ATTACHMENT 1

CLASS VI INJECTION WELL: QUALITY ASSURANCE AND SURVEILLANCE PLAN

December 2024

Jasper County Storage Facility

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Acronym	**Definition**
°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	microgram per liter
µL/L	microliters per liter
AoR	Area of Review
ASTM	ASTM International
bgs	below ground surface
BP	BP Carbon Solutions LLC
cc	cubic centimeter
CCS	carbon capture and storage
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COC	chain-of-custody
DAS	distributed acoustic sensing
DRO	diesel range organics
DTS	distributed temperature sensing
EPA	Environmental Protection Agency
ft	feet
ft/hr	feet per hour
g/cc	gram per cubic centimeter

Acronym	**Definition**
GC-DID	Gas Chromatography-Discharged Ionization Detector
GC/FID	Gas Chromatography with Flame Ionization Detection
GC-MS	Gas Chromatography Mass Spectrometry
GC-SCD	Gas Chromatography Sulfur Chemiluminescence Detector
GC/TCD	Gas Chromatography Thermal Conductivity
HCl	hydrochloric acid
in	inches
L	liter
lb/hour	pounds per hour
M	magnitude
mg/L	milligrams per liter
MIT	mechanical integrity testing
mL	milliliter
MLB	Moisture and Leak Barrier
MS/MSD	matrix spike/matrix spike duplicates
N/A	not applicable
NTU	nephelometric turbidity unit
ohms/cm	ohms centimeter
ppm	parts per million
PQL	practical quantitation limits
psi	pounds per square inch
psi/ft	pounds per square inch per foot
PVTX	pressure, volume, temperature, composition
QA	quality assurance
QASP	Quality Assurance and Surveillance Plan
QC	quality control
RPD	relative percent difference
Site	Jasper County Storage Facility
SOP	standard operating procedure
TBD	to be determined
TDS	total dissolved solids
TNRCC	Texas Natural Resource Conservation Commission
TPH	total petroleum hydrocarbons
UIC	Underground Injection Control
USDW	underground source of drinking water
VOA	volatile organic analysis
VOC	volatile organic compound

TITLE AND APPROVAL SHEET

This Quality Assurance and Surveillance Plan (QASP) is approved for use and implementation at the BP Carbon Solutions LLC (BP) Jasper County Storage Facility (Site). The signatures below denote the approval of this document and intent to abide by the procedures outlined within it.

Signature	Date

To Be Updated

Testing and Monitoring Lead

Signature	Date

To Be Updated

Project Manager

DISTRIBUTION LIST

The following project participants will receive the completed QASP and all future updates for the duration of the project.

Table A.1 Distribution List for QASP

Name	Organization	Project Role	Contact Information
Project Manager	BP	Project Manager	To Be Updated
Testing and Monitoring Lead	BP	Testing and Monitoring Lead	To Be Updated
Lead Engineer	BP	Lead Engineer	To Be Updated
Facility Manager	BP	Facility Manager	To Be Updated

A. Project Management

A.1. Project/Task Organization

A.1.a. Key Individuals and Responsibilities

The Jasper County Storage Facility (Site), managed by BP Carbon Solutions LLC (BP), will be supported by multiple contractors sharing project responsibilities. The responsibilities, as discussed in the Testing and Monitoring Plan (**Appendix E**), are organized as follows:

- Carbon dioxide (CO_2) stream analysis
- Operational parameters (injection pressure, rate, volume, temperature)
- Shallow groundwater sampling (Claimed as PBI [redacted])
- Intermediate groundwater sampling (Claimed as PBI [redacted])
- Mechanical integrity testing (MIT)
- Well logging
- Geophysical monitoring

This section will be updated prior to project initiation to include the contractors accountable for each responsibility above.

A.1.b. Independence from Project Quality Assurance Manager and Data Gathering

Physical samples and the data generated from the Testing and Monitoring Plan will be collected, processed, and analyzed by independent third parties.

A.1.c. Quality Assurance Responsibility

BP will maintain responsibility for updating and distributing this Quality Assurance and Surveillance Plan (QASP). Periodic reviews will be conducted to assure the QASP complies with regulatory requirements and is approved by the Underground Injection Control (UIC) Program Director when changes to the plan, if any, are warranted.

A.1.d. Organizational Chart for Key Project Personnel

BP's preliminary management structure for the implementation of the project and this QASP are shown on **Figure A.1** (Preliminary BP Jasper Organization Structure). Specific roles and individuals filling each role will be confirmed and provided to the UIC Program Director prior to project initiation.

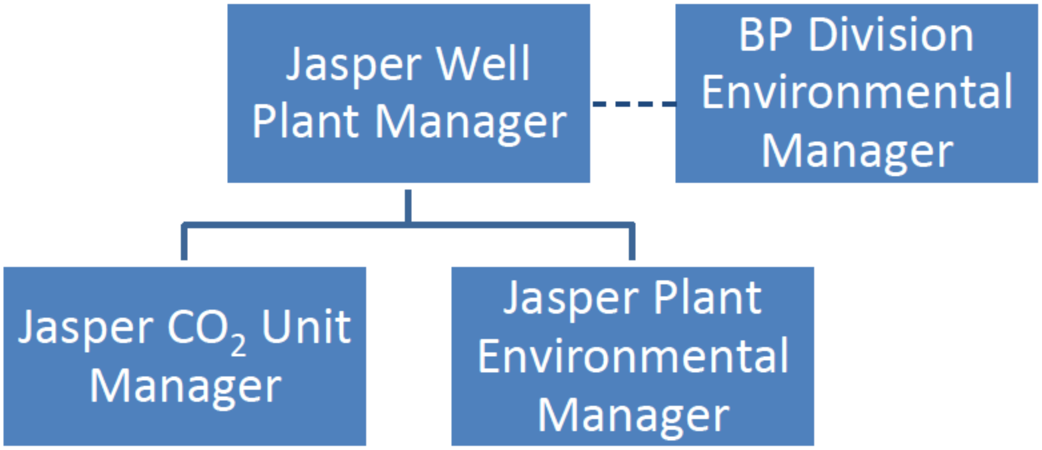

Figure A.1. Preliminary BP Jasper Organization Structure

A.2. Problem Definition/Background

A.2.a. Reasons for Initiating the Project

BP is submitting the Class VI injection well permit application for a carbon capture and storage (CCS) project located in Jasper County, Texas. On October 27, 2023, BP submitted Revision 1 of this QASP for the Class VI application for the Site, and the application was deemed administratively complete on November 22, 2023. In this Revision 2, the QASP has been updated based on changes in the Area of Review (AoR) model and planned well construction. The model has been updated to incorporate appraisal well (BP America A469 #1) data, providing an enhanced understanding of the subsurface. This update is expected to reduce project risk by minimizing the AoR extent, moving away from known faults within the AoR, optimizing injection well operations, and reducing interactions with legacy wells. BP intends to sequester CO_2 at the Site Claimed as PBI [redacted] is estimated to be stored at the Site during the injection period. Geological storage of the CO_2 will be in strata of the Frio Formation.

