PRE-OPERATIONAL PLAN
40 CFR §146.82

Brown Pelican CO_2 Sequestration Project

CONTENTS

Facility name: Brown Pelican CO_2 Sequestration Project
BRP CCS1, BRP CCS2 and BRP CCS3 Wells

Facility contact: [redacted]

Well location: Penwell, Texas

BRP CCS1	31.76479314	-102.7289311
BRP CCS2	31.76993805	-102.7332448
BRP CCS3	31.76031163	-102.7101566

1. Introduction / Purpose

The Brown Pelican CO_2 Sequestration Project (BRP Project or Project) includes participation of multidisciplinary teams from Occidental Oil & Gas Corporation (Oxy), parent company of Oxy Low Carbon Ventures (OLCV) consultants, and subcontractors. Each team will provide technical expertise and economic inputs to the Project to ensure a safe, successful, and efficient operation.

The testing activities described in this document are restricted to drilling, testing, and completing wells during the Pre-Injection phase. Testing and monitoring activities during the Injection and Post-Injection Site Care phases are described in the Testing and Monitoring Plan, along with other non-well related pre-injection baseline activities, such as geochemical monitoring.

The pre-injection operational testing plan described in this document is designed to meet the testing requirements of Title 40 of the U.S. Code of Federal Regulations Section §146.87 (40 CFR §146.87) and the well construction requirements of 40 CFR §146.86.

The pre-operational testing program will utilize a combination of open and cased hole logging, coring, fluid sampling, and formation hydrogeologic testing to determine and verify the depth, thickness, mineralogy, lithology, porosity, permeability, and geomechanical information of the Injection Zone, confining zones, and other relevant geological formations.

All pre-injection testing procedures for logging, sampling, and testing, as required by 40 CFR §146.87, will be submitted to the Underground Injection Control Director for review. The results of the testing activities will be documented in a report and submitted to the US Environmental Protection Agency (EPA) after the well drilling and testing activities have been completed, but before the start of CO_2 injection operations.

The BRP Project will notify the EPA at least 30 days prior to conducting the test and provide a detailed description of the testing procedure. Notice and the opportunity to witness these tests/logs shall be provided to the EPA at least 48 hours in advance of a given test/log.

A table of the wells described in this document is shown below (Table 1). A summary of pre-operational data collected or planned for collection is presented in Table 2.

Table 1--Summary of wells drilled/planned for the BRP Project

Regulatory Well Name	Project Well Name	Drill Date	Purpose	Latitude (NAD 27)	Longitude (NAD 27)
Shoe Bar 1	SLR1	2023	Stratigraphic test well; to be converted to SLR1	31.76343602	-102.7034981
Shoe Bar 1AZ	ACZ1	2023	Stratigraphic test well	31.76448869	-102.7305326
Shoe Bar 1USDW	USDW1	2023	Monitor lowermost USDW	31.76411900	-102.7316750
Shoe Bar 2SLR	SLR2	2025*	Monitor Injection Zone	31.74670102	-102.7259011
Shoe Bar 3SLR	SLR3	2030*	Monitor Injection Zone	31.78023685	-102.7418093
Shoe Bar 1CCS	BRP CCS1	2024*	CO_2 Injector	31.76479314	-102.7289311
Shoe Bar 2CCS	BRP CCS2	2024*	CO_2 Injector	31.76993805	-102.7332448
Shoe Bar 3CCS	BRP CCS3	2025*	CO_2 Injector	31.76031163	-102.7101566
Shoe Bar 1WW	WW1	2024	Brine water withdrawal	31.76289539	-102.6959232
Shoe Bar 2WW	WW2	2024	Brine water withdrawal	31.78419981	-102.7275869
Shoe Bar 3WW	WW3	2024	Brine water withdrawal	31.75008553	-102.7102206
Shoe Bar 4WW	WW4	2024	Brine water withdrawal	31.76384464	-102.7539505

*Anticipated drill timing

Table 2--Summary of data acquired or planned for wells in the BRP Project

	Basic Log Suite	Advanced Logging Suite				Core Acquisition		Formation Testing				Formation Fluid Sampling		Mechanical Integrity Testing	Plume Monitoring
	GR, SP, NPHI, RHOB, SGR, RES, PEF	ECS	NMR	FMI	Dipole Sonic	Whole Core	Sidewall Core	MDT - Pressure	Mini-Frac	SRT	PFOT	MDT	Downhole Fluid Sampling	Isoscanner/USIT /CBL-VDL	Pulsed Neutron Logging
Shoe Bar 1 (SLR1)	1	1	1	1	1	1	1	1	1	1	1	1	2, 3	1, 2	1, 2, 3
Shoe Bar 1AZ (ACZ1)	1	1	1	1	1	1	1	1		1	1	1	2, 3	1, 2	1, 2, 3
BRP CCS1	1	1	1	1	1			1	1		2	1		1	
BRP CCS2	1	1	1	1	1			1	1		2	1		1	
BRP CCS3	1	1	1	1	1		1	1	1		2	1		1	
USDW1	1												2, 3	1, 2	1, 2, 3
SLR2	1				1			1				1	2, 3	1, 2	1, 2, 3
SLR3	1				1			1				1	2, 3	1, 2	1, 2, 3
WW1	1				1			1				1	2, 3	1, 2	1, 2, 3
WW2	1				1			1				1	2, 3	1, 2	1, 2, 3
WW3	1				1			1				1	2, 3	1, 2	1, 2, 3
WW4	1				1			1				1	2, 3	1, 2	1, 2, 3

Notes: Summary of logging, coring, MIT, formation testing and sampling in the wells at BRP Project. The numbers indicate the phase of the Project the data will be acquired: 1 – During Construction, 2 – During Injection, 3 – During Post-Injection

1.1 Overview of Logging Suite(s)

A brief description of the logging tools that will be run during construction summarized in Table 2 is documented below.

- Basic log suite: A triple combo with spectral gamma ray will be the basic log suite that will be run in all the wells in the BRP Project. The measurements obtained include Gamma Ray (Total and Spectral), Spontaneous Potential (SP), Neutron Porosity (NPHI), Bulk Density (RHOB), Resistivity (RES), and Photoelectric Factor (PEF). The combination of these log measurements enables interpretation and quantification of key petrophysical properties such as porosity, mineralogy, fluid saturations with a high degree of resolution and accuracy.

- Advanced log suite(s)

  - Elemental Capture Spectroscopy (ECS): This tool is used to quantify elemental dry weight concentrations of key elements such as Calcium, Magnesium, Silicon, Sulfur, Iron, and others. This data can then be used to determine detailed mineralogy. The Lithoscanner tool (from Schlumberger) is an example of such a tool.

  - Nuclear Magnetic Resonance (NMR): NMR tools can quantify porosity, pore size distribution, bound and free fluid volumes and provide estimation of permeability, from which injectivity can be interpreted.

  - Formation Micro-Imager (FMI): This tool when run can generate precisely oriented false-color image of the formation at a 5mm resolution based on an array of micro-resistivity sensors. From these images geoscientists can identify bedding, sedimentary structures, diagenetic features, and tectonic features such as fractures, faults, folds, as well as mechanically induced features from drilling processes like breakouts and/or induced fractures. The orientation (e.g., dip and strike) of any feature observed in the image can also be precisely quantified.

  - Modular Formation Dynamics Tester (MDT): A mission-configurable, modular platform consisting of a series of reservoir interfaces (single-packer, dual-packer, or probe types), a downhole pump, a suite of real-time measurements to identify and quantify properties of fluid in the tool flowline, and various sizes and types of fluid sampling chambers. The principal sequestration project applications are to measure formation water mobility, to capture representative formation water samples (in both USDWs and Injection Zones), and to perform direct in-situ measurements of fracture breakdown pressure and closure pressure (in both Confining Zones and Injection Zones) by pumping fluid into a ~3ft interval isolated by inflatable dual packers.

- Dipole Sonic: These tools quantify the slowness of various acoustic wave modes in the formation, including compressional, fast, and slow shear, horizontal shear, and Stoneley. These measurements provide the starting point for a continuous 1D mechanical earth model (MEM) including interpreted formation properties such as Young's Modulus, Poisson's Ratio, Unconfined Compressive Strength (UCS), and tensile strength. The data can also be used to interpret principal stress magnitudes and orientation. The Sonic Scanner tool (from Schlumberger) is an example of such a tool.

- Sidewall Coring Tool: These tools such as XLRock (from Schlumberger) use a hydraulic-powered rotary drilling assembly that cuts and retrieves a core sample from the borehole wall measuring 1.5" in diameter and up to 3" in length. The samples are suitable for all types of routine core analysis (RCA) as well as a broad portfolio of special core analysis (SCAL) measurements appropriate for CCS projects in both Confining Zones and Injection Zones.

2. Stratigraphic Wells

2.1 Overview of Stratigraphic Wells

The Shoe Bar 1 and Shoe Bar 1AZ stratigraphic wells were drilled in 2023 to provide site-specific characterization data for the BRP site. The Shoe Bar 1AZ is located within the proposed AoR, close to the locations in proposed Injector wells. Core data collected in the Shoe Bar 1AZ is representative of the subsurface at the locations of proposed future injectors BRP CCS1 and BRP CCS2, which will be located less than 2,000 ft around Shoe Bar 1AZ (see additional details in Pre-Operational Plan Appendix A). The Shoe Bar 1 is located in the easternmost extent of the modeled AoR, approximately 1.5 miles East of Shoe Bar 1AZ.

