or matrix spike analysis. These tests will be performed, as needed by the vendor or contractor, to calibrate equipment, in accordance with their individual SOPs. Field accuracy can be determined by collection of field blanks to screen for vessel contamination. Logging equipment is typically calibrated by the contractor prior to commencement of a job using known standards. Gauges and meters will be tested for accuracy prior to deployment.

1.4.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic subset of a given population. Representativeness was considered in designing the network of monitoring wells and the network of soil gas monitoring stations. Representativeness will be considered when evaluating chemical results of fluid and dissolved gas samples.

The network of monitoring wells was designed to provide data points inside and outside of the expected CO_2 plume and pressure front and across multiple stratigraphic levels. The data obtained from these wells will be used to calibrate and refine the dynamic simulation model. If needed to better reflect site conditions, additional wells will be added to the Project.

Soil gas sampling stations are typically selected to represent the breadth and diversity of the near-surface environments present within the AoR. Little environmental diversity is observed at the BRP site. The surface consists primarily of ranchland; no surface water or marsh lands are present.

Images from airborne photos and satellite images indicate that caliche soils are likely present in some locations and there are shallow depressions that may collect ephemeral drainage. For the Project, soil gas stations will be placed in the vicinity of existing and future artificial penetrations and the Stratos facility, as well as sensitive areas, e.g., lease boundaries.

Groundwater samples will be evaluated for representativeness based on ion and mass balance. Ion balances with ±10% error are considered valid. In the case where ion balance is greater than ±10%, mass balance will be assessed to evaluate and identify the source of the error. If the relative percent difference is >10% for a sample and its duplicate, the sample may be considered non-representative.

1.4.5 Completeness

Data completeness is a measure of the amount of valid data collected compared to the amount of valid data that was expected to be collected under normal conditions. Data completeness is measured as a percentage of anticipated data obtained from the valid measurements. For the Project, 90% data completeness is acceptable to meet monitoring goals.

1.4.6 Comparability

Data comparability qualifies the level of confidence with which one data set can be compared to another. The testing and monitoring systems for this Project have been designed to allow for repeat measurements and the comparability among datasets of the same type from the same source are expected to be high due to the use of standardized methods and consistent levels of QA/QC requirements. Historical data from sources other than the BRP, if available, will be assessed for their applicability to the Project and level of quality before use.

1.4.7 Sensitivity

Sensitivity describes the minimum detection or quantification limit of a method, instrument, or laboratory. The tables below describe detection limits and operating ranges for instruments and tools used on this Project.

Table 9a--Summary of measurement parameters for field gauges

Parameters	Analytical Methods[1]	Detection Limit / Range[2]	Typical Precision[2]	QC Requirements
Surface injection line pressure gauge	Pressure sensor feeds data back to SCADA	0.5 psig / -14.7 – 4,000 psig	+/- 0.065% of full span	Annual or per manufacture recommendation, whichever is more frequent
Surface injection line temperature gauge	Resistance temperature detector or thermocouple	1°F / -58 - 842° F	±0.3°F	Annual or per manufacture recommendation,

				whichever is more frequent
Downhole temperature and pressure gauges	Permanent gauge	-14.7 to 10,000 psi, 302° F	±2 psi, ± 0.27° F	Annual or per manufacture recommendation, whichever is more frequent
Wellhead tubing pressure	Pressure sensor feeds data back to SCADA	0.5 psig / -14.7 – 4,000 psig	+/- 0.065% of full span	Annual or per manufacture recommendation, whichever is more frequent
Wellhead annulus pressure	Pressure sensor feeds data back to SCADA	0.5 psig / -14.7 – 4,000 psig	+/- 0.065% of full span	Annual or per manufacture recommendation, whichever is more frequent
CO_2 injection mass flow rate	Coriolis meter feeds data back to SCADA	1.5 metric ton/day/0-1500 metric ton/day	+/- 0.25% of full span	Quarterly or per manufacture recommendation, whichever is more frequent

[1] An equivalent method may be employed with the prior approval of the UIC Program Director.

[2] Detection limits and precision are typical for these analytical methods.

SCADA = Supervisory Control and Data Acquisition

Table 9b--Downhole pressure and temperature gauge specifications

Parameter	Value
Calibrated working pressure range	Atmospheric to 10,000 psi
Initial pressure accuracy	<± 2 psi over full scale
Pressure resolution	0.005 psi at 1 sec sample rate
Pressure drift stability	<± 2 psi per year over full scale
Calibrated working temperature range	77 – 302 ºF
Initial temperature accuracy	<± 0.27 ºF at 1 sec sample rate
Temperature resolution	0.009 ºF at 1 sec sample rate
Temperature drift stability	<± 0.018 ºF at 1 sec sample rate
Max temperature	302 ºF

Table 9c--Surface pressure gauge specifications

Parameter	Value
Calibrated working pressure range	-14.7 to 4,000 psig
Initial pressure accuracy	± 0.075%
Pressure resolution	0.5 psig
Pressure drift stability	0.05% annually

Table 9d—Coriolis meter

Parameter	Value
Sizing	3 in. meter body, orifice size by meter vendor
Temperature range	-50°F to 200°F
Tolerance	Based on manufacturer's manual

Table 9e--Pressure gauge specifications: Injection tubing pressure

Parameter	Value
Calibrated working pressure range	-14.7 to 4,000 psig
Initial pressure accuracy	± 0.075%
Pressure resolution	0.5 psig
Pressure drift stability	0.05% annually

Table 9f--Pressure gauge specifications: Annulus pressure

Parameter	Value
Calibrated working pressure range	-14.7 to 4,000 psig
Initial pressure accuracy	± 0.075%
Pressure resolution	0.5 psig
Pressure drift stability	0.05% annually

Table 9g--Temperature Gauge Specifications: Injection tubing temperature

Parameter	Value
Calibrated working temperature range	-58 to 842 ºF
Initial temperature accuracy	±0.12 %
Temperature resolution	0.3 ºF
Temperature drift stability	±0.54 deg. F following 1000 hours at max. specified temperature

Table 9h--CO_2 mass flow rate gauge specifications

Parameter	Value
Calibrated working flow rate range	0 – 1500 metric ton / day
Initial flow rate accuracy	± 0.25 %
Mass flow rate resolution	1.5 metric ton / day

Table 10--Summary of specifications for on-line gas analyzers

Parameters	Analytical Methods
Analysis time	Approximately 5-10 minutes
Repeatability	±0.25% for CO2 mol%
Temperature Range	-4°F to 140°F
Calibration	Besides automated calibration feature that is available to the GC, the manufacture shall recommend appropriate inspection, maintenance, and

	calibration frequency per the specific application. The manufacturer recommends monthly evaluation of QC data for the GC.
Range	Pipeline quality gas with less than 100 ppm H_2S
Components measured	$CO_{2\,\mathrm{Mol}\,\%}$, H_2O ppmv, O_2 ppmv

Table 11a--Technical specifications for DTS fiber

Parameter	**Value**
Spatial resolution	1 m (3.2 ft) across entire measurement range
Sampling resolution	To 0.5 m (1.6 ft) across entire measurement range
Temperature resolution	<0.1°C (0.18°F)
Accuracy	±0.5°C (±0.9°F)
Measurement range	Up to 12 km
Measurement temperature range	-250°C to 400°C
Measurement times	10 sec to 24 hr
Dynamic range	30 dB
Operating environment	-10°C to 60°C, humidity 0% to 95% non-condensing
Tensile strength	2,372 lbf
Yield strength	2,018 lbf
Strain at yield	0.31%
Hydrostatic Pressure	23,872 psi
Burst Pressure	28,050 psi
Working Pressure	20,526 psi
Static Bend Radius	3 in.

Table 11b--Technical specifications for DAS fiber

Parameter	**Value**
Spatial resolution	2m - 200m
Sampling resolution,	1m
Accuracy	Typical Sensitivity −57 dB Rad/√Hz
Measurement range	100Km
Sample clock frequency	1,000 MHz
Measurement times	Interrogation Rates 0.5, 0.8, 1, 2, 2.5, 3.125, 4, 5, 8, 10 kHz
Measurement times	10 sec to 24 hr
Dynamic range	30 dB
Operating environment	-10°C to 60°C, humidity 0% to 95% non-condensing
Output channel pitch	1.027 m, 2.05m, 5.14m, 10.27m

Table 12a--Representative logging tool specifications for mechanical integrity tools

	UIC Class VI Injectors	SLR, ACZ and WW			
Parameter	**Temperature Log**	**Isolation Scanner**	**UltraSonic Imager Tool**	**Cement Bond Log**	**Variable Density log**
Logging speed	<1800 ft/hr	< 2,700 ft/hr	<1,800 ft/ hr	<3,600 ft /hr	<3,600 ft/hr
Depth of investigation	wellbore	Casing and annulus up to 3 in	Casing to cement interface	Casing and cement interface	Depends on bonding and formation
Vertical resolution	Point measurement	0.6 - 6 in	0.6 – 6 in	3 ft	5 ft
Range of measurement	0 – 350 ºF	0.15 - 0.79 in	0 - 10 MRayl	0 – 100+mV	Waveform recording
Temperature rating	350 ºF	350 ºF	350 ºF	350 ºF	350 ºF
Pressure rating	20,000 psi	20,000 psi	20,000 psi	20,000 psi	20,000 psi

Table 12b--Representative logging tool specifications for Reservoir Saturation Tools

Parameter	**PNX Pulsar – Pulsed Neutron (Schlumberger)**	**RMT-3D Pulsed Neutron (Halliburton)**
Acquisition	Real time	Real time
Logging speed	200 to 3,600 ft/hr	180 to 900 ft/hr
Depth of investigation	3 - 10 in	6 to 12 in.
Vertical resolution	3 ft	30 in.
Range of measurement	0 to 60 pu	5 to 60 pu
Temperature rating	350°F	325°F
Pressure rating	15,000 psi	15,000 psi

Table 12c--Representative Logging Tool Specifications for Single Phase Sampling Tool

Parameter	**Single Phase Sampling Tool (Schlumberger)**
Acquisition	Real time
Sample Capacity	600 cm^3
Service	Sour
Temperature rating	392°F
Pressure rating	15,000 psi

Table 13--Summary of measurement parameters for seismometers[1]

Parameters	**Value**
Nominal Sensitivity	750 V-s/m
Precision	±0.5%
Bandwidth/120s	-3 dB points at 120 s and 108 Hz

Bandwidth/20s	-3 dB points at 20 s and 108 Hz
Off-axis Sensitivity	±0.5%
Clip Level	26 mm/s up to 10 Hz and 0.17 g above 10 Hz
Operating Tilt Range/120s	±2.5°
Operating Tilt Range/20s	±10°
Parasitic Resonances	None below 200 Hz
Dynamic Range	> 152 dB @ 1 Hz

[1] Specifications for Nannometrics seismometers are shown. No vendor contract has been awarded.

Table 14--Summary of measurement parameters for Vertical Seismic Profiles

Parameter	
Horizontal Accuracy	< 6 feet
Detection limit	< 40 microseconds
DAS recording gauge length	32 feet
DAS receiver spacing	16 feet
Source spacing	82 feet

Table 15--Summary of measurement parameters for DInSAR and GPS

Parameter	Value
Sensitivity, DInSAR	±0.0001 m
Sensitivity, GPS	±0.001 m
Detection limit, DInSAR	±0.001 m/year
Detection limit, GPS	±0.01 m/year

Table 16a. Summary of Measurement Parameters for Optical Gas Imaging (OGI) Camera

Parameter	Value for OGI
Sensitivity to detect CO_2	<1.1 ppm (ΔT = 10ºC, Distance = 1 m)
Thermal sensitivity	15 mK at 30ºC (86ºF)
Spectral range	4.2 µm
Operating Temperature Range	-20ºC to 50ºC (-4ºF to 122ºF)

Table 16b. Summary of Measurement Parameters for Surface Sensors

Parameter	Value for Surface Sensors
Sensitivity to detect CO_2	2% V/V
Accuracy	<±0.04% V/V
Operating Temperature Range	-20ºC to +50ºC (-4ºF to +122ºF)

1.5 Special Training / Certifications

1.5.1 Specialized Training and Certifications

Trained, qualified, and certified personnel will operate geophysical survey equipment and wireline logging tools. The contractor company who provides the equipment will determine the qualifications necessary to use the equipment. Data acquired from these methods will be processed according to industry standards. Fluid and dissolved gas sampling will be conducted by personnel trained to understand and follow specific sampling procedures that will be provided by the Operator. Relevant personnel will participate in a H_2S Safety Training course compliant with the scope elements defined in the ANSI Z390.1-2017 on an annual basis.

1.5.2 Providing and Assuring Training

Training for personnel will be provided by the Operator or contractor responsible for the data collection activity.

1.6 Documents and Records

1.6.1 Report Format and Package Information

OLCV will submit a semi-annual report containing the required Project data in accordance with 40 CFR §146.91, including testing and monitoring information as specified by the UIC Class VI permit. All data and Project records will be stored electronically on secure servers and will have routine backups. Data will be provided in electronic or another format, as required by the UIC Program Director.

