Class VI Injection Well: Quality Assurance and Surveillance Plan

Version 5
15 October 2024

Prepared by:

One Carbon Partnership, LP

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List of Acronyms

ACZ	Above Confining Zone
ACZ1	Proposed Above Confining Zone Well
CBL	Cement Bond Log
CCS	Carbon Capture and Sequestration
CCS1	Proposed Injection Well
CO_2	Carbon Dioxide
EPA	Environmental Protection Agency
MIT	Mechanical Integrity Testing
NA	Not Applicable
OBS1	Deep Observation Well
OCP	One Carbon Partnership, LP
PISC	Post Injection Site Care and Site Closure
PNL	Pulsed Neutron Logging
QA	Quality Assurance
QASP	Quality Assurance Surveillance Plan
QC	Quality Control
SCADA	Supervisory Control and Data Acquisition
SOP	Standard Operating Procedure
TBD	To Be Determined
TDS	Total Dissolved Solids
UIC	Underground Injection Control
USDW	Underground Sources of Drinking Water
USDW1	Proposed Lowermost USDW Monitor Well

1 Title and Approval Sheet

This Quality Assurance and Surveillance Plan (QASP) is approved for use and implementation at One Carbon Partnership, LP's (OCP) facility in Union City, IN for the Hoosier #1 Project. The signatures below denote the approval of this document and intent to abide by the procedures outlined within it.

Signature	Date
[INSERT TYPED NAME]	
[INSERT TITLE]	
Signature	Date
[INSERT TYPED NAME]	
[INSERT TITLE]	
Signature	Date
[INSERT TYPED NAME]	
[INSERT TITLE]	

2 Distribution List

The following project participants will receive the completed QASP and all future updates for the duration of the project. The Project Manager will be responsible to ensure that all people on the distribution list below receives the most current version of the approved QASP.

One Carbon Partnership, LP (OCP)

Jeremy Herlyn
Plant Manager, Cardinal Ethanol
1554 N. 600 E.
Union City, IN 47390

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Email: adamh@vault4401.com

Well Location: 1554 N. 600 E.
Union City, IN 47390
Randolph County
CO_2 Injection Well Location for Cardinal CCS #1
Latitude 40.186587°
Longitude -84.864284°

3 Project Management

3.1 Project/Task Organization

3.1.1 Key Individuals and Responsibilities

Cardinal Ethanol and Vault 44.01 are the partners in the OCP Project. Testing and monitoring responsibilities through the pre-operational, injection, and post-injection phases of the project will be shared between these two partners with support from various subcontractors. The QASP covers testing and monitoring activities that will take place during the pre-operational testing phase, 30 year injection phase, and 50 year post injection site care (PISC) phase of the project (Attachment 5: Pre-Op Testing Program, 2022) (Attachment 7: Testing And Monitoring, 2022) (Attachment 9: Post-Injection Site Care, 2022). Seven subcategories have been identified as part of the testing and monitoring program.

1. Shallow Groundwater Sampling and Monitoring,
2. Deep Groundwater Sampling and Monitoring,
3. Injection Well Monitoring,
4. Mechanical Integrity Testing (MIT),
5. Pressure and Temperature Monitoring,
6. Carbon dioxide (CO_2) Stream Analysis,
7. Plume Modeling.

3.1.2 Independence from Project Quality Assurance Manager and Data Gathering

The physical samples to be collected, and the data gathered as a part of the monitoring program will be, on occasion, analyzed, processed, and/or witnessed by third party contractors, independent of the laid out project management structure.

3.1.3 Project Quality Assurance Plan Responsibility

OCP will be responsible for maintaining and distributing the official, approved Project QASP. Vault will review the QASP periodically and discuss with the Environmental Protection Agency (EPA) should changes to the plan be warranted.

3.1.4 Organizational Chart for Project Organizational Structure

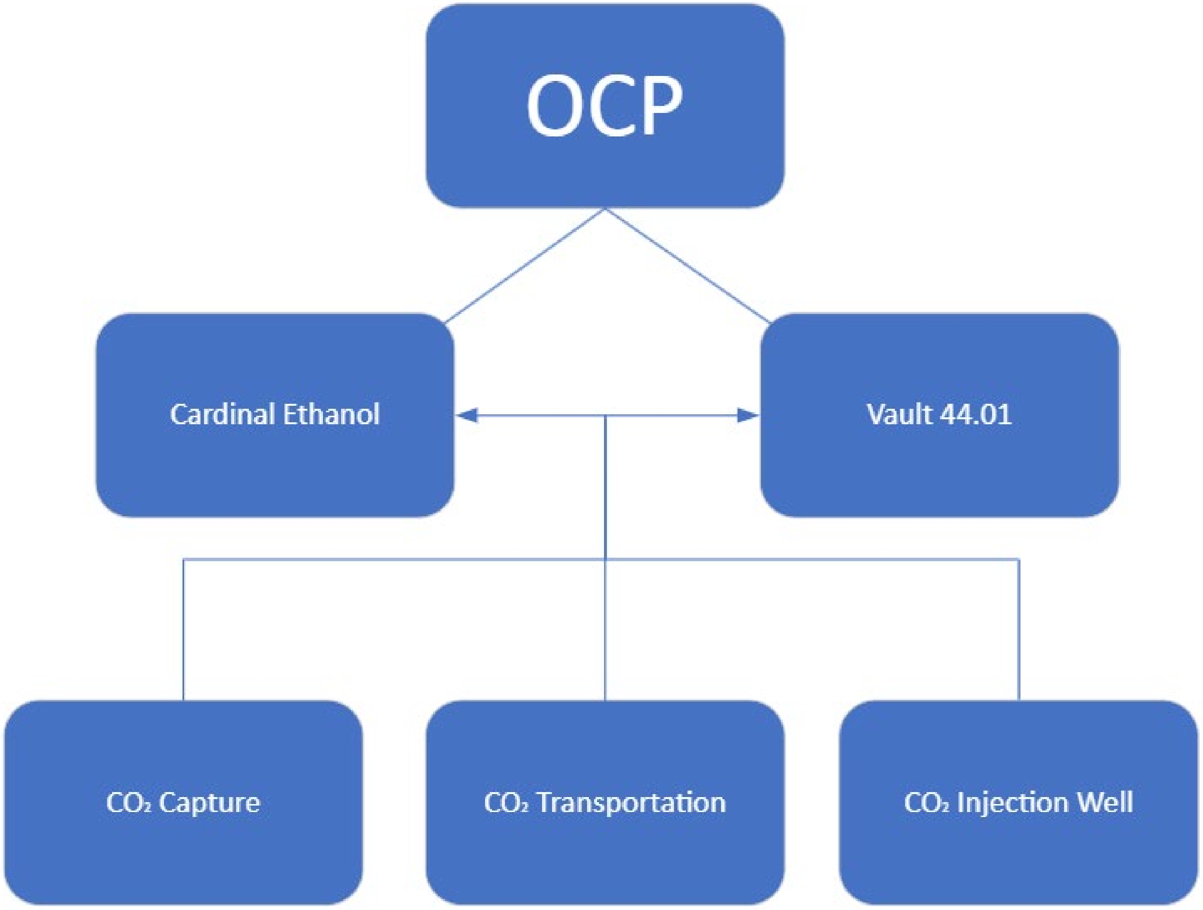

Figure 1. Organizational Chart for Key Project Personnel and Responsibilities

3.2 A.2. Problem Definition/Background

3.2.1 A.2.a. Reasoning

The OCP carbon capture and sequestration (CCS) project has a robust monitoring program, which includes operational, plume, and environmental components.

Operational monitoring serves to ensure that all procedures and processes associated with the project are safe. Data will be collected to monitor the response of the sequestration unit and layers overlying the confining zone by monitoring the following parameters:

- Injection pressure,
- Injection Well Annulus pressure,
- Mt. Simon Sandstone pressure,
- Above Confining Zone (ACZ) formation pressure,
- Lowermost Underground Source of Drinking Water (USDW) pressure.

In addition to the pressure components of the operational monitoring, additional parameters such as injection rate, total volume/mass injected, injection well temperature profile, and passive seismic data will be collected and evaluated.

The plume monitoring component of the program will provide information to evaluate the extent to which the CO_2 plume has spread and whether any leakage of the CO_2 through the caprock has occurred. The primary component of this monitoring is Pulsed Neutron Logging (PNL), but additional data will be gathered from pressure and temperature monitoring.

The environmental component of the monitoring program is meant to determine if CO_2 is being released into the shallow groundwater layers or the environment. The primary component of this monitoring consists of fluid sampling and monitoring, with additional monitoring from the PNL, which is a primary component of the plume monitoring program.

The robust monitoring program developed for this project is based on experience gained from other approved Class VI projects, as well as extensive geologic evaluation, reservoir modeling, and understanding of federal regulations on the matter. The result of this experience yields a high level of confidence that the Mt. Simon Sandstone is a suitable injection formation, and that the Eau Claire is a sufficient caprock, capable of ensuring the injected CO_2 will remain permanently sequestered in the Mt. Simon Sandstone.

The primary goal of the monitoring program is to continue to demonstrate the activities of this project are safe for the health of the general public and environment. In order to help facilitate this demonstration, the QASP was developed to ensure the quality of the demonstration methods meet the requirements of the EPA Underground Injection Control (UIC) Program for Class VI wells.

3.2.2 A.2.b. Reasons for Initiating the Project

The purpose of the OCP CCS project is to demonstrate the ability of the Mt. Simon Sandstone to accept and retain supercritical CO_2 in eastern Indiana. This project intends to reduce the amount of CO_2 emissions from the ethanol facility into the atmosphere. In order to demonstrate the efficacy of this project and the long term sequestration of CO_2, the rigorous testing and monitoring program presented in this application will be implemented that covers the pre-operational, injection, and post-injection phases of the project. The QASP presented in this document provides additional information on the methodology and technical standards that will comprise the proposed testing and monitoring program.

3.2.3 A.2.c. Regulatory Information, Applicable Criteria, Action Limits

Class VI regulations stipulate that the owners or operators of Class VI wells perform several types of activities throughout the life of the project to ensure the following:

i. That the wells maintain their mechanical integrity,
ii. That injected fluid migration and pressure changes are within the limits described in the permit application, and
iii. That USDWs are not endangered during or after operations.

The activities to demonstrate the objectives detailed above consist of, but are not limited to, the following:

- MIT,
- Well tests performed on the injection well during operation,
- Groundwater monitoring from several zones,
- CO_2 and pressure plume tracking.