The Project acquired a comprehensive suite of basic and advanced geophysical logs, whole core through the injection interval, sidewall cores, reservoir pressure data and fluid samples. After each well was constructed, the BRP team conducted step-rate tests in the injection and confining intervals. Shoe Bar 1 will be converted to the SLR1; it will be plugged above the Injection Zone and used for future DTS/DAS monitoring. The Shoe Bar 1AZ will be plugged above the Injection Zone prior to the commencement of injection. The portion of the well above the upper confining zone will temporarily be left unplugged and inactive pending further evaluation of utilization for this wellbore.

The following sections summarize the details of the logging and coring plans executed in the stratigraphic wells.

2.2 Logging Program in Stratigraphic Wells

The Shoe Bar 1 was drilled in January 2023. The well was planned with a 3-string casing design with the surface section (or surface string casing) at 0-1,800’ MD, intermediate section (or intermediate string casing) at 1,800-3,800' MD, and production section (or long string casing) at 3,800-6,550' MD.

Table 3 summarizes the data acquisition program conducted in the Shoe Bar 1.

Table 3--Data acquired in the Shoe Bar 1 Well

Method	Interval Section(s)	Purpose
Open Hole Logs, Surveys and Sampling During Construction		
Deviation survey [40 CFR §146.87 (a) (1)]	Every 100 ft while drilling as minimum, from surface to TD.	Define well trajectory, displacement, and tortuosity
Wireline- Spontaneous Potential – [40 CFR §146.87 (a) (2) (i)]	Intermediate, Production	Correlation log, volume of shale indicator, estimate salinity
Wireline – Caliper – [40 CFR §146.87 (a) (2) (i)]	Intermediate, Production	Identify borehole enlargement and calculate cement volume
Wireline –Resistivity – [40 CFR §146.87 (a) (3) (i)]	Intermediate, Production	Fluid identification, estimate salinity, correlation log
Wireline -Gamma ray – [40 CFR §146.87 (a) (3) (i)]	Intermediate, Production	Define stratigraphy, correlation log, shale indicator
Wireline -Magnetic resonance image – [40 CFR §146.87 (a) (3) (i)]	Production	Estimate porosity, pore size distribution, permeability index
Wireline -Sonic Scanner – [40 CFR §146.87 (a) (3) (i)]	Intermediate, Production	Estimate mechanical properties, validation of velocity model, well tie to seismic
Wireline - Spectral gamma ray – [40 CFR 146.87 (a) (3) (i)]	Intermediate, Production	Define uranium rich formation, clay indicator
Wireline - Density / neutron – [40 CFR 146.87 (a) (3) (i)]	Intermediate, Production	Estimate porosity, mineralogical characterization
Wireline -High-definition image – [40 CFR §146.87 (a) (3) (i)]	Production	Identify fracture, structural information, minimum stress orientation
Wireline - Litho-scanner – [40 CFR §146.87 (a) (3) (i)]	Production	Identify mineralogy
Wireline - Formation Dynamics Testing	Production	Measure formation pressures, fluid sampling, mini-frac testing
Mud Logging	Surface to TD (every 30 ft)	Identify lithology, hydrocarbon shows, gases composition

The Shoe Bar 1AZ was drilled in August 2023. This well is located in the AoR, within 2,000' of the planned future injector locations. The well was drilled with a 3-string casing design with the surface section at 0-1,800' MD, intermediate section at 1,800-3,910' MD, and production section at 3,910-6,725' MD. The Shoe Bar 1AZ will be plugged above the Injection Zone prior to the commencement of injection. The portion of the well above the upper confining zone will temporarily be left unplugged and inactive pending further evaluation of utilization for this wellbore. Summarized below is the data acquisition program conducted in the Shoe Bar 1AZ.

Table 4--Data acquired in the Shoe Bar 1AZ well

Method	Interval Section(s)	Purpose
Open Hole Logs, Surveys and Sampling During Construction		
Deviation survey [40 CFR §146.87 (a) (1)]	Every 100 ft while drilling as minimum, from surface to TD	Define well trajectory, displacement, and tortuosity
Wireline- Spontaneous Potential – [40 CFR §146.87 (a) (2) (i)], [40 CFR §146.87 (a) (3) (i)]	Surface, Intermediate, Production	Correlation log, volume of shale indicator, estimate salinity
Wireline –Resistivity – [40 CFR §146.87 (a) (2) (i)], [40 CFR §146.87 (a) (3) (i)]	Surface, Intermediate, Production	Fluid identification, estimate salinity, correlation log
Wireline – Caliper – [40 CFR §146.87 (a) (2) (i)], [40 CFR §146.87 (a) (3) (i)]	Surface, Intermediate, Production	Identify borehole enlargement and calculate cement volume
Wireline -Gamma ray – [40 CFR §146.87 (a) (2) (i)], [40 CFR §146.87 (a) (3) (i)]	Surface, Intermediate, Production	Define stratigraphy, correlation log, shale indicator
Wireline -Magnetic resonance image – [40 CFR §146.87 (a) (3) (i)]	Production	Estimate porosity, pore size distribution, permeability index
Wireline -Sonic Scanner – [40 CFR §146.87 (a) (2) (i)], [40 CFR §146.87 (a) (3) (i)]	Surface, Intermediate, Production	Estimate mechanical properties, validation of velocity model, well tie to seismic
Wireline - Spectral gamma ray – [40 CFR §146.87 (a) (2) (i)], [40 CFR §146.87 (a) (3) (i)]	Surface, Intermediate, Production	Define uranium rich formation, clay indicator
Wireline - Density / neutron – [40 CFR §146.87 (a) (2) (i)], [40 CFR §146.87 (a) (3) (i)]	Surface, Intermediate, Production	Estimate porosity, mineralogical characterization
Wireline -High-definition image – [40 CFR §146.87 (a) (3) (i)]	Production	Identify fracture, structural information, minimum stress orientation
Wireline - Litho-scanner – [40 CFR §146.87 (a) (3) (i)]	Production	Identify mineralogy
Wireline - Formation Dynamics Testing	Production	Measure formation pressures, fluid sampling
Mud Logging	Surface to TD (every 30 ft)	Identify lithology, hydrocarbon shows, gases composition

In addition to the open-hole logs, cased-hole logs were acquired over each section post-casing in both stratigraphic wells. The table below table summarizes the cased-hole data that was acquired.

Table 5--Cased-hole logs acquired

Method	Interval Section(s)	Purpose
Cased Hole Logs and surveys Before Injection		
Wireline - CBL-VDL-USIT-CCL – [40 CFR §146.87 (a)(2) (ii)], [40 CFR §146.87 (a)(3) (ii)]	Surface, Intermediate, Production	Cement bond, casing integrity. Validate external mechanical integrity
Annulus Pressure Test - Long string casing [40 CFR §146.87 (a)(4) (i)]	Annular between tubing and long string	Validate internal mechanical integrity between the tubing, long-string, and packer
Wireline - Activate pulsed neutron – Long string casing [40 CFR §146.87 (a)(4) (ii)]	Surface, Intermediate, Production	CO_2 saturation, baseline for monitoring

2.3 Coring Program

2.3.1 Whole and Sidewall Core Acquisition

The coring program for the Shoe Bar 1 and Shoe Bar 1AZ wells was designed to obtain full 4-in whole core from the Sequestration Zone, the Lower San Andres formation. The program collected 1.5-in diameter sidewall core plugs in the Grayburg and Upper San Andres formations, which are the Upper Confining Zones, and the Glorieta and Wichita-Albany formations, which are Lower Confining Zones. In addition, sidewall cores were also obtained to evaluate a prospective secondary sequestration zone, the Clearfork formation.

In Shoe Bar 1, the Project successfully achieved 100% recovery of ~714ft of whole core through the Lower San Andres and 78 sidewall cores from Grayburg, Upper San Andres, Glorieta, Clearfork, and Wichita-Albany formations.

In Shoe Bar 1AZ, the Project successfully achieved 100% recovery of ~725ft of whole core through the Lower San Andres and 51 sidewall cores from Grayburg, Upper San Andres, Glorieta, and Clearfork formations.

2.3.2 Core Analysis Program

The laboratory analysis of core acquired in Shoe Bar 1 and Shoe Bar 1AZ involved core slabbing, routine core analysis (RCA), petrographic analysis, and special core analysis (SCAL). Table 6 summarizes the program.