1.6.2 Other Project Documents, Records, and Electronic Files

Other documents, records, and electronic files, such as well logs, test results, or other data will be provided, as requested by the UIC Program Director.

1.6.3 Data Storage and Duration

OLCV will maintain the required Project data in accordance with 40 CFR §146.91(f) or as specified in the UIC Class VI permit.

1.6.4 QASP Distribution Responsibility

The Project Manager will be responsible for distributing the most current copy of the approved QASP to those individuals on the distribution list.

2.0 Data Generation and Acquisition

2.1 Sampling Process Design

This section will focus on CO_2 injectate stream sampling, corrosion coupons, groundwater fluid and dissolved gas sampling and soil gas sampling, because physical samples are collected with those methods. Other monitoring methods, such as seismic, pressure, temperature, and logging do not involve physical samples and their testing methodology will not be described here.

Components of the CO_2 injectate stream that are highly important for maintaining mechanical integrity and reservoir in the flowline will be continuously monitored via on-line gas analyzers and sampled quarterly for laboratory geochemical analysis. The proposed frequency of sampling is expected to be sufficient to detect changes in composition that could potentially occur over the facility's lifetime and will serve as a backup to the on-line analyses. The CO_2 injectate stream composition will also be analyzed in a laboratory after significant maintenance events or after facilities changes at Stratos.

Corrosion monitoring via coupons will be used to detect evidence of internal metal loss resulting from the CO_2 injectate stream, which could occur if a water phase is present. Detection of corrosion past the acceptable limit of 4 mils per year (mpy) will result in review of the operating conditions to determine the source of corrosion and the required adjustment needed to control corrosion.

Sampling of fluid and dissolved gas in the Injection Zone (WW1, WW2, WW3, WW4, SLR2 and SLR3 wells) and in the first permeable zone above the confining zone, which is the lowermost USDW (USDW 1 well), will occur during construction and before injection (except for SLR3, because it will be constructed after injection commences) to establish a baseline characterization. Additional monitoring of these zones will be conducted during the injection and post-injection period of the Project at the determined schedules or as needed, based on Project triggers (see Table 2 for sampling frequencies). If pressure or temperature changes in the SLR1, SLR2, SLR3 or ACZ1 wells suggest that CO_2 or brine has potentially been displaced from the Injection Zone, fluid and soil gas will be sampled and analyzed to confirm the presence or absence of CO_2 or displaced brine.

Although CO_2 injection activities are not expected to result in CO_2 or displaced brine reaching the USDW, routine fluid and dissolved gas sampling of the lowermost USDW, and routine soil gas sampling of the near-surface will be conducted to provide additional technical confidence. A comprehensive set of chemical compounds and isotopes were selected to monitor groundwater. The following considerations were evaluated: (1) constituents with primary and secondary EPA drinking water maximum contaminant levels, (2) constituents most susceptible to react if CO_2 or brine is introduced to the system, (3) constituents necessary for controlling water quality, particularly in the injection, (4) constituents needed to discern the source of anomalous CO_2 detections or potential brine migration, and (5) constituents needed for geochemical modelling.

The analytical suites for each geological layer of interest are presented in Tables 6a, 6b, 6c, 6d, 6e and 7 and include geochemical and isotopic parameters.

Soil gas will be analyzed prior to commencement of CO_2 injection operations to establish a chemical and isotopic characterization that describes normal biological respiration processes and nearby anthropogenic sources, if present. During injection, sampling will be conducted at each station on a quarterly basis for the first three years and compared with the pre-injection characterization to identify deviations from the expected trend. Following the third year, sampling will be conducted at a subset of locations on an annual basis. If deviations are present, an attribution analysis will be conducted. Soil gas sampling in the post-injection period will be event-driven, triggered by P/T data in the USDW1 well or other wells. Similar to the groundwater monitoring programs, the analytical parameters to characterize and monitor soil gas at the near-surface include composition gases and isotopes. The components were selected considering: (1) constituents which may suggest potential migration pathway, (2) constituents to help distinguish CO_2 produced from biological processes or anthropogenic sources, (3) constituents most susceptible to react if CO_2 is introduced to the system, and (4) constituents needed for geochemical modelling.

2.1.1 Design Strategy

2.1.1.1 Monitoring the CO_2 Stream

The purpose of monitoring the CO_2 injectate stream is to understand potential interactions between the injectate and the fluids and solids in the Injection Zone. Another purpose of monitoring the CO_2 stream is to identify potential interactions between the injectate stream and well materials or other facilities. Additionally, it is important to monitor the chemical and isotopic composition of the CO_2 stream to potentially distinguish the injectate from native fluids in the unlikely event of leakage.

The CO_2 injectate stream for BRP will be continuously monitored using on-line analyzers at the Stratos facility. Additionally, CO_2 injectate stream samples will be routinely collected in the pipeline transporting the injectate stream to UIC Class VI wells and analyzed by a third-party contractor.

The Class VI rule requires that monitoring frequency should be sufficient to detect changes in physical or chemical properties that may result in deviation from permitted composition. OLCV is confident that the monitoring frequency and locations selected for the BRP Project will allow prompt detection of deviation in injectate composition.

2.1.1.2 Monitoring Corrosion

The purpose of corrosion monitoring is to identify the presence or absence of loss of metal thickness, cracking, or pitting of well components that could result in loss of mechanical integrity.

The Class VI rule requires that corrosion be monitored with coupons, a flow loop or alternative method approved by the Director.

Corrosion management of the injection system is based on maintaining the CO_2 stream purity specification and maintaining pressure and temperature conditions in the flowlines that prevent formation of a water phase. Because some well materials that are in contact with CO_2 may become saturated with water during shutdowns, corrosion resistant alloys are selected for these zones. Internally coated carbon steel is used for injection tubing above the packer because it will only be exposed to the CO_2 stream and not to water. During workovers, the tubing will be accessible for full inspection and could be replaced, if necessary.

The materials selected for the BRP Project will be designed to mitigate and inhibit corrosion. To further determine the presence or absence of corrosion, coupons of well materials will be collected and analyzed by a third-party contractor on a quarterly basis. Finally, casing inspection logs will be run during well maintenance events. OLCV is confident that these actions will prevent or detect corrosion of well materials prior to loss of mechanical integrity.

2.1.1.3 Monitoring Fluid in the Injection Zone

The purpose of monitoring the fluid in the Injection Zone is to identify the presence or absence of the CO_2 plume or pressure front away from the injection well. Direct monitoring of the pressure front is required by 40 CFR §146.90(g)(1) and indirect monitoring is required in 40 CFR §146.90(g)(2) .

Injection Zone monitoring wells (SLR2 and SLR3) and brine withdrawal wells (WW1, WW2, WW3, and WW4) at the BRP Project will be used to monitor the geochemistry, pressure and temperature of the Injection Zone. OLCV will sample the WWs and SLR2 prior to the commencement of CO_2 injection to establish a baseline. OLCV may be sample fluids in the WWs, SLR2 or SLR3 wells during the injection period or post-injection period, if OLCV detects changes in pressure and temperature observed in Injection Zone monitoring wells.

The positions of WW1, WW2, WW3, WW4, SLR2 and SLR3 wells were selected to observe long-term changes in the plume and pressure front. Once CO_2 reaches the wells, they are no longer helpful for future modeling of the CO_2 plume or pressure front. OLCV is confident that this monitoring and testing strategy, along with indirect detection methods, will constrain the presence of the CO_2 plume and pressure front.

2.1.1.4 Monitoring Fluid in First Permeable Zone Above the Confining Zone, coincident with the Lowermost USDW

The purpose of monitoring fluid in the first permeable zone above the confining zone is to determine the presence or absence of injection fluids or displaced brine expelled from the Injection Zone [40 CFR §146.90(d)]. A change in pressure, temperature, or geochemical composition in the fluid above the Upper Confining Zone may indicate a breach of Upper Confining Zone integrity or mechanical integrity of a wellbore. Based on data obtained in the WW1, WW2, WW3, and WW3 there is an absence of permeable zones above the confining zone and below the lowermost USDW, which is the Dockum group. Therefore, the first permeable zone above the Confining Zone in the BRP Project AoR is coincident with the lowermost USDW in the Project AoR.

Due to the relatively small (<6 miles^2) size of the BRP Project AoR, OLCV will use one well to monitor the lowermost USDW. The USDW 1 well is located close to the BRP CCS1 and BRP CCS2 UIC Class VI injectors, because this location is likely to experience the highest reservoir pressure resulting from injection, it is the location that is most likely to experience displaced brine or injectate, in the unlikely event that leakage occurs.

The Shoe Bar 1 stratigraphic test well was plugged above the Injection Zone and converted to a monitoring well, SLR1, before commencement of CO_2 injection operations. The Shoe Bar 1AZ well was also plugged above the Injection Zone prior to commencement of injection operations and converted to a monitoring well, ACZ1. Both wells will be used to monitor integrity of the Upper Confining Zone by conducting saturation logging. Pressure and temperature may also be obtained in the Upper Confining Zone in the SLR1.

Prior to injection activities, temperature and pressure will be monitored, and fluid and dissolved gas samples will be collected for analysis (see Table 6a, 6b, 6c, 6d, 6e for analytical parameters) to establish baseline conditions within the first permeable zone above the Upper Confining Zone. As shown in Table 2, prior to CO_2 injection, samples from the lowermost USDW will be collected and analyzed for geochemical and isotopic parameters quarterly for at least one year to establish baseline conditions. During the injection, the USDW will be monitored for geochemical composition and a subset of isotopic analysis quarterly between year 1 and 3, and annually thereafter. During the post-injection period, the USDW will be monitored for geochemical composition and a subset of isotopic analysis annually for the first 10 years and event-driven thereafter, pending an approved PISC plan. If anomalous pressure and temperature changes are observed in the SLR2, SLR3 or ACZ1 wells, or there is any indication of leakage through the injection wells during the injection and post-injection periods of the Project, additional fluid samples may be obtained for geochemical and isotopic analysis and comparison to pre-injection sample results.

OLCV is confident that the combination of monitoring the integrity of the Upper Confining Zone, and the chemistry and isotopic composition of the lowermost USDW will confirm the presence or absence of integrity of the Upper Confining Zone and Upper Confining System.

2.1.1.5 Monitoring Soil and Soil Gas Composition

The objective of soil gas monitoring is to provide an additional line of evidence supporting the presence or absence of CO_2 containment in the Injection Zone. Because soil gas in the near-surface and groundwater composition in shallow wells has considerable variation due to natural processes, monitoring both soil gas and fluid composition at multiple subsurface levels is a more reliable leak monitoring method.

The BRP Project installed 20 soil gas probes in and around the AoR of the BRP Project between June – August 2024. The following factors were considered in siting soil gas probes: (1) the location of injection and monitoring wells, (2) the location of artificial penetrations discussed the Area of Review and Corrective Action Plan; (3) variable surface soil characteristics, such as caliche deposits; (4) site accessibility constraints; (5) the potential effects of the Stratos facility on natural processes in the near-surface; and (6) the location of adjacent property owners. Three probe stations are located near the proposed injection wells, where highest pressures and resulting risk of vertical migration may be expected. One probe station is located near each BRP Project monitoring well and each heritage artificial penetration within the AoR (i.e., heritage wells drilled for oil and gas exploration). Two probe stations are located near the Stratos facility and three probe stations are located along the southern boundary of the Shoe Bar Ranch near an adjacent ranch.

Following probe construction, soil samples were collected in general accordance with EPA Method LSASDPROC-300-R5 (EPA, 2023a) and analyzed in a laboratory for pH, electrical conductivity, sodium adsorption ratio, total organic carbon (TOC), and soil moisture, in accordance with the methods specified in Table 7. Soil samples will only be conducted once.

Soil gas samples were collected and analyzed for gas and isotopic composition in June, September, and December 2024. Two additional sampling events, March and June 2025, are anticipated to be conducted prior to commencement of CO_2 injection. The samples collected prior to CO_2 injection will define a characteristic profile for the site. During the injection period, soil gas will be monitored for gas composition quarterly between year one and three and annually thereafter. Note that the number of sample stations may be reduced if OLCV determines that monitoring a subset of soil probe stations will provide a representative set of data to ensure that CO_2 is not migrating from the Injection Zone through preferential pathways. If anomalous pressure and temperature changes are observed in the nearby ACZ1 or SLR wells, or there is any indication of leakage through the injection wells, additional soil gas samples will be collected for gas composition and/or isotopic analysis and comparison to pre-injection sample results.

OLCV is confident that the combination of soil gas and fluid monitoring throughout the stratigraphic column will indicate whether leakage of CO_2 injectate or displaced brine has occurred.

2.1.1.5 Monitoring the AoR with Geophysical Techniques

OLCV will directly and indirectly monitor the AoR. OLCV will directly monitor the position of the AoR through geochemical monitoring and pressure and temperature data obtained from the Injection Zone and the first permeable zone above the Upper Confining Zone. OLCV will indirectly monitor the AoR by collecting repeat saturation logs in the Injection Zone and the first permeable zone above the Upper Confining Zone. In addition, OLCV will indirectly monitor the

AoR using 2D Vertical Seismic Profiles (2D VSP), 2D surface seismic, Differential Interferometric Synthetic-Aperture Radar (DInSAR), and Global Positioning Systems (GPS). More details on geophysical methods are presented in the Testing and Monitoring Plan.