This document is intended to detail the methods of measurement and the steps that will be taken to ensure the quality of the collected data so that confident informed decisions can be made during the project.

3.3 A.3. Project/Task Description

3.3.1 A.3.a/b. Summary of Work to be Performed

Table 1 displays the major tasks for the testing and monitoring program described in Testing and Monitoring and PISC sections of this permit application (Attachment 7: Testing And Monitoring, 2022) (Attachment 9: Post-Injection Site Care, 2022). This table displays the location of monitoring points, method of sampling, analytical technique applied, lab/custody procedures to be followed (if applicable), and the purpose of each item. Details on the frequency of the testing and monitoring program activities can be found in the Pre-operational Testing Plan, Testing and Monitoring Program, and the PISC sections of this application (Attachment 5: Pre-Op Testing Program, 2022) (Attachment 7: Testing And Monitoring, 2022) (Attachment 9: Post-Injection Site Care, 2022).

Tables 2 and 3 display details of the instrumentation used at each monitoring location, and geophysical surveys, respectively.

Table 1. Summary of Testing and Monitoring

Activity	Location(s)	Method	Analytical Technique	Lab/Custody	Purpose
CO_2 stream analysis					
CO_2 stream analysis – downstream	CO_2 Delivery Pipeline	Direct Sampling	Chemical Analysis	to be determined (TBD)	Monitor injectate quality and composition
Continuous Recording					
Injection rate	CCS1 Wellhead	Flowmeter	Direct Measure	Not Applicable (NA)	Monitoring injection rate
Injection volume	CCS1 Wellhead	Flowmeter	Direct Measure	NA	Calculated injection volume
Injection pressure	CCS1 Wellhead	Continuous Monitoring	Direct Measure	NA	Monitoring injection pressure
Wellhead pressure	ACZ1 Wellhead	Continuous Monitoring	Direct Measure	NA	
Annular pressure	CCS1 Wellhead Deep Observation Well (OBS1) Wellhead	Continuous Monitoring	Direct Measure	NA	Monitoring annulus pressure
Downhole pressure	CCS1 Injection Interval OBS1 Injection Interval	Downhole Gauge	Direct Measure	NA	Monitoring injection zone
Downhole temperature	CCS1 Wellbore	Downhole Gauge	Direct Measure	NA	Monitoring injection zone, wellbore integrity
Microseismic	Various Monitoring Stations	Geophones and Seismometers	Direct Measure	NA	Injection zone and confining zone integrity
Well Integrity					
Corrosion monitoring	CO_2 Delivery Pipeline CCS1 Wellhead	Coupon	Direct Measure Chemical Analysis	TBD	Monitoring injectate, wellbore integrity
Annular fluid volume	CCS1 Wellhead OBS1 Wellhead	Site Glass Readings	Direct Measure	NA	Monitoring annulus fluid volume changes
Mechanical integrity (internal)	CCS1 Wellhead OBS1 Wellhead	Annulus Pressure Test	40 CFR 146.89 (b)	NA	Wellbore integrity

Activity	**Location(s)**	**Method**	**Analytical Technique**	**Lab/Custody**	**Purpose**
Mechanical integrity (external)	CCS1 Wellbore OBS1 Wellbore (temp log only)	Various	40 CFR 146.87 (a)(4) 40 CFR 146.89 (c)(2) Log Interpretation	NA	Wellbore integrity
Cement Evaluation	CCS1 Wellbore OBS1 Wellbore ACZ1 Wellbore	Logging	Direct Measure Log Interpretation	NA	Wellbore integrity
Plume Tracking					
PNL	CCS1 Wellbore OBS1 Wellbore	Logging	Direct Measure Log Interpretation	NA	CO_2 saturation, vertical plume development
Downhole pressure	OBS1 Injection Interval CCS1 Injection Interval	Direct Sampling	Direct Measure	NA	Monitoring injection zone pressure, plume monitoring, confining zone integrity
Microseismic Monitoring	Minimum of 5 stations TBD	Geophones and Seismometers	Direct Measure	NA	Injection zone and confining zone integrity
Time-lapse 3D Seismic Data	Area sufficient to image an 8.97 mi2 plume	3D Seismic Surface Seismic Survey	Data Analysis and Interpretation	NA	Indirect measurement of plume development
Fluid Sampling					
Shallow Groundwater Sampling (Glacial Drift)	12 wells spatially distributed throughout the AoR	In-situ	Chemical Analysis	Table 4 for parameters	Detection of changes in groundwater quality for the shallow USDWs.
Lowermost USDW Sampling (Maquoketa Shale)	USDW1	In-situ	Chemical Analysis	Table 5 for parameters	Detection of changes in the groundwater quality in the lowermost USDW.
Above Confining Zone Sampling (Knox Formation)	ACZ1	In-situ	Chemical Analysis	Table 6 for parameters	Detection of changes in groundwater quality above the confining zone.
Injection Interval Monitoring (Mt. Simon Sandstone)	OBS1	In-situ	Chemical Analysis	Table 7 for parameters	Detection of changes in groundwater quality, geochemistry, and CO_2 saturation in the injection internal.

Table 2. Instrumentation Summary

Monitoring Location	Instrument Type	Monitoring Target/Interval	Data Collection Location(s)	Explanation
CO_2 Facility	Gas sampling port	Surface	Downstream of Compressor	Monitoring injectate quality and composition
CCS1	Temperature Pressure Flow	Wellhead - injection Wellhead - injection Surface	Tubing Tubing Flowline	Monitoring operational parameters of surface and well equipment.
	Temperature Pressure	Wellbore - injection Wellbore - injection	Packer Packer	Monitoring operational parameters at bottom hole conditions.
	Pressure	Wellhead - annulus Wellhead - MIT (internal)	Annulus Annulus	Monitoring well integrity.
	Corrosion	Surface	Upstream from Wellhead	Monitoring corrosion of the wellhead equipment and tubulars before potential future equipment failure.
OBS1	Pressure	Wellbore – injection zone	Packer	Monitoring bottomhole injection pressure in injection zone
	Pressure	Wellhead - annulus Wellhead - MIT (internal)	Annulus Annulus	Monitoring well integrity.
ACZ1	Pressure	Wellhead - ACZ zone	Suface	
Seismic Stations	Seismometer(s) Geophones	Surface and borehole	All Strata Various Locations TBD	Passive seismic monitoring equipment to be used to monitor and detect seismic events over within the AoR.

Table 3. Geophysical Surveying Summary

Survey Activity	Well	Tool/Survey Description	Explanation
Logging	CCS1	Temperature/Radioactive Tracer Log	Mechanical Integrity, Fluid Movement, CO_2 Detection
		Pressure Falloff Test	Injection Zone Pressure Response, Geophysical and Geomechanical Monitoring
		Pre-operation Testing Logging	Well charecterization
		PNL	Mechanical Integrity, Fluid Movement, CO_2 Detection
	OBS1	Temperature Log	Mechanical Integrity, Fluid Movement, CO_2 Detection
		Pre-operation Testing Logging	Well charecterization
		PNL	Mechanical Integrity, Fluid Movement, CO_2 Detection
	ACZ1	Cement Bond Log (CBL)	Mechanical Integrity
Seismic Stations	Surface Survey Area	3D Seismic Survey	Monitor extent of CO_2 plume.

3.3.2 A.3.c. Geographic Locations

Figure 2. Cardinal Ethanol Facility and Associated CCS Related Equipment

Figure 3. Ethanol Facility, flowlines, surface capture facility, CCS1, proposed lowermost USDW monitor well (USDW1), and proposed above confining zone monitoring well (ACZ1) location.

Figure 4. Ethanol Facility and OBS1 Location

3.3.3 A.3.d. Resource and Time Constraints

No major time or resource constraints have been identified for the Hoosier #1 Project. Wells drilled, tested, and monitored as laid out in the permit application will serve their purpose for pre-operation, active operations, and post closure care.

Following the full closure of the project and the post operational monitoring period OCP plans to plug and abandon all wells associated with the project in a manner consistent with federal regulations. As part of the financial assurance package, money will be allocated to ensure these activities are fully funded.

3.4 A.4.Quality Objectives and Criteria

3.4.1 A.4.a. Performance/Measurement Criteria

The objective of the Quality Assurance (QA) system for the monitoring program is to develop and utilize procedures for surface and subsurface monitoring, field samples, laboratory analysis, and routine reporting. The results of these activities will demonstrate the viability, characterization, and non-endangerment objectives of the project.

Groundwater monitoring will be conducted:

- Before injection begins,
- During injection operations,
- Post-injection operations.

Specific monitoring frequency and timing is provided in the preoperational testing plan, the testing and monitoring plan, and the post-injection site care portions of the application (Attachment 5: Pre-Op Testing Program, 2022) (Attachment 7: Testing And Monitoring, 2022) (Attachment 9: Post-Injection Site Care, 2022). This monitoring will be performed on shallow and deep groundwater wells. Analytical and monitoring parameters for groundwater samples are provided in Tables 4-7.

Note for Tables 4-7:

ICP – inductively coupled plasma

MS – mass spectrometry

OES – optical emission spectrometry

GC-P – gas chromatography – pyrolysis

Table 8 contains analytes for CO_2 stream analysis.

Tables 9 and 10 shows other CO_2 and injection related parameters, instrumentation, and standards of analysis.

Table 11 contains detail on the major monitoring outputs for the testing and monitoring plan.

The list of analytes provided herein may be reassessed periodically and adjusted as necessary based on the effectiveness of the current testing and monitoring program with respect to its objectives.

Key monitoring areas and their major methods and analytes include (but are not limited to):

i. Shallow Groundwater Sampling
    a. Aqueous chemical concentrations (Table 4)
ii. Deep Groundwater Sampling
    a. Aqueous chemical concentrations (Table 5-7)
iii. Well Logging
    a. PNL
iv. MIT and Corrosion Monitoring
    a. PNL (external)
    b. Temperature (external)
    c. Annulus Pressure Test (internal)
    d. CBL (external)
    e. Coupon monitoring
v. Pressure and Temperature Monitoring
    a. In-situ pressure/temperature gauges

    b. Baseline data
    c. Surface pressure/temperature gauges
- vi. CO_2 Stream Analysis
    - a. CO_2 Purity
    - b. Total Hydrocarbons as Methan
    - c. Carbon Monoxide
    - d. Oxides of Nitrogen
    - e. Nitrogen
    - f. Oxygen
    - g. Methane
    - h. Hydrogen Sulfide
    - i. Sulphur Dioxide
    - j. Acetaldehyde
    - k. Ethanol
- vii. Geophysical Monitoring
    - a. 3D seismic profile
    - b. Time-lapse reporting
    - c. Seismic activity monitoring

Table 4. Summary of Analytical and Field Parameters for Fluid Samples from Shallow Groundwater (GW2-13) Samples (All analysis to be performed by Cardinal or a designed third party laboratory to be identified.)