Table 6--Core Analysis Performed

Core	Test	Frequency
Whole Core	Slabbing	100% of whole core
	DECT Scan	
	WL, UV Photography	
	Core description*	
Full Diameter Core	Total Porosity	12 from Shoe Bar 1; 7 from Shoe Bar 1AZ; in the Injection Zone
	Horizontal permeability	
	Vertical permeability	
	Grain density	
Whole Core, Horizontal plugs	Total Porosity	Selected samples from Upper Confining and Injection Zones
	Permeability	
	Grain density	
	XRF, XRD **	
	Thin section ***	
	SEM	
	MICP	
	Relative permeability	
Whole Core, Vertical plugs	Porosity	Selected samples from Upper Confining and Injection Zones
	Vertical permeability	
	Grain density	
	Entry pressure	
Whole Core, Geomechanical	Static/Dynamic Elastic Anisotropy	Selected samples from Upper Confining and Injection Zones
	Poro-elastic Coefficients (VTI)	
	Multistage Confined Compression	
RSWC XL	Total Porosity	Every sample from Upper Confining and Injection Zones
	Permeability	
	Grain density	

*Core description: Detailed description of the slabbed core will assign core facies based on lithology, texture, biogenic structures, fossils, grain size trends, environment of deposition, and sedimentary structures.
**XRD: This will provide bulk composition and clay typing
***Thin section: A detailed description will include grain composition, pore distribution, textural characteristics, and fabric of the rock.

2.4 Formation Fluid Characterization Program

2.4.1 Acquisition of Formation Fluid Samples

A Modular Formation Dynamics Tester (MDT) tool was utilized during the open-hole wireline logging runs to obtain representative samples of in-situ reservoir fluid. A MDT tool with pump-out module, Live Fluid Analyzer (LFA) module, and flow line resistivity measurement identifies and collects high-quality reservoir fluid samples suitable for laboratory analysis. Flowline resistivity measurements taken by the sensor on the MDT tool help discriminate between formation fluids and filtrate from muds. Equipping the MDT tool with a pump-out module makes it possible to sample fluid, while monitoring the flowline resistivity, by pumping filtrate-contaminated fluid into the mud column. Fluid removed from the formation is excluded from the sample chamber until an uncontaminated sample can be recovered.

The BRP Project utilized an MDT tool to acquire baseline reservoir fluid samples from three depths in the Lower San Andres in each of the two stratigraphic wells. These samples were transported under pressure to a third-party lab for comprehensive analysis including pH, conductivity, alkalinity, major cations, major anions, trace metals, dissolved gases, density, and TDS (Total Dissolved Solids) among others.

2.4.2 Analysis and Reporting

Table 7 indicates the analytical methods used to determine the measured parameters.

Table 7--Parameters and analytical methods for fluid analyses for Shoe Bar 1 and Shoe Bar 1AZ

Parameter	Analytical method
Lower San Andres (Injection Interval)	
Cations: Al, Ba, Cd, Ca, Cr, Co, Cu, Fe (disolved), Fe (total), Pb, Li, Mg, Mn, Mo, Ni, P, K, Si, Na, Sr, V, Zn	CL Metals by ICP – Section 1.28-2
Cations: Hg (Mercury)	SW7470A
Anions: B (as $B(OH)_4^-$)	CL Metals by ICP – Section 1.28-2
Anions: F, NO_3, NO_2, PO_4, SO_4	CL Anions by IC – Section 1.27-2
Dissolved CO_2	ASTM D 513-82
Anions: Br, Cl, I	CL Anions by IC – Section 1.27-2/ CL Chlorides Determination – Section 1.22-3
Anions: Ar (arsenic)	EPA 200.7
Anions: S (sulfide)	Standard Methods: 4500-S2-D
Total organic carbon	SM5310B
Total dissolved solids (TDS)	EPA 160.1
Total Sulfate and Sulfide	Standard Methods: 4500-S2-D
Density	ASTM D1217
Dissolved CO_2	ASTM D 513-82
Alkalinity (as HCO_3^-), Carbonate (CO_3^{2-})	Titration, ASTM D3875-97 CL Bicarbonate/Carbonate Determination Section 1.26-3
pH and Temperature	ASTM D1293 (pH Electrode)
Conductivity	ASTM D1125
Specific gravity	ASTM D1429 / ASTM D1480
$\delta^{13}C$	gas-bench IRMS
$\delta^{18}O$	gas-bench IRMS
δD	gas-bench IRMS

Dissolved Gas Abundances: CO_2, CO, N_2, Ar, He, H_2, O_2, C1-C6+	Determined by GC for full compositions
Dissolved Gas Isotopes: $\delta^{13}CO_2$, $\delta^{18}CO_2$	Conventional Offline Prep / Dual Inlet MS
$^{87}Sr/^{86}Sr$	Strontium isolation by extraction chromatography, analysis by MC-ICP-MS

2.5 Fracture Pressure

2.5.1 Confining zone

The fracture pressures of the Upper Confining Zone (Upper San Andres and Glorieta) and the Injection Zone (Lower San Andres) were estimated using mini-frac tests in the Shoe Bar 1 and Shoe Bar 1AZ wells. The fracture gradients are in the range of 1.19-1.58psi/ft. The table below shows the results.

Table 8--Summary of Confining Zone Fracture Pressure Estimates

Well	Test	Zone	Formation	Measured Depth, ft	Fracture propagation pressure, psi	Fracture gradient, psi/ft
Shoe Bar 1	Mini-frac	Upper confining zone	Upper San Andres	4042	5941	1.47
Shoe Bar 1	Mini-frac	Lower confining zone	Glorieta	5076	7044	1.39
Shoe Bar 1AZ	Mini-frac	Upper confining zone	Upper San Andres	3792	Could not initiate fracture at max. downhole pressure of 6000 psi	>1.58
Shoe Bar 1AZ	Mini-frac	Lower Confining Zone	Glorieta	5026	Could not initiate fracture at max. downhole pressure of 6000 psi	>1.19

2.5.2 Injection Zone

The fracture pressure of the Injection Zone was estimated using Mini-frac (or Diagnostic Fracture Injection Test) and Step Rate Tests (SRT) performed in the Shoe Bar 1 and Shoe Bar 1AZ wells. The table below summarizes the results:

Table 9–Summary of Injection Zone Fracture Pressure Estimates

Well	Zone	Tested Interval Top Perf-Bottom Perf (MD, ft)	Initial Reservoir Pressure (psi)	Type of Test	Estimated Fracture Gradient (psi-ft)
Shoe Bar 1	Lower San Andres	4827-4829	2200@4400ft	Mini-Frac	[redacted]
Shoe Bar 1	Lower San Andres	4421-5024	2200@4400ft	Step Rate Test	[redacted]
Shoe Bar 1AZ	Lower San Andres	5122-5132	2522@5088ft	Step Rate Test	[redacted]
Shoe Bar 1AZ	Upper San Andres	4723-4733	2307@4596ft	Step Rate Test	[redacted]

3. Injection Wells – Pre-Op Strategy

The BRP Project will construct three new wells for CO_2 injection. An extensive suite of tests and logs will be acquired during drilling, casing installation, and post-casing installation in the injector wells in accordance with the testing required under 40 CFR §146.87(a), (b), (c), and (d).

3.1 Logging Program

The Project will plan and execute an extensive data acquisition program consisting of logs, surveys, and tests consistent with the data acquired in the stratigraphic test wells, shown in Table 4.

The table below shows the proposed logging and survey planned for injector wells.

Table 10–Proposed logging program for CO_2 injectors

Method	Interval Section(s)	Purpose
Open Hole Logs, Surveys and Sampling During Construction		
Deviation survey	Every 100 ft while drilling as minimum, from surface to TD	Define well trajectory, displacement, a tortuosity
Wireline – Spontaneous Potential	Surface, Intermediate, Production	Correlation log, volume of shale indicator, estimate salinity
Wireline – Resistivity	Surface, Intermediate, Production	Fluid identification, estimate salinity, correlation log
Wireline – Caliper	Surface, Intermediate, Production	Identify borehole enlargement and calculate cement volume
Wireline – Gamma ray	Intermediate, Production	Define stratigraphy, correlation log, shale indicator

Wireline – Magnetic resonance image	Production	Estimate porosity, pore size distribution, permeability index
Wireline – Sonic Scanner	Intermediate, Production	Estimate mechanical properties, validation of velocity model, well tie to seismic
Wireline – Spectral gamma ray	Intermediate, Production	Define uranium rich formation, clay indicator
Wireline – Density / neutron	Intermediate, Production	Estimate porosity, mineralogical characterization
Wireline – High-definition image	Production	Identify fracture, structural information, minimum stress orientation
Wireline – Litho-scanner or equivalent	Production	Identify mineralogy
Wireline – Formation Dynamics Testing	Production	Measure formation pressures, fluid sampling, mini-frac testing
Mud Logging	Surface to TD (every 30 ft)	Identify lithology, hydrocarbon shows, gases composition
Cased Hole Logs and surveys Before Injection		
Wireline – CBL-VDL-USIT (Casing inspection log)-CCL	Surface, Intermediate, Production	Cement bond, casing inspection log (USIT); Validate external mechanical integrity
Annulus Pressure Test – Long string casing	Annular between tubing and long string	Validate internal mechanical integrity between the tubing, long-string, and packer
Wireline – Activate pulsed neutron (Oxygen Activation Log) – Long string casing	Surface, Intermediate, Production	CO_2 saturation, baseline for monitoring
Wireline – Temperature Log	Surface, Intermediate, Production	Measure baseline temperature profile on the well from surface to top of perforation
Fiber Optic – DAS, DTS survey	Surface, Intermediate, Production	Measure baseline temperature profile on the well from surface to top of perforation Acquire baseline 3D VSP survey for monitoring plume migration over time

3.2 Coring Program

The Project will not collect whole core or sidewall cores in the CO_2 injector wells BRP CCS1 and BRP CCS2 wells, because representative core data were already acquired in the Shoe Bar 1AZ, which is located less than 2,000’ away from the planned injector wells. Based on seismic interpretation of a recently acquired project-specific 3D dataset, OLCV interprets structural and stratigraphic conformance, and consistency of rock and fluid properties between the stratigraphic test well and the planned injectors. See Appendix A to the BRP Pre-Operations Testing Plan for additional justification on the similarity of geology at the stratigraphic test well location compared to the planned injectors.