2D VSP and 2D surface seismic data were collected in the BRP CCS1, BRP CCS2, BRP CCS3 and SLR2 using distributed acoustic sensing fiber (DAS) in January 2025. OLCV anticipates conducting repeat VSPs during injection operations at years one, two, five and 10. Additional VSP surveys may be conducted if temperature, pressure, or geochemical data suggest a change in the AoR that could be interpreted with geophysical data. OLCV anticipates acquiring repeat 2D surface seismic during year 10 of injection, and once every five-year period during the Post Injection Site Care Period.

OLCV contracted a third-party company specializing in DInSAR to evaluate historical satellite images and interpret ground deformation for the period of January 2017 to August 2024. This evaluation was repeated for the period of August 2024 to December 2024. Quarterly evaluation will continue during the Injection and Post-Injection periods. OLCV installed 11 monuments to serve as corner reflectors in and around the BRP Project AoR in July 2024. The purpose of corner reflectors is to increase the signal to noise ratio and improve accuracy of measurements around the BRP Project area. To further improve precision of deformation measurements, GPS data were collected at corner reflectors in August 2024 and November 2024. Future GPS data will be collected on a quarterly basis during the injection and post-Injection periods. DInSAR and GPS data can detect mm-scale changes in surface deformation that may result from operational activities in the Injection Zone. These data are well-suited to provide a site-wide, frequent information on AoR movement.

2.1.2 Sample Strategy

2.1.2.1 Number of Samples and Sampling Locations

- CO_2 injectate stream samples will be collected and analyzed quarterly from a port in the pipeline that is directly downstream of the custody transfer meter measuring the mass of CO_2 delivered to the BRP Project.
- Corrosion coupons will be collected and analyzed on a quarterly basis. In addition to coupons, OLCV will conduct weekly visual inspection of the facilities, conduct quarterly OGI camera evaluations, and continuously monitor pressure and temperature data for indications of potential leakage that could result from corrosion.
- Injection Zone fluid and dissolved gas sampling will be conducted in WWs and SLR2 prior to injection and following injection (including SLR3). If pressure or temperature data from the Injection Zone monitoring wells indicates the potential presence of CO_2 plume front, fluid samples will be collected and analyzed.

- Fluid and dissolved gas sampling in the lowermost USDW will be conducted in one USDW-level well on a quarterly basis for at least one-year prior to injection. During the injection period, groundwater samples will be collected quarterly starting in the first year of injection operations and continuing through the third year of injection operations. Beginning in the fourth year of operations, sampling will be conducted annually. Annual sampling will continue for the first 10 years post injection. Additional sampling will be conducted if pressure or temperature data from the SLR wells or fluid data from the USDW-level well indicates the potential presence of CO_2 injectate or displaced brine above the Upper Confining Zone.
- Soil gas sampling will be conducted at 20 stations on approximately a quarterly basis for approximately one year prior to commencement of CO_2 injection. During the injection period, soil gas samples will be collected quarterly starting in the first year of injection operations and continuing through the third year of injection operations. Beginning in the fourth year of operations, sampling at a subset of soil gas stations will be conducted annually. Annual soil gas samples will be collected post-injection until site closure. Additional samples will be collected if pressure or temperature data from the SLR wells or fluid data from the USDW-level well indicates the potential presence of CO_2 injectate or displaced brine above the Upper Confining Zone.
- Soil samples were collected at 20 soil probe locations once prior to the commencement of CO_2 injection operations.

OLCV will collect VSP and 2D surface seismic, pressure and temperature gauge data, GPS measurements, DInSAR and passive seismicity data. These data are not samples collected or analyzed in a laboratory and therefore not discussed in this section.

2.1.2.2 Sampling Contingency

The BRP Project wells and soil gas stations are located on acreage to which OLCV has surface access rights. There are no anticipated problems with access to sampling locations. Sampling schedules will be adjusted based on weather conditions or other operational activities (e.g., workovers). It is expected that adjustments to the sampling schedule would not impact the ability of OLCV to meet permit requirements.

2.1.2.3 Activity Schedule

The schedule for sampling is summarized in Table 2 of this document. In general, baseline monitoring activities will be conducted for approximately one year during the pre-injection period. Testing and monitoring during the injection and post-injection periods will be conducted for 12 years and 50 years, respectively.

2.1.2.4 Critical / Secondary Data

The following information is considered critical and will be recorded during sampling: date and time of activity, persons performing activity, specific location of activity, instrument calibration data, field parameters, and other data to describe the type of activity. Secondary data may include information such as duration of sampling processes.

2.1.2.5 Sources of Variability

There are multiple sources of variability that could impact sampling and the subsequent interpretation of collected data.

Key sources of variability are discussed below.

- Variations in composition of groundwater and soil gases are expected based on naturally occurring biologic processes, naturally occurring geologic processes and global atmospheric trends. For example, ecosystems have a naturally occurring balance of O_2 and CO_2 that varies daily, seasonally and with climate changes. In addition, naturally occurring methane may oxidize to CO_2 under certain conditions.
- Subsurface fluids in the Injection Zone and above the Injection Zone may be impacted by activities of other operators who are engaged in oil and gas production activities offset to the BRP Project site. Although these activities are >5 miles from the proposed UIC Class VI injectors, impacts from hydrocarbon production or brine injection may result in pressure, temperature, and fluid composition changes over the life of the BRP Project injection and post-injection periods.
- Variability may result from changes in instrument calibration, changes in personnel collecting or analyzing samples, changes in environmental conditions during sample collection in the field, or data input errors.

Activities to mitigate or reconcile variability are:

- Collecting data to establish a chemical and isotopic characterization of fluids and dissolved gases in groundwater, soils and soil gases prior to injection.
- Collecting data to establish a chemical and isotopic characterization of the CO_2 injectate stream prior to injection.
- Utilizing a process-based approach to evaluate changes in fluid or dissolved gas chemical or isotopic composition and appropriately attribute the change.
- Evaluating data in a timely manner after collection to allow for resampling and re-analysis if anomalies are observed.
- Recording critical data in the field or laboratory that describe the conditions in which the sample was obtained, or analysis was performed.
- Checking instrument calibration according to best practices.
- Training staff and requiring training for third parties conducting sampling or analysis.
- Conducting blind checks in the laboratory.
- Utilizing qualified personnel to QC analysis and interpretations.

2.2 Sampling Methods

2.2.1 Sampling Standard Operating Procedures (SOP)

2.2.1.1 SOP for Sampling CO_2 Stream

CO_2 sampling will be conducted by a third-party contractor using process GPA-2177-20.

2.2.1.2 SOP for Sampling Corrosion Coupons

The Project will use a third-party company for placement and retrieval of coupons. OLCV will ensure that the third-party has an SOP for retrieval and placement of coupons under pressure using double block and bleed retrieval tools.

2.2.1.3 SOP for Sampling Fluid in the Injection Zone

Fluid samples will be collected in Injection Zone from the SLR2 using a U-tube system. Fluid samples in the SLR3 will be collected by wireline Single Phase Sampling (SPS) tool or through a U-tube system, depending upon the operational results learned from the U-tube system installed in the SLR2. A U-tube sampling system allows fluid and dissolved gas samples to be preserved at reservoir pressure and returned to the surface. A SPS tool is commonly used for collecting unaltered, noncontaminated single-phase fluid samples. The samples remain in single-phase condition above reservoir pressure as the tool is retrieved from the hole. The sampler can collect up to 600 cm^3 per each of the two sample chambers, which will be sufficient to conduct the fluid and isotopic analyses planned for the Project.

Baseline fluid samples were obtained from the wellhead of the WW wells, which is a proven, industry-accepted methodology for collecting fluid samples from producing wells. Future fluid samples from the WW wells will also be collected at the wellhead.

2.2.1.4 SOP for Sampling Fluid in the Lowermost USDW

Fluid samples from the USDW-level well will be collected primarily using low-flow sampling techniques by qualified third-party operators who will follow procedures described in the EPA manual LSASDPROC-301-R6 (EPA, 2023a) and guidelines set by Yeskis and Zavala (2002).

- The static water level will be measured using an electronic water level indicator and the volume of water in wellbore will be calculated, if necessary for purging.
- The temperature, pH, specific conductance, dissolved oxygen, turbidity, and oxidation-reduction potential will be measured in the field using portable probes and a flow-through cell. Groundwater turbidity will be measured using a portable turbidity meter. Field water quality probes will be calibrated at the beginning of each sampling day according to specifications set by equipment manufacturer.

- Purging will be conducted by a dedicated downhole bladder pump to mitigate cross-contamination, with the pump intake positioned in the middle of the screen interval. Groundwater will be purged until stabilization of field parameters, pH, temperature, and specific conductance, is reached to ensure samples are representative of formation water quality. Field parameters will be considered stable when three successive measurements collected three minutes apart meet the criteria listed in Table 17 below.
- After purging is complete and field parameters have stabilized, samples will be collected from the discharge line of the pump as soon as possible. Sample agitation will be minimized, and the pump discharge line will not contact the sample container. Samples will be placed in labeled containers and preserved as soon as possible in an ice-filled cooler or as specified by the laboratory.
- Samples requiring filtration (e.g., dissolved metals) will be filtered through 0.45-µm flow-through filter cartridges as appropriate and consistent with ASTM D6564-00. Prior to sample collection, filters will be purged with a minimum of 100 mL of well water (or more if required by the filter manufacturer). Samples will be properly preserved per analyte requirements.
- Sample blanks will be collected if equipment is field-cleaned and re-used on site. No equipment is anticipated to be re-used for sampling fluid in the lowermost USDW.
- Air monitoring will be conducted in the worker's breathing zone and well headspace before and during sample collection using a multi-gas meter.

Table 17. Stabilization criteria of water quality parameters during USDW-Level well purging

Field Parameter	**Stabilization Criteria**
pH	±0.2 Standard Units
Temperature	±10% of reading
Specific conductance	±3% of reading
Oxidation-Reduction Potential (ORP)	±10 mV of reading
Dissolved oxygen	±10% of reading or 0.3 mg/L whichever is greater
Turbidity	±10% of reading or below 10 NTU

2.2.1.5 SOP for Sampling Soil and Soil Gas

Soil gas samples at the probe stations will be collected, generally following the procedures set forth in EPA Method SESDPROC-307-R5 (EPA, 2023b) and industry standards ASTM D7648/D7648M-18, by a qualified and experienced third-party contractor(s). Soil gas probes were installed generally between 8 to 10 feet below ground surface (ft bgs). Low permeability tubing

(Nylaflow, or similar) was connected to the soil gas probe, extending a few feet above ground surface. The borehole around the tubing was sealed according to the industry standards mentioned above to prevent ambient air interference. A shut-in test was conducted prior sample collection to ensure the sampling train is free of leakage. The sampling train and the borehole was covered with a shroud for additional test to ensure no leakage occurred during the purging process.

During sample collection, helium gas is injected into the shroud and a vacuum is applied to the tubing above the surface using a 60 mL air-tight syringe, equipped with a 3-way valve, to purge at least two casing volumes. Field parameters are measured from a 1-liter Tedlar bag containing soil gas using a helium detector, multi-gas meter (Multi-RAE or similar) and a photoionization detector (PID). A soil gas sample are then collected in appropriate sample containers provided by the laboratories.

During installation of soil gas probes, soil samples were collected in general accordance with EPA Method LSASDPROC-300-R5 (EPA, 2023c). Soil samples were collected in appropriate sample containers provided by the laboratories and preserved in ice-filled cooler or the method specified by the laboratory.

2.2.2 In-Situ and Continuous Monitoring

In-situ or continuous monitoring is not planned for the following: fluid in the Injection Zone, fluid above the Upper Confining Zone, fluid in the lowermost USDW, corrosion coupons or soil gas.

In-situ, continuous monitoring of the CO_2 injectate stream is planned. The process will be as follows:

- The CO_2 sampling line will be tapped off from the BRP CO_2 process manifold, upstream of all UIC Class VI injection wells, and immediately downstream or upstream of the CO_2 custody transfer meter at the Stratos facility.
- Pressure Control Valve(s) as part of decompressing system will be installed to reduce the pressure to an acceptable level required by sampling equipment and analyzers.
- Individual Pressure Relief Valves, Adjustable Orifice Valves, as well as Rotameters will be installed for continuous CO_2 stream chemical analysis.
- Appropriate filter / coalescer will be considered in the design.
- Appropriate heat trace circuit will be considered in the design.
- Because of the high CO_2 mol% content of the samples and diverse component sampling tasks, the sampling system will be a combination of multiple gas analysis technology that may consist of:
    - Continuous Gas Analyzers with Quantum Cascade Lasers (QCLs), Interband Cascade Lasers (ICLs) and Tunable Diode Lasers (TDLs), Non-dispersive infrared

(NDIR), non-dispersive ultraviolet (NDUV), paramagnetic detector, various electrochemical cells,

- Gas Chromatograph that meets consensus standards, with Flame Ionization Detector (FID), Flame Photometric Detector (FPD) or Thermal Conductivity Detector (TCD),
- Other additional field proven analyzer technology as appropriate, and
- A sample system will be bult to include above mentioned instruments / equipment, local analyzer controller, as well as any independent sensor transmitters. All analyzer signals will be communicated to nearby Programmable Logic Controller (PLC) through either analog 4 – 20mA signal or multiplex communication protocol such as Modbus.