Parameters	Analytical Methods[(1)]	Detection Limit/Range	Typical Precisions	Quality Control Requirements
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb, Se, and Tl	ICP-MS EPA Method 6020	0.001 to 0.1 mg/L(2)	±15%	Daily calibration, blanks, duplicates, and matrix spikes at 10% or greater.
Ca, Fe, K, Mg, Na, and Si	ICP-OES EPA Method 6010B	0.005 to 0.5 mg/L(2)	±15%	Daily calibration, blanks, duplicates, and matrix spikes at 10% or greater.
Anions: Br, Cl, F, NO_3, and SO_4	Ion Chromatography EPA Method 300.0	0.02 to 0.13 mg/L(2)	±15%	Daily calibration, blanks, and duplicated at 10% or greater frequency.
Dissolved CO_2	Coulometric Titration ASTM D513-11	25 mg/L	±15%	Duplicate measurement; standards at 10% or greater frequency
Total Dissolved Solids	Gravimetry APHA 2540C	12 mg/L	±10%	Balance calibration, duplicate analysis
Alkalinity	APHA 2320B	4 mg/L	±3 mg/L	Duplicate analysis
pH (field)	EPA 150.1	2 to 12 pH units	±0.2 pH units	Calibration per manufacturer specifications
Specific conductance (field)	APHA 2510	0 to 200 mS/cm	±1% of reading	Calibration per manufacturer specifications
Temperature (field)	Thermocouple	-5 to 50°C	±0.2°C	Calibration per manufacturer specifications

Note 1: An equivalent method may be employed with the prior approval of the UIC Program Director. Note 2: Analyte, dilution, and matrix dependent.

Table 5. Summary of Analytical and Field Parameters for Fluid Samples from Lowermost USDW Groundwater (USDW1) Samples. (All analysis to be performed by Cardinal or a designed third party laboratory to be identified.)

Parameters	Analytical Methods(1)	Detection Limit/Range	Typical Precisions	QC Requirements
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb, Se, and Tl	ICP-MS EPA Method 6020	0.001 to 0.1 mg/L(2)	±15%	Daily calibration, blanks, duplicates, and matrix spikes at 10% or greater.
Ca, Fe, K, Mg, Na, and Si	ICP-OES EPA Method 6010B	0.005 to 0.5 mg/L(2)	±15%	Daily calibration, blanks, duplicates, and matrix spikes at 10% or greater.
Anions: Br, Cl, F, NO_3, and SO_4	Ion Chromatography EPA Method 300.0	0.02 to 0.13 mg/L(2)	±15%	Daily calibration, blanks, and duplicated at 10% or greater frequency.
Dissolved CO_2	Coulometric Titration ASTM D513-11	25 mg/L	±15%	Duplicate measurement; standards at 10% or greater frequency
Isotopes: $\delta^{13}C$ of DIC	Isotope ratio mass spectrometry(3)	12.2 mg/L HCO_3^- for $\delta^{13}C$	±0.15% for $\boldsymbol{\delta^{13}C}$	10% duplicates; 4 standards/batch
Total Dissolved Solids	Gravimetry APHA 2540C	12 mg/L	±10%	Balance calibration, duplicate analysis
Water Density (field)	Oscillating body method	0.0000 to 2.0000	±0.0002 g/mL	Duplicate measurements
Alkalinity	APHA 2320B	4 mg/L	±3 mg/L	Duplicate analysis

Parameters	Analytical Methods(1)	Detection Limit/Range	Typical Precisions	QC Requirements
pH (field)	EPA 150.1	2 to 12 pH units	±0.2 pH units	Calibration per manufacturer specifications
Specific conductance (field)	APHA 2510	0 to 200 mS/cm	±1% of reading	Calibration per manufacturer specifications
Temperature (field)	Thermocouple	-5 to 50°C	±0.2°C	Calibration per manufacturer specifications

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

Note 2: Analyte, dilution, and matrix dependent

Note 3: Gas evolution technique by Atekwana and Krishnamurthy (1998), with modifications made by Hackley et al. (2007)

Table 6. Summary of Analytical and Field Parameters for Fluid Samples from ACZ1
(Cation, anion, TDS, and alkalinity analyte measurements will be performed by a laboratory meeting the requirements outlined in the EPA Environmental Laboratory Accreditation program. All other analysis to be performed by Cardinal or a designed third party laboratory, to be identified.)

Parameters	Analytical Methods(1)	Detection Limit/Range	Typical Precisions	QC Requirements
Cations:				
Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb, Se, and Tl	ICP-MS EPA Method 6020	0.001 to 0.1 mg/L(2)	±15%	Daily calibration, blanks, duplicates, and matrix spikes at 10% or greater.
Ca, Fe, K, Mg, Na, and Si	ICP-OES EPA Method 6010B	0.005 to 0.5 mg/L(2)	±15%	Daily calibration, blanks, duplicates, and matrix spikes at 10% or greater.
Anions:				
Br, Cl, F, NO_3, and SO_4	Ion Chromatography EPA Method 300.0	0.02 to 0.13 mg/L(2)	±15%	Daily calibration, blanks, and duplicated at 10% or greater frequency.

Parameters	Analytical Methods(1)	Detection Limit/Range	Typical Precisions	QC Requirements
Dissolved CO_2	Coulometric Titration ASTM D513-11	25 mg/L	±15%	Duplicate measurement; standards at 10% or greater frequency
Isotopes: $\delta^{13}C$ of DIC	Isotope ratio mass spectrometry(3)	12.2 mg/L HCO_3^- for $\delta^{13}C$	±0.15% for **$\delta^{13}C$**	10% duplicates; 4 standards/batch
Total Dissolved Solids	Gravimetry APHA 2540C	12 mg/L	±10%	Balance calibration, duplicate analysis
Water Density (field)	Oscillating body method	0.0000 to 2.0000	±0.0002 g/mL	Duplicate measurements
Alkalinity	APHA 2320B	4 mg/L	±3 mg/L	Duplicate analysis
pH (field)	EPA 150.1	2 to 12 pH units	±0.2 pH units	Calibration per manufacturer specifications
Specific conductance (field)	APHA 2510	0 to 200 mS/cm	±1% of reading	Calibration per manufacturer specifications
Temperature (field)	Thermocouple	-5 to 50°C	±0.2°C	Calibration per manufacturer specifications

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

Note 2: Analyte, dilution, and matrix dependent

Note 3: Gas evolution technique by Atekwana and Krishnamurthy (1998), with modifications made by Hackley et al. (2007)

Table 7. Summary of Analytical and Field Parameters for Fluid Samples from Mt. Simon Sandstone Groundwater (OBS1) Samples.
(All analysis to be performed by Cardinal or a designed third party laboratory to be identified.)

Parameters	Analytical Methods(1)	Detection Limit/Range	Typical Precisions	QC Requirements
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb, Se, and Tl	ICP-MS EPA Method 6020	0.001 to 0.1 mg/L(2)	±15%	Daily calibration, blanks, duplicates, and matrix spikes at 10% or greater.
Ca, Fe, K, Mg, Na, and Si	ICP-OES EPA Method 6010B	0.005 to 0.5 mg/L(2)	±15%	Daily calibration, blanks, duplicates, and matrix spikes at 10% or greater.
Anions: Br, Cl, F, NO_3, and SO_4	Ion Chromatography EPA Method 300.0	0.02 to 0.13 mg/L(2)	±15%	Daily calibration, blanks, and duplicated at 10% or greater frequency.
Dissolved CO_2	Coulometric Titration ASTM D513-11	25 mg/L	±15%	Duplicate measurement; standards at 10% or greater frequency
Isotopes: $\delta^{13}C$ of DIC	Isotope ratio mass spectrometry(3)	12.2 mg/L HCO_3^- for $\delta^{13}C$	±0.15% for **$\delta^{13}C$**	10% duplicates; 4 standards/batch
Total Dissolved Solids	Gravimetry APHA 2540C	12 mg/L	±10%	Balance calibration, duplicate analysis
Water Density (field)	Oscillating body method	0.0000 to 2.0000	±0.0002 g/mL	Duplicate measurements
Alkalinity	APHA 2320B	4 mg/L	±3 mg/L	Duplicate analysis

Parameters	Analytical Methods[1]	Detection Limit/Range	Typical Precisions	QC Requirements
pH (field)	EPA 150.1	2 to 12 pH units	±0.2 pH units	Calibration per manufacturer specifications
Specific conductance (field)	APHA 2510	0 to 200 mS/cm	±1% of reading	Calibration per manufacturer specifications
Temperature (field)	Thermocouple	-5 to 50°C	±0.2°C	Calibration per manufacturer specifications

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

Note 2: Analyte, dilution, and matrix dependent

Note 3: Gas evolution technique by Atekwana and Krishnamurthy (1998), with modifications made by Hackley et al. (2007)

Table 8. Summary of Analytical Parameters for CO_2 Stream.
All analysis to be performed by Cardinal or a designed third party laboratory, to be identified. Primary constituents to be reported are in bold.

