Enclosure 1 – Evaluation of Project Plans for the CTV VI Class VI Project
Request for Additional Information

Carbon TerraVault (CTV) VI Carbon Capture and Storage (CCS) Project
Underground Injection Control (UIC) Permit Application
Class VI Pre-Construction Permit Application Nos. R9UIC-CA6-FY24-2.1 to 2.7

Note – this document contains confidential business information (CBI).

This combined evaluation report for the proposed CTV VI Class VI Sequestration Project summarizes EPA's evaluation of several plans in the permit application submitted by Carbon TerraVault Holdings, LLC (CTV). The evaluation includes comments on the following sections of the permit application:

A. Operating Procedures, Appendix 4
B. Corrective Action Plan, Attachment B
C. Testing and Monitoring Plan, Attachment C
D. Post-Injection Site Care and Site Closure Plan, Attachment E
E. Proposed Emergency and Remedial Response Plan, Attachment F
F. Well Construction and Plugging Plans, Attachment D and Attachment G
G. Financial Responsibility Demonstration, Attachment H
H. Pre-Operational Testing Plan, Attachment I

A. Operating Procedures and Summary of Requirements

This evaluation covers the operational procedures CTV submitted in *Appendix 4: Operational Procedures* dated July 31, 2024 (Version 1).

Operational parameters and conditions for each of the seven proposed injection wells are described in Tables 1 through 7 and summarized in Table 1 below:

Table 1. Operating Parameters and Conditions

Parameters/Conditions	**Unit**	Claimed as PBI [redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Maximum Allowable Injection Pressure								
Surface	psig	1,714	1,646	1,670	2,833	2,721	2,778	3,147
Downhole	psig	3,396	3,245	3,304	5,957	5,697	5,833	6,674
Average Injection Rate	mmscfpd	Claimed as PBI [redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Average Injection Pressure Surface Downhole	 psig psig	 1,137 2,343	 1,129 2,250	 1,127 2,267	 1,373 4,026	 1,323 3,816	 1,334 3,896	 1,568 4,727
Maximum Injection Rate	mmscfpd	Claimed as PBI [redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Injection Rate Range	mmscfpd Tonnes/day	26-52 1,376.8-2753.5	27-54 1,429.7-2,859.4	27-54 1,429.7-2,859.4	25-50 1,323.8-2,647.6	25-50 1,323.8-2,647.6	25-50 1,323.8-2,647.6	20-40 1,059-2,118
Average Injection Volume and/or Mass	million tons	Claimed as PBI [redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Average Annulus Pressure Surface Downhole	 psig psig	 375 2,434	 375 2,343	 356 2,359	 478 4,115	 344 3,906	 425 3,986	 737 4,816
Annulus – Tubing pressure differential at Packer	psig	109	110	109	112	112	112	113

Injection Pressure

CTV estimated surface and bottomhole injection pressures using PROSPER, a multiphase well nodal analysis software, based on the results of their reservoir simulation. The maximum allowable injection pressure (MAIP) calculated for each well is based on 90% of the formation fracture pressure, where local fracture pressure is estimated using an assumed fracture gradient of 0.8 psi/ft. CTV assumed this fracture gradient in their Area of Review (AoR) modeling based on step rate tests (SRTs) in nearby wells. SRTs will be conducted to confirm the fracture gradient per *Attachment I: Pre-Operational Testing Plan (POTP)*, but CTV's estimate is acceptable at this point in the review. In these calculations, CTV assumed a 100% carbon dioxide (CO_2) injectate, though CTV notes that this will be refined as the injection stream composition is ascertained during the pre-injection phase. While the injection pressure is based on assumptions, they are consistent with other information in the application and are acceptable at this point in the application review.

CTV states that injection pressures will be automated during operation to never exceed the MAIPs. Fracture gradient, MAIPs, and average injection rates and pressures are consistent between Appendix 4: Operational Procedures and Tables 3.4 and 3.5 in the AoR/CA Plan.

Annulus Pressure

CTV proposes to maintain a minimum annular pressure differential of at least 100 psi over the injection pressure measured at the surface during injection in order to detect a loss of annular pressure via continuous monitoring as described in *Attachment C: Testing and Monitoring (T&M) Plan*. CTV asserts that the range of annular pressures proposed for each well are suitable to the well designs. A comparison of the downhole annular pressure against the well material strength and burst ratings (specifically the long string casing, tubing, and packer) indicate that the well material ratings are well above the anticipated annular pressures for each well.