The Project will collect up to 75 sidewall cores in the BRP CCS3 well, which is anticipated to have different rock properties than were encountered in the nearby Shoe Bar 1. The core depths will be finalized based on the petrophysical analysis of the triple combo logs run prior to the sidewall coring run. The Project will plan to acquire ~10 (subject to change) sidewall cores in each Confining Zone and ~50 (subject to change) sidewall cores in the Injection Zone.

Table 11–Projected depths for rotary sidewall core sampling zones in well BRP CCS3

Well Name	Formation Top	Comment	Z [FT]	MD [FT]
CCS3	Grayburg	Upper Confining Zone	-841.91	4023.8
CCS3	Upper San Andres	Upper Confining Zone	-1081.27	4502.53
CCS3	Lower San Andres (G4)	Injection Zone	-1451.68	5243.34
CCS3	Lower San Andres (G1)	Injection Zone	-1593.2	5526.39
CCS3	Lower San Andres (Holt)	Injection Zone	-1972.34	6284.67
CCS3	Glorieta	Lower Confining Zone	-2150.56	6641.1

Table 12–Core analysis plan for BRP CCS3

Core	Test	Frequency
Rotary Sidewall Cores (RSWC)	Total Porosity (Ambient and NCS) Permeability (Ambient and NCS) Grain density	Every sample
	XRD ** Thin section *** SEM MICP	Select samples from Confining Zones and Injection Zone

*XRD: This will provide bulk composition and clay typing

**Thin section: A detailed description will include grain composition, pore distribution, textural characteristics, and fabric of the rock.

Geomechanical testing of core is required to accomplish at least two primary goals. First is to calibrate the dynamic and static elastic properties that are inputs to the well-based stress model. The second objective is to build a rock mechanics database that is used to build predictive rock property models so that rock properties can be predicted in future wells with the necessary input well data. The testing results also provide the foundational data required to understand physical properties and characteristics of facies, lithotypes, textures, etc. Both dynamic and static data are required to build dynamic to static conversions. Dynamic data are calculated from velocity data and density and are equivalent to the same properties calculated from well data. Dynamic data must be converted to static data and the dynamic to static conversions based on core data are required to accomplish critical step. Table 11 summarizes the dynamic and static measurements to be completed on the core samples. Testing is accomplished using the proprietary single plug protocol from New England Research (NER). The method requires only a single horizontal plug and provide vertical and horizontal measurements required to characterize elastic anisotropy. Because it only requires a single horizontal plug, rotary sidewall cores (RSWC) plugs can be utilized to expand the scope of investigation of both seal and reservoir formations. In Shoe Bar 1, 12 samples from the suite of RSWC plugs are tested in the reservoir, upper seal, and lower seal. In Shoe Bar 1AZ, both whole core and RSWC are utilized to characterize 20 samples distributed across the upper seal, reservoir, and lower seal.

Table 13–Geomechanical Parameters from Core Testing

Property	Variable	Dynamic	Static
Density	Rhob	--	Yes
Compressional Velocity	Vp	Yes	--
Shear Velocity	Vs	Yes	--
Young's Modulus	E	Yes	Yes
Poisson's Ratio	v	Yes	Yes
Biot's Coefficient	α	--	Yes
Stiffness Coefficients	Cij	Yes	Yes
Compliance Coefficients	Sij	Yes	Yes
Unconfined Compressive Strength	UCS	--	Yes

3.3 Well Mechanical Integrity Testing (MIT)

The BRP Project will conduct both internal and external mechanical integrity tests on all injection wells in the Project. Internal mechanical integrity refers to the absence of leaks in the casing by tubing annulus, the tubing, and the packer. External mechanical integrity refers to the absence of formation fluid or CO_2 movement through channels in the cement on the exterior of the casing.

Upon completion and installation of the downhole equipment in the wells, BRP will conduct an annular pressure test (APT) to verify internal mechanical integrity. The APT is a short-term pressure test (30 minutes) where the well is shut in and the fluid in the annulus is pressurized to a predetermined pressure and is monitored for leak off. BRP will use a test pressure of 500 psi for the MIT's. BRP will use a 5% decrease in pressure (test pressure x .05) from the stabilized test pressure during the duration of the test to determine if test is successful. If the annulus pressure decreases by ≥5%, the well will have failed the APT. If a well fails an APT, the test will be repeated. If the APT is again failed, the downhole equipment will be removed from the well and the source of the failure will be investigated. In general, the test procedure will be as follows:

1. Connect a high-resolution pressure transducer to the annulus casing valve and increase the annulus pressure to 500 psi and hold this pressure for 30 minutes.
2. At the conclusion of the 30-minute test the annulus pressure will be bled off to 0 psi and the pressure recording equipment will be removed from the casing valve.

Upon well completion, BRP will run cased hole logs to demonstrate external mechanical integrity of the casing and cement sheath prior to the start-up of operations. BRP will run Casing Inspection Logs (CIL) to evaluate casing integrity. In addition, BRP will acquire baseline temperature logs to demonstrate a lack of fluid movement through channels or communication paths through the tubing or annulus. BRP will also run an ultrasonic imaging tool (USIT) to provide further confidence that there are no channels in the cement sheath for formation fluids or CO_2 to migrate upwards in the well.

3.4 Cement Logs

The BRP Project will collect noninvasive data to confirm the presence of an annular barrier and bond between casing and cement. Cement placement is a critical component of the well architecture for ensuring mechanical support of the casing, protection from fluid corrosion, and for isolation of permeable zones at different pressure regimes to prevent hydraulic communication. Tools such as Ultrasonic Imager tool (USIT) uses a single transducer mounted on an Ultrasonic Rotating Sub (USRS) on the bottom of the tool. The transmitter emits ultrasonic pulses between 200 and 700 kHz and measures the received ultrasonic waveforms reflected from the internal and external casing interfaces. The rate of decay of the waveforms received indicates the quality of the cement bond at the cement/casing interface, and the resonant frequency of the casing provides the casing wall thickness required for pipe inspection. Because the transducer is mounted on the rotating sub, the entire circumference of the casing is scanned. This 360° data coverage enables the evaluation of the quality of the cement bond as well as the determination of the internal and external casing condition. The very high angular and vertical resolutions can detect channels as narrow as 1.2 in. [3.05 cm]. Cement bond, thickness, internal and external radii, and self-explanatory maps are generated in real time at the wellsite.

An advanced option such as Isolation Scanner can be used to provide more certainty. This tool combines a pulse-echo technique along with an ultrasonic technique to induce a flexural wave in the casing. A transmitter measures the resulting signals at two receivers, and the attenuation calculated between the two receivers is paired with the pulse-echo measurement and compared with a laboratory-measured database to produce an image of the material immediately behind the casing. By measuring radially beyond traditional cement evaluation boundaries, this service confirms zonal isolation, pinpoints any channels in the cement, and ensures confident operational decisions. The signal resulting from the interface between the annulus and the borehole or outer casing can be detected and measured. These third-interface echoes (TIEs) provide the position of the casing within the borehole, and if the borehole size is known, the velocity of the annulus material can be determined. These flexural measurements can provide useful information to image complex cement geometries and are helpful datasets if remediation is required.

3.5 Fracture Pressure

The fracture pressure of the Confining and Injection Zones is determined to understand injection pressure limit to maintain matrix flow. To determine the fracture pressure, a fracture is created and sustained for a small amount of time. The fracture pressure in the Injection Zone is determined through a mini-frac or Diagnostic Fracture Injection Test (DFIT). These tests will determine Instantaneous Shut-in Pressure (ISIP), the ISIP Gradient, and the Fracture Closure Pressure (FCP). These terms are defined as below and illustrated in Figure 1.

- Instantaneous Shut-In Pressure (ISIP) = Final Injection Pressure – friction pressure
- ISIP Gradient (or fracture gradient) = ISIP/formation depth
- Fracture Extension Pressure (FEP) = Minimum pressure need to develop and extend a fracture once it has been initiated
- Fracture Closure Pressure (FCP) = Minimum pressure needed to keep a fracture open; this is also the minimum horizontal formation stress
- Net Pressure (Δpnet) = Pressure in the fracture above fracture closure pressure

Following the drilling and logging of the injection well(s), an open hole wireline formation tester (such as MDT) mini-frac will be performed to determine the minimum horizontal stress of the formation intervals. The tester will be setup in a dual packer configuration to isolate ~3ft intervals for stress testing to determine the fracture initiation, fracture breakdown, and fracture propagation pressure. The proposed test intervals will be pre-screened to ensure no structural weaknesses (such as natural fractures) are present using a processed FMI log. The mini-frac operations will preferably occur from the deepest to shallowest depth interval following the procedure outlined below:

Step 1: Packer Inflation

- Inflate the packers until the pressure in the interval (PAQP) starts to rise. When PAQP reaches 100psi greater than hydrostatic pressure, close the inflate seal vale, stop the pump, open the interval seal valve, and exit port to relieve the pressure. This will also allow the packers to relax during the inflation process. Continue to inflate the packers to 300-400 psi inflation pressure.