Parameters	Analytical Methods[1]	Detection Limit/Range	Typical Precisions	QC Requirements
CO_2 Purity	ISBT 2.0	5 % v/v	±10 % of reading	Calibration per manufacturer specifications
Total Hydrocarbons as Methane	ISBT 10.0	0.1 ppm v/v as CH_4	5-10% of reading	Daily blank, daily standard within 10% of calibration, secondary standard after calibration
Total Non-Methane Hydrocarbons (TNMHC)	ISBT 10.1	0.1 ppm v/v as CH_4		
Carbon Monoxide (CO)	ISBT 5.0	0.5 ppm v/v	±20% of reading	Duplicate analysis
Ammonia (NH_3)	ISBT 6.0	0.5 ppm v/v		
Oxides of Nitrogen (NO_x)	ISBT 7.0	0.5 ppm v/v	±20% of reading	Duplicate analysis
Nitrogen Dioxide (NO_2)	ISBT 7.1	0.5 ppm v/v		
Nitric Oxide (NO)	ISBT 7.2	0.5 ppm v/v		
Source Specific Parameters:				
Hydrogen Cyanide (HCN)	ISBT 17.0	0.5 ppm v/v		
Vinyl Chloride (C_2H_3Cl)	ISBT 18.0	0.1 ppm v/v		
Phosphine (PH_3)	ISBT 19.0	0.1 ppm v/v		
Ethylene Oxide (C_2H_4O)	ISBT 20.0	0.1 ppm v/v		
Non-Condensable Gases:				
Nitrogen (N_2)	ISBT 4.0	4.0 ppm v/v	±10% of reading	Daily standard within 10% of calibration, secondary standard after calibration
Oxygen (O_2)	ISBT 4.0	4.0 ppm v/v	±10% of reading	
Argon (Ar)	ISBT 4.0	4.0 ppm v/v		

Parameters	**Analytical Methods(1)**	**Detection Limit/Range**	**Typical Precisions**	**QC Requirements**
Hydrogen (H_2)	ISBT 4.0	10.0 ppm v/v		
Helium (He)	ISBT 4.0	10.0 ppm v/v		
<u>Volatile Hydrocarbons:</u>				
Methane	ISBT 10.1	0.5 ppm v/v	5-10% of reading	Daily blank, daily standard within 10% of calibration, secondary standard after calibration
Ethylene	ISBT 10.1	0.5 ppm v/v		
Ethane	ISBT 10.1	0.5 ppm v/v		
Propylene	ISBT 10.1	0.5 ppm v/v		
<u>Volatile Hydrocarbons cont'd:</u>				
Propane	ISBT 10.1	0.5 ppm v/v		
Isobutane	ISBT 10.1	0.5 ppm v/v		
n-Butane	ISBT 10.1	0.5 ppm v/v		
Butenes	ISBT 10.1	0.5 ppm v/v		
Isopentane	ISBT 10.1	0.5 ppm v/v		
n-Pentane	ISBT 10.1	0.5 ppm v/v		
Pentenes	ISBT 10.1	0.5 ppm v/v		
C_{6+}	ISBT 10.1	0.5 ppm v/v		
<u>Aromatic Hydrocarbons:</u>				
Benzene (AHC)	ISBT 12.0	0.002 ppm v/v		
Toluene	ISBT 12.0	0.002 ppm v/v		
Ethyl Benzene	ISBT 12.0	0.002 ppm v/v		
m+p Xylene	ISBT 12.0	0.002 ppm v/v		
o-Xylene	ISBT 12.0	0.002 ppm v/v		

Parameters	Analytical Methods[1]	Detection Limit/Range	Typical Precisions	QC Requirements
Volatile Sulfur Compounds:				
Hydrogen Sulfide (H_2S)	ISBT 14.0	0.02 ppm v/v	5-10% of reading	Daily blank, daily standard within 10% of calibration, secondary standard after calibration
Carbonyl Sulfide (COS)	ISBT 14.0	0.02 ppm v/v		
Sulphur Dioxide (SO_2)	ISBT 14.0	0.02 ppm v/v	5-10% of reading	
Methyl Mercaptan	ISBT 14.0	0.02 ppm v/v		
Ethyl Mercaptan	ISBT 14.0	0.02 ppm v/v		
Dimethyl Sulfide	ISBT 14.0	0.02 ppm v/v		
Carbon Disulfide	ISBT 14.0	0.02 ppm v/v		
i-Propyl Mercaptan	ISBT 14.0	0.02 ppm v/v		
t-Butyl Mercaptan	ISBT 14.0	0.02 ppm v/v		
n-Propyl Mercaptan	ISBT 14.0	0.02 ppm v/v		
Methyl Ehtyl Sulfide	ISBT 14.0	0.02 ppm v/v		
sec-Butyl Mercaptan	ISBT 14.0	0.02 ppm v/v		
i-Butyl Mercaptan	ISBT 14.0	0.02 ppm v/v		
Dimethyl Disulfide	ISBT 14.0	0.02 ppm v/v		
n-Butyl Mercaptan	ISBT 14.0	0.02 ppm v/v		
Dimethyl Disulfide	ISBT 14.0	0.02 ppm v/v		
Other Sulfurs	ISBT 14.0	0.02 ppm v/v		
Total Sulfur Content (TSC)	ISBT 13.0	0.02 ppm v/v		
Volatile Oxygenates:				
Acetaldehyde (AA)	ISBT 11.0	0.05 ppm v/v	5-10% of reading	Daily blank, daily standard within 10% of calibration, secondary standard after calibration
Ethyl Oxide	ISBT 20.0	0.1 ppm v/v		
Dimethyl Ether	ISBT 11.0	0.1 ppm v/v		

Parameters	Analytical Methods[1]	Detection Limit/Range	Typical Precisions	QC Requirements
Methyl Ethyl Ether	ISBT 11.0	0.2 ppm v/v	5-10% of reading	Daily blank, daily standard within 10% of calibration, secondary standard after calibration
Methanol (MeOH)	ISBT 9.0	0.2 ppm v/v		
Propionaldehyde	ISBT 11.0	0.2 ppm v/v		
Acetone	ISBT 11.0	0.2 ppm v/v		
Ethanol	ISBT 11.0	0.2 ppm v/v		
Isopopanol	ISBT 11.0	0.2 ppm v/v		
Ethyl Acetate	ISBT 11.0	0.2 ppm v/v		
t-Butanol	ISBT 11.0	0.2 ppm v/v		
n-Propanol	ISBT 11.0	0.2 ppm v/v		
2-Butanol	ISBT 11.0	0.2 ppm v/v		
Isobutanol	ISBT 11.0	0.2 ppm v/v		
n-Butanol	ISBT 11.0	0.2 ppm v/v		
Isoamyl Alcohol	ISBT 11.0	0.2 ppm v/v		
Isoamyl Acetate	ISBT 11.0	0.2 ppm v/v		

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

Table 9. Summary of Analytical Parameters for Corrosion Coupons.

Parameters	Analytical Methods	Detection Limit/Range	Typical Precisions	QC Requirements
Mass	NACE RP0775-2005	0.005 mg	±2%	Annual third party calibration of scale (certification number to be provided)
Thickness	NACE RP0775-2005	0.001 mm	±0.005	Factory calibration

Table 10. Summary of Measurement Parameters for Field Gauges.*

Parameters	Methods	Detection Limit/Range	Typical Precisions	QC Requirements
Injection tubing temperature	ANSI Z540-1-1994	±0.001 °F, 0-500 °F	±0.01 °F	Annual third party calibration of scale (cert number to be provided)
Injection tubing pressure	ANSI Z540-1-1994	±0.001 psi, 0-3,000 psi	±0.01 psi	Annual third party calibration of scale (cert number to be provided)
Injection flow rate	NA	± 0.1% of rate	50,522-303-133 lb/hr	Annual third party calibration of scale (cert number to be provided)
CCS1 annulus pressure	ANSI Z540-1-1994	±0.001 psi, 0-3,000 psi	±0.01 psi	Annual third party calibration of scale (cert number to be provided)
CCS1 downhole pressure	ANSI Z540-1-1994	±0.001 psi, 0-10,000 psi	±0.01 psi	Annual third party calibration of scale (cert number to be provided)
CCS1 downhole temperature	ANSI Z540-1-1994	±0.001 °F, 0-300 °F	±0.01 °F	Annual third party calibration of scale (cert number to be provided)
OBS1 annulus pressure	ANSI Z540-1-1994	±0.001 psi, 0-3,000 psi	±0.01 psi	Annual third party calibration of scale (cert number to be provided)
OBS1 downhole pressure	ANSI Z540-1-1994	±0.001 psi, 0-10,000 psi	±0.01 psi	Annual third party calibration of scale (cert number to be provided)
ACZ1 wellhead pressure	ANSI Z540-1-1994	±0.001 psi, 0-3,000 psi	±0.01 psi	Annual third party calibration of scale (cert number to be provided)

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

*Standards, detection limits/ranges, and precision parameters are subject to change based on the finalization of equipment

Table 11. Actionable Testing and Monitoring Outputs.

Activity or Parameter	Project Action Limit	Detection Limit	Anticipated Reading
Part II (External) MIT *PNL*	Action to be taken if CO_2 is outside of anticipated range or location.	TBD based on contractor tool specifications	TBD based on results of baseline logs Readings vary by zone.
Part II (External) MIT *Temperature Logging* *RAT Logging*	Action to be taken if an anomaly in the temperature/GR profile is identified.	TBD based on contractor tool specifications	TBD based on results of baseline logs Readings vary by zone.
Part I (Internal) MIT *Annulus Pressure Test*	Action to be taken if pressure change is greater than 3% in one hour.	See Table 10	Less than 3% pressure change in one hour.
Surface pressure (CCS1)	Action to taken if injection pressure is above MAIP.	See Table 10	Less than the MAIP as detailed in Section 6
Downhole pressure/temperature (CCS1)	Action to taken if pressure is above maximum allowable botthom hole pressure (MABHP).	See Table 10	Less than the corresponding BHP as determined in the MAIP in Section 6
Downhole pressure (OBS1)	Action to be taken if pressure varies significantly from modeled values or is above MABHP.	See Table 10	TBD based on results of a baseline pressure and temperature survey
Water quality	Action to be taken if ACZ or USDW/GW water quality deviates significantly from baseline water quality measurements.	See Tables 4-7	TBD based on baseline samples to be taken prior to injection.
3D time-lapse seismic surveys	Action to be taken if CO_2 plume is detected outside of modeled plume/AoR.	Variable dependent on fluid saturation, formation velocities, etc.	Similar CO_2 plume migration in comparison to the model.
Passive seismic monitoring	Action to be taken if notable seismic activity is measured concurrent with injection operations.	Refer to ERRP section for further discussion on detection limits and action items.	Consistent with baseline/background seismic measurements.

3.4.2 A.4.b. Precision

For groundwater sampling, data accuracy will be assessed regularly by the collection and analysis of blanks to test procedures and matrix spikes to test lab and sampling procedures. Field blanks will be taken no less than one per sampling event to spot check for sample container contamination. Laboratory assessment of the precision of the analytes will be the responsibility of the laboratory chosen to analyze the field samples based on acceptable operating procedures.

Table 12 presents the specifications and precision information for the downhole pressure and temperature gauges to be used for downhole pressure and temperature monitoring in the injection and above confining zone intervals.