The Site's Testing and Monitoring Plan details the environmental monitoring, operational monitoring, and verification components to be implemented. Environmental monitoring includes groundwater monitoring and pulsed neutron logging from the Reservoir Saturation Tool logs to demonstrate non-endangerment of the underground sources of drinking water (USDWs). Operational monitoring includes monitoring of pressure in the injection tubing and annular spaces at the surface wellhead, bottomhole injection pressure, CO_2 storage formation pressure, pressure above the confining zone, and USDW aquifer pressure. Operations are monitored by measuring other injection well parameters including injection rates and temperature profile. The verification component includes pressure and temperature monitoring and pulse neutron logging above the confining zone and in the injection zone. The verification component is used to confirm CO_2 plume and pressure front containment and conformance.

Technologies and methodologies outlined in this QASP reflect current Best Available Techniques and Best Environmental Practices. Future technological advances and changes in scientific understanding may facilitate changes to the monitoring approach outlined in this QASP. If changes to the Best Available Techniques and Best Environmental Practices are proposed, these changes will be communicated to the UIC Program Director prior to implementation.

A.2.b. Regulatory Information, Applicable Criteria, Action Limits

The minimum technical criteria for Class VI carbon sequestration wells are established under the United States Environmental Protection Agency (EPA)'s *Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide Geologic Sequestration Wells* (75 FR 77230, December 10, 2010), and codified at 40 CFR 146.81 et seq. (Class VI Rule).

Testing and Monitoring Requirements (40 CFR 146.90) under the Class VI Rule require owners or operators of Class VI wells to develop and implement a comprehensive testing and monitoring plan that includes injectate monitoring; corrosion monitoring of the well's tubular, mechanical, and cement components; pressure fall-off testing; groundwater quality monitoring; and CO_2 plume and pressure front tracking. These requirements (40 CFR 146.90(k)) are supported by this QASP. The QASP establishes the procedures to collect, process, manage, and analyze the data to ensure the data quality for the testing and monitoring activities described in the Testing and Monitoring Plan meets the requirements of the EPA's UIC Program for Class VI wells.

A.3. Project/Task Description

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

BP will implement the Testing and Monitoring Plan to verify that the storage site is operating as permitted and is not endangering USDWs. A summary of testing and monitoring activities, locations, methods, techniques, custody, and purposes is provided in **Table A.2** (Summary of Testing and Monitoring). Instrumentation and geophysical surveys are summarized in **Table A.3** (Instrumentation Summary) and **Table A.4** (Geophysical Surveys Summary), respectively. The Testing and Monitoring Plan contains the schedule for the activities listed on the tables mentioned above. Select criteria of this QASP also apply to the Post-Injection Site Care and Site Closure Plan provided as **Appendix G**.

Claimed as PBI

[redacted]

Claimed as PBI

[redacted]

A.3.c. Geographic Locations

The planned location of injection and monitoring wells are provided in **Table A.5** (Planned Location of Injection and Monitoring Wells) and are shown on **Figure A.2** (Planned Location of Injection and Monitoring Wells).

Claimed as PBI

[redacted]

Claimed as PBI [redacted]

A.3.d. Resource and Time Constraints

No resource or time constraints have been identified for the BP Testing and Monitoring Plan.

A.4.Quality Objectives and Criteria

A.4.a. Performance/Measurement Criteria

The quality assurance (QA) objectives, both qualitative and quantitative, of the Testing and Monitoring Plan activities are to develop and implement procedures to monitor and evaluate the performance of the storage reservoir to meet the permit and USDW protection requirements. In accordance with EPA 816-R-13-001 (EPA, 2013) – Testing and Monitoring Guidance, the well testing and monitoring program includes operational CO_2 injection stream monitoring, well MIT, geochemical and indicator parameter monitoring of groundwater above the confining zone(s), and indirect geophysical monitoring. Shallow and intermediate groundwater monitoring wells will be used to gather water quality samples and pressure data. Groundwater monitoring will be conducted during the pre-injection, injection, and post-injection phases of the project. All the groundwater analytical and field monitoring parameters for each interval are listed in **Table A.6** (Summary of Analytical and Field Parameters for Groundwater Samples Above the Confining Zone Claimed as PBI [redacted]). **Table A.7** (Summary of Analytical Parameters for CO_2 Stream)**, Table A.8** (Summary of Analytical Parameters for Corrosion Coupons)**, Table A.9** (Summary of Measurement Parameters for Field Gauges), and **Table A.10** (Actionable Testing and Monitoring Outputs) show analytical parameters for CO_2 stream gas monitoring, corrosion coupon assessment, gauge specifications, and actionable testing and monitoring outputs, respectively.

Claimed as PBI

[redacted]

Claimed as PBI

[redacted]

Claimed as PBI

[redacted]

Claimed as PBI

[redacted]

Table A.8. Summary of Analytical Parameters for Corrosion Coupons

Parameters	Analytical Methods[1]	Detection Limit/Range	Typical Precisions	QC Requirements
Mass	NACE RP0775-2005 or ASTM G1-03(2017)e1	TBD	TBD	Annual calibration of scale
Thickness	NACE RP0775-2005 or ASTM G1-03(2017)e1	TBD	TBD	Factory calibration

Note:
QC – quality control; TBD – to be determined
[1] An equivalent method may be used with the prior approval of the UIC Program Director.

Claimed as PBI [redacted]

Claimed as PBI

[redacted]	Typical Precisions	QC Requirements
[redacted]	0.01 psi	Annual calibration
[redacted]	0.01 °F	Annual calibration
[redacted]	0.01 psi	Annual calibration
[redacted]	0.01 psi	Annual calibration
[redacted]	0.01 psi	Annual calibration
[redacted]	0.01 °F	Annual calibration
[redacted]	0.01 lb/hour	Annual calibration

Note:
°F – degrees Fahrenheit; lb/hour – pounds per hour; psi – pounds per square inch; TBD – to be determined
[1] An equivalent method may be used with the prior approval of the UIC Program Director.