2.2.3 Sample Homogenization, Composition, Filtration

No samples are anticipated to be homogenized.

2.2.4 Sample Equipment

2.2.4.1 Equipment for Sampling CO_2 Injectate Stream

Samples of the CO_2 injectate stream will be collected by a third-party contractor according to process GPA 2177-20.

2.2.4.1 Equipment for Sampling Coupons

Coupon retrieval equipment used to retrieve and place coupons are owned by the third-party company who provides the Project with coupon retrieval and placement services.

2.2.4.3 Equipment for Sampling Fluid from the Injection Zone

A third-party contractor will collect fluid samples from the WWs, SLR2 and SLR3 wells. The third-party will provide the specified sampling containers.

Fluid samples from the WW wells will be collected at the wellhead utilizing fittings and tubing connected to the sampling port. A water quality flow-through cell and turbidity meter will be used to collect water quality parameters during low-flow purging. Laboratory-provided containers, with appropriate preservatives, are provided below in Table 19a below. Samples in the SLR2 (and possibly the SL3), will be collected by OLCV or its contractors qualified to operate a U-tube (Table 19b).

2.2.4.4 Equipment for Sampling the Lowermost USDW

For collecting groundwater samples from the USDW-level monitoring well, the necessary equipment will include:

- Sampling pump (i.e., dedicated bladder pump),
- Compressed gas (e.g., nitrogen) for bladder pumps,
- Water quality probes, flow-through cell, and calibration solutions,
- Water level indicator,
- Laboratory-provided containers, with appropriate preservatives (see Tables 19c and 19d for details), and
- Labels, chain-of-custody forms, and coolers/shipping containers.

2.2.4.5 Equipment for Sampling Soil Gas

For collecting soil gas samples from the vadose zone, the necessary equipment will include:

- Vacuum pump (e.g., syringe),
- 60-mL syringes and 3-way valves,
- Leak detection test gas (i.e., helium) and shroud,
- Helium meter,
- Laboratory-provided containers, with appropriate preservatives (see Table 20 for details), and
- Labels, chain-of-custody forms, and coolers/shipping containers.

For collecting soil samples during the installation of the soil gas probes, the necessary equipment will include:

- Sampling hand tools (e.g., spatula, trowel, core knives),
- Laboratory-provided containers, with appropriate preservatives (see Table 20 for details), and
- Labels, chain-of-custody forms, and coolers/shipping containers.

2.2.5 Sample Preservation

2.2.7.1 Preservation of CO_2 Injectate Stream Samples

Preservation, if any will be done in accordance with GPA 2177-20 by a third-party contractor.

2.2.5.2 Preservation of Coupon Samples

Coupons are collected after retrieval and stored in dry plastic bags or paper envelops.

2.2.7.3 Preservation of Fluid from the Injection Zone

Fluid samples from the Injection Zone will be preserved in accordance with SOP of the third-party contractor selected for the sampling (Tables 19a and 19b).

2.2.5.4 Preservation of Samples from the Lowermost USDW

For groundwater and other aqueous samples for characterizing and monitoring the Dockum group, the preservation methods provided in Table 19c or 19d will be used.

2.2.5.5 Preservation of Soil and Soil Gas Samples

For soil and soil gas samples for monitoring the near-surface, the preservation methods provided in Table 20 will be used.

2.2.6 Cleaning/Decontamination of Sampling Equipment

2.2.6.1 Cleaning/Decontamination of CO_2 Injectate Stream Sampling Equipment

The cleaning and decontamination of CO_2 sampling equipment will be conducted in accordance with GPA 2177-20.

2.2.6.2 Cleaning/Decontamination of Coupon Sample Equipment

Coupons are cleaned using methanol and blasted using standard coupon cleaning procedure to remove any corrosion or scale to allow for accurate measurement of metal loss and depth of corrosion pitting.

2.2.6.3 Cleaning/Decontamination of Equipment for Sampling Fluid from the Injection Zone

Cleaning or decontamination will be conducted in accordance with the third-party operator's SOP, as needed.

2.2.6.4 Cleaning/Decontamination of Equipment for Sampling Fluid from the Lowermost USDW

A solution of industrial grade detergent (e.g., Liquinox® or Alkanox®) and deionized water will be used to decontaminate non-dedicated sampling equipment utilized for groundwater sampling (e.g., water level indicator).

2.2.6.5 Cleaning/Decontamination of Equipment for Sampling Soil and Soil Gas

No cleaning or decontamination will be required for soil gas samples, as a brand new 60-mL gas-tight syringe will be utilized to collect each sample, and each soil gas probe site will include dedicated sampling tubing.

A solution of industrial grade detergent (e.g., Liquinox® or Alkanox®) and deionized water will be used to decontaminate drilling rods, hand augers, hand tools, and other non-dedicated sampling equipment utilized for soil sampling.

2.2.7 Support Facilities

2.2.7.1 Support Facilities for CO_2 Injectate Stream Sampling

An sampling port to collect samples of the CO_2 injectate stream is located directly downstream of the custody transfer meter measuring the mass of CO_2 delivered to the BRP Project. A technician reporting to the third-party manufacturer is required during initial calibration of the continuous gas analyzer, gas chromatograph and other gas analyzers that are installed at the sampling station. The third-party technician will also assist the OLCV team in commissioning and construction to install, commission, and startup the analyzer equipment; and will provide theoretical and hands-on field training of all analyzers to the BRP Operation / Maintenance crew. Besides the automated calibration feature that is available to some of the analyzers, the third-party manufacturer will also recommend appropriate inspection, maintenance, and calibration frequencies per the specific application. Finally, a full list of spare parts for equipment on the sampling skid will be provided by the third-party installer or manufacturer.

2.2.7.2 Support Facilities for Coupon Sampling

Coupon retrieval from locations above ground may require platforms to reach the coupon access fittings.

2.2.7.3 Support Facilities for Sampling Fluid from the Injection Zone

The third-party contractor responsible for logging will supply any support facilities that are necessary for wireline-deployed sample collection tools in the Injection Zone. A third-party contractor will install the U-tube in the SLR2 well and any required support facilities.

2.2.7.4 Support Facilities for Sampling Fluid from the Lowermost USDW

Support facilities necessary for collecting and analyzing fluid and dissolved gas samples from the USDW-level monitoring well will be determined in consultation with the selected sampling contractors and laboratories, prior to each mobilization.

2.2.7.5 Support Facilities of Equipment for Sampling Soil Gas

Support facilities necessary for collecting and analyzing soil and soil gas samples from the near-surface will be determined in consultation with the selected sampling contractors and laboratories, prior to each mobilization.

2.2.8 Corrective Action, Personnel, Documentation

The party responsible for collecting samples in the field or analyzing samples in the laboratory will also be responsible for calibrating and testing equipment and performing corrective actions on broken or malfunctioning equipment. If corrective action cannot be taken, then the equipment will be returned to the manufacturer for repair or replacement. The party conducting sampling or analyses will record the actions, if corrective actions were required before or after samples were acquired or analyses were conducted.

For fluid, soil and soil gas sampling and analysis, replacements and backups for all supplies, equipment, reagents, and tools are kept on hand. If replacements are necessary, third-party field technicians will contact their managers to inform them of the replacement. Duplicates of all equipment/sample bottles are pulled to ensure backups are available.

2.3 Sample Handling and Custody

This section pertains to physical samples that will be collected in a field and analyzed in a lab. Logging, gauge measurements, fiber measurements, seismic, DInSAR, GPS, and passive seismicity do not have physical samples and are not discussed in this section.

2.3.1 Maximum Hold Time / Preservation

The sampling hold times described in the tables below are listed in the following tables.

Table 18--Containers, preservation techniques and holding times for samples.

Sample Type	Container and volume	Preservation Technique	Max Holding Time
CO_2 Injectate Stream	In accordance with GPA 2177-20		
Coupons	Placed in sealed plastic bags or paper envelops to prevent rusting	NA	Delivered to the lab within one week
Fluid from Injection Zone	See table below		
Fluid from Lowermost USDW	See table below		
Soil Gas	See tables below		

Table 19a--Containers, preservation techniques and holding times for groundwater sample parameters collected in the Injection Zone (Lower San Andres) after drilling for the Water Wells (WW1 through WW4)

Parameters	Container and Volume	Preservation Technique	Max Holding Time
Geochemical Samples			
Total Metals/Metalloids and Dissolved Metals/Metalloids: Ag, Al, As, Ba, B, Cd, Ca, Co, Cu, Cr, Fe, Pb, Li, Mg, Mn, Mo, Ni, P, K, Sb, Se, Si, Na, Sr, Ti, Th, Tl, V, and Zn	250 mL/HDPE	Nitric acid, cooled to 4°C	180 days
Total Metals/Metalloids and Dissolved Metals/Metalloids: U	250 mL/HDPE	Nitric acid, cooled to 4°C	28 days

Total Metals/Metalloids and Dissolved Metals/ Metalloids: Hg	250 mL/HDPE	Nitric acid, cooled to 4°C	28 days
Anions: Br, Cl, F, NO_2, NO_3 and SO_4	500 mL/HDPE	Cooled to 4°C	28 days, 48 hours for NO_2 and NO_3 only
Total Bicarbonate, Carbonate, & Hydroxide Alkalinity	500 mL/HDPE	Cooled to 4°C	14 days
pH (lab)	60 mL/HDPE	Cooled to 4°C	Immediately
Total dissolved solids (TDS)	500 mL/HDPE	Cooled to 4°C	7 days
Water density (lab)	500 mL/HDPE	Cooled to 4°C	14 days
Dissolved Anions: PO_4^{3-}	125 mL/HDPE	Filtered, cooled to 4°C, sulfuric acid	48 hours
Total and dissolved Phosphorus as P	125 mL/HDPE	Cooled to 4°C, sulfuric acid	28 days
Dissolved Inorganic Carbon (DIC)	3x40 mL vial	Filtered, cooled to 4°C, sulfuric acid	28 days
Dissolved Organic Carbon (DOC)	3x40 mL vial	Filtered, cooled to 4°C, sulfuric acid	28 days
Conductivity/Specific Conductance	500 mL/HDPE	Cooled to 4°C	28 days
Volatiles: Benzene, toluene, ethylbenzene and xylenes	4x40 mL vial	Cooled to 4°C, hydrochloric acid	14 days
Water Isotopic Analyses			
$^{228}Ra/^{226}Ra$	1 L/HDPE	Nitric acid, cooled to 4°C	180 days
$^{87}Sr/^{86}Sr$	3x125 mL/HDPE	Filtered, none	> 365 days
$\delta^{18}O$ and $\delta^{2}H$ of H_2O	3x125 mL/HDPE	Filtered, none	> 365 days
$\delta^{13}C$ of DIC	3x125 mL/HDPE	Filtered, none	28 days
^{14}C of DIC	3x125 mL/HDPE	Filtered, none	28 days
Dissolved Gas Samples and Isotopic Analyses			
Dissolved Gas: N_2, CO_2, CO, O_2, Ar, H_2, He, CH_4, C_2H_6, C_3H_8, i-C_4H_{10}, n-C_4H_{10}, i-C_5H_{12}, n-C_5H_{12} and C6+	0.6 L IsoFask ®	None	1 year
$\delta^{13}C$ of dissolved CO_2, C1-C5, $\delta^{2}H$ of CH_4	0.6 L IsoFask ®	None	1 year
^{14}C of CH_4	0.6 L IsoFask ®	None	1 year
Dissolved CO_2	125 mL/HDPE	Cooled to 4°C	24 hours
Dissolved Gas: H_2S	125 mL/HDPE	Cooled to 4°C, zinc acetate and sodium hydroxide	28 days

Note: Sample preservation at temperatures up to 6 ºC is acceptable for laboratory analytical analyses.

Table 19b--Containers, preservation techniques and holding times for groundwater sample parameters collected in the Injection Zone after drilling in the Injection Zone (Lower San Andres) after drilling for In-Zone monitoring wells (SLR2 and SLR3).