Table 13 presents the parameters and specifications for the logging tools to be used as part of the testing and monitoring plan in the pre-operational, injection, and post injection site care phases of the project.

3.4.3 A.4.c. Bias

Assessments of the analytical biases present in analysis are the responsibility of the contacted laboratories based on acceptable operating procedures. It is assumed there are no measurement biases for direct temperature, pressure, or logging measurements.

3.4.4 A.4.d. Representativeness

For groundwater sampling, data representativeness expresses the degree to which data accurately and precisely represents a characteristic of a sample population, parameter variations at a specific sampling point, a process condition, or an environmental condition. The sampling network laid out in the monitoring program is designed to provide data that is representative of site conditions.

For analytical results of individual groundwater samples, representativeness will be estimated by ion and mass balance determination. Ion balance determinations with ±10 percent error, or less, will be considered valid. Mass balance determinations will be used in cases where the ion balance is great that the ±10 percent threshold to attempt to determine the source of the measurement error.

For samples (and their duplicates) if the relative percent difference varies by more than 10%, the sample may be considered not representative.

3.4.5 A.4.e. Completeness

Data completeness is a measure of the amount of valid data obtained from a measurement point compared to the amount of data that was expected to be obtained from the data point under normal conditions. It is anticipated that 90 percent data completeness for groundwater samples will be considered acceptable to meet monitoring objectives.

For direct pressure, temperature, and logging measurements, it is anticipated that data will be recorded no less than 90 percent of the time.

3.4.6 A.4.f. Comparability

Data comparability expresses the confidence with which one data set can be compared to others. The data sets generated by this project are anticipated to be comparable to future data sets because of the use of standard methods of measurement and the high levels of QA/QC of data.

Historical groundwater quality data will be assessed for their level of quality, and assuming they are of high enough quality, will be used for comparative purposes. Direct pressure, temperature and logging measurements will be directly comparable to previously collected data.

3.4.7 A.4.g. Method Sensitivity

Tables 12 through 22 provide additional information on gauge and sensor sensitivities as well as logging and downhole tool specifications.

Table 12. Pressure and Temperature (OBS1/ACZ1/CCS1) – Downhole Gauge Specifications. (1)

Parameter	Value
Calibrated working pressure range	14.7 to 10,000 psi
Initial pressure accuracy	± 0.015% over full scale
Pressure resolution	0.006 psi/second
Pressure drift stability	0.01% Full Scale/Year
Calibrated working temperature range	to 150°C
Initial temperature accuracy	±0.1 °C
Temperature resolution	0.005 °C/second
Temperature drift stability	0.1% °C/yearr
Max temperature	150 °C
Instrument calibration frequency	From manufacturer

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

Table 13. Representative Logging Tool Specifications.(1)

Parameter	PNL	CBL	USIT	Temperature Log
Logging speed	1,000 ft/hr	1,800 ft/hr	2,700 ft/hr	900 ft/hr
Investigation	Formation	Formation, casing, cement bond quality	Formation, casing, cement bond quality	Formation
Temperature rating	Up to 350°F	Up to 302 °F	Up to 350°F	Up to 150°C
Pressure rating	Up to 15,000 psi	Up to 14,000 psi	Up to 20,000 psi	Up to 14,500 psi

Note 1: A suitable replacement tool could be used pending tool availability, updated specifications will be provided should such a change occur.

Table 14. Temperature Field Probe – Post Compressor. (1)

Parameter	Value
Calibrated working temperature range	0-500 °F
Initial temperature accuracy	<0.0055%
Temperature resolution	0.001 °F

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

Table 15. Pressure Field Probe – Post Compressor. (1)

Parameter	Value
Calibrated working pressure range	0-3,000 psi
Initial pressure accuracy	0.025%
Pressure resolution	0.001 psi

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

Table 16. Flow Rate Field Flowmeter – Post Compressor. (1)

Parameter	Value
Calibrated working flow rate range	50,000-303,000 lb/hr
Initial mass flow rate accuracy	<0.18%
Mass flow rate resolution	0.0001lb/hr

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

Table 17. Temperature Field Probe – Injection Tubing. (1)

Parameter	Value
Calibrated working temperature range	0-500 °F
Initial temperature accuracy	<0.0055%
Temperature resolution	0.001 °F

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

Table 18. Pressure Field Probe – Injection Tubing. (1)

Parameter	Value
Calibrated working pressure range	0-3,000 psi
Initial pressure accuracy	0.025%
Pressure resolution	0.001 psi

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

Table 19. Flow Rate Field Flowmeter – Injection Tubing. (1)

Parameter	**Value**
Calibrated working flow rate range	50,000-303,000 lb/hr
Initial mass flow rate accuracy	<0.18%
Mass flow rate resolution	0.0001lb/hr

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

Table 20. Pressure Field Probe – CCS1 Annulus. (1)

Parameter	**Value**
Calibrated working pressure range	0-3,000 psi
Initial pressure accuracy	0.025%
Pressure resolution	0.001 psi

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

Table 21. Pressure Field Probe – OBS1 Annulus. (1)

Parameter	**Value**
Calibrated working pressure range	0-3,000 psi
Initial pressure accuracy	0.025%
Pressure resolution	0.001 psi

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

3.5 A.5. Special Training/Certifications

3.5.1 A.5.a. Specialized Training and Certifications

Geophysical surveying equipment and wireline logging tools will be operated by trained, qualified, and certified personnel. This will be verified by the respective contracted service company that provides the equipment and services. The data collected as a result of these activities will be analyzed according to industry standards.

There are currently no special certifications required for personnel to collect groundwater samples. These activities will still be performed by qualified personnel. Groundwater sampling will be performed by personnel trained to understand and follow the specific and detailed sampling procedures.

If requested OCP will provide the EPA with all laboratory Standard Operating Procedures (SOPs) for the specific parameters for the approved methods. Each laboratory technician conducting analysis on the samples will be trained in these SOPs for the standard method they are using. Technician certifications will be provided with the regular reports.

3.5.2 A.5.b/c. Training Provider and Responsibility

Training will be provided by the contracted operator or subcontractor responsible the collection of data.

3.6 A.6. Documentation and Records

3.6.1 A.6.a. Report Format and Package Information

A report from OCP to EPA will contain all required project data, sampling results, and analytical analysis results. The frequency of this report is defined the Testing and Monitoring section of this application. Data will be provided in digital formats unless otherwise requested.

3.6.2 A.6.b. Other Project Documents, Records, and Electronic Files

Other files (i.e., well logs, reports, test results, etc.) will be provided as required by the UIC Program Director and Class VI Permit.

3.6.3 A.6.c/d. Data Storage and Duration

OCP will maintain digital copies of all relevant files for the project as stipulated in the Testing and Monitoring and PISC sections of this application (Attachment 7: Testing And Monitoring, 2022) (Attachment 9: Post-Injection Site Care, 2022).

3.6.4 A.6.e. QASP Distribution Responsibility

OCP will be responsible for ensuring that all people listed on the distribution list below will receive the current copy of the approved QASP.

4 B. Data Generation and Acquisition

4.1 B.1. Sampling Process Design

Discussion in this section is focused on groundwater fluid sampling and does not discuss monitoring methods associated with non-physical samples (logging, seismic, pressure/temperature monitoring, etc.).

During the pre-operational, injection, and PISC phases, groundwater sampling analysis is planned to include an extensive set of chemical analytes to aid in establishing a quality baseline data set. These analytes will include:

i. primary and secondary EPA drinking water maximum contaminant levels,
ii. are most responsive to CO_2 or brine contact,
iii. are necessary for quality control (QC) and,
iv. might be necessary for geochemical modeling.

The full set of monitoring parameters is provided in Tables 4-7. After a sufficient baseline dataset is established, the scope of the monitored analyte may shift to a more detailed subset of parameters that are:

i. the most responsive to interaction with CO_2 or brine contact, and
ii. are necessary for QC.

Implementation of a reduced set of parameters will be done in conjunction with consultation with the EPA.

Isotopic analyses will be performed on baseline samples to assist with verification of initial conditions, or to help with understanding non-project related variations. For-non baseline samples, isotopic analysis may be reduced in monitoring wells if review of historical analytical results or other data determines that is no longer needed. Isotopic analyses will be conducted using established and accepted methods.

During a period where a reduced set of analytes is used, should statistically significant trends develop that are presumed to be a result of unintended CO_2 or brine migration, the analytical list will be expanded to the initial, full set of analytical parameters.

ACZ groundwater samples will be analyzed using a laboratory that meets the requirements laid out in the EPA Environmental Laboratory Accreditation Program. All other samples will be analyzed by the operator or a contracted third party lab. Dissolved CO_2 will be analyzed by methods consistent with *Test Method B of ASTM D 513-06, "Standard Test Methods for Total and Dissolved Carbon Dioxide in Water"* or a suitable equivalent.

4.1.1 B.1.a. Design Strategy

4.1.1.1 CO_2 Stream Monitoring Strategy

The primary purpose of analyzing the CO_2 stream is to evaluate the potential interactions of CO_2 and other potential constituents of the injected with formation solids. the analysis performed can also identify or potentially rule out interactions with well materials of construction. Establishing chemical composition of the injectate also will help to support the determination of whether this injectate meets the qualifications of hazardous waste paid out under the RC RA act from 1976. In addition to those stipulations laid out in the Resource Conservation and Recovery Act (RCRA act), this determination will also be made with respect to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA act) from 1980.

Additional monitoring of chemical and physical characteristics of the CO_2 may help distinguish the inject a from native brine and gases if potential unintended leakage from the reservoir occurs injectate monitoring will occur at such frequency to detect potential changes to any physical or chemical properties that may result in deviation from the permit specifications and baseline data.

Yearly calibration of temperature, pressure, and flowrate probes and transponder meant to monitor the response of the injection of CO_2 into CCS1, will also be conducted annually at OBS1 and ACZ1. Calibration reports will contain information on the test equipment used to calibrate the probes, including: equipment manufacturer information, serial numbers, calibration dates, and expiration dates of equipment and calibration. These calibration activities will be performed throughout the injection and PISC phases of the project.

4.1.1.2 Corrosion Monitoring Strategy

Corrosion coupon analysis will be conducted regularly to aid and ensuring the mechanical integrity of all equipment that comes in contact with the CO_2 stream. Coupons will be sent regularly to a third party company for analysis. This analysis will be conducted in accordance with NACE Standard RP-0775, or similar, to determine and document any potential corrosion or wear rates based on mass loss.