Claimed as PBI

[redacted]

Notes:
AoR – Area of Review; CO_2 – carbon dioxide; M3.5 – magnitude 3.5; psi – pounds per square inch; psi/ft – pounds per square inch per foot
[1] See Table 2 in Appendix H (Emergency and Remedial Response Plan)

A.4.b. Precision

Precision is a measure of reproducibility; that is, agreement of individual repeated measurements of the same property, under similar conditions. Precision for physical and analytical measurement parameters is detailed within the individual laboratory's test methodology and within established detection limits. Laboratory equipment calibration and maintenance are described by the individual laboratory in its Analytical Quality Assurance Manual. Following laboratory selection, the laboratory's Analytical Quality Assurance Manual can be provided upon request. Precision for field measurement parameters will be determined by replicate measurements and field standards established for the equipment or process. Field equipment will be calibrated and maintained in accordance with the manufacturer guidelines. Equipment not meeting precision criteria will be subject to re-calibration and/or replacement. Precision for field standards will be maintained by personnel applying criteria for the various activities (logging, mapping, and descriptive processes) under the direction of the Field Manager.

Field duplicates will be evaluated relative to their "identical" sample. All duplicate samples will be submitted to the laboratory with no identifying information to identify the "identical" sample. A formula for relative percent difference (RPD) will be used to compare the results, and precision is achieved if the analytical results for both samples are within an RPD of 10 percent. The following formula will be used to calculate RPD:

(Eq. 1) $$RPD\ (\%) = \frac{(V1 - V2)\ x\ 100}{\frac{1}{2}\ x\ (V1 + V2)}$$

Equipment blanks will be evaluated using practical quantitation limits (PQL). Precision will be achieved if the laboratory result is below the PQL and/or if the only contaminants detected are attributable to lab contamination rather than field contamination.

A.4.c. Bias

Bias is the difference, quantitatively, between the reference value and the average of measurements made on the same object. The potential for bias is not applicable in direct measurements including logging, temperature, and pressure. Evaluation of analytical bias will be the responsibility of the individual laboratories per their Analytical Quality Assurance Manual. Analytical results received from individual laboratories will be reviewed to ensure they have been evaluated for analytical bias.

A.4.d. Representativeness

Representativeness is the degree to which data expresses a characteristic of a population, parameter variation at a point, or an environmental condition. Representativeness for analytical results of groundwater samples will be estimated by ion and mass balances. Ion balances with ±10% error or less will be considered valid. Mass balance assessment will be used in cases where the ion balance is greater than ±10% to help determine the source of error. For a sample and its duplicate, if the RPD is greater than 10% the sample may be considered non-representative.

To ensure sample representativeness, all sample collection will be performed in accordance with EPA-recommended procedures for collection and preservation and EPA-recommended holding times specified in the June 19, 1990, Federal Register, EPA SW-846 (Test Methods for Evaluating Solid Waste).

A.4.e. Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected under normal conditions. It is expected that the designated analytical laboratory will provide data meeting the quality control (QC) acceptance criteria for 90 percent or more for all samples tested. In addition to the laboratory internal QA/QC processes, the sampling contractor will evaluate the data validation and whether samples meet the QC acceptance criteria. For direct pressure and temperature measurements, it is expected that data will be recorded no less than 90% of the time. Following completion of the analytical testing and data validation, the percent completeness will be calculated by the following equation:

(Eq. 2)

$$Completeness\ (\%) = \frac{(Number\ of\ Valid\ Data)\ x\ 100}{(Number\ of\ Samples\ Collected\ for\ Each\ Parameter\ Analyzed)}$$

A.4.f. Comparability

Data comparability is defined as the degree of confidence with which one data set may be compared to another. The groundwater samples will be comparable if collection, compositing, splitting, and testing methods are the same and the measurement units are the same. Comparability for field measurements will be achieved if the test procedures and measurement units within each group of tests are the same (e.g., pH, conductivity, temperature). Operating procedures will be followed to assure comparability including those specified in published EPA guidance documents.

A.4.g. Method Sensitivity

Tables A.11 and **A.12** provide details on equipment specifications and sensitivities.

Table A.11. Pressure and Temperature—Downhole Gauge Specifications

Parameter	Value
Calibrated working pressure range	atmospheric—10,000 psi
Initial pressure accuracy	<+/- 2 psi over full scale
Pressure resolution	0.005 psi at 1-s sample rate
Pressure drift stability	<+/- 1 psi per year over full scale
Calibrated working temperature range	77–266 °F
Initial temperature accuracy	<+/- 0.9 °F per +/-0.27 °F
Temperature resolution	0.009 °F at 1-s sample rate
Temperature drift stability	<+/- 0.1 °F per year at 302 °F
Max temperature	302 °F
Instrument calibration frequency	Per manufacturer's specifications

Notes:
°F – degrees Fahrenheit; psi – pounds per square inch

Table A.12. Representative Logging Tool Specifications

Parameter	Pulsed Neutron	Cement Bond Log	Ultrasonic Casing / Cement Inspection
Logging Speed	Up to 3,600 ft/hr	Up to 3,600 ft/hr	400 to 4,500 ft/hr
Vertical Resolution	15 in	3 ft	0.6 to 6.0 in
Investigation	Formation fluid saturation, annular space, mechanical integrity	Cement bond (cement-casing, cement-formation)	Casing and cement (cement-casing, cement-formation and annular coverage)
Temperature Rating	350 °F	350 °F	350 °F
Pressure Rating	15,000 psi	20,000 psi	20,000 psi

Notes:
°F – degrees Fahrenheit; ft – feet; ft/hr – feet per hour; in – inches; psi – pounds per square inch

Field pressure, temperature, and mass flow gauge parameter values can be provided upon request after vendor selection. Values may change depending upon vendor, service provider, and/or specific item chosen at time of operation.

A.5. Special Training/Certifications

A.5.a. Specialized Training and Certifications

Specialized equipment (geophysical, wireline, etc.) will be operated by qualified, trained, and certified staff as appropriate and recommended by the equipment manufacturer. Groundwater monitoring will be performed by trained staff familiar with the Site, the Testing and Monitoring Plan, and this QASP. No certification is required for groundwater monitoring personnel.