Parameters	Container and Volume	Preservation Technique	Max Holding Time
Geochemical Samples			
Cations/metals: Al, Ba, Cd, Ca, Cr, Co, Cu, Fe, Fe, Fe, Pb, Li, Mg, Mn, Hg, Mo, Ni, P, K, Si, Na, Sr, V, and Zn	In review	In review	In review
Cation/metal: As	In review	In review	In review
Cation/metal: Hg	In review	In review	In review
Anion: Borate	In review	In review	In review
Anions: Br, Cl, and I	In review	In review	In review
Anions: F, NO_2, NO_3, PO_4, and SO_4	In review	In review	In review
Anion: S	In review	In review	In review
Alkalinity: total bicarbonate and carbonate	In review	In review	In review
Total Dissolved Solids (TDS)	In review	In review	In review
Organic Acids: Acetate, Butyrate, Formate, Glycolate, Propionate, Valerate	In review	In review	In review
Total Organic Carbon	In review	In review	In review
Cation Anion Balance	In review	In review	In review
Water density / Specific Gravity (lab)	In review	In review	In review
Salinity (from Conductivity)	In review	In review	In review
pH (lab)	In review	In review	In review
Gas-Water Ratio	In review	In review	In review
Dissolved Gas			
Dissolved Gas Abundances: N_2, CO_2, H_2S, C1, C2, C3, iC4, nC4, iC5, nC5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20+	In review	In review	In review

In review = Parameter will be determined after laboratory is selected.

Table 19c--Containers, preservation techniques and holding times for groundwater sample parameters collected in the first permeable zone above the Upper Confining Zone / the lowermost USDW during the March 2024 sampling event.

Parameters	Container and Volume	Preservation Technique	Max Holding Time
Geochemical Samples (Eurofins Labs)			
Total Metals/Metalloids: Al, Ag, As, B, Ba, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Ni, Li, Na, Pb, Sb,	2x250 mL/HDPE	Nitric acid, cooled to 4°C	180 days

Parameters	Container and Volume	Preservation Technique	Max Holding Time
Se, Si, Sr, Th, Tl, V, and Zn			
Total Metals/Metalloids: U			180 days
Total Metals/Metalloids: Hg			28 days
Dissolved Metals/Metalloids: Al, Ag, As, B, Ba, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Ni, Li, Na, Pb, Sb, Se, Si, Sr, Th, Tl, V, and Zn	2x250 mL/HDPE	Filtered, nitric acid, cooled to 4°C	180 days
Dissolved Metals/Metalloids: U			180 days
Dissolved Metals/ Metalloids: Hg			28 days
Anions: Br, Cl, F, NO2, NO3 and SO_4	500 mL/HDPE	Cooled to 4°C	28 days, 48 hours for NO2 and NO3 only
Alkalinity: Total, Bicarbonate, & Carbonate			14 days
pH (lab)			48 hours
Conductivity/Specific Conductance			28 days
Cation Anion Balance	500 mL/HDPE	Cooled to 4°C	N/A
Water density / Specific Gravity (lab)	500 mL/HDPE	Cooled to 4°C	14 days
Total dissolved solids (TDS)	500 mL/HDPE	Cooled to 4°C	7 days
Dissolved Anions: PO_4^{3-}	125 mL/HDPE	Filtered, cooled to 4°C, sulfuric acid	48 hours
Dissolved Inorganic Carbon (DIC)	3x40 mL vial	Filtered, cooled to 4°C, sulfuric acid	28 days
Dissolved Organic Carbon (DOC)	3x40 mL vial	Filtered, cooled to 4°C, sulfuric acid	28 days
Volatiles: Benzene, toluene, ethylbenzene and xylenes	3x40 mL vial	Cooled to 4°C, hydrochloric acid	14 days
Water Isotopic Analyses			
$^{228}Ra/^{226}Ra$	1 L/HDPE	Nitric acid, cooled to 4°C	180 days
$^{87}Sr/^{86}Sr$	3x125 mL/HDPE	Filtered, none	> 365 days
$\delta^{18}O$ and $\delta^{2}H$ of H_2O			> 365 days
$\delta^{13}C$ of DIC			28 days
^{14}C of DIC	125 mL/HDPE	Filtered, none	28 days
Dissolved Gas Samples and Isotopic Analyses			
Dissolved Gas: N_2, CO_2, CO, O_2, Ar, H_2, He, CH_4, C_2H_6, C_3H_8, i-C_4H_{10}, n-C_4H_{10}, i-C_5H_{12}, n-C_5H_{12}	0.6 L IsoFask ®	None	1 year

Parameters	Container and Volume	Preservation Technique	Max Holding Time
and C6+			
$\delta^{13}C$ of dissolved CO_2, C1-C5, $\delta^{2}H$ of CH_4			1 year
^{14}C of CH_4			1 year
Dissolved Gas: H_2S	500 mL/HDPE	Cooled to 4°C, zinc acetate and sodium hydroxide	28 days

Note: Sample preservation at temperatures up to 6 °C is acceptable for laboratory analytical analyses.

Table 19d--Containers, preservation techniques and holding times for groundwater sample parameters collected in the first permeable zone above the Upper Confining Zone / the lowermost USDW following the March 2024 sampling event.

Parameters	Container and Volume	Preservation Technique	Max Holding Time
Geochemical Samples (Green Analytical Lab)			
Total Metals/Metalloids: Ag, Al, As, B, Ba, Ca, Cd, Cr, Cu, Co, Fe, K, Mg, Mn, Mo, Ni, Li, Na, Pb, Sb, Se, Si, Sr, Th, Tl, Ti, V, and Zn	250 mL/HDPE	Nitric acid, cooled to 4°C	180 days
Total Metals/Metalloids: U			180 days
Total Metals/Metalloids: Hg			28 days
Dissolved Metals/Metalloids: Ag, Al, As, B, Ba, Ca, Cd, Cr, Cu, Co, Fe, K, Mg, Mn, Mo, Ni, Li, Na, Pb, Sb, Se, Si, Sr, Th, Tl, Ti, V, and Zn	250 mL/HDPE	Filtered, nitric acid, cooled to 4°C	180 days
Dissolved Metals/Metalloids: U			180 days
Dissolved Metals/ Metalloids: Hg			28 days
Anions: Br, Cl, F, NO2, NO3 and SO_4	500 mL/HDPE	Cooled to 4°C	28 days, 48 hours for NO2 and NO3 only
Alkalinity: Total, Bicarbonate, Carbonate, & Hydroxide			14 days
Total dissolved solids (TDS)			7 days
Conductivity/Specific Conductance			28 days
Water density (lab)			14 days
Dissolved Anions: PO_4^{3-}	125 mL/HDPE	Filtered, cooled to 4°C, sulfuric acid	48 hours

Parameters	Container and Volume	Preservation Technique	Max Holding Time
Total and dissolved: Phosphorus as P	125 mL/HDPE	Cooled to 4°C, sulfuric acid	28 days
pH (lab)	60 mL/HDPE	Cooled to 4°C	48 hours
Dissolved Inorganic Carbon (DIC)	3x40 mL vial	Filtered, cooled to 4°C, sulfuric acid	28 days
Dissolved Organic Carbon (DOC)	3x40 mL vial	Filtered, cooled to 4°C, sulfuric acid	28 days
Volatiles: Benzene, toluene, ethylbenzene and xylenes	4x40 mL vial	Cooled to 4°C, hydrochloric acid	14 days
Water Isotopic Analyses			
$^{228}\text{Ra}/^{226}\text{Ra}$	1 L/HDPE	Nitric acid, cooled to 4°C	180 days
$^{87}\text{Sr}/^{86}\text{Sr}$	3x125 mL/HDPE	Filtered, none	> 365 days
$\delta^{18}O$ and $\delta^{2}H$ of H_2O			> 365 days
$\delta^{13}C$ of DIC			28 days
^{14}C of DIC			28 days
Dissolved Gas Samples and Isotopic Analyses			
Dissolved Gas: N_2, CO_2, CO, O_2, Ar, H_2, He, CH_4, C_2H_6, C_3H_8, i-C_4H_{10}, n-C_4H_{10}, i-C_5H_{12}, n-C_5H_{12} and C6+	0.6 L IsoFask ®	None	1 year
$\delta^{13}C$ of dissolved CO_2, C1-C5, $\delta^{2}H$ of CH_4			1 year
^{14}C of CH_4			1 year
Dissolved CO_2	125 mL/HDPE	Cooled to 4°C	24 hours
Dissolved Gas: H_2S	125 mL/HDPE	Cooled to 4°C, zinc acetate and sodium hydroxide	28 days

Note: Sample preservation at temperatures up to 6 ºC is acceptable for laboratory analytical analyses.

Table 20--Containers, preservation techniques and holding times for soil gas and soil samples.

Sample Type	Container and volume	Preservation Technique	Max Holding Time
Soil Samples			
pH	16 oz. clear glass jar	Cooled to 4°C	24 hours
Electrical conductivity (EC)	16 oz. clear glass jar	Cooled to 4°C	180 days
Sodium Adsorption Ratio (SAR)	16 oz. clear glass jar	Cooled to 4°C	180 days
Moisture	16 oz. clear glass jar	Cooled to 4°C	60 days

Soil Gas Samples			
Gas: H_2, He, O_2, N_2, CO_2, CH_4, CO, Ar, C2-C6+	0.3-L IsoBag Gas Bag®	None	180 days
^{14}C of CO_2	0.3-L IsoBag Gas Bag®	None	180 days
$\delta^{13}C$ of Methane and CO_2, $\delta^{2}H$ of Methane	0.3-L IsoBag Gas Bag®	None	180 days

Note: Sample preservation at temperatures up to 6 °C is acceptable for laboratory analytical analyses.

2.3.2 Sample Transportation and Storage

It is the responsibility of the sampling contractor to ensure that all samples are delivered to the laboratories for analysis in appropriate conditions as described below.

Table 21. Containers, preservation techniques and holding times for CO_2 injectate, coupons, groundwater, soil, and soil gas samples.

Sample Type	Transportation	Storage
CO_2 Injectate Stream	In accordance with GPA 2177-20	
Coupons	Placed in dry containers	Delivered to the testing lab within one week
Fluid from Injection Zone	Shipped to testing facility within 24 hours of sample collection.	Placed in appropriate containers provided by laboratories and, as needed, placed in ice-filled containers and maintained at 4°C until analysis.
Fluid from Lowermost USDW	Shipped to testing facility within 24 hours of sample collection.	Placed in ice-filled coolers and maintained at 4°C until analysis
Soil	Shipped to testing facility within 24 hours of sample collection.	Placed in ice-filled coolers and maintained at 4°C until analysis
Soil Gas	Shipped to testing facility at the end of sampling event	Placed in appropriate containers provided by laboratories

Note: Sample preservation at temperatures up to 6 °C is acceptable for laboratory analytical analyses.

2.3.3 Sample Chain-of-Custody: Documentation, Identification, Tracking

All sample containers will have waterproof labels with relevant information regarding the project name, sampling date, sampling location, sample identification number, sample type, sample method, and sample preservation (if any).

2.3.3.1 Chain-of-Custody for CO_2 Injectate Samples

The third-party who collects the CO_2 injectate samples will maintain a chain-of custody procedure in accordance with GPA 2177-20.

2.3.3.2 Chain-of-Custody for Coupon Samples

Coupons are retrieved by contractor and analyzed for weight loss, pitting depth and any other damage (e.g., erosion). Results are reported to the Production Engineer for action and coupons will be retained for three years.

2.3.3.3 Chain-of-Custody for Groundwater Fluid Samples

Groundwater samples will be collected in accordance with the procedures described in Section 2.2 and field logbooks or an equivalent logging method will be maintained by the sampling contractors using standardized forms (if applicable) for consistency in the information reported. The information recorded in the field logbook will include at the minimum:

- The project information (e.g., project name and location);
- Daily activity entries (e.g., date, sampling start and end, weather conditions, name of sampling personnel);
- Field instrumentation used and calibration results; and
- Sample records, which should document the sample collection and field measurements (e.g., water quality parameters and water level). Sample records should also document sample locations and identification, consistent with the sample container labels for internal tracking.

When transferring the possession of samples, the personnel relinquishing and receiving the samples will sign, date, and note the time on the record. If a signature cannot be obtained, a note will be made in the "Received By" space of the chain-of-custody form. Copies of the form will be provided to the person/lab receiving the samples as well as the person/lab transferring the samples. The field logbooks and chain-of-custody forms will be retained and archived to allow simplified tracking of sample status. The chain-of-custody forms and the record-keeping task are both the responsibilities of the groundwater sampling team personnel and selected laboratories.

2.3.3.4 Chain-of-Custody for Soil and Soil Gas Samples

The chain-of-custody and field logbook requirements for soil and soil gas sampling are the same as the chain-of-custody requirements for groundwater described above.

2.4 Analytical Methods

This section pertains to physical samples that will be collected in a field and analyzed in a lab. Logging, gauge measurements, fiber measurements and seismic do not have physical samples and are not discussed in this section.

2.4.1 Description of Analytical Methods

2.4.1.1 Analytical Methods for CO_2 Injectate

CO_2 injectate will be analyzed by third-party lab in accordance with GPA 2177-20.

2.4.1.1 Analytical Methods for Coupons

Weight loss and pitting depth are measured to calculate the general corrosion and pitting corrosion rates and reported to the Production Engineer. Data is trended to determine if corrosion is present and changing over time.