4.1.1.3 Shallow Groundwater Monitoring Strategy

Twelve dedicated monitoring wells have been selected for the shallow groundwater monitoring program. Note that these wells primarily consist of existing private use water wells in the area. If necessary, wells will be drilled and installed to varying depths, from just below surface to above the lowermost USDW. These wells are intended to monitor and cover all currently used aquifers in the area. Further details on the existing wells are provided in the AoR and Corrective Action Plan (Attachment 2: AOR and Corrective Action, 2022). These wells will be sampled routinely as is detailed in the Pre-operational Testing Plan, the Testing and Monitoring Program, and the PISC Plan (Attachment 5: Pre-Op Testing Program, 2022) (Attachment 7: Testing And Monitoring, 2022) (Attachment 9: Post-Injection Site Care, 2022). The names of these wells are as follows:

- GW2
- GW3
- GW4
- GW5
- GW6
- GW7
- GW8
- GW9
- GW10
- GW11
- GW12
- GW13

Should alteration to these well names occur, proper updating of all relevant documentation and reports will be provided following these changes. These wells will be installed at various locations within and outside of the AoR. The wells will be spatially distributed as well as located at critical groundwater source points.

4.1.1.4 Deep Groundwater Monitoring Strategy

USDW1

One dedicated deep groundwater monitoring well will be installed in close proximity to the injection well (CCS1). This well will be installed and screened within the identified lowermost USDW. This well will serve as an early leakage detection point at or near the injection well. This interval is assumed to have sufficient permeability and porosity such that suitable fluid samples may be taken.

With the planned sampling methods and outlined frequency, it is expected that baseline conditions can be documented, and any natural variability in conditions can be characterized, and that unintended brine or CO_2 leakage will be detected quickly if it occurs.

ACZ1

One dedicated above confining zone monitoring well (ACZ1) will also be installed in close proximity to the injection well. This well will be installed and completed within a permeable layer above the confining zone. This well will also serve as an early leakage detection point at or near the injection well. This well will be completed and a zone with sufficient permeability and porosity such that suitable fluid samples may be taken. This well will also be assumed to have sufficient permeability and porosity such that valid pressure monitoring may occur.

With the planned sampling methods and outline frequency, it is expected that baseline conditions can be documented, and any natural variability in the conditions can be characterized, and that unintended brine or CO_2 leakage will be detected quickly if it occurs. Sufficient data will be collected from this well to demonstrate that the effects of CO_2 injection are limited to the intended reservoir.

CCS1 and OBS1

Fluid samples will be collected from the injection well as part of the pre-operational testing program. Once injection begins, fluid sampling in the Mt. Simon Sandstone will occur in the deep observation well (OBS1) only.

4.1.2 B.1.b. Type and Number of Samples/Test Runs

Table 1 contains a listing of type in number of samples that will be run and collected from each of the wells mentioned above.

4.1.3 B.1.c. Site/Sampling Locations

Groundwater sampling locations are provided above and table. Specific analytes for groundwater sampling are provided in Tables 4 through 7.

4.1.4 B.1.d. Sampling Site Contingency

Locations of off-site sampling and monitoring points have not been finalized. It is currently anticipated, however, that no site access issues will be occur. All other wells will be located on the facility. If weather makes well access difficult, sampling schedules will be adjusted as necessary to ensure access and proper sampling may occur. Any changes to sampling schedule will be discussed with the EPA prior to them occurring.

CO_2 gas stream and corrosion coupon sampling points will also be located at the facility. If weather makes access to these sampling points difficult, sampling schedules will be adjusted as necessary to ensure access and proper sampling may occur. Any changes to sampling schedule will be discussed with the EPA prior to them occurring.

4.1.5 B.1.e. Activity Schedule

Sampling frequencies and occurrences are detailed in the pre operational testing plan, the testing and monitoring plan, and the PISC plan sections of the permit application (Attachment 5: Pre-Op Testing Program, 2022) (Attachment 7: Testing And Monitoring, 2022) (Attachment 9: Post-Injection Site Care, 2022).

4.1.6 B.1.f. Critical/Informational Data

Detailed documentation from field and laboratory activities will be taken during groundwater sampling and analytical work. Important documentation to be collected during these times are as follows:

- time and date of activity,
- person(s) performing activity,
- location of activity,
- equipment calibration data, and
- field parameter values.

During laboratory analysis much of the above listed critical data are generated during the analysis, and provided as part of the typical output reports from analysis. Additional noncritical data may be collected. This data may include appearance and odor of sample, problems with well or any sampling equipment, and any weather conditions which may impact sampling.

4.1.7 B.1.g. Sources of Variability

Potential sources of variability related to the aforementioned monitoring activities include:

- natural variation in fluid quality, formation pressure and temperature, and seismic activity,
- variation in fluid quality, formation pressure and temperature, and seismic activity due to injection operations,
- changes in aquifer recharge due to rainfall, drought, or snowfall,
- changes in instrument calibration during sampling or analytical activities,
- changes in collection staff or analytical staff,
- differences in environmental conditions during field sampling activities,
- changes in analytical data quality during the life of the project, and
- data entry errors related to maintaining a project database.

Activities that may serve to limit reduce or reconcile some of these sources of variability related to monitoring activities include:

- collecting long-term baseline data to observe and document natural variation in monitoring parameters,
- evaluating data and a timely manner after collection such that anomalies in the data can be observed and addressed and re sampling or reanalysis may occur,
- conducting statistical analysis of the data collected data to determine whether variability and data set is a result of project activities or natural variation (i.e., determining if variation is biased or statistically significant),
- maintaining a database of weather related data using on site and regional weather monitoring data or data collected from other near location sources,
- checking instrument calibration before during and after sampling or analysis,
- thoroughly training all staff to the standards that were detailed and sub sections 3.5.1 and 3.5.2,
- conducting routine quality assurance checks using third party reference materials and or blind and or duplicate sample checks, and
- developing a systematic review process of data that can include site and sample specific data quality checks.

4.2 B.2. Sampling Methods

Logging, geophysical monitoring, and pressure and temperature monitoring does not apply to this section and is, therefore, omitted.

4.2.1 B.2.a/b. Sampling SOPs

Groundwater samples will be collected primarily using a low-flow sampling method that is consistent with ASTM D6452-99 (2005) or Puls and Barcelona (1996). This method intends for a flow through cell to be used. Should a flow through cell not be used, field parameters will be measured from grab samples. All groundwater wells will be purged to ensure samples are representative of formation water quality.

Static water levels in each well will be determined using an electronic water level indicator before any purging or sampling activities occur. Dedicated pumps will be installed in each of the monitoring wells to minimize potential cross contamination between wells.

Groundwater pH temperature, specific conductance, and dissolved oxygen will be monitored in the field using portable probes and a flow through cell consistent with standard methods. Given sufficient flow rates and volumes. Field chemistry probes will be calibrated at the beginning of each sampling day according to the given equipment manufacturer procedures and using standard reference solutions.

When a flow through cell is used, field parameters will be continuously monitored and will be considered stable when three successive measurements made three minutes apart meet the criteria listed in the following table.

Table 22. Stabilization Criteria of Water Quality Parameters During Shallow Well Purging.

Field Parameter	**Stabilization Criteria**
pH	± 0.2 units
Temperature	± 1°C
Specific conductance	± 3% of reading in µS/cm
Dissolved oxygen	± 10% of reading or 0.3 mg/L, whichever is greater

Any newly installed groundwater monitoring wells will be developed extensively at the time of completion. Methods for development include, but are not limited to, air lifting, submersible pumps, or swabbing.

For deep groundwater sampling (defined as the ACZ or deeper), a wireline conveyed system with a sampling device capable of collecting downhole samples from discrete intervals will be utilized. Prior to sampling, any zones from these wells will be purged and ensure that stabilization criteria are met before taking representative samples. Standard methods, such as down hole submersible pumps or swabbing, will be used to develop these wells. The representative sample taken after the stabilization criteria have been met may be small relative to the total amount of fluid purged from the wells.

For shallower groundwater monitoring wells, methods such as air lift or submersible pumps may be used to help with sampling fluid from the wells.

After field parameters and stabilized per the above table, samples will be collected. Samples will be filtered through 0.45 µm through filter cartridges as appropriate and consistent with ASTM D6564-00, or suitable alternative.

Prior to sample collection, filters will be purged with a minimum of 100 mL of well water or more for quired by the filter manufacturer. For alkalinity and total CO_2 sampling, reasonable effort will be made to minimize exposure to atmospheric conditions during filtration, collection in sample containers, and analysis.

4.2.2 B.2.c. In-situ Monitoring

In-situ monitoring of groundwater chemistry and analytes is not currently planned.

4.2.3 B.2.d. Continuous Monitoring

No continuous pressure monitoring is anticipated or planned at any of the groundwater monitoring wells.

4.2.4 B.2.e. Sample Homogenization, Composition, Filtration

Information on the sampling, homogenization, composition and filtration it provided in section 4.2.1.

4.2.5 B.2.f. Sample Containers and Volumes

For CO_2 stream monitoring, samples will be collected and clean sample containers rated appropriately for sample collection pressure. To ensure a clean sample is taken, ,the collection cylinder(s) will be purged at least five time (with the sample gas) prior to sample collection.

Information for the regular CO_2 gas analysis is provided in Table 8.

For shallow and deep groundwater samples, all sample bottles will be new sample bottles and bags for analytes will be used as received from the vendor or contract analytical laboratory for the handle it if interest. A summary of sample containers used as presented in Table 25.

4.2.6 B.2.g. Sample Preservation

For aqueous and groundwater samples, the preservation methods listed in Table 25 will be used.

At this time, preservation of CO2 gas stream samples is not currently anticipated. In additional details of the sampling requirements are shown below in Table 24.

Corrosion coupon sampling only requires that the coupons be physically separated during transportation to prevent physical abrasion.

Table 23. Summary of Sample Containers, Preservation Treatments, and Holding Times for CO2 Gas Stream Analysis.

Sample	Volume/Container Material	Preservation Technique	Sample Holding time (max)
CO_2 gas stream	(1) 75 cm^3 mini gas cylinder (2) 2L MLB polybags	Sample storage cabinets	5 business days

4.2.7 B.2.h. Cleaning/Decontamination of Sampling Equipment

As detailed in Section 4.2.1, dedicated pumps will be installed in each of the groundwater monitoring wells to minimize potential cross contamination between wells. These pumps will remain in each well throughout the project, except for routine maintenance, for the duration of the pre-operational testing, injection, and PISC phases of the project. Prior to pump installation, the pumps will be cleaned on the outside, with a non phosphate detergent. Pumps will be rinsed the minimum of three times with the ionized water. A minimum of 1 L of deionized water will then be pumped through the pump and sample tubing.