Step 2: Leak Off Test

- Carry out at least one leak-off test (doing two or three is better). The purpose of the test is to check that the pressure rises roughly linearly with time during injection, which indicates that there is only a small amount of leak-off and that enough flow rate will be available to drive a hydraulic fracture into the formation. Another advantage of this test, when carried out several times, is that it minimizes the storage of the tool as the packers ease their way on the wellbore wall.

- Inject at a constant rate until pressure is approximately 1000psi below the estimated breakdown pressure.
- Stop injection and record the pressure decline. This test may take less than a minute. In low permeability formations, it is acceptable to not have to wait until pressure comes back to the initial value (it might take unreasonably long to do so).

Step 3: Hydraulic Fracturing Cycle

- To initiate a fracture, pump into the interval at a constant rate of about 1000 rpm (up to 2200 rpm). After a period of pressure build-up, a sudden decrease of injection pressure should be observed. This is the fracture initiation pressure.
- Continue pumping until a stable or gradually increasing fracture propagation trend is observed. Pump for 2-3 more minutes.
- Close the interval valve and immediately stop the pump. Monitor pressure decline until it stabilizes or reaches approximately 500 psi above hydrostatic pressure. In very low permeability intervals, the flowback sample chamber can be used to help with fracture closure.

Step 4: Re-opening Tests

- Reopen the fracture by injecting at the same rate until a fracture propagation trend is observed again. Pump for 2-3 minutes and shut in. Monitor and record the pressure decline.
- 2 or 3 more fracture reopening cycles should then be performed. These reopening tests will confirm the presence of a fracture and are critical to ensure that the minimum principal stress has indeed been measured. More cycles may be added if quality of the data, in particular the repeatability of the pressure at which the fracture propagates, is not satisfactory.

Mini-fracs will be performed in distinct porosity / permeability packages within the proposed Injection Zone and Upper and Lower Confining Zones. Thin intervals (<2ft) that are interpreted to have limited horizontal extent will not be considered. The interval for mini-frac will be selected upon review of logging data (Phi>10%, Layer thickness >5ft). The Fracture Extension Pressure will be interpreted by qualified OLCV reservoir and completions engineers to determine injection limits throughout the Injection Zone.

To perform a DFIT, the test zone will be perforated with a limited number of perforations to ensure fluid is injected over a small area. Fluid will then be injected down the tubing to apply pressure to the formation to induce a breakdown of the formation and establish a fracture. Pressure will be recorded on a surface gauge attached to the wellhead, and at a gauge at the end of the tubing. Once a fracture is created, a small volume of fluid will be pumped to extend the fracture before injection is terminated. To extend the fracture, the Δpnet needs to be above the FCP. The ISIP is the final pressure point when rate and pressure drop is zero, where net pressure is still present, and the fracture is open. At the ISIP, a fracture gradient is calculated at the depth of the fracture. Pressure decline is analyzed using G-function and root-time methods to determine fracture closure pressure.

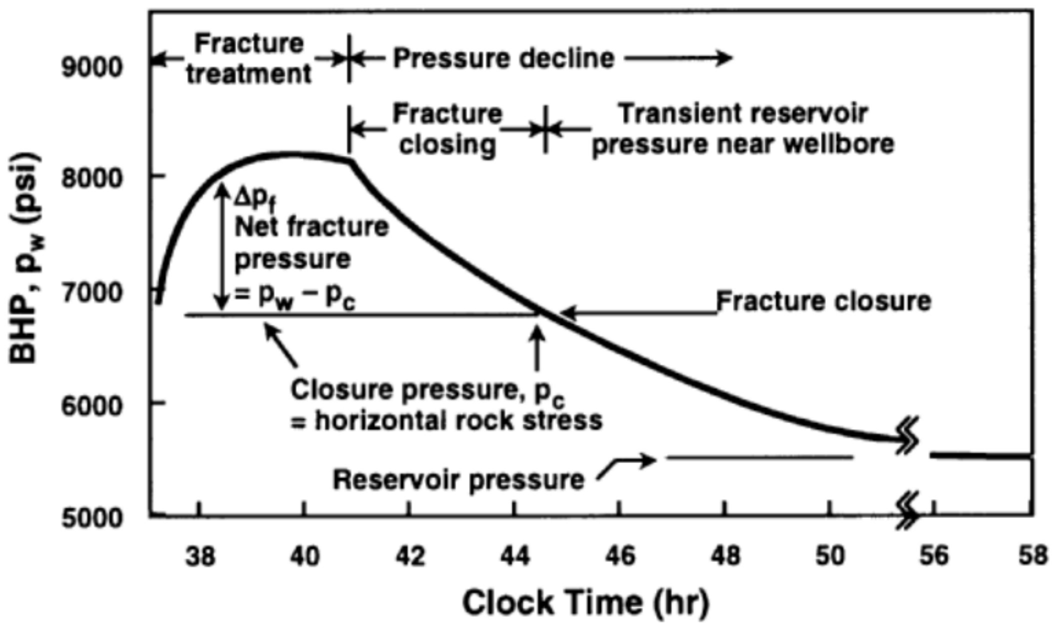

Figure 1: Well Injection Test (Talley, 1999)

3.6 Injection Well Testing

An injection test will be performed in the Lower San Andres after the injection well is complete, including perforation of the Injection Zone and installation of the injection tubing and packer. The pre-operation injectivity testing will serve as the baseline for future pressure fall-off testing. The purpose of conducting an injectivity test is to verify or establish the injection well operating parameters and constrain the inputs used for dynamic injection simulation modeling.

The injection testing will comprise of a period (typically 12-24hrs) of injection at constant rate (typically 0.5-2bpm) subject to a maximum bottom hole pressure limit (less or equal to 90% of the estimated fracture gradient for the perforated interval). This is followed by a shut-in/pressure fall off period (typically 24-48hrs) for monitoring. The injection period will be used to establish/monitor well injectivity performance and the fall off analysis will indicate the well/reservoir flow regime, average reservoir flow characteristics and the presence (if any) of reservoir baffles/boundaries/interwell interference. The tests will be planned to cover the entire perforated interval of the injector well. Injection profile logs may be run to further verify injection test results.

3.7 Pressure Fall-Off Testing

The main objectives for the pressure fall-off testing are to:

- Inform the expected rate and volume of CO_2 injectivity into the Lower San Andres formation.
- Identify potential baffles or barriers to subsurface flow.
- Verify or establish the maximum operation pressures of the well.
- Establish baseline reservoir performance for comparison with subsequent tests.

3.7.1 Test Activity Summary

The pre-injection test will be performed using brine or municipal water. There will be an injection period at constant rate followed by a zero-rate (shut-in) period for pressure monitoring (Figure 2).

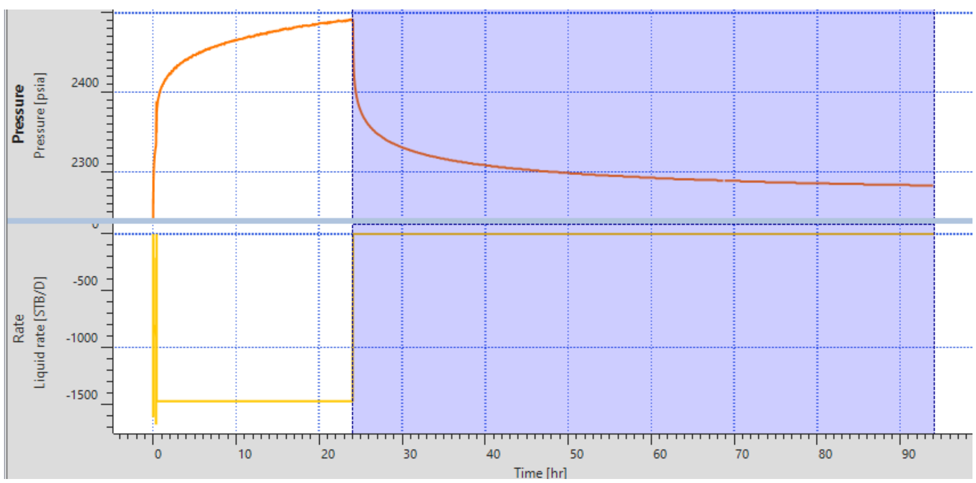

Figure 2: Schematic of Injection Fall-off testing

The test will be conducted with the following considerations:

- The maximum injection pressure will be ≤90% of the estimated fracture pressure of the interval. The shut-in period will be sufficient to observe near-wellbore reservoir and boundary effects.
- Bottomhole pressure measurements will be recorded using the downhole pressure gauge near the perforations. A surface pressure gauge may also serve as a monitoring tool for tracking the test progress.
- Injection profile logs and other complementary data may be acquired during the test.

- Testing procedures will follow the EPA recommended methodology (EPA, 2002). The recommendations provided in these guidance documents will be followed to the extent possible. If BRP proposes a significantly different approach, the proposed operational changes will be reviewed with the UIC Program Director prior to initiation.