2.4.1.3 Analytical Methods for Groundwater

All laboratory analyses of groundwater samples collected for monitoring the lowermost USDW, the first permeable zone above the Upper Confining Zone, and the Injection Zone will be conducted in accordance with EPA-approved methodologies or standardized methods (see Tables 6). Laboratory analyses of groundwater samples will be completed in accordance with SOPs developed by the respective laboratories to be consistent with referenced methods. Upon request, OLCV can provide all SOPs implemented for specific parameters using appropriate standard methods after a contract with the selected laboratories are established. The laboratories will summarize the analytical results, associated QA/QC results, and the laboratory certifications in a laboratory report.

2.4.1.4 Analytical Methods for Soil and Soil Gas

All laboratory analyses of soil and soil gas samples collected for characterizing and monitoring near-surface conditions will be conducted in accordance with EPA-approved methodology or standardized methods (see Table 7). Laboratory analyses of soil and soil gas samples will be completed in accordance with SOPs developed by the respective laboratories to be consistent with referenced methods. Upon request, OLCV can provide all SOPs implemented for specific parameters using appropriate standard methods after a contract with the selected laboratories are established. The laboratories will summarize the analytical results, associated QA/QC results, and the laboratory certifications in a laboratory report.

2.4.2 Performance Criteria

2.4.2.1 Performance Criteria for CO_2 Injectate Measurements

CO_2 injectate is considered acceptable if it meets the specifications established in the Testing and Monitoring Plan. Those specifications are also listed below in Table 22.

Table 22—CO_2 injectate specifications.

Component	Specification
CO_2 content	>95 mol% (>96.5 mass%)
Water	<30 lbm/MMscf
Nitrogen	<4 mol%
Sulphur	<35 ppm by weight
Oxygen	<5 mol%
Glycol	<0.3 gal/MMscf
Carbon Monoxide	<4,250 ppm by weight
NOx	<6 ppm by weight
SOx	<1 ppm by weight
Particulates ($CaCO_3$)	<1 ppm by weight
Argon	<1 mol%
Surface pressure	>1,600 psig
Surface temperature	>65°F and <120°F

Component	Specification
Isotopes	δ13C and 14C of CO_2

2.4.2.1 Performance Criteria for Coupon Measurements

Corrosion monitoring by coupons are considered acceptable if corrosion rates are:

- General corrosion rate < 0.1 mm/yr (4 mpy)
- Pitting corrosion rate < 0.2 mm/yr (8 mpy)

2.4.2.2 Performance Criteria for Groundwater Measurements

Internal audits of field activities for collection of physical groundwater samples will be conducted by OLCV or contractor, as necessary, to verify that the protocols specified in this document are being followed and correct any deficiencies in the execution of the field procedures. These internal audits may include an evaluation of the field sampling records, instrument operation records and groundwater sample collection and handling.

Laboratory performance criteria will be designated once the third-party analytical laboratory is selected and contracted, based on their quality assurance and quality control specifications. The selected laboratory will be responsible for implementing their internal laboratory assessments and correct any deficiencies to ensure their compliance with the analytical method SOPs. Any performance criteria failure will be reported to OLCV as pertinent to the testing and monitoring program for the BRP Project.

2.4.2.3 Performance Criteria for Soil and Soil Gas Measurements

Meeting the performance criteria for field and laboratory activities for soil and soil gas samples will follow the same procedures described in Section 2.4.2.2.

2.4.3 Corrective Action Plans

2.4.3.1 Corrective Action Plans for CO_2 Injectate

Short term anomalous variations related to temporary system upsets may occur. Continuous on-line analyzers measuring O_2, H_2O or CO_2 are alarmed and will alert OLCV analysts if the composition of these components is off-specification. In the event that the CO_2 injectate stream is off-specification for more than 60 minutes, OLCV will cease acceptance of the CO_2 injectate stream. OLCV will not resume accepting the stream unless on-line testing demonstrates conformance to the specified composition.

Measurement of injectate stream components other than O_2, H_2O and CO_2 will be measured quarterly by laboratory analysis. If laboratory measurements indicated that the injectate stream of off-specification, testing will be repeated. In the event that the CO_2 injectate stream is confirmed to be off-specification by repeat testing, OLCV will cease acceptance of the CO_2 injectate stream until it can be demonstrated to conform to the specification.

2.4.3.1 Corrective Action Plans for Coupons

If corrosion rates exceed the target, process conditions must be reviewed to determine if operating conditions contributed to corrosion or erosion and if these changes remain or are corrected. The determination of whether corrosion continues will be confirmed with the next retrieval cycle, or OLCV may increase the retrieval frequency until corrosion is under control. High corrosion rates may trigger further inspection for verification of the condition of the equipment.

2.4.3.3 Corrective Action Plans for Groundwater

Corrective actions during groundwater sample collections will be triggered during the preparation for and performance of the field activities if any of the following conditions are encountered:

- Insufficient equipment or materials available for collection of groundwater samples in accordance with the procedures specified in this document;
- The sampling program must be modified due to unexpected field conditions (i.e., extreme weather conditions);
- Field and/or laboratory specifications must be altered or are not achieved; and/or
- Field and/or laboratory procedures are not properly implemented as confirmed during audits.

Minor adjustments in field and laboratory procedures (e.g., change in sampling order, change in location of equipment blank, change in sample on which matrix spike and matrix spike duplicate analysis is performed) will be made at the discretion of the sampling contractors and laboratory personnel without prior approval from OLCV, and the modifications will be recorded in the field logbooks and laboratory reports. EPA will be notified of the modifications made in the submittal of regular project reports.

If major modifications which could affect the Project objectives are necessary, as determined by OLVC and/or contractors (e.g., change in sampling strategy for Injection Zone), OLCV will notify the EPA UIC Director for approval before implementation.

The sampling contractors and selected laboratories will be responsible for implementing the corrective actions necessary to address the change in field and laboratory conditions while ensuring adherence to the Project protocols. Potential types of corrective action may include re-sampling by sampling technicians or re-injection/re-analysis of samples by the laboratory personnel. The corrective actions conducted will be recorded in the field logbook and laboratory reports.

2.4.3.4 Corrective Action Plans for Soil and Soil Gas

The corrective action plan for soil and soil gas sampling will follow the same procedures described for groundwater.

2.5 Quality Control (QC)

2.5.1 Field Quality Control Activities and Frequency

2.5.1.1 Field QC of Groundwater

In addition to the samples collected at the Project monitoring wells, QC samples will be collected. General practices regarding the QC protocol for groundwater sampling are summarized in the table below for each sampling zone (i.e., lowermost USDW/first permeable zone above the Confining Zone and Injection Zone). All QC samples will be placed on ice after collection and shipped to respective third-party laboratories under chain-of-custody control.

Table 23--Field QC of groundwater.

QC Sample Type	Frequency
Field Duplicate	10% of the Primary Samples (minimum of 1 sample per field mobilization and sample zone)
Field Blank [1]	1 per sampling field mobilization
Equipment Blank [1]	1 per equipment or type of supplies, if non-dedicated equipment is used

[1] QC sample collected for the lowermost USDW monitoring program only.

<u>Field Duplicate</u>

A field duplicate sample will be collected at a frequency of one duplicate sample for every 10 samples, or, 10% of the primary samples. OLCV anticipates collecting one field duplicate sample for each sampling event and sampling zone. General precautions for collecting duplicate samples will be followed while sampling, including but not limited to alternating sample containers between the primary and duplicate samples if multiple containers are used. The duplicate samples will be analyzed for the same analytical parameters as the primary samples.

<u>Field Blank</u>

A field blank will be collected at a frequency of at least one field blank per field mobilization for sampling the USDW-level well. To collect the field blank sample, an open container of deionized water supplied by the laboratory will be placed near the monitoring well on the day of the field mobilization. At the end of the field mobilization, the water in the open container will be poured into a set of laboratory-supplied containers and immediately placed on ice for shipment to the laboratory under chain-of-custody control. OLCV anticipates collecting one field blank sample for each sampling event and the field blank sample will be analyzed for geochemical parameters only.

<u>Equipment Blank</u>

If additional USDW-level wells are constructed and non-dedicated equipment is used to collect groundwater samples, one equipment blank sample will be collected from at least one equipment type (sample pump) or type of supply (tubing). To prepare an equipment blank, the same decontamination procedures employed between sampling locations will be followed and a sample of deionized water provided by the laboratory will be run through the sample pump or tubing and collected in an appropriate sample container. OLCV anticipates collecting one equipment blank sample for each sampling event, if applicable, and the equipment blank sample will be analyzed for geochemical parameters only.

2.5.1.2 Field QC of Soil and Soil Gas

Field duplicate samples of soil and soil gas will be collected at a frequency of one duplicate sample for every 10 samples, or, 10% of the primary samples. General precautions for collecting duplicate samples will be followed while sampling, including but not limited to alternating sample containers between the primary and duplicate samples if multiple containers are used. The duplicate samples will be analyzed for the same analytical parameters as the primary samples for each sample medium.

2.5.1.3 Field QC of other samples collected

- Injectate sampling will be conducted by a third-party contractor in accordance with GPA 2177-20.
- Coupon testing will be performed by a third-party. OLCV will require an annual audit of the third-party contractor's retrieval procedures, coupon handling and transfer.
- Logging will be performed by a third-party contractor according to their SOP. The contractor will record information including: operating company; log type; well name; location and elevation; collection date; number of logging runs conducted; log depths; any environmental corrections that were performed; and, the name of the person who recorded the log and a witness. Following data collection, log data are QCd in the office by the contractor.
- Gauges, on-line gas analyzers, and geophysical data are collected in the field by a third-party contractor. Instrument QC and calibration is discussed in Section 2.7 of this document.

2.5.2 Laboratory or Office Quality Control Activities

- CO_2 injectate samples will be QCd in the laboratory by a third-party contractor according to that lab's procedures and in accordance with GPA 2177-20.
- For coupons, OLCV will require an annual audit of the third-party contractor's sample handling, sample analysis procedures, reporting, data management and reporting.
- Groundwater samples will be analyzed in the laboratory by a third-party contractor. The contractor will QC samples in the laboratory according to industry standard processes. Duplicates and blanks will be analyzed, in accordance with the contractors SOP. QC requirements are presented in Table 6a, 6b, 6c, 6d, and 6e.
- Soil and soil gas analysis will be conducted by a third-party contractor according to their SOP. QC requirements are presented in Table 7.

- Logging data will be QC'd in the office by the third-party contractor before being reviewed by the BRP team.
- Gas chromatograph data, gauge measurements, and optical cameras will be QC'd in the office by the BRP team.
- DInSAR, GPS, 2D VSP, 2D Surface seismic, and Seismicity data will be QC'd by third-party contractors in conjunction with qualified Oxy or OLCV personnel prior to being used for interpretations by the BRP Project team.

2.5.3 Control Limits and Corrective Action

- The specified composition is the control limit for the CO_2 injectate. Deviations of O_2, H_2O and CO_2 from specified limit will result in in an evaluation of the on-line analyzers measuring those components and a re-evaluation of the data. Gas analyzers will be programmed to trigger an alarm if the composition exceeds the specification for O_2, H_2O or CO_2. If an alarm is triggered, OLCV Engineers will be alerted, and the source of the problem will be investigated. In the case of minor system upsets, the composition is typically restored to specification within a few minutes. In cases where the source of the problem cannot be determined within 60 minutes, OLCV will cease acceptance of the CO_2 injectate stream until the stream is restored to the specification.
- If corrosion rates of 0.1 mm/yr (4 mpy) and 0.2 mm/yr (8 mpy) pitting rate are exceeded, review of operating conditions for the past three months will be conducted to determine possible events that may have contributed to the increase in corrosion rates. This may result in increase in frequency of coupon retrieval to monthly. At 2 mm/yr corrosion rate (i.e., 0.5 mm in three months) in addition to increase in coupon retrieval frequency, inspection of equipment will be conducted.
- If the analytical results for groundwater samples collected from the BRP monitoring zones exceed the ion balances by ±10%, further examination of the analytical results will be conducted. This evaluation will include the ratio of the measured total dissolved solids (TDS) to the calculated TDS (i.e., mass balance) per APHA method (APHA, 1999). The identification and evaluation of the suspected ion will be conducted in accordance with the APHA method. The results from the calculations will be compared to typical acceptance criteria, as well as historical data, if available. Potential corrective actions to address exceedance of control limits may include reanalyzing the suspected sample or suspected ion analytes, and potentially given less importance in data interpretations.
- For soil and soil gas, if sample analytical results do not fall within control limits set by the third-party laboratory, further examination of the results will be conducted and additional or repeat analyses may be conducted. The source of the deviation from control parameters will be determined before action is taken.
- Pressure Transmitters / Switch data inputs will be programmed within the PLC to trigger an alarm if injection pressure is approaching operational limits; and will trigger an automatic injection well shut in (through closing the actuated shutdown valve at the well

head) if the injection pressure is approaching: 90% of fracture pressure, pipeline operating limits, or casing pressure limits.
- DAS/DAT, seismic, seismicity, DInSAR, GPS and surface monitoring cameras do not have control limits. The data obtained by these sources will be evaluated by the third-party contractor who collects the data.