Once all pumps in their associated tubing are clean, they will be placed in plastic storage bags and transported for installation. All glassware to be used in the field will be cleaned first with tap water to remove any loose dirt, then washed in a dilute nitric acid solution, and finally rinsed with deionized water before use.

Gas stream sampling containers will be disposed of or decontaminated by the analytical lab. No sampling equipment will be utilized with the corrosion coupons or annual field calibrations.

4.2.8 B.2.i. Support Facilities

In order for proper groundwater sampling to occur, the following equipment are required:

- Air compressor
- Vacuum pump
- Generator
- Multi-electrode water quality measurement tool
- Analytical meters

It is assumed that the proper sampling tubes, connections and valves required to sample the gas stream will be supplied by the analytical lab, providing the sampling containers. Sampling will occur within the compression building.

Corrosion coupons will also be evaluated from sampling points within the injection line within the compression building.

Field gauges will be utilized for bottom hole pressure measurements in the wells. The deployment and retrieval of downhole well gauges will be done using procedures and equipment recommended by the vendor contract or per industry standard practice. It is currently anticipated that the primary way of deploying or retrieving these gauges is via wireline. These gauges will remain in place for the entirety of the pre-operational, operational, and PISC monitoring periods.

4.2.9 B.2.j. Corrective Action, Personnel, and Documentation

Field staff are responsible for ensuring that all equipment is properly functioning. Corrective action will be performed on broken or malfunctioning equipment in the field as necessary. If corrective action cannot be taken in the field, the equipment will be uninstalled and returned to the manufacturer for repair or replacement. Any significant corrective actions that are required will be documented.

4.3 B.3. Sample Handling and Custody

Logging, geophysical monitoring, and pressure and temperature monitoring does not apply to this section and is, therefore, omitted.

Sample holding times provided in Table 25 will be consistent with those described By EPA guidelines from 1974, American Public Health Association in 2005, Wood in 1976, and ASTM Method D6517-00 from 2005.

After collection, all samples will be placed in and ice chest in the field and, which will be maintained thereafter to proximately 4 °C until analysis can be performed. These samples will be maintained at this preservation temperature and sent to their designated laboratory within 24 hours of collection and storage.

Analysis of the samples will be completed within the holding time listed in Table 25. As appropriate, alternative sample containers and preservation techniques approved by the UIC program director may be used to meet analytical requirements.

4.3.1 B.3.a. Maximum Hold Time/Time Before Retrieval

See Table 25 for maximum hold times for different samples.

4.3.2 B.3.b. Sample Transportation

See beginning of section 4.3 for sample transportation details and standards.

4.3.3 B.3.c. Sampling Documentation

Field notes will be collected for all groundwater samples that are collected. These forms and notes will be retained in archived. His reference sample documentation is the responsibility of the groundwater sampling personnel.

An analytical authorization form will be provided for each gas stream sample provided for analysis as shown by the example in Appendix A, which will be provided at a later date after vendor selection.

4.3.4 B.3.d. Sample Identification

All sample bottles will have waterproof labels with the following information:

- Project name
- Sampling date
- Sampling location
- Sampling, identification number
- Sample type
- Analyte
- Volume
- Filtration used

And preservative usedAppendix A will include examples of sample documentation including an example of such a label for a sample bottle.

Table 24. Summary of Anticipated Sample Containers, Preservation Treatments, and Holding Times for Groundwater Samples.

Target Parameters	Volume (Container Material)	Preservation Technique	Sample Holding Time
Cations: Ca, Fe, K, Mg, Na, Si, Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb, Se, Tl	250 ml (HDPE)	Filtered, nitric acid, cool 4 °C	60 days
Dissolved CO_2	2 – 60 ml (HDPE)	Filtered, cool 4 °C	14 days
	60 ml (HDPE)	Filtered, cool 4 °C	14 days
Isotopes: ^{3}H, δD, δ^{18}O, δ^{34}S, δ^{13}C	2 – 60 ml (HDPE)	Filtered, cool 4 °C	4 weeks
Isotopes: δ^{34}S	250ml (HDPE)	Filtered, cool 4 °C	4 weeks
Isotopes: δD, δ^{18}O, δ^{13}C	60 ml (HDPE)	Filtered, cool 4 °C	4 weeks
Alkalinity (anions): Br, Cl, F, NO_3, SO_4	500 ml (HDPE)	Filtered, cool 4 °C	45 days
Field Confirmation: Temperature Dissolved Oxygen Specific Conductance pH	200 ml (glass jar)	None	<1 hour
Field Confirmation: Density	60 ml (HDPE)	Filtered	<1 hour

4.3.5 B.3.e. Sample Chain-of-Custody

For gas stream analysis, an analysis authorization form provided will accompany the sample to the lab, at which point this chain of custody form accompanies the sample throughout the analytical process.

For groundwater samples, chain of custody will be documented using a standard form. This form is similar to that will which be used for all groundwater samples. Copies of the form will be provided to the person or lab receiving the samples, as well as the person or lab transferring the samples. These forms will be retained and archived to allow simplified tracking of sample status. The chain of custody form and record keeping is the responsibility of the groundwater sampling personnel and all lab personnel involved in analysis.

4.4 B.4. Analytical Methods

Logging, geophysical monitoring, and pressure and temperature monitoring does not apply to this section and is, therefore, omitted.

4.4.1 B.4.a. Analytical SOPs

Analytical SOPs and their critical parameters are referenced in Tables 4 through 7. Other laboratory specific SOPs utilized by the contracted laboratories will be determined after such laboratory has been selected.

Upon request, OCP will provide the agency with all laboratory SOPs developed for the specific parameters, using the appropriate standardized method. Each laboratory technician conducting the analysis on these samples will be trained on the SOPs developed for each standardized method. OCP will include the technicians training certification(s) with the regular reports.

4.4.2 B.4.b. Equipment/Instrumentation Needed

Any equipment and instrumentation that is needed is specified in the individual analytical methods which are referenced in Tables 4 through 7.

4.4.3 B.4.c. Method Performance Criteria

It is not anticipated that any non standard method of performance criteria will be necessary for this project.

4.4.4 B.4.d. Analytical Failure

Each contracted laboratory conducting the analysis laid out in Tables 4 through 7 will be responsible for appropriately addressing any analytical failures according to their individual SOPs.

4.4.5 B.4.e. Sample Disposal

Each contracted laboratory conducting the analysis laid out in Tables 4 through 7 will be responsible for appropriate sample disposal according to their individual SOPs.

4.4.6 B.4.f. Laboratory Turnaround

Turn around time will vary by laboratory. It is generally anticipated that the turn around time of verified analytical results will be received within one month for project needs.

4.4.7 B.4.g. Method Validation for Nonstandard Methods

It is not anticipated that any nonstandard methods of validation will be necessary for this project. Should this change in the future, the EPA will be consulted on additional appropriate actions to be taken.

4.5 B.5. QC

Logging, geophysical monitoring, and pressure and temperature monitoring do not apply to this section and is, therefore, omitted. Appendix B will include standard industry practices and will be populated at a later date after vendor selection.

4.5.1 B.5.a. QC activities

4.5.1.1 Blanks

For shallow groundwater sampling, a field blank will be collected and analyzed for the inorganic analytes detailed in Tables 4 through 7 at a frequency of 10% or greater. It is noted that field blanks will be exposed to the same field and transportation conditions as the groundwater samples described in Section 4.4.

Blanks will also be utilized for deep groundwater sampling and analyzed for the same inorganic analytes detailed in Tables 4 through 7 at a frequency of 10% or greater.

Field blanks will be used to detect contamination, resulting from the collection and transportation processes.

4.5.1.2 Duplicates

For shallow groundwater sampling, a duplicate groundwater sample will be collected from a well on a rotating schedule. Duplicate samples are collected from the same source of immediately after the original sample is taken. These samples will be kept in different storage containers and process the same as other samples. Duplicate samples are used to assess sample heterogeneity and analytical precision.

4.5.2 B.5.b. Exceeding Control Limits

If the analytical results exceed control limits, further examination of the analytical results will be done by evaluating the ratio of the measured TDS count to the calculated TDS count per the APHA method.

This method indicates which ion analysis should be considered suspect based on the mass balance ratio. Suspect ion analyses are then reviewed in the context of historical data and inter laboratory results if available. Suspect ion analyses are then brought to the attention of the analytical laboratory for confirmation and/or reanalysis.

The ion balance is then recalculated and if the error is still not resolved, suspect data are identified and may be given less importance and data interpretation.

4.5.3 B.5.c. Calculating Applicable QC Statistics

4.5.3.1 Charge Balance

The analytical results are evaluated to determine the correctness of the applied analysis based on anion-cation charge balance calculation. Due to the fact that potable waters are electrically neutral, the chemical analysis should yield equally negative and positive ionic activity. The anion-cation charge balance is calculated using the following formula:

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

Wherein the sums of the ions are represented in milliequivalents (meq) per L and the criteria for acceptable charge balance is ± 10%.

4.5.3.2 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:

$$1.0 < \frac{measured\,TDS}{calculated\,TDS} < 1.2$$

Wherein the anticipated values are between 1.0 and 1.2.

4.5.3.3 Outliers

It is essential to determine the presence of any statistical outliers when performing evaluation and analytical analysis of groundwater. This project will utilize EPA's Unified guidance, published in March of 2009, as the basis for selection of recommended statistical methods to identify outliers and groundwater chemistry datasets as appropriate.

The techniques detailed in this documentation include:

- Probability plots
- Box plots
- Dixon's test
- Rosner's test

The EPA 1989 outlier test may also be used as an acceptable screening tool to identify any potential outliers within the data sets.

4.6 B.6. Instrument/Equipment Testing, Inspection, and Maintenance

Logging tool equipment will be maintained and cared for, as detailed in the wireline industry best practices which will be provided in Appendix B at a later date.

Groundwater sampling field equipment will be maintained, serviced and calibrated per manufacturer recommendation. Spare parts that may be needed during sampling will be included and supplied during field sampling.

The contracted laboratories will be responsible to provideall testing, inspection, and maintenance of all laboratory equipment used for analytical purposes. Standard practice and method specific control should be followed during these activities.