The following general procedure will be followed for pressure fall off testing:

1. Hook-up brine or municipal water to the well to prepare for injection.
2. Record static shut-in pressure at the downhole gauge.
3. Commence injection per planned rate schedule, approximately 1bpm increase every 30mins until the planned maximum injection rate is reached.
4. Maintain the injection rate within the maximum injection pressure limit for approximately 24 hours.
5. Cease injection as rapidly as possible using a controlled shut-down, and commence pressure fall off testing.
6. Perform a preliminary analysis of the pressure fall off data after 24 hours to identify radial flow period as well as other transient reservoir features.
7. End the pressure fall off test after confirmation of sufficient data acquisition.

Note: The injection rate schedule and the duration of the injection period and the pressure fall-off testing may be modified based on dynamic reservoir response.

3.7.2 Analysis and Reporting

Fall-off testing analysis allows for calculation of the following parameters: transmissivity, storage capability, skin factor, and well flowing and static pressures. A Cartesian plot of the pressure and temperature versus real time or elapsed time will be used to confirm pressure stabilization and look for anomalous data. A log-log diagnostic of the pressure and semilog derivative analysis will be performed for well/reservoir performance characterization (Petrowiki, 2016)

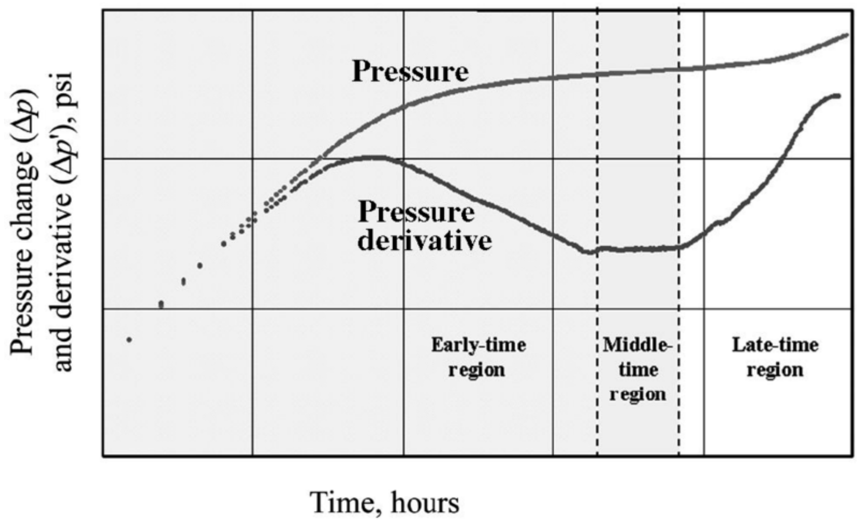

Figure 3. Pressure derivative analysis diagnostic chart (Petrowiki, 2016)

BRP will conduct the following data analysis, integration, and reporting:

- The results of the wireline logging program and the fracture pressure evaluation program will be integrated to support and corroborate the hydrogeologic properties.
- The fall-off testing report will be submitted no later than 60 days following the test and will include well schematic, gauge information, test information, rate/pressure data, reservoir parameters and summary of analysis.
- The testing will be repeated using carbon dioxide within the first 90 days following initiation of sequestration operations. This will allow for comparison to the baseline fluid-to-fluid test with the change in the injection fluid from brine water to carbon dioxide.
- The fall-off test will be performed annually at five-year intervals (within +/-3 months of the anniversary of the previous test), for the lifetime of injection operations. Periodic testing is expected to provide insight into the performance of sequestration site and potentially aid in interpreting the dimensions of the CO_2 plume, based on the expected lateral transition from supercritical CO_2 near the wellbore to native formation brine beyond the plume.
- A final pressure fall-off test will be run after the cessation of injection into the Injection Well.

3.8 Injection Wells Directional Survey

Wellbore deviation measurements will be conducted at periodic intervals while drilling the injection wells. Additionally, a final directional survey may be acquired from total depth to the surface to provide borehole inclination and azimuthal information.

3.9 Injection Wells Formation Pressure and Fluid Sampling

The BRP Project will utilize a formation testing tool (example: MDT) to quantify the reservoir pore pressure and collect fluids from selected intervals in the Injection Zone. The pore pressure testing, and fluid sampling procedure is outlined below:

1. Rig up formation testing tool.
2. Run in hole, for casing check, to above casing shoe.
3. Run in hole for depth correlation. Correlation should be recorded in the same direction as reference log (mostly log up)
4. Log depth correlation pass.
5. Perform pore pressure tests at selected depth intervals in formations of interest.
    a. Two consecutive pretests of 10cc each at every station is run using volumetric drawdown.
    b. After setting the tool and performing the first 10cc pretest, pressure should be allowed to stabilize only to a 10^{th} of a psi following which the second 10cc pretest should be carried out and pressure allowed to build up to a 100^{th} of a psi for 20 seconds.
    c. If after the first 10cc pretest the formation appears to be tight (labeled as dry test), the tool should be retracted without doing a second pretest.
6. Upon completion of pressure testing, re-log for depth correlation.
7. Pick depth intervals with good mobility (identified from pressure tests) for fluid sampling.
8. Perform fluid sampling at selected depth intervals. This involves pump out of fluid volume while monitoring the fluid properties in real time using Live Fluid Analyzer (LFA) module to capture reservoir fluid without mud or other contaminants. The sampling steps involve:
    a. Inflate the packers with 5-7 liters (between 350-400 psi). Inflation pressure may decrease during operations to as low as 20-50 psi, but no further action is required.
    b. Perform a pretest with 2-4 strokes to ensure seal. Expected pretest duration is 10-15 minutes.
    c. Pump-out starting at 300 rpm and increase the rate by 300 rpm steps to the highest rate possible without exceeding tool limitations (5000psi differential pressure on packers). Continue to pump out until formation fluid is observed on the Live Fluid Analyzer (LFA) module. Expected duration of this step is 45 minutes.
    d. Continue to pump-out at the same rate until low contamination is achieved. The expected duration is 30 minutes.
    e. Fill sampling bottle with formation fluid and seal.
    f. If more sampling volume is needed, continue to pump-out and fill additional bottles.
9. Pull out of hole to surface.

Based on data from the Shoe Bar 1 and Shoe Bar 1AZ, OLCV anticipates encountering three distinct porosity zones. OLCV will collect fluid and dissolved gas samples in each of these zones. The final sampling depths will be selected after reviewing logs for the specific Injector well. The analytes and analytical methods for fluids and dissolved gasses are shown in Table 14.

Table 14. Summary of analytical parameters for fluid and dissolved gas samples in the Injection Zone (Lower San Andres).

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, and SO_4, NO_2 and NO_3 as N	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

PO_4 as 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
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	0.20 per mil	20% of all analyses are either check/reference standards or duplicate analyses.

		50mg/L required		
$\delta^{18}O$ and δ^2H of H_2O	Analyzed via CRDS	N/A	$\delta^{18}O$: 0.10 per mil; δ^2H: 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.

3.10 Temperature logging

Temperature logs are used to locate gas entries, detect casing leaks, and evaluate fluid movement behind casing. They are also used to detect lost-circulation zones and cement placement. Temperature logs are used as a basic diagnostic tool and are usually paired with other tools like acoustics or multi arms calipers if more in depth analysis is required.

Temperature instruments used today are based on elements with resistances that vary with temperature. The variable resistance element is connected with bridge circuitry or constant current circuit, so that a voltage response proportional to temperature is obtained. The voltage signal from temperature device is then usually converted to a frequency signal transmitted to the surface, where it is converted back to a voltage signal and recorded. The absolute accuracy of temperature logging instruments is not high (in the order of +- 5°F), but the resolution is good (0.05°F or better), although this accuracy can be compromised by present day digitalization of the signal on the surface. The temperature instrument usually can be included in the string with other tools, such as radioactive tracer tools or spinners flowmeters. Temperature logs are run continuously, typically at cable speeds of 20 to 30 ft/min.

Temperature logging is anticipated to be collected at the same time as oxygen activation logging. The proposed plan for logging is as follows:

1. Logging crew to arrive on location, hold safety meeting with all parties that will be present during operation prior to beginning any work.
2. Move-in and spot wireline unit and crane.
3. Perform lifting plan and validate with crew and client.
4. Verify wellhead connection and wellhead pressure to be zero before install packoff.
5. Logging crew to rig up PNX-PBMS tool string and packoff.
6. Pressure test to 3k PSI to verify the equipment integrity.
7. Surface check on tools prior to run in hole(RIH). Minitron NOT to be turned on at surface at any time.
8. RIH to 1000 ft and turn on minitron, perform a test log to verify tool is operational, once completed turn off minitron and continue RIH with tool on logging GR-CCL.
9. RIH to TD power on minitron and wait for tool stabilization.
10. Once stable, begin main pass at 900 ft/hr in GSH-Commercial mode GR-CCL-Temp-Press.
11. Log up to 500 ft “confirm logging interval with client at well-site”.
12. Once main pass completed, RIH and perform a repeat pass 200 ft.
13. Upon logging completion turn off minitron and wait below 200 ft for at least 30 minutes before pulling out of hole (POOH).
14. Upload data and confirm data integrity with Domain Champion prior to rigging down.
15. POOH and rig down tools.