2.5.4 Applicable QC Statistics

2.5.4.1 Applicable QC Statistics CO_2 Injectate Samples

CO_2 injectate sample composition analyzed by a third-party contractor will be evaluated for trends and compared with data from on-line gas analyzers.

2.5.4.2 Applicable QC Statistics Coupons

Corrosion rate data will be evaluated for trends and correlated to operating parameters to identify events that have contributed to change in corrosion rates.

2.5.4.3 Applicable QC Statistics Groundwater

Groundwater data quality validation will include a review of the concentration units, sample holding times, a review of the duplicates, blanks, and other results. Data will be entered into a database that will be periodically reviewed for trends.

The following statistical analyses will be used to evaluate the accuracy of the groundwater sample results. If any of these tests are not met, additional investigation will be conducted and corrective action will be taken, including re-analysis of questionable parameters.

Field Precision

Field precision objectives for target parameters are ±30% relative percent difference (RPD) between field duplicates and expressed by the following equation:

$$\mathrm{RPD}\ (\%) = \frac{|X_1 - X_2|}{(X_1 + X_2)/2} \times 100$$

Where: RPD (%) = relative percent difference
X_1 = Original sample concentration
X_2 = Duplicate sample concentration

Charge Balance

The analytical results for the lowermost USDW will be evaluated to determine the accuracy of the analyses based on anion-cation charge balance calculations (APHA, 1999). All potable waters are expected to be electrically neutral, so the anion-cation charge balance calculated using the following formula below should yield zero percent, as the ion sums are calculated in milliequivalents per liter (meq/L):

$$\% \, difference = 100 \times \frac{\sum cations - \sum anions}{\sum cations + \sum anions}$$

The criterion for acceptable charge balance is ±10% for the BRP.

Mass Balance

The ratio of the measured TDS to the calculated TDS will be calculated in instances where the charge balance acceptance criteria are exceeded using the following formula:

$$1.0 < \frac{Measured\ TDS}{Calculated\ TDS} < 1.2$$

Outliers

Outliers will be evaluated using EPA approved statistical tools before conducting additional statistical evaluation of the groundwater analytical results (EPA, 2009). These tools may include Probability Plots, Box Plots, and Dixon’s test.

2.5.4.4 Applicable QC Statistics Soil and Soil Gas

Field Precision

Field precision objectives for target parameters are ±30% RPD between field duplicates and expressed by the following equation:

$$\text{RPD (\%)} = \frac{|\text{X}_1 - \text{X}_2|}{(\text{X}_1 + \text{X}_2)/2} \times 100$$

Where: RPD (%) = relative percent difference
X_1 = Original sample concentration
X_2 = Duplicate sample concentration

If RPD objectives are not met for the soil and soil gas analytical parameters, additional investigation will be conducted and corrective action will be taken, including re-analysis of questionable parameters.

Outliers

Outliers will also be evaluated using EPA approved statistical tools before conducting additional statistical evaluation of the groundwater analytical results (EPA, 2009). These tools may include Probability Plots, Box Plots, and Dixon's test.

2.5.4.5 Applicable QC Statistics for Other Data Types

- Log data, seismic data, seismicity data and DInSAR will be QCd by the third-party vendor collecting the data.
- Gauge, fiber and GPS measurements will be QCd based on their measurement resolution.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance

2.6.1 Instrument/Equipment Maintenance and Testing Plan and Schedule

2.6.1.1 Maintenance and Testing for CO_2 Injectate On-line Chromatographs

Maintenance and calibration of on-line gas analyzers is conducted by a third-party contractor or the equipment vendor. These units are designed to require minimal routine maintenance and extend for months between calibration events.

2.6.1.2 Maintenance and Testing for Coupons

Access fittings maintenance are conducted during retrieval and replacement of coupons along with the retrieval tools are the responsibility of the third-party contractor.

2.6.1.3 Maintenance and Testing for Groundwater

Water quality sensors used to measure field parameters during groundwater sampling (i.e., pH, temperature, specific conductance, oxidation-reduction potential, turbidity, and dissolved oxygen) will be calibrated according to manufacturer recommendations and equipment manuals each day before sample collection begins. Recalibration is performed if any components yield atypical values or fail to stabilize during sampling. All calibrations will be documented in the field logbook and will include:

- Date/time of calibration,
- Name of person performing the calibration,
- Reference standard used,
- Temperature at which readings were taken, and
- Calibration readings, as appropriate.

The typical calibrations standards for water quality sensors are described in the table below. However, the water quality sensor vendor may require different calibration standards.

Table 24—Calibration standards for groundwater samples

Field Parameter	Typical Calibration Standard

pH	3-Point calibration: 4, 7, and 10 pH standard unit solutions or +/- 0.2 Standard Units of calibration standards
Specific conductance	1-Point calibration: 1,413 microsiemens per centimeter (µS/cm) at 25°C or +/- 5% of calibration standard
Dissolved oxygen	1-Point calibration: 100% saturation or +/- 0.2 mg/L of calibration standard
Oxidation-Reduction Potential	1-Point calibration: 223 mV Zobell solution at 25°C or +/- 10 mV of calibration standard
Turbidity	1-Point calibration: 10 NTU or +/- 10% of calibration standard

Sensor maintenance may also include factory-service, and factory-calibration per manufacturer's recommendations. If equipment is outside the calibration interval, the equipment will be placed out of service and replaced with similar equipment in proper working conditions.

During groundwater sampling, a multi-gas (i.e., MultiRAE) meter and PID will be calibrated on-site prior to use in accordance with the manufacturer's specifications. The acceptable ranges of calibration check for the multi-gas and PID meters are:

- MultiRAE: %LEL, O2, CO2, H2S: +/-5%
- PID: zero calibration and isobutylene span calibration: +/-1ppm and +/-5%

For all laboratory equipment testing and maintenance will be the responsibility of the analytical laboratory per standard practices, method-specific protocols (i.e., SOPs), or accreditation agency (e.g., NELAP) requirements.

2.6.1.4 Maintenance and Testing for Soil and Soil Gas

For soil gas sampling, the portable field H_2S meter will be maintained, factory-serviced, and factory-calibrated per manufacturer's recommendations.

During soil and soil gas sampling, multi-gas and PID meters will be calibrated on-site prior to use in accordance with the manufacturer's specifications. The acceptable ranges of calibration check for the multi-gas and PID meters are:

- MultiRAE: %LEL, O2, CO2, H2S: +/-5%
- PID: zero calibration and isobutylene span calibration: +/-1ppm and +/-5%

For all laboratory equipment, testing, inspection, and maintenance will be the responsibility of the analytical laboratory per standard practices, SOPs, or accreditation agency requirements.

2.6.1.5 Maintenance and Testing for Logging

Logging equipment is maintained by the third-party contractor selected to conduct logging operations.

2.6.1.6 Maintenance and Testing for Gauges and Instruments

- Gauges are designed to require no routine maintenance. If anomalous downhole gauge results are recorded, the BRP Production Engineer and support staff will determine the source of the anomaly. Downhole gauge measurements can be corroborated with gauges deployed via wireline. If a surface gauge is suspected to require maintenance, the BRP team will investigate the source of the potential error and contact the vendor for replacement parts, as needed. Based on operational experience, OLCV recognizes that the gauges may fail during normal use and may need to be replaced at some point during the injection period.
- Fiber does not require routine maintenance. If the fiber yields anomalous measurements or fails, the OLCV team will investigate the source of the apparent issue. If the fiber is damaged near the wellhead, it may be repairable. Downhole issues are generally not repairable. In the case of downhole fiber failure, OLCV will rely on installed gauge measurements for the remainder of the injection or monitoring period.
- GPS devices will be maintained by OLCV and by the third-party vendor responsible for their deployment.
- Seismometers that are part of the network for measuring passive seismicity do not require routine maintenance. In the event that a seismometer fails, a third-party operator will be contracted to replace or repair the device as needed. Because the BRP Project will have a network of passive seismic monitors, the temporary absence of one station will not impede the ability to monitor seismicity in the area.
- OGI cameras and surface CO_2 sensors are designed to require minimal maintenance and will be calibrated by the vendor. In the event that a camera or sensor fails, the vendor will be contacted to provide maintenance or replacements.

2.6.2 Description of Preventive Maintenance

- Maintenance of on-line gas analyzers is conducted by a third-party contractor or the equipment vendor. These units are designed to require minimal routine maintenance.
- Access fittings and retrieval equipment for corrosion coupons must be kept clean, covered, and protected from dirt and the external environment by maintaining covers.
- The sampling contractor will be responsible for ensuring the water quality probes are stored in appropriate conditions and the sensors are maintained or replaced at regular intervals according to the manufacturer(s) recommendations, to make sure that the equipment remains in proper conditions (e.g., replace potassium chloride (KCl) solution and membrane cap every 30 days for dissolved oxygen sensors). Laboratory personnel will be responsible for conducting the necessary preventative maintenance on their equipment in accordance with the analytical laboratory per standard practices, SOPs, or accreditation agency requirements.

- Soil gas stations are not anticipated to require routine maintenance. Stations will be inspected upon each sampling event. If a station requires maintenance or replacement, it will be conducted by a third-party contractor. The sampling contractor will be responsible for ensuring the H_2S meter is stored in appropriate conditions and the sensors are maintained or replaced at regular intervals according to the manufacturer(s) recommendations, to make sure that the equipment remains in proper conditions. Laboratory personnel will be responsible for conducting the necessary preventative maintenance on their equipment in accordance with the analytical laboratory per standard practices, SOPs, or accreditation agency requirements.
- Logging equipment will be maintained by the third-party contractor responsible for logging.
- Downhole and surface gauges are designed to require minimal maintenance. If maintenance is required on surface gauges, OLCV field personnel will inspect the equipment to determine whether it can be fixed in the field. If the equipment cannot be fixed in the field, the equipment vendor will be contacted to provide a repair or replacement. Downhole gauges will be repaired or replaced by a third-party contractor.
- Fiber does not require routine maintenance. If fiber data is anomalous, the OLCV team will visually inspect the fiber connections at the wellhead. If maintenance at the wellhead is required, a fiber vendor or third-party contractor will be contacted to provide the service.
- Passive seismic monitoring stations do not require routine maintenance. If a station fails or yields anomalous data a third-party contractor will be contacted to make an inspection of the station and perform a repair or replacement, if necessary.
- GPS devices will be maintained by OLCV or the vendor providing the devices. If a device fails or yields anomalous data a third-party contractor will be contacted to make an inspection of the device and perform a repair or replacement, if necessary.
- Seismic and DInSAR equipment will be maintained by the third-party contractor responsible for acquiring those data.
- Surface OGI cameras and surface CO_2 sensors require minimal routine maintenance. If maintenance is needed, the field team will conduct the maintenance or contact a third-party contractor.

2.6.3 Critical Spares

2.6.3.1 Critical Spares for CO_2 Injectate On-line Gas Chromatographs

- If the on-line gas analyzers fail, a portable chromatograph can be deployed, and the analyzers will be replaced as soon as is feasible. Increased frequency of sampling for laboratory analysis will be conducted if the on-line gas analyzers are unavailable.
- Critical spares are not applicable to coupons. Coupons will be provided by the third-party contractor as part of their retrieval contract.

- Spare equipment for groundwater sampling and monitoring will be provided by the third-party laboratory responsible for conducing the sampling and analyses. Those key equipment include but are not limited to sample containers in proper condition, calibration solutions for water quality sensors, sampling pump parts that require regular replacement (e.g., O-rings), compressed gas (e.g., nitrogen) for bladder pumps and decontamination solutions. The laboratory will be responsible for ensuring that the critical spares are available to conduct necessary maintenance in order to avoid erroneous results or project delays.
- Spare equipment for soil and soil gas sampling and monitoring will be provided by the third-party laboratory responsible for conducing the sampling and analyses. Those key equipment include but are not limited to: sample containers in proper condition, 60 mL gas-tight syringes, 3-way valves, and helium gas as a tracer. The laboratory will be responsible for ensuring that the critical spares are available to conduct necessary maintenance in order to avoid erroneous results or project delays.
- In the event that a downhole gauge fails, surface gauges or fiber measurements will be used to collect continuous monitoring data until a replacement gauge can be installed. In the event that a surface gauge fails, a gauge can be sourced and replaced in a few days. During this time, the UIC Class VI injection well will be shut in until replacement gauges can be sourced and installed.
- It is not possible to have spare fiber. If fiber fails near the wellhead, it may be possible to conduct a repair. Fiber that fails downhole is not possible to repair. In the event that downhole fiber fails, gauge measurements will be used to provide continuous reporting of operational parameters.
- The logging operator is responsible for spare logging tools.
- Passive seismometer stations are expected to operate for years without maintenance or failure. If one station does fail, the seismicity will continue to be monitored by the remaining seismometer network until the station can be repaired for replaced.
- The third-party companies responsible for acquiring seismic and DInSAR data are responsible for spare equipment.
- Surface OGI cameras provide complimentary information to downhole gauge and fiber measurements. In the event that a OGI camera fails, the downhole gauge and fiber will continue to provide information on mechanical integrity, until the surface equipment can be repaired or replaced.
- Surface CO_2 sensors provide complimentary information to other leak detection methods. In the event that a surface sensor fails, the other leak detection methods will be used until the surface equipment can be repaired or replaced.