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

Personnel responsible for data collection activities will be provided applicable training by the operator and/or the responsible contractor.

A.6. Documentation and Records

A.6.a. Report Information

BP will prepare and submit semi-annual reports during operation and annually during post-injection to the UIC Program Director pursuant to the requirements under 40 CFR 146.91(a)(7). The reports will include all project data including the results of testing and monitoring as specified in the Testing and Monitoring Plan.

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

BP will prepare and provide the UIC Program Director all necessary documents, records, or electronic files upon request.

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

BP will maintain the project data collected pursuant to the Testing and Monitoring Plan and this QASP for a minimum period of 10 years following Site closure, in accordance with 40 CFR 146.91(f).

A.6.e. QASP Distribution Responsibility

The Project Manager will be responsible for ensuring that those on the distribution list, and other essential staff, receive the most current copy of this QASP.

B. Data Generation and Acquisition

B.1. Sampling Process Design

B.1.a. Design Strategy

CO_2 Stream Monitoring Strategy

BP will analyze the CO_2 stream during the operation period to yield data representative of its chemical and physical characteristics and to meet the requirements of 40 CFR 146.90(a).

Sampling of the CO_2 stream will take place both on a continuous and an intermittent basis via online gas analysis and routine spot sampling, respectively. Analysis of the CO_2 stream will be monitored closely to assess risks to flow assurance and mechanical integrity of both the CO_2 pipeline and the injection well, as well as any impact on fluid behavior in the subsurface. Sample points will be located at the receipt point(s) of CO_2 stream(s) into the pipeline network to assess the quality of the CO_2 stream prior to transportation and injection. Sampling frequency will occur at least quarterly during the initial injection phases, subject to assessment and approval of the UIC Program Director.

Corrosion Monitoring Strategy

BP will monitor well materials during the operation period for loss of mass, thickness, cracking, pitting, and other signs of corrosion to ensure that the well components meet the minimum standards for material strength and performance, in accordance with 40 CFR 146.90(c).

The corrosion monitoring program consists of using conventional corrosion coupons that generally match the materials that are used in the construction of the pipeline, injection well, and the compression equipment, which will be exposed to the CO_2 stream. Prior to CO_2 exposure, each coupon will be measured, photographed, and weighed. **Table 4** (List of Equipment with Materials of Construction) of the Testing and Monitoring Plan (**Appendix E**) details equipment coupons and materials of construction. Coupons shall be sent quarterly to a qualified company for analysis conducted in accordance with National Association of Corrosion Engineers Standard RP-0775 or the ASTM International (ASTM) G1-03(2017)e1 (or similar) to determine and document corrosion wear rates based on mass loss.

Claimed as PBI [redacted]

Shallow Groundwater Monitoring Strategy

Claimed as PBI [redacted]

Intermediate Groundwater Monitoring Strategy

Claimed as PBI [redacted]

Claimed as PBI
[redacted] Representative groundwater samples from this monitoring well will allow for direct water quality assessment immediately above the confining zone, which will serve to confirm that CO_2 is not moving through the confining zone.

These shallow and intermediate monitoring wells were selected to provide a clear picture of the groundwater quality at different depths and multiple lateral locations around the CO_2 injection wells.

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

The type and number of samples/test runs for CO_2 stream, corrosion coupons, and groundwater monitoring are provided in **Section 4** (CO_2 Stream Analysis), **Section 6** (Corrosion Monitoring), and **Section 7** (Above Confining Zone Monitoring) of the Testing and Monitoring Plan (**Appendix E**).

B.1.c. Site/Sampling Locations

The general Site location and selected groundwater sampling locations are depicted on **Figure A.2** (Planned Location of Injection and Monitoring Wells).

B.1.d. Sampling Site Contingency

Sampling sites located on non-BP owned property will be accessed through active access agreements between BP and relevant landowners. No problems of Site inaccessibility are anticipated.

B.1.e. Activity Schedule

The schedule of testing and monitoring activities is provided in **Table 5** (Monitoring of Groundwater Quality, Pressure, and Geochemical Changes Above the Confining Zone) of the Testing and Monitoring Plan (**Appendix E**).

B.1.f. Critical/Informational Data

Field activities of monitoring, gauging, and sampling will be documented in field notebooks, forms, and photographs as applicable. Standard documented information will include time and date of activity, person(s) performing activity, location(s), equipment, calibration data, and field parameter values. For laboratory analyses, much of the critical data are generated during the analysis and included in the laboratory issued report. Additional field data may include appearance and odor of the sample, equipment issues, and weather conditions.

B.1.g. Sources of Variability

Groundwater monitoring and sampling is subject to multiple sources of variability, including the following:

- Natural heterogeneity in fluid geochemical composition and total dissolved solids (TDS), formation pressure and temperature, and seismic activity;

- Instrument variability due to calibration and drift during sampling or analytical activity;
- Alternating staff responsible for collecting/analyzing samples;
- Changes in environmental conditions during field sampling activities including temperature, rainfall, drought, and snowfall; and
- Typographic errors related to data management.

Reasonable actions to minimize and/or mitigate these variables will be performed, to include the following:

- Use pre-injection data as a reference to observe and record natural variation in the monitored formations and conduct statistical analysis for attributing potential deviations from the reference;
- Data entry and evaluation in a timely manner following collection;
- Documenting and monitoring Site weather from a consistent, local source;
- Performing and documenting equipment calibration, maintenance, and inspections in accordance with manufacturer's recommendations;
- Appropriately trained and consistent staff;
- Laboratory QA checks using third-party reference materials, and/or blind, and/or replicate sample checks; and
- Systematic review process of data that can include sample-specific data quality checks (i.e., cation/anion balance for aqueous samples).

B.2. Monitoring Well Sampling Methods

<u>B.2.a/b. Sampling Standard Operating Procedures</u>

Shallow Groundwater Monitoring Wells

Claimed as PBI [redacted]

[redacted] Specific steps will be described in the sampling and analysis plan.

Claimed as PBI [redacted] **Table B.1** (Stabilization Criteria of

Water Quality Parameters During Purging of Groundwater Monitoring Wells) lists field parameters that will be measured approximately every five minutes. The wells will be purged until at least three of the six water quality parameters have stabilized for three consecutive measurements. All field parameters will be logged on field sampling forms.