3.11 Oxygen activation logging

Oxygen activation log (OAL) provides formation evaluation and reservoir monitoring in cased holes. OALis deployed as a wireline logging tool with an electronic pulsed neutron source and one or more detectors that typically measure neutrons or gamma rays. High-speed digital signal electronics process the gamma ray response and its time of arrival relative to the start of the neutron pulse. Spectral analysis algorithms translate the gamma ray energy and time relationship into concentrations of elements. Each logging company has its own proprietary designs and improvements on the tool.

Schlumberger's Pulsar Multifunction Spectroscopy Service (PNX) pairs multiple detectors with a high output pulsed neutron generator in a slim tool with an outer diameter (o.d.) of 1.72 in. for through-tubing access in cased hole environments. The housing is corrosion-resistant, allowing deployment in wellbore environments such as CO2. The tool's integration of the high neutron output and fast detection of gamma rays with proprietary pulse processing electronics, allows to differentiate and quantify gas-filled porosity from liquid-filled and tight zones. The tool can accurately determine saturation in any formation water salinity across a wide range of well conditions, mineralogy, lithology, and fluid contents profile at any inclination. Detection limits for CO2 saturation for the PNX tool vary with the logging speed as well as the formation porosity. Detailed measurement and mechanical specifications for the PNX tool are provided in the QASP document. The wireline operator will provide QA/QC procedures and tool calibration for their equipment.

Haliburton's RMT-D reservoir monitor tool: The Halliburton Reservoir Monitor Tool 3-Detector™ (RMT-3D™) pulsed-neutron tool solves for water, oil, and gas saturations within reservoirs using three independent measurements (Sigma, C/O, and SATG). This provides the ability to uniquely solve simple or complex saturation profiles in reservoirs, while eliminating phase-saturation interdependency. The RMT-#D provides gas phase analysis to identify natural gases, nitrogen, CO2, steam, and air. The tool has 2.125 in diameter OD that allows it to be run through tubing.

Temperature logging is anticipated to be collected at the same time as oxygen activation logging. The proposed plan for logging is as follows:

1. Logging crew to arrive on location, hold safety meeting with all parties that will be present during operation prior to beginning any work.
2. Move-in and spot wireline unit and crane.
3. Perform lifting plan and validate with crew and client.
4. Verify wellhead connection and wellhead pressure to be zero before install packoff.
5. Logging crew to rig up PNX-PBMS tool string and packoff.
6. Pressure test to 3k PSI to verify the equipment integrity.

7. Surface check on tools prior to run in hole(RIH). Minitron NOT to be turned on at surface at any time.
8. RIH to 1000 ft and turn on minitron, perform a test log to verify tool is operational, once completed turn off minitron and continue RIH with tool on logging GR-CCL.
9. RIH to TD power on minitron and wait for tool stabilization.
10. Once stable, begin main pass at 900 ft/hr in GSH-Commercial mode GR-CCL-Temp-Press.
11. Log up to 500 ft “confirm logging interval with client at well-site”.
12. Once main pass completed, RIH and perform a repeat pass 200 ft.
13. Upon logging completion turn off minitron and wait below 200 ft for at least 30 minutes before pulling out of hole (POOH).
14. Upload data and confirm data integrity with Domain Champion prior to rigging down.
15. POOH and rig down tools.

3.12 Fluid level testing

OLCV will utilize an echometer to obtain a fluid level in the injector wells. The echometer tool contains a small chamber that is loaded with compressed CO_2 or N_2. The tool is charged to a pressure greater than the well pressure and connected to the well via an appropriately rated hose. A valve is then opened allowing a pressure pulse to be expelled into the well. This acoustic pulse travels through the gas in the borehole. Some of the energy is reflected back by well construction materials: tubing collars, tubing anchors, perfs, and other downhole jewelry. The remaining pulse energy is reflected by the gas/liquid interface at the depth of the fluid level. The reflected signals are detected by microphones at the surface. A calculation is then performed to determine the depth of the fluid level based upon the speed required to travel downhole, reflect off the gas/fluid interface and return to surface.

4. SLR Monitoring Wells – Pre-Op Strategy

The Injection Zone for the BRP Project will be monitored by two Injection Zone Monitoring wells (SLR2 and SLR3). The SLR2 will be drilled prior to the commencement of CO_2 injection operations. The SLR3 will be drilled after operation injections commence, and its location may be refined based on updated AoR information. In addition to SLR wells, the Injection Zone will be monitored with data collected in four Water Withdrawal wells (WW).

Data collected in the water withdrawal wells (constructed and tested in Spring 2024) indicates an absence of permeable zones between the upper confining zone and the lowermost USDW. Therefore, the lowermost USDW is coincident with the first permeable zone above the confining zone. The lowermost USDW will be monitored by the USDW1 well.

The Shoe Bar 1 stratigraphic test well will be plugged above the Injection Zone prior to the commencement of CO_2 injection. The portion of the well above the Injection Zone contains

DTS/DAS fiber that may be used during VSP seismic acquisition and for monitoring pressure and temperature above the confining zone. The Shoe Bar 1 AZ will be plugged above the Injection Zone prior to the commencement of CO_2 injection. The confining zone integrity will be monitored in this well.

The need for additional monitoring wells will be considered during AoR re-evaluations, and at least every five years following commencement of injection. The locations and timing of monitor wells is discussed in the AoR and Corrective Action Plan.

4.1 Logging Program

4.1.1 Logs in SLR monitoring wells

See Section 3 of this document for a description of the data collected in the Shoe Bar 1 (SLR1) and Shoe Bar 1AZ (ACZ1) wells. The log data listed in the table below is planned for collection in the SLR2 and SLR3 wells.

Table 15–Logging program for SLR2 and SLR3 monitoring wells

Method	Interval (ft)	Purpose
Open Hole Logs, Surveys and Sampling During Construction		
Deviation survey	Every 100 ft while drilling as minimum, from surface to TD	Define well trajectory, displacement, and tortuosity
Wireline – Spontaneous Potential	Production	Correlation log, volume of shale indicator, estimate salinity
Wireline – Gamma ray	Production	Define stratigraphy, correlation log, shale indicator
Wireline – Resistivity	Production	Fluid identification, estimate salinity, correlation log
Wireline – Caliper	Production	Identify borehole enlargement and calculate cement volume
Wireline – Sonic Scanner	Production	Estimate mechanical properties, validation of velocity model, well tie to seismic
Wireline – Spectral gamma ray	Production	Define uranium rich formation, clay indicator
Wireline – Density / Neutron	Production	Estimate porosity, mineralogical characterization.
Wireline – Formation dynamics testing	Production	Measure formation pressures, fluid sampling
Mud Logging	Surface to TD (every 30 ft)	Identify lithology, hydrocarbon shows, gases composition

Cased Hole Logs and surveys Before Injection		
CBL-VDL-USIT-CCL	Surface, Intermediate, Production	Cement bond, casing integrity. Validate external mechanical integrity
Annulus Pressure Test – Long string casing	Annular between tubing and long string.	Validate internal mechanical integrity between the tubing, long string, and packer
Wireline – Activate pulsed neutron, through tubing	Surface, Intermediate, Production	CO_2 saturation, baseline for monitoring
Wireline – Casing Inspection Tool	Surface, Intermediate, Production	Wall thickness, corrosion, ovality of tubulars. Validate external mechanical integrity. Baseline for monitoring
Fiber Optic – DTS survey	Surface, Intermediate, Production	Measure baseline temperature profile on the well from surface to top of perforation. Acquire baseline 3D VSP survey for monitoring plume migration over time

The logs listed in Table 15 will be conducted on the SLR2 and SLR3 wells.

4.2 Coring Program

Whole core and sidewall cores were collected in the Shoe Bar 1 and Shoe Bar 1AZ wells. The Project does not intend to acquire any additional core in future monitoring wells.

4.3 Formation Fluid Characterization Program

4.3.1 Acquisition

The BRP Project will utilize an MDT tool to acquire reservoir fluid samples from the zones being monitored in the SLR2 and SLR3 wells. The Project will obtain fluid samples from the Lower San Andres (up to six samples, subject to change). The final sample acquisition depths in these monitoring wells will be determined based on the petrophysical analysis of the open hole logs run prior to the MDT logging run.

Fluid samples were collected by an MDT tool in the water withdrawal wells, WW1, WW2, WW3 and WW4, during construction. See Section 6.3 for additional details on fluid sampling in these wells.

4.3.2 Analysis and Reporting

The fluid sample containers will be transported under pressure to a third-party lab for comprehensive analysis of fluid and dissolved. See Table 16 for the analytical methods and QC parameters for fluid and dissolved gas analyses.

Table 16–Summary of analytical parameters for fluid and dissolved gas samples in the Injection Zone (Lower San Andres).

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, and SO_4, NO_2 and NO_3 as N	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
PO_4 as 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
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	Approximately 40 ppm	± 0.00002	SRM 987 Sr standard within the long-term precision

	to the University of AZ			(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.