CTV proposes to fill the annulus with 4% KCl with corrosion inhibitors and biocide. This is suitable for CO_2 injection, as the corrosion inhibitor and biocide will help reduce the potential for corrosion. This fluid will help protect the production casing and tubing from corrosion by filling the space between the outside diameter of the tubing, inside diameter of the casing, and the packer.

Injection Rate and Volume

The proposed average and maximum injection rates corresponding to the MAIPs for each well are shown in Table 1 above. These rates and the total volume CTV proposes to inject [redacted] are consistent with assumptions on which CTV based storage capacity estimates and modeling and are acceptable pending confirmation of modeling inputs, e.g., via SRT.

Automated Shutdown System

CTV proposes to monitor downhole temperature and pressure and surface flow/mass movement, pressure, and temperature data in real time. CTV will configure alarms with a threshold to trigger when injection rate or pressure vary to beyond 10% above or below the expected maximum allowable value. If the operating threshold is reached or exceeded, the software will issue visual, audible, and digital alerts and/or begin an unload procedure and initiate the shutdown process. In the event that an alarm is triggered, CTV will review the system to understand the issue, and the resolution to the alarm would depend on the cause of the exceedance.

CTV has not yet established the monitoring system that would trigger the automated shutdown system, and will share information about the monitoring system with EPA when it is established. This is acceptable; however, CTV shall provide this information as soon as possible to avoid delays in authorizing injection should a permit be issued.

Per the Emergency and Remedial Response (E&RR) Plan, CTV will notify the UIC Program Director, pursuant to 40 CFR 146.91(c)(3), within 24 hours of any triggering of a surface or downhole shut-off system.

Stimulation

CTV states in Section 5.1 of the narrative that it does not plan to perform any stimulation activities. 40 CFR §146.88(a) requires that all stimulation programs be approved by the Director as part of the permit application and incorporated into the permit. If the initial permit does not include a stimulation program and the operator identifies a need for well stimulation later in the life of the project, a major permit modification would be necessary. EPA requests that CTV prepare and include a proposed well stimulation program in the permit application.

Questions / Requests for CTV:

1. To avoid the need for a permit modification if stimulation were to become necessary in the future, EPA requests that CTV prepare a draft stimulation plan. The plan should describe:
    a. How the stimulation fluids are to be used, including any additives (e.g., corrosion inhibitors, clay inhibitors, biocides, complexing agents, or surfactants) or diverting agents; and
    b. Step-by-step procedures that would be employed during stimulation.

B. Corrective Action Plan

This evaluation covers the assessment of wells/artificial penetrations within the AoR and the corrective action CTV proposes to address potential migration of injection fluids and impacts to underground sources of drinking water (USDWs), as presented in *Attachment B: Area of Review and Corrective Action (AoR/CA) Plan* dated July 31, 2024 (Version 1).

Tabulation/Assessment of Wells within the AoR

To identify wells within the AoR, CTV reviewed internal databases and California Geologic Energy Management Division (CalGEM) data. Table 5.1 summarizes the number and type of wellbores found within the AoR, and Appendix 6 provides a detailed table of information for the wells including their location, type, depth, construction methods, plugging and abandonment (P&A) methods (if applicable), and CTV's proposed determination for corrective action; the Appendix 6 table provides all of the information required at 146.84(c)(2).

The area searched is consistent with the AoR defined in the AoR and Corrective Action Plan. However, if any modifications to the modeling inputs are needed based on pre-operational testing (e.g., porosity, permeability, geochemistry), CTV must demonstrate to EPA that no additional wells are present in the revised AoR.

CTV identified two wellbores, Claimed as PBI [redacted] that penetrate the Claimed as PBI [redacted] confining zone within the AoR. Figure 5.1 shows the locations of the wells within the AoR. The depth of the Claimed as PBI [redacted] confining zone at the location of each of the wells was determined through open-hole well logs and deviation surveys and is consistent with information in the site narrative. Corrective action is needed in both of these wellbores because during their previous abandonment, the open-hole section of the cement plug across the surface casing is set above the USDW, and would not provide adequate protection.