Once water quality parameters in the purged well have stabilized, laboratory-provided sample containers will be filled, capped, labeled, and placed in a cooler with ice for transport to the laboratory. The sampler will remove waste associated with sampling activities (tubing, personal protective equipment, consumables) from the Site.

Purged water will be discharged to the ground near the well. Decontamination procedures will be followed between sampling at each monitoring well to avoid cross-contamination of groundwater samples. Decontamination procedures will be detailed in the sampling and analysis plan.

For each sampling event, BP will document field and sampling activities on field forms, which will include Site conditions at each sampling location, calibration of field instruments, details of well purging, field parameter measurements, sample collection date and time, QA/QC sampling, and details of sample handling, storage, and shipping. All samples will be logged on a chain-of-custody (COC) form as described in **Section B.3**. The COC will be signed by the sampler and, upon transfer of custody to a commercial delivery service or the laboratory, tracking information will be retained. Sample transport will be planned so as not to exceed sample holding times before laboratory analysis and to maintain samples at necessary temperatures. The samples will be shipped to one or more accredited laboratory(ies) for analysis.

Table B.1. Stabilization Criteria of Water Quality Parameters During Purging of Groundwater Monitoring Wells

Field Parameter	Stabilization Criteria
pH	+/- 0.2 units
Temperature	+/- 3%
Specific Conductance	+/- 3%
Redox Potential	+/- 10 millivolts
Dissolved Oxygen	+/- 10%
Turbidity	Stabilized or <10 NTUs

Note:
NTU – nephelometric turbidity unit

Intermediate Groundwater Monitoring Wells

Claimed as PBI [redacted] The samples would be transported under reservoir conditions to an accredited laboratory. Claimed as PBI [redacted]

B.2.c. In-situ Monitoring

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

B.2.d. Continuous Monitoring

Claimed as PBI [redacted]

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

To obtain representative samples, groundwater samples will be collected primarily using low-flow sampling methodologies consistent with ASTM D6452-99 (2017). If a monitoring well does not supply adequate water for sampling, samples will be collected within 24 hours of the well being purged or, if the well remains dry, the condition of the well will be investigated and may be considered for replacement. Purging will continue until three successive measurements of the indicator parameters meet the stabilization criteria per **Table B.1** (Stabilization Criteria of Water Quality Parameters During Purging of Groundwater Monitoring Wells). Samples for metals may either be field-filtered or requested for laboratory filtration.

B.2.f. Sample Containers and Volumes

Table B.2 (Summary of Sample Containers, Preservation Treatments, and Holding Times for CO_2 Gas Stream Analysis) and **Table B.3** (Summary of Anticipated Sample Containers, Preservation Treatments, and Holding Times for Groundwater Samples) detail the sample containers and volumes required for aqueous samples and CO_2 stream samples, respectively. Sample containers and/or bags will be used as received from the selected laboratory.

B.2.g. Sample Preservation

Table B.3 (Summary of Anticipated Sample Containers, Preservation Treatments, and Holding Times for Groundwater Samples) details the preservation techniques for aqueous samples associated with this project. **Table B.2** (Summary of Sample Containers, Preservation Treatments, and Holding Times for CO_2 Gas Stream Analysis) details the preservation techniques for CO_2 stream samples. Holding times and preservation techniques are not applicable to corrosion coupon samples, which are maintained physically separated to prevent abrasion.

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

Equipment used for sampling and other activities associated with on-site work will be decontaminated before and after each dedicated activity. Disposable items will be disposed of as solid waste in an approved, permitted facility.

B.2.i. Support Facilities

Support facilities will be provided by the service provider responsible for sampling and analysis. Field activities will usually be completed in field vehicles.

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

Field technicians will be responsible for testing equipment and performing necessary corrective actions on defective field equipment. If corrective action cannot be taken in the field, the equipment will be returned to the manufacturer for repair or replacement. Significant corrective actions potentially affecting analytical results will be documented in field notes.

B.3. Sample Handling and Custody

This section details the sample handling and custody procedures for samples requiring laboratory analysis. Direct monitoring (i.e., logging, pressure/temperature, geophysical) is excluded.

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

Table B.3 (Summary of Anticipated Sample Containers, Preservation Treatments, and Holding Times for Groundwater Samples) details the preservation and holding times for aqueous samples associated with this project. **Table B.2** (Summary of Sample Containers, Preservation Treatments, and Holding Times for CO_2 Gas Stream Analysis) details the preservation and holding times for CO_2 stream samples. Holding times and preservation techniques are not applicable to corrosion coupon samples, which are maintained physically separated to prevent abrasion.

B.3.b. Sample Transportation

The individual sample containers will be placed in a cooler with packing material. Ice or chemical ice packs will be placed on the top of the packing materials to maintain the applicable preservation temperature (typically less than six degrees Celsius and without allowing the sample to become frozen) while in transport to the laboratory.

If the sample cooler is to be shipped to the analytical laboratory, the COC will be sealed in a plastic bag and placed in the cooler. The cooler will be closed and sealed with sealing tape or duct tape and a signed custody seal and shipping label will be affixed.

B.3.c. Sampling Documentation

All sample numbers will be recorded on the field label, field data sheet, COC, and in the field notebook. Completed field data sheets and field notebooks will be digitized and archived for reference by the operator. Any changes in the logbooks or data sheets will be initialed and dated.

B.3.d. Sample Identification

Each sample will be containerized and labeled at the time of collection. The label will contain a unique sample number identifying the sampling location and sample date. Additional information included on the sample label will identify sampling time, sample matrix, requested analytes, and sample preservation (if any). An example (generic) sample label as provided in EPA guidance is included as **Attachment A**.