4.4 Fracture Pressure

Fracture pressure was obtained in the Shoe Bar 1 and Shoe Bar 1AZ and will be obtained in the CO_2 injection wells. No fracture pressure measurements area planned for the SLR2 or SLR3 wells.

4.5 Well Mechanical Integrity

4.5.1 Mechanical Integrity Testing (MIT)

The BRP Project will conduct both internal and external mechanical integrity tests on the SLR2 and SLR3 wells. Internal mechanical integrity refers to the absence of leaks in the casing by tubing annulus, the tubing, and the packer. External mechanical integrity refers to the absence of formation fluid or CO_2 movement through channels in the cement on the exterior of the casing.

Upon completion and installation of the downhole equipment in the wells, BRP will conduct an APT to verify internal mechanical integrity. The APT is a short-term pressure test (30 minutes) where the well is shut in and the fluid in the annulus is pressurized to a predetermined pressure and is monitored for leak off. BRP will use a test pressure of 500 psi for the MIT's. BRP will use a 5% decrease in pressure (test pressure x .05) from the stabilized test pressure during the duration of the test to determine if test is successful. If the annulus pressure decreases by ≥5%, the well will have failed the APT. If a well fails an APT, the test will be repeated. If the APT is again failed, the downhole equipment will be removed from the well and the source of the failure will be investigated. The proposed procedure will be as follows:

1. Connect a high-resolution pressure transducer to the annulus casing valve and increase the annulus pressure to 500 psi and hold this pressure for 30 minutes.
2. At the conclusion of the 30-minute test the annulus pressure will be bled off to 0 psi and the pressure recording equipment will be removed from the casing valve.

Upon well completion, BRP will run cased hole logs to demonstrate external mechanical integrity of the casing and cement sheath prior to the start-up of operations. BRP will acquire baseline temperature logs to demonstrate a lack of fluid movement through channels or communication paths through the tubing or annulus. BRP will also run an ultrasonic imaging tool (USIT) to provide further confidence that there are no channels in the cement sheath for formation fluids or CO_2 to migrate upwards in the well.

5. USDW Monitoring Well

The Dockum group is the lowermost Underground Source of Drinking Water. Maps and additional stratigraphic details for the USDWs are included in the "Area of Review and Corrective Action Plan" document in Section 2.2.8 and in Section 2.4 of Appendix B to the AoR document. The USDW1 well was drilled in late 2023 and completed in early 2024. The dedicated purpose of this well is to monitor the Dockum group.

Although the shallow Pecos Valley alluvium is considered a USDW, it is generally not productive of water near the BRP Project. There are no current or planned wells in the AoR or near the AoR targeting the Pecos Valley alluvium.

5.1 Logging Program

Table 17 shows the logging and surveys conducted in the USDW monitoring well.

Table 17--Logs collected in the USDW-level well

Method	Interval (ft)	Purpose
Open Hole Logs, Surveys and Sampling During Construction		
Deviation survey	Every 100 ft while drilling as minimum, from surface to TD	Define trajectory, displacement, and tortuosity
Wireline – Spectral gamma ray	Surface to TD	Define uranium rich formation, clay indicator
Wireline- Spontaneous Potential	Surface to TD	Correlation log, volume of shale indicator, estimate salinity
Wireline –Resistivity	Surface to TD	Fluid identification, estimate salinity, correlation log
Wireline – Density / Neutron	Surface to TD	Estimate porosity, mineralogical characterization
Wireline – Caliper	Surface to TD	Identify borehole enlargement and calculate cement volume

5.2 Formation Fluid Characterization Program

5.2.1 Acquisition

The Project will monitor the chemical composition of the fluids and dissolved gases in the lowermost USDW, the Dockum group. A fluid sample was collected during well construction. The results are presented in Section 5.0 of Appendix A to the AoR document. Baseline samples will be collected on a quarterly basis for approximately one year prior to the start of injection. Baseline data collection will commence in June 2024. These samples will be collected by a qualified environmental monitoring and service provider and overseen by Oxy or OLCV personnel.

5.2.2 Analysis and Reporting

Table 18 includes the analysis that will be performed by the qualified environmental service provider and verified by Oxy or OLCV personnel.

Table 18-- Summary of analytical parameters for fluid and dissolved gas samples in the USDW (Dockum group)

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, and SO_4, NO_2 and NO_3 as N	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
PO_4 as 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
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, δ^2H of C1	High precision (offline) analysis via Dual Inlet IRMS	Varies by component	$\delta^{13}C$: 0.1 per mil; δ^2H: 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 δ^2H of H_2O	Analyzed via CRDS	N/A	$\delta^{18}O$: 0.10 per mil; δ^2H: 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.

5.3 Well Mechanical Integrity

Per Texas Water Development Board, mechanical integrity testing is not required for the USDW1 monitoring well.

6. Water Withdrawal Wells

BRP Project has constructed four water withdrawal wells in Spring 2024. The purpose of these wells is to remove brine from the Injection Zone for pressure management. The Project collected logs and fluid samples in these wells. Preliminary results are presented in Section 5.2 of Appendix A to the AoR document.

6.1 Logging Program

The table below shows the logging and surveys for the water withdrawal wells.

Table 19--Logging, survey, and sampling program for water withdrawal wells

Method	Interval Section(s)	Purpose
Open Hole Logs, Surveys and Sampling During Construction		
Deviation survey	Every 100 ft while drilling as minimum, from surface to TD	Define well trajectory, displacement, and tortuosity
Wireline- Spontaneous Potential	Production	Correlation log, volume of shale indicator, estimate salinity
Wireline – Resistivity	Production	Fluid identification, estimate salinity, correlation log
Wireline – Caliper	Production	Identify borehole enlargement and calculate cement volume
Wireline -Gamma ray	Production	Define stratigraphy, correlation log, shale indicator
Wireline -Sonic Scanner	Production	Estimate mechanical properties, validation of velocity model, well tie to seismic
Wireline - Spectral gamma ray	Production	Define uranium rich formation, clay indicator
Wireline - Density / Neutron	Production	Estimate porosity, mineralogical characterization
Wireline - Formation Dynamics Testing	Production	Fluid sampling, estimate Kv/Kh*
Wireline – Magnetic resonance image**	Production	Estimate porosity, pore size distribution, permeability index
Cased Hole Logs		
Wireline - CBL-VDL-USIT-CCL	Surface, Intermediate, Production	Cement bond, casing integrity. Validate external mechanical integrity
Wireline – Temperature Log	Surface, Intermediate, Production	Measure baseline temperature profile on the well
Annulus Pressure Test - Long string casing	Annular between tubing and long string	Validate internal mechanical integrity between the tubing, long-string, and packer
Wireline - Activate pulsed neutron – Long string casing	Intermediate, Production	CO_2 saturation, baseline for monitoring

* - Vertical interference testing performed in SBR 1WW and SBR 2WW only, for estimation of Kv/Kh
** - Magnetic resonance log only run in SBR 2WW and SBR 3WW

The logs listed in Table 19 were conducted in the water withdrawal wells.

6.2 Coring Program

No core was collected in the water withdrawal wells.

6.3 Formation Fluid Characterization Program

The BRP Project utilized an MDT tool to acquire reservoir fluid samples in the water withdrawal wells during construction to capture baseline fluid properties and chemistry. BRP Project is awaiting the geochemical results of water samples obtained from the Injection Zone.

The BRP Project attempted to acquire reservoir fluid samples above the upper confining zone and below the lowermost USDW, however these zones were tight. See Section 5.2 of Appendix A to the AoR document for details on sampling above the confining zone.

6.4 Fracture Pressure

No fracture pressure measurements were collected in the water withdrawal wells.

6.3 Well Mechanical Integrity

The BRP Project conducted both internal and external mechanical integrity tests on four water withdrawal wells. Internal mechanical integrity refers to the absence of leaks in the casing by tubing annulus, the tubing, and the packer. External mechanical integrity refers to the absence of formation fluid or CO_2 movement through channels in the cement on the exterior of the casing.

Upon the completion of drilling of the four water withdrawal wells and prior to perforating, BRP conducted an internal mechanical integrity test (MIT) to confirm wellbore mechanical integrity. The MIT is a short-term pressure test (30 minutes) where the internal wellbore is loaded with fluid and pressured up to a predetermined pressure and is monitored for leak-off. BRP used a test pressure of 500 psi for the MITs. BRP used a 5% decrease in pressure (test pressure x .05) from the stabilized test pressure during the duration of the test to determine if test is successful. If the annulus pressure had decreased by ≥5%, the well would have failed the internal MIT. None of the four water withdrawal wells failed their MIT.

The procedure was:

1. Connect a high-resolution pressure transducer to the annulus casing valve and increase the annulus pressure to 500 psi and hold this pressure for 30 minutes.
2. At the conclusion of the 30-minute test the annulus pressure will be bled off to 0 psi and the pressure recording equipment will be removed from the casing valve.

Upon the completion of drilling, BRP conducted cased hole logs to demonstrate external mechanical integrity of the casing and cement sheath prior to the start-up of operations. BRP acquired baseline temperature logs to demonstrate a lack of fluid movement through channels or communication paths through the tubing or annulus. BRP conducted an ultrasonic imaging tool (USIT) to provide further confidence that there are no channels in the cement sheath for formation fluids or CO_2 to migrate upwards in the well.

7. References

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