4.7 B.7. Instrument/Equipment Calibration and Frequency

Geophysical monitoring does not apply to this section and is, therefore, omitted.

4.7.1 B.7.a. Calibration and Frequency of Calibration

Pressure and temperature gauges as well as Flowmeter information is provided in Tables 12 through 22.

Logging tool calibration will be performed at the discretion of the contracted service company providing the equipment, assuming that it follows the standard industry practices noted in Appendix B which will be provided at a later date. Further calibration frequency will be determined by standard industry practices.

For groundwater sampling, the portable field meters or multiprobe sondes that will be used to determine that field parameters are calibrated according to manufacturer recommendations and equipment manuals each day before sampling begins. Recalibration will be performed if any components yield atypical values or fail to stabilize during sampling.

4.7.2 B.7.b. Calibration Methodology

Logging tool calibration methods will follow standard industry practices and will be provided in Appendix B at a later date.

For groundwater sampling, the standards for calibration are typically as follows:

- For pH -7 to 10
- For specific conductance - potassium chloride solution yielding a value of 1413 µS/cm at 25 °C
- For dissolved oxygen - a 100% dissolved O_2 solution

Calibration is performed for the pH meters per manufacturer specification.

Coulometry instrumentation will be routinely evaluated using sodium carbonate standards.

4.7.3 B.7.c. Calibration Resolution and Documentation

Logging tools, calibration, resolution, and documentation will follow the standard industry practice and will be provided in Appendix B at a later date.

For groundwater sampling tools, calibration values will be noted in daily sampling recordings, as well as errors in calibration, should there be any. For parameters where calibration is not acceptable, redundant equipment maybe used to ensure that any potential loss of data is minimized.

4.8 B.8. Inspection/Acceptance for Supplies and Consumables

4.8.1 B.8.a/b. Supplies, Consumables, and Responsibilities

As required by approved vendors, supplies and consumables for field and laboratory operations will be procured, inspected, and accepted as appropriate. Acquisition of such supplies and consumables related to groundwater analysis will be the responsibility of each laboratory per the established method or operating procedures.

4.9 B.9. Nondirect Measurements – Seismic Monitoring

4.9.1 B.9.a. Data Sources

For time-lapse seismic surveys, repeatability is paramount for accurate differential comparison. To ensure survey quality, the locations for the surface shots and acquisition method of sequential surveys must be consistent. Once these surveys have been acquired, they'll be compared to a baseline survey to track and monitor CO_2 plume development.

For Mt. Simon Sandstone, downhole gauges in the OBS1 well will be used to gather pressure and temperature data.

4.9.2 B.9.b. Relevance to Project

Time-lapse seismic surveys will be used to track changes in the CO_2 plume in the injection formation. Processing and comparing the subsequent surveys to the baseline survey taken before injection starts allows for the assessment and monitoring of CO_2 plume growth. It will also help to ensure that the CO_2 plume does not out grow outside of the intended storage zone. Additional modeling will be used to predict CO_2 plume growth and migration overtime by combining the process seismic data and the existing geologic model.

The Mt. Simon Sandstone monitoring data will also be used in the computational modeling to predict CO_2 plume and pressure front behavior and to confirm the CO_2 plume stays within the AoR.

4.9.3 B.9.c. Acceptance Criteria

By following standard industry practices, it will be ensured that the gathered seismic data will be able to be used for accurate modeling and monitoring. Repeatable ground conditions, shot point locations, functional geophones, and similar seismic input data will be used from survey to survey to insure repeatability.

When processing this data, several quality assurance checks will be done in accordance with industry standards. Further detail on this industry standard methods of reformatting, structuring and application will be provided and further documents. Detail on these methods will be provided in the final Testing and Monitorig Plan (Attachment 7: Testing And Monitoring, 2022)

4.9.4 B.9.d. Resources/Facilities Needed

OCP will provide all resources, equipment, and facilities needed for all seismic surveys. Seismic monitoring will be provided by a third part contractor. Downhole pressure monitoring will be performed in wells associated with the project. Groundwater sampling will be performed by a third part contractor.

4.9.5 B.9.e. Validity Limits and Operating Conditions

Trained personnel will handle the review and analysis of all collected data to be used for the seimic surveys and numerical modeling. These checks will be done according to industry standard practices.

4.10 B.10. Data Management

4.10.1 B.10.a. Data Management Scheme

OCP or a designed third-party contractor will maintain the required data as provided elsewhere in the permit application. Data will be backed up digitally, or via hard copy as necessary

4.10.2 B.10.b. Recordkeeping and Tracking Practices

All records and gathered data will be held securely and organized properly.

4.10.3 B.10.c. Data Handling Equipment/Procedures

All equipment used to collect and store data will be properly maintained and operated according to industry standard practices. All supervisory control and data acquisition (SCADA) system(s) and other data acquisition system will interface with each other as necessary. All data will be held and stored securely.

4.10.4 B.10.d. Responsibility

The primary project managers, as outlined in this document and in the permit application, will be responsible for ensuring the proper data management is maintained.

4.10.5 B.10.e. Data Archival and Retrieval

All data will be held by OCP. These data will be maintained and stored for review as necessary as detailed in Section 4.10.1 above.

4.10.6 B.10.f. Hardware and Software Configurations

All OCP and vendor hardware/software configurations will be interfaced appropriately.

4.10.7 B.10.g. Checklists and Forms

All required checklists and forms will be generated and produced for usage, as necessary.

5 C. Assessment and Oversight

5.1 C.1. Assessments and Response Actions

5.1.1 C.1.a. Activities to be Conducted

Please refer to the Pre-Operational Testing Plan, the Testing and Monitoring Program, and PISC sections of the permit application to see the frequency of data collection for the activities listed in Table 1 of this document (Attachment 5: Pre-Op Testing Program, 2022) (Attachment 7: Testing And Monitoring, 2022) (Attachment 9: Post-Injection Site Care, 2022).

After completion of sample analysis and data collection, results will be QCed for the criteria as noted in Section 4.5 (QC) section of the QASP document. If the collected data and sample analysis are found to not be consistent with these standards of QC, they will be reanalyzed as detailed in the section. All evaluations of data consistency will be performed according to industry standard methods and those described in the EPA 2009 unified guidance.

5.1.2 C.1.b. Responsibility for Conducting Assessments

Third party organizations gathering and analyzing data will be responsible for conducting their own internal assessments.

5.1.3 C.1.c. Assessment Reporting

All assessment information should be reported to the individual project managers as outlined in this document.

5.1.4 C.1.d. Corrective Action

Corrective action that is taken to improve any individual organization's data collection responsibility should be addressed, verified, and documented by the project manager that the issue is reported to. After this, the individual project manager will communicate this information to the other project managers, as necessary.

Corrective actions that impact multiple organizations should be addressed by all members of the project leadership and communicated to the other members on the distribution list as outlined above for the QASP.

It is noted that the results of the corrective action may impact multiple sources of monitoring data/equipment and/or multiple organizations. It is, therefore, the responsibility of OCP to ensure the most cost-effective and efficient action is implemented across the project.

5.2 C.2. Reports to Management

5.2.1 C.2.a/b. QA status Reports

It is currently anticipated that QA status reports will not be necessary. If any of the testing or monitoring activities detailed in the Pre-Operational Testing Plan, the Testing and Monitoring Program, and PISC sections are altered, the QASP will be reviewed and updated as necessary in consultation with the EPA. Revised QASPs will then be distributed to the full distribution list detailed at the beginning of this document.

6 D. Data Validation and Usability

6.1 D.1. Data Review, Verification, and Validation

6.1.1 D.1.a. Criteria for Accepting, Rejecting, or Qualifying Data

Groundwater quality data validation will include the review of the following:

- Concentration units
- Sample holding times
- Review of duplicate Blank and other appropriate QA/QC results

All groundwater quality results will be entered into a database for periodic review and analysis.

Copies of this analysis and a laboratory analytical test results and or reports will be kept. In the regular periodic reports, data will be presented in graphical and tabular formats as appropriate to characterize general groundwater quality data and identify intra well variability.

After sufficient data has been collected, additional methods might be used to evaluate interwell variations for groundwater constituents and to evaluate if significant changes have occurred that could result in the leakage of CO_2 or brine beyond the intended reservoir.

6.2 D.2. Verification and Validation Methods

6.2.1 D.2.a. Data Verification and Validation Processes

See Sections 6.1.1 and 4.5. Appropriate statistical software will be utilized to determine data consistency.

6.2.2 D.2.b. Data Verification and Validation Responsibility

OCP or the designated third party contractor will verify and validate groundwater sampling data.

6.2.3 D.2.c. Issue Resolution Process and Responsibility

OCP or the designated third party contractor will review the groundwater data handling management and assessment processes as necessary. Staff involved in these processes will consult with the Project Manager to determine if any actions are required to resolve issues.

6.2.4 D.2.d. Checklist, Forms, and Calculations

Checklists and forms will be developed specifically to meet permit requirements. These checklists or forms will be developed at a later date and provided as a part of regular reports, if necessary.

6.3 D.3. Reconciliation with User Requirements

6.3.1 D.3.a. Evaluation of Data Uncertainty

The physical software will be used to determine groundwater data consistency using methods consistent with the EPA 2009 unified guidance documents.

6.3.2 D.3.b. Data Limitations Reporting

Data that is collected and evaluated will be presented using appropriate data-use limitations.

7 ReferencesReferences

(2022). *Attachment 1: Narrative Hoosier #1.* Class VI Permit Application Narrative; .

(2022). *Attachment 10: ERP.* Emergency And Remedial Response Plan; Hoosier #1.

(2022). *Attachment 11: QASP; Hoosier #1.*

(2022). *Attachment 2: AOR and Corrective Action.* Area Of Review And Corrective Action Plan; Hoosier #1.

(2022). *Attachment 3: Financial Responsibility.* Financial Responsibility; Hoosier #1.

(2022). *Attachment 4: Well Construction.* Injection Well Construction Plan; Hoosier #1 .

(2022). *Attachment 5: Pre-Op Testing Program.* Pre-Operational Formation Testing Program; Hoosier #1.

(2022). *Attachment 6: Well Operations.* Well Operation Plan; Hoosier #1.

(2022). *Attachment 7: Testing And Monitoring.* Testing And Monitoring Plan; Hoosier #1.

(2022). *Attachment 8: Well Plugging.* Hoosier #1.

(2022). *Attachment 9: Post-Injection Site Care.* Post-Injection Site Care And Site Closure Plan; Hoosier #1.