Table B.2. Summary of Sample Containers, Preservation Treatments, and Holding Times for CO_2 Gas Stream Analysis

Sample	Volume/Container Material	Preservation Technique	Sample Holding time (max)
CO_2 gas stream	(2) 2L MLB Polybags (1) 75 cc Mini Cylinder	Sample cooler/cabinet	5 days

Notes:
cc – cubic centimeter; CO_2 – carbon dioxide; L – liter; MLB – Moisture and Leak Barrier

Table B.3. Summary of Anticipated Sample Containers, Preservation Treatments, and Holding Times for Groundwater Samples

Target Parameters	Volume/Container Material	Preservation Technique	Sample Holding Time
Total Suspended Solids	1 L plastic	0–6 °C	7 days
Total Dissolved Solids	1 L plastic	0–6 °C	7 days
Fe^{2+} (field or lab)	5 mL	None	15 minutes
S^{2-} (field)	10 mL	None	15 minutes
Alkalinity	500 mL plastic	0–6 °C	14 days
Cations: Ca, Mg, K, Na, Fe, Al, Si, Sr, Mn, Cu, Sb, and Tl	250 mL plastic	0–6 °C, Nitric acid	60 days
Anions: Br, Cl, F, NO_3, NO_2, o-P and SO_4	500 mL plastic	0–6 °C	28 days
Dissolved CO_2	100 mL plastic	0–6 °C	14 days
Isotopes: $\delta^{13}C$ of DIC, $\delta^{14}C$, $\delta^{18}O$, δD	TBD upon selected laboratory		
Metals: As, Ba, Cr, Pb	250 mL plastic	0–6 °C Nitric acid	180 days
Fluid Density	250 mL plastic	0–6 °C	28 days
CO_2, CH_4 and H_2S	2x 40-mL VOA vials	0–6 °C HCl	7 days
Aromatics and Semi-aromatics (x16), TPH, DRO	2x 40-mL VOA vials	0–6 °C HCl	14 days

Notes:
°C – degrees Celsius; DRO – diesel range organics; HCl – hydrochloric acid; L – liter; mL – milliliter; TBD – to be determined; TPH – total petroleum hydrocarbons; VOA – volatile organic analysis

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

Possession of samples collected in the field will be traceable from the time of collection until analysis in the laboratory. The COC form will be completed daily for samples collected during the sampling event and will include project name and number, sample identification number and location, name(s) of individual(s) who collected the sample(s), type of sample, number and type of containers, date and time of collection, required analyses, preservatives, shipping or courier data, and signatures documenting transfer of sample custody.

The COC form will accompany the sample at all times. Individuals receiving and relinquishing the samples will sign, date, and note the time of transfer on the record. A commercial delivery service need only be identified by company name. Samples will remain in the physical possession of the person to whom they are assigned until the samples are shipped to the laboratory or are stored prior to shipping. The COC form will accompany the samples to the laboratory and subsequently be returned to the project files. An example COC form included in the individual laboratory's Analytical Quality Assurance Manual will be provided by the laboratory to the UIC Program Director upon request.

B.4. Analytical Methods

B.4.a. Analytical Standard Operating Procedures

Analytical standard operating procedures (SOPs) are referenced in the laboratory methods provided in **Table A.6** (Summary of Analytical and Field Parameters for Groundwater Samples Above the Confining Zone Claimed as PBI [redacted]), **Table A.7** (Summary of Analytical Parameters for CO_2 Stream), and **Table A.8 (**Summary of Analytical Parameters for Corrosion Coupons). Other laboratory-specific SOPs used by the laboratory will be determined after a contract laboratory has been selected and can be provided to the UIC Program Director upon request.

B.4.b. Equipment/Instrumentation Needed

Analytical equipment/instrumentation necessary for the analytical methods identified for this project in **Tables A.6** through **A.8** will be the responsibility of the selected laboratory(ies).

B.4.c. Method Performance Criteria

Analytical methods identified for this project are detailed in **Tables A.6** through **A.8** with the standard performance criteria established with respect to the methodologies.

B.4.d. Analytical Failure

Analytical failure(s) will be the responsibility of and addressed by the selected laboratory(ies) conducting the analyses detailed in **Tables A.6** through **A.8** according to the laboratory's SOPs.

B.4.e. Sample Disposal

Sample disposal responsibility lies with the selected laboratory(ies) and will be conducted in accordance with the laboratory's SOPs.

B.4.f. Laboratory Turnaround

Laboratory turnaround time can vary between analytical methods and individual labs. In general, validated data is available for project evaluation within one month of sample submittal.

B.4.g. Method Validation for Nonstandard Methods

It is not anticipated that nonstandard methods will be required for this project. Upon identification of such a need or if nonstandard methods are proposed, BP will consult the UIC Program Director on appropriate actions to be completed prior to implementation.

B.5. Quality Control

B.5.a. Quality Control Activities

Blanks

Blanks will be submitted to the laboratory to provide a check for procedural contamination. Trip blanks for volatile organic compound (VOC) analysis will be included with any shipment at a frequency of one per cooler of samples and analyzed for VOCs.

Duplicates

A split or duplicate sample from pre-determined sample locations will be submitted for analysis to assess laboratory techniques, accuracy, and sample variability and representativeness. Duplicate samples will be collected at a frequency of one per 10 samples.

Matrix Spike/Matrix Spike Duplicates

Matrix spike/matrix spike duplicates (MS/MSD) are used to assess potential influence of sample matrix (media interference) on sample analysis. Each MS/MSD sample will be "spiked" with a known concentration of compounds by the laboratory, as specified by the laboratory SOPs prior to extraction/analysis for each analyte and matrix. The primary sample(s) selected for MS/MSD analysis will be collected in triplicate to ensure adequate volume for analysis and will be identified on the COC. MS/MSD samples will be collected at a frequency of one per 20 samples.

B.5.b. Exceeding Control Limits

Upon identification of data exceeding control limits, further examination of the analytical results will be completed. Additional evaluation will include a review of field notes and parameters, sample handling, laboratory reports, and comparison with historical data, if available. Unresolved exceedances may result in resampling/measuring to confirm data validity.

B.5.c. Calculating Applicable Quality Control Statistics

Charge Balance

Anion-cation charge balance calculations will be used to determine the correctness of analyses. Given potable waters are electrically neutral, the chemical analyses are anticipated to yield equally negative and positive ionic activity. The anion-cation charge balance will be calculated using the following equation:

(Eq. 3) $$\%\, difference = \frac{\sum cations - \sum anions}{\sum cations + \sum anions}\ x\ 100$$

Sums of the ions are represented in milliequivalents per liter, and the criteria for acceptable charge balance is ±10%.

Mass Balance

When the charge balance calculations exceed the acceptance criteria (±10%), further examination of analytical results will be performed by evaluation of the ratio of measured TDS to calculated TDS in accordance with the American Public Health Association *Standard Methods* *for the Examination of Water and Wastewater* (APHA, 2023). The mass balance will be calculated using the following equation:

(Eq. 4) $$1.0 < \frac{measured\ TDS}{calculated\ TDS} < 1.2$$

Outliers

Statistical methods in accordance with the EPA *Unified Guidance for Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities*, which will be referred to as the Unified Guidance (EPA, 2009), will be used to evaluate potential outliers in the project data as appropriate. Select methods may include use of probability plots, box plots, Dixon's test, and/or Rosner's Test.