2.6.4 Re-inspection and Effectiveness of Corrective Actions

- CO_2 injectate samples collected for laboratory analyses may be re-collected for duplicate analyses. If the injectate stream is found to be off-specification, duplicate samples may be collected for re-analyses. OLCV will cease to accept the CO_2 injectate stream until the stream meets the specification. UIC Class VI injection wells will be shut in until samples meet the specification. Re-inspection is not applicable to on-line gas analyzers.

- Re-inspection is not applicable to coupons.
- Equipment and materials used for collecting groundwater samples will be inspected at the beginning of each sampling day to ensure their adequate working conditions. Equipment or materials found to be defective will be removed from service and replaced with brand-new items of similar effectiveness. If equipment or materials are suspected of becoming compromised during sampling activities, the sampling contractors will re-inspect the equipment or materials in question. After inspection, corrective actions may be necessary to address the defective items, including re-calibration or replacement. The sampling technicians will continue to monitor the conditions of the recalibrated or replacement item to ensure that the implemented corrective actions were successful in addressing the issues.
    - Laboratory personnel will be responsible for re-inspecting their instruments and evaluating the effectiveness of any corrective actions taken to amend or replace defective parts. If instrument deficiencies are suspected to affect the quality of the data, the laboratory personnel will reanalyze the affected samples.
    - Re-inspection on groundwater samples may be conducted if data is anomalous. If re-sampling is determined to be appropriate, it will be conducted as quickly as is feasible. Other monitoring methods, including gauges, fiber and surface CO_2 monitors and cameras will be utilized to provide plume monitoring in the interim.
- Soil gas sampling equipment and materials (e.g., 60 mL gas-tight syringes, 3-way valves, laboratory provided sample containers) will be inspected at the beginning of each sampling day to ensure their adequate working conditions. If equipment or materials are suspected of becoming compromised during sampling activities, the sampling contractors will replace them with a similar item in proper working conditions.
    - Laboratory personnel will be responsible for re-inspecting their instruments and evaluating the effectiveness of any corrective actions taken to amend or replace defective parts. If instrument deficiencies are suspected to affect the quality of the data, the laboratory personnel will reanalyze the affected samples.
    - Soil gas may be re-sampled if data is anomalous. If re-sampling is determined to be appropriate, it will be conducted as quickly as is feasible. Other monitoring methods, including gauges, fiber and surface CO_2 monitors and cameras will be utilized to provide plume monitoring in the interim.
- Re-inspection is not applicable to gauges. If gauge data is determined to be anomalous, wireline deployed gauges may be used to provide a comparison, or the results will be compared to fiber data.
- If log data is determined to be anomalous, alternative logging tools may be run and/or another vendor may be used so that results could be compared.

- Re-inspection is not applicable to seismic data, seismicity data, DInSAR, GPS, OGI devices or surface sensors.

2.7 Instrument Calibration, Frequency and Methodology

2.7.1 Instruments to be Calibrated

- On-line gas analyzers will be calibrated at by the equipment vendor at the frequency specified by the manufacturer. Laboratory sampling equipment will be calibrated by the third-party laboratory.
- Instrument calibration is not applicable to coupons.
- Water quality sensors used to measure field parameters during groundwater sampling (i.e., pH, temperature, specific conductance, oxidation-reduction potential, turbidity, and dissolved oxygen) will be calibrated according to manufacturer recommended schedules by sampling personnel each day before sample collection begins or factory-calibrated as needed.
- Laboratory equipment for analyzing water and dissolved gas will be tested inspected, and maintained by the analytical laboratory responsible for the work. Calibration will be conducted at schedules determined by equipment manufacturer, standard practices, SOPs, or accreditation agency requirements.
- Soil gas samples will be analyzed by a third-party laboratory. For all laboratory equipment, testing, inspection, and maintenance will be the responsibility of the analytical laboratory and will be conducted at schedules determined by equipment manufacturer, standard practices, SOPs, or accreditation agency requirements.
- Logging equipment is calibrated by the logging vendor.
- Gauges are calibrated by the vendor on a frequency specified by the manufacturer.
- Fiber does not require routine calibration
- Seismometers, VSP and DInSAR instrumentation will be collected by a third-party vendor and instrumentation used to collect these data will be performed by the vendor.
- GPS units will be calibrated at a frequency recommended by the manufacturer.
- OGI devices and surface sensors will be calibrated by the vendor according to the frequency and methodology specified by the manufacturer.

2.7.2 Maintaining and Tracking Calibration Records

Records will be archived for the life of the Project and maintained in an accessible database.

- Calibration records for equipment used during groundwater sampling, as well as any deviation, will be kept in field logbooks by sampling contractor. Corrective actions implemented to resolve any discrepancies will also be recorded.
- The laboratories responsible for analyzing fluids and dissolved gases, soil gases and the CO_2 injectate stream will be responsible for maintaining their calibration records in

compliance with standard practices, SOPs, or accreditation agency requirements. The laboratory may provide applicable certifications of instrument calibration to OLCV upon request.

- Field calibration records are not anticipated for soil and soil gas sampling. However, should any field instrument be used for collecting measurements, the sampling contractors will record the calibration results in the field logbooks, as well as any deviations.

2.8 Inspection/Acceptance of Supplies and Consumables

2.8.1 List of Supplies and Consumables, Acceptance Criteria, Responsibility

- The vendor for the on-line gas analyzers or the laboratory conducting the gas chromatography analyses will maintain spare parts, supplies and consumables.
- The third-party contractor conducting coupons must maintain spare parts for the retrieval tools and coupons to allow for immediate coupon retrieval upon call.
- The third-party contractor for groundwater sampling and analysis must maintain spare sampling equipment and analysis instrumentation. Samples will be collected in method-specified containers, with appropriate preservatives, supplied and certified contaminant-free by the laboratory. Sample containers with appropriate preservatives will be inspected by field crew for breakage and proper sealing of caps. Other sampling equipment/supplies (e.g., sample coolers, tubing etc.) and field measurement supplies (e.g., calibration solutions) will also be inspected before use by field personnel for damage and proper seals. Defective supplies and equipment will be discarded and replaced.
- The third-party contractor responsible for installing and maintaining soil gas sampling equipment, logging equipment, gauges, seismometers, VSP, DInSAR, GPS, OGI, and surface sensors will be responsible for inspecting and accepting consumables.
- There are no supplies and consumables for fiber following the installation.

2.9 Non-direct Measurements

2.9.1 Sources and Description of Non-direct Data

Indirect geophysical monitoring techniques including DInSAR, GPS, 2D VSP, 2D surface seismic, and saturation logging will be used to monitor the CO_2 plume and pressure front. In addition, saturation logging data, temperature gauge data, and DTS data from selected monitoring wells will be used to constrain movement of the plume.

The interpretation of indirect monitoring methods requires a pre-injection baseline. OLCV collected DInSAR, GPS, VSP, 2D surface seismic and saturation logging prior to injection. Gauges and DTS will also be installed, and data will be collected prior to commencement of injection.

2.9.2 Acceptance Criteria of Non-direct Data

Geophysical and logging data will be collected by third-party vendors using practices that are accepted by the industry. The third-party operator will perform QA checks before, during, and after data acquisition. Data will also be checked by the geophysical processing vendor and further checked by qualified OLCV or Oxy geophysicists.

2.10 Data Management

2.10.1 Data Management Scheme

OLCV will maintain required Project data using a custom-designed data management system involving state-of-the art cloud storage solutions. Data will be maintained for the required duration of the Project.

2.10.2 Recordkeeping and Tracking Practices

BRP Project data will be categorized with appropriate metadata for future tracking and retrieval. The data will be securely stored using cloud-based services that were specifically designed to meet the needs of the BRP Project.

2.10.3 Data Handling Equipment and Procedures

Gauge, fiber, on-line gas analyzers and other instrument-derived field data collected at the BRP site will be transmitted to a control room staffed by Oxy and OLCV personnel. A fiberoptic network will be installed to transmit high-density data from CO_2 Injector wells and some monitoring wells. Other monitoring wells that are expected to have a lower density of data will utilize wireless transmission. OLCV will implement a Supervisory Control and Data Acquisition (SCADA) system to collect data and support monitoring. For events that require maintenance or remediation, tickets will be created to track the progress of action to completion.

Data that are collected and processed or analyzed by third-party vendors, such as fluid and soil gas analyses, VSP, and DInSAR will be delivered to OLVC's office location for interpretation by integration by OLCV or Oxy geologists, geophysicists, and engineers.

2.10.4 Responsibility

The BRP Project Manager will be responsible for ensuring that proper data management is maintained. The Project Manager will utilize third-party contractors, OLCV and Oxy Information Technology support staff, as needed.

2.10.5 Data Archival and Retrieval

Data will be securely stored and archived on cloud-based systems. Metadata will be used to categorize the data for future retrieval. These data will be retrievable from the digital repositories.

2.10.6 Hardware and Software Configurations

BRP will ensure that hardware and software are compatible between office and field locations.

2.10.7 Checklists and Forms

Checklists or forms will be generated, if needed, to audit data storage and retrievability.

3.0 Assessment and Oversight

3.1 Assessment and Response Actions

3.1.1 Activities to be Conducted

The testing and monitoring activities will be conducted at a frequency outlined in Table 2 of this document. The data resulting from these activities will be evaluated by OLCV or Oxy geologists and engineers. Data will be integrated, as appropriate, into updates of the AoR and shared with the EPA Class VI Administrator, as needed.

3.1.2 Responsibility for Conducting Assessments

Internal assessments of data will be conducted by the department responsible for evaluating and interpreted those data. For example, petrophysicists and geologists will evaluate log data, geophysicists will evaluate VSP and passive seismic data. Field instrumentation analysists will evaluate gauge and on-line chromatography data.

3.1.3 Assessment Reporting

Assessment data will be reported, as required.

3.1.4 Data Corrections

Corrections that may impact multiple teams or functions will be communicated to those functions. Corrective actions impacting multiple teams or functions will be shared with appropriate personnel. The BRP Project Manager is responsible for ensuring that information on data corrections is distributed to those who need the information.

3.2 Reports to Management

3.2.1 Status Reports

QA status reports are not required unless there are significant adjustments to the methods and procedures described in this document. If the QA process is substantially changed, the revisions will be discussed with the UIC Program Director and distributed to relevant parties.

4.0 Data Validity and Useability

4.1 Data Review, Verification and Validation

4.1.1 Criteria for Accepting, Rejecting, or Qualifying Data

Validations of data will include a review of concentration units, sample holding times, and a review of duplicate, blank and other QA/QC results. Laboratory results will be retained for the life of the Project and reported according to the requirements for the Permit. Reports will present data in a graphical or tabular format, as appropriate to characterize the specific component being analyzed. After sufficient data have been collected, additional methods, such as those described in the US EPA 2009 Unified Guidance (EPA, 2009), will be used to examine intrawell variations for groundwater constituents to assess whether significant changes have occurred that could be the result of CO_2 or brine seepage into the storage reservoir.

4.2 Verification and Validation Methods

4.2.1 Data Verification and Validation Process

Verification will include a review of documentation to confirm the location, date, data type and other identifying information. Oxy and OLCV geologists and engineers will utilize decades of industry experience to interpret the data and integrate the data into updated subsurface characterization and simulation modelling.

4.2.2 Data Verification and Validation Responsibility

Third-party contractors who are responsible for collecting and analyzing data are responsible for verification and validation. Data collected in the field from gauges, DTS and on-line gas analyzers will be verified and validated by OLCV or Oxy field-based or office-based well analysts.

4.2.3 Checklist, Forms, and Calculations

If needed to meet permit requirements, checklists and forms will be designed to collect and report the required data.

4.3 Reconciliation with User Requirements

4.3.1 Evaluation of Data Uncertainty

OLVC or designated contractors will use statistical tools consistent with EPA guidelines (EPA, 2009) to provide data uncertainty, if applicable. The evaluation and reporting of the generated data to EPA will describe and quantify those uncertainties

4.3.2 Data Limitations Reporting

Each function will be responsible for ensuring that the data presented in their interpretation or analyses are appropriately used. OLCV will comply with Class VI Permit guidance on use, sharing, and presentation of data. OLCV will use the operating procedures described in this document for utilizing, sharing, and presenting results and/or data for the BRP Project. The procedures have been developed to ensure quality and internal consistency and facilitate tracking and record keeping of data end users and associated publications and reporting, as well as compliance with 40 CFR §146.90(h).

5.0 References

ASTM Standard D 5002 – 99, 2005, Standard Test Method for Density and Relative Density of Crude Oils by Digital Density Analyzer

APHA, 1999, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, Washington, DC.

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EPA, 2023b. Soil Gas Sampling: LSASDPROC-307-R5. Region 4 U.S. Environmental Protection Agency Laboratory Services and Applied Science Division, Athens, Georgia, 22 April 2023.

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