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

Field instruments/equipment will be acquired, inspected, and accepted as required from vendors selected by BP and/or the contractor responsible for the field activity. Inspections will be conducted prior to use and in accordance with the operational manuals. If problems occur with field instruments or equipment that cannot be resolved by the field team personnel, they should contact the field team leader. If field equipment fails inspection, it is the field team leader's responsibility to investigate and resolve the problem. Maintenance of instruments/equipment will be performed in accordance with the procedures and schedule prescribed by the manufacturer.

B.7. Instrument/Equipment Calibration and Frequency

B.7.a. Calibration and Frequency of Calibration

Field instruments/equipment calibration will be performed before each field event in accordance with the manufacturer's recommendations and/or equipment manual. The frequency of calibration during each field event depends on factors including weather, sampling frequency, and duration of field event and will be adjusted according to the specific equipment manual.

B.7.b. Calibration Methodology

Instruments will be calibrated to ensure accurate readings. Calibrations will be conducted in accordance with the specific instrument manufacturer's supplied manual.

B.7.c. Calibration Resolution and Documentation

Calibration resolution will be dependent upon the specific equipment and environmental factors. Anticipated resolution per manufacturer's recommendations, environmental factors (time of day, weather, etc.), and results of calibration will be documented in the field book and/or calibration sheets. Electronic copies of the field book and/or calibration sheets will be archived per the data management practices described in **Section B.10** (Data Management).

B.8. Inspection/Acceptance for Supplies and Consumables

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

Supplies and consumables for field events (inspections, gauging, sampling) will be acquired, inspected, and accepted as required from vendors selected by BP and/or the contractor responsible for the field activity. Containers for laboratory analysis will be acquired directly from the selected laboratory and meet the established standard methodology or operating procedures for the respective analysis.

B.9. Non-Direct Measurements

B.9.a. Data Sources

Non-direct data sources will be both qualitative and quantitative, for example:

- Photographs and/or topographical maps produced outside this project;
- Existing sampling and analytical data and evaluation/assessment files from a previous project, current project, and/or related project;
- Information and/or data from published literature;
- Background data from facilities or state files; and
- Measurements or data that are ancillary to addressing the project's objectives (for example, meteorological data, primarily used to better predict or explain dispersion and concentration of airborne toxic compounds in a localized area).

Existing non-direct data sources identified through the project's planning process include purchased seismic reflection data necessary for three-dimensional geological modeling for the storage facility. Considering additional non-direct data sources, BP has previously worked with the University of Texas at Austin to develop CCS pilot projects, including collaboration with the *Frio Brine Pilot* in 2004 and the S*outheast Regional Carbon Sequestration Partnership (SECARB) Early Test* at Cranfield in 2008. Similarly, since 2000, BP has collaborated with Los Alamos National Laboratory—through the joint-industry *CO_2 Capture Project*—on evaluating and characterizing legacy well leakage data and risk.

B.9.b. Relevance to Project

Purchased access to non-direct, commercially available, seismic reflection data supports analyses ensuring that project facilities are sufficiently characterized to obtain the Class VI "Authorization to Construct" permits.

Existing non-direct data sources identified through the project's planning process include purchased seismic reflection data necessary for three-dimensional geological modeling for the storage facility. Claimed as PBI [redacted]

<u>B.9.c. Acceptance Criteria</u>

Non-direct data acceptance will include review from subject matter experts who are familiar with the AoR and specific and relevant non-direct data.

<u>B.9.d. Resources/Facilities Needed</u>

No additional resources or facilities are needed at this time.

<u>B.9.e. Validity Limits and Operating Conditions</u>

BP used non-direct data deemed reliable and relevant to the proposed project, as well as direct logging and test data from the storage complex collected through an appraisal well. From these data, analytical, and geocellular numerical models were produced following standard industry practices and after an iterative process of refinement that involved internal experts.

B.10. Data Management

<u>B.10.a. Data Management Scheme</u>

BP will use its internal data management system for archiving project documentation. Data management includes back up protocols and secure servers.

<u>B.10.b. Recordkeeping and Tracking Practices</u>

All data associated with the project will be held securely and associated metadata will be gathered and maintained to ensure tracking purposes.

<u>B.10.c. Data Handling Equipment/Procedures</u>

BP employs robust data management procedures to ensure the maintenance and security of data gathered from the field and external data sources.

<u>B.10.d. Responsibility</u>

The Project Manager(s) and associated Information Technology Managers will be responsible for ensuring data management is properly maintained.

<u>B.10.e. Data Archival and Retrieval</u>

BP will archive all data associated with the Site. All data will be organized and properly labeled for easy reference and auditing purposes.

<u>B.10.f. Hardware and Software Configurations</u>

BP will ensure that software and hardware are appropriate to integrate the multiple data sources and handle large volumes of data.

<u>B.10.g. Checklists and Forms</u>

Checklists and forms necessary for the management and security of data will be generated and recorded by BP in accordance with its data management system.

C. Assessment and Oversight

C.1. Assessments and Response Actions

C.1.a. Activities to be Conducted

Specific testing and monitoring activities including sampling, analysis, and data management activities are summarized in the Testing and Monitoring Plan, with detailed information pertaining to sampling and analytical activities presented in **Section B** (Data Generation and Acquisition) of this QASP document. Quality system self-assessments will be performed to reduce the potential for impacts of non-conformance and potential acquisition of questionable data. The scope of internal assessments will be determined by the BP Project Manager, and may include but not be limited to the following:

- Surveillance of scheduled field activities including sample collection, sample handling, logging, non-direct method implementation, etc.;
- Review of laboratory data management activities;
- Examination of data reporting systems;
- Verification of instrument and equipment acceptability including maintenance and calibration frequency;
- Re-evaluation of analytical method implementation, including CO_2 stream and corrosion evaluation methods; and
- Evaluation of external organization/contractor adherence to application elements of this QASP.

For example, the assessment may include periodic evaluation of data quality to ensure QC criteria were met, and subsequent re-analysis if QC requirements were not met (e.g., holding time exceedances). EPA guidance and standards will be used to inform the assessment team.

C.1.b. Responsibility for Conducting Assessments

BP may use external organizations (contractors) to collect samples, conduct well logging, and perform other activities as outlined in the Testing and Monitoring Plan. Each organization gathering data will be responsible for conducting their internal assessments and to ensure that pertinent elements of the Testing and Monitoring Plan and this QASP are adhered to. The BP Quality Assurance Manager may perform the above internal assessments to ensure that external organizations/contractors are adhering to required protocol. All stop-work orders will be handled internally within individual organizations, although a stop work order may also be issued as necessary by the BP Quality Assurance Manager if necessitated by assessment results.

C.1.c. Assessment Reporting

Internal organizational assessments performed by external organizations/contractors will be reported to external organization/contractor management. Should any deviations to this QASP be identified by the external organizations/contractors as part of internal assessments, the external organizations/contractors must report this information to the BP Quality Assurance Manager within 24 hours of problem identification.

C.1.d. Corrective Action

Should external organization/contractor assessments identify issues requiring corrective action, it is the external organization/contractor's responsibility to address, document and implement corrective actions, notifying the BP Quality Assurance Manager of all said issues and corrective actions. Also, any BP officer-directed assessment results that indicate violation of a protocol or requirement by an external organization/contractor will be reported to that organization, who will then identify and implement corrective action. Corrective actions affecting multiple organizations will be communicated to all affected organizations by the BP Quality Assurance Manager, who will also coordinate corrective actions if said actions affect multiple organizations, as warranted.

C.2. Reports to Management

C.2.a/b. Quality Assurance Status Reports

BP may conduct internal quality assessments and resulting changes to the Testing and Monitoring Plan and/or QASP or permit modifications, as required, will be communicated to the UIC Program Director.

D. Data Validation and Usability

D.1. Data Review, Verification, and Validation

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

Data validation will include the review and evaluation of multiple data characteristics including the unit(s) of measurement, sample holding times, and QA/QC results (including field duplicates, trip blanks, method blanks, etc.). Data will be entered into a database or spreadsheet and reviewed and analyzed periodically. BP will maintain electronic copies of the laboratory analytical reports for archiving. Analytical results will be reported on a frequency based on the approved Class VI permit conditions. These reports will provide data in tabular and/or graphic formats as necessary to characterize the general groundwater quality and identify data variability. After sufficient data have been collected, additional methods, such as those described in the EPA Unified Guidance (EPA, 2009), will be used to examine variations for monitored groundwater constituents and assess whether significant changes have occurred that could be indicative of CO_2 leakage outside the storage unit.

D.2. Verification and Validation Methods

D.2.a. Data Verification and Validation Processes

The data verification and validation process will be conducted utilizing the criteria and standards detailed in **Sections B.5** (Quality Control) and **D.1.A** (Criteria for Accepting, Rejecting, or Qualifying Data) of this QASP.

D.2.b. Data Verification and Validation Responsibility

The BP Quality Engineer and/or its designated contractor(s) will provide verification and validation of data generated with the project.

D.2.c. Issue Resolution Process and Responsibility

Identified data issues will be brought to the attention of the Quality Engineer and Project Manager for consultation and determination of the action(s) required to resolve the issues.

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

Checklists, forms, and calculations will be developed specifically to meet Class VI permit requirements and the project needs.

D.3. Reconciliation with User Requirements

D.3.a. Evaluation of Data Uncertainty

BP will use statistical software to evaluate groundwater data consistency in accordance with the EPA Unified Guidance (EPA, 2009).

D.3.b. Data Limitations Reporting

The BP Project Manager(s) will be responsible for ensuring that program data is reported with appropriate data-use limitations.

E. References

ANSI/NCSL (American National Standards Institute / National Conference of Standards Laboratories). 2006. ANSI/NCSL Z540.3-2006 (reapproved 2013): Requirements for the calibration of measuring and test equipment.

APHA (American Public Health Association). 2023. *Standard methods for the examination of water and wastewater* (24^{th} edition). American Public Health Association, Washington, DC.

ASTM (ASTM International). 1962. Method D1945-14 (reapproved 2019): Standard test method for analysis of natural gas by gas chromatography. ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA.

ASTM (ASTM International). 1967. Method G1-03(2017)e1 (reapproved 2017). Standard practice for preparing, cleaning, and evaluating corrosion test specimens. ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA.

ASTM (ASTM International). 2016. Method D513-11e1: Standard test methods for total and dissolved carbon dioxide in water. ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA.

ASTM (ASTM International). 2017. Method D6452-99 (reapproved 2017): Standard guide for purging methods for wells used for ground-water quality investigations. ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA.

ASTM (ASTM International). 2018. Method D5907: Filterable matter (total dissolved solids) and nonfilterable matter (total suspended solids) in water. ASTM International,100 Barr Harbor Drive, West Conshohocken, PA.

ISBT (International Society of Beverage Technologists). 2021. BVG-00001: Bulk carbon dioxide: Quality & food safety guidelines and analytical methods and techniques reference.

NACE International. 2005. NACE RP0775: Preparation, installation, analysis, and interpretation of corrosion coupons in oilfield operations.

Texas Commission on Environmental Quality. 2000. Draft TNRCC Method 1006: Characterization of Nc_6 to Nc_{35} petroleum hydrocarbons in environmental samples.

EPA (U.S. Environmental Protection Agency). 1993. Method 300.0 (revision 2.1): Determination of inorganic anions by ion chromatography.

EPA (U.S. Environmental Protection Agency). 2009. *Statistical analysis of groundwater monitoring data at RCRA facilities—Unified Guidance*. EPA 530/R-09-007.

EPA (U.S. Environmental Protection Agency). 2013. *Geologic sequestration of carbon dioxide: Underground injection control (UIC) program Class VI well testing and monitoring guidance*. EPA 816-R-13-001.

EPA (U.S. Environmental Protection Agency). 2018. Method 6010D (SW-846) (revision 5): Inductively coupled plasma-optical emission spectrometry. Washington, DC.

ATTACHMENT A
EXAMPLE OF SAMPLE LABEL AND CUSTODY SEAL

(Name of Sampling Organization)

Sample Description:_____________

Sample Location: _____________

Date:_______ Time:________

Matrix: _______________
Sample Type: _______________
Preservative: _______________

Sampled By: _______________
Sample ID #: _______________

Remarks:_______________

CUSTODY SEAL

Date ______________________

Signature ______________________

CUSTODY SEAL

____
Date

____
Signature