CTV indicates that additional corrective action will be performed if monitoring during operations indicates that plume development varies from modeled predictions. If the AoR is adjusted and new wells are identified, these will be evaluated for corrective action.

Planned Corrective Action

Appendix 7 describes CTV's approach for corrective action on each wellbore, and Appendix 8 provides the associated wellbore schematics and further information on each well to be re-abandoned. Plugging details are provided on each proposed abandonment schematic, including the volume, depth, and method of plug emplacement. The plug depths are consistent with the depths of target formations as described in the site narrative.

To plug the wells, CTV proposes to drill out the existing plugs and re-plug the wellbores using Class G cement at depths targeting key formations within the wellbore as follows:

- Plug 1 will be placed across the top of the well's producing interval [redacted] and extend at least 100 ft into the overlying confining zone [redacted]
- Plug 2 will be placed across the top of the [redacted]
- Plug 3 will be placed across the base of the lowermost USDW and extend at least 100 ft above the base of the lowermost USDW.
- Plug 4, the surface plug, will be placed from at least 25 ft below grade to the ground surface.

Due to its depth, an additional plug (Plug 1a) is proposed for [redacted] wellbore across the top of [redacted]

Following the placement and curing of the surface plug, the surface casing will be cut from 5 to 10 ft below grade and a plate will be welded to the top of the cut casing. The surface will then be restored to pre-existing conditions.

The annulus between the cement plugs will be filled with abandonment mud. The plug details for each wellbore are summarized in Tables 1 and 2 of Appendix 7 and are consistent with those provided on the schematics in Appendix 8.

The corrective action procedures for the two wellbores identified within the CO_2 plume of the AoR appear to be sufficient. However, to address the potential for corrosion due to exposure to CO_2, EPA requests the Class G cement be modified, e.g., using engineered cement or by the use of additives.

Plan for Site Access

CTV obtained surface access rights for the duration of the project.

Corrective Action Schedule

CTV indicated that all corrective action will be completed prior to commencing CO_2 injection into the reservoir.

Questions / Requests for CTV:

2. The information provided on the corrective action wells within the AoR is sufficient at this time, however, EPA could request additional information, such as an aerial or ground survey, if deemed necessary further in the review process.
3. If any modifications to the modeling inputs are needed based on pre-operational testing (e.g., porosity, permeability, geochemistry), CTV must demonstrate to EPA that no additional wells are present in the revised AoR. If the AoR is adjusted and new wells are identified, these will be evaluated for corrective action.

4. To address concerns about corrosion, please modify the Corrective Action Plan to refer to engineered Class G cement or incorporate additives to the Class G cement in plugs that may be exposed to CO_2.

C. Testing and Monitoring Plan

This evaluation covers the Testing and Monitoring Plan, submitted as *Attachment C: Testing and Monitoring Plan* dated July 31, 2024 (Version 1).

CTV proposes to submit the results of all injection phase testing and monitoring activities to EPA in compliance with the requirements under 40 CFR 146.91.

Carbon Dioxide Stream Analysis

To meet the requirements of 40 CFR 146.90(a), CTV plans to analyze the CO_2 stream quarterly for the constituents identified in Table C-1 of the T&M Plan, which is replicated below:

Parameter	**Analytical Method(s)**
Oxygen, Argon, and Hydrogen	ISBT 4.0 (GC/DID) GC/TCD
Nitrogen	ISBT 4.0 (GC/DID) GC/TCD
Carbon Monoxide	ISBT 5.0 (Colorimetric) ISBT 4.0 (GC/DID)
Total Hydrocarbons	ISBT 10.0 THA (FID)
Ammonia	ISBT 6.0 (DT)
Ethanol	ISBT 11.0 (GC/FID)
Oxides of Nitrogen	ISBT 7.0 Colorimetric
Methane, Ethane, Ethylene	ISBT 10.1 (FID)
Hydrogen Sulfide and Sulfur Dioxide	ISBT 14.0 (GC/SCD)
CO_2 purity	ISBT 2.0 Caustic absorption Zahm-Nagel ALI method SAM 4.1 subtraction method (GC/DID) GC/TCD
δ13C	Isotope ratio mass spectrometry

CTV proposes to use International Society of Beverage Technologists (ISBT) analytical methods and gas chromatography for injectate monitoring. While there are no EPA-approved CO_2 stream analytical methods, ISBT methods are considered to be industry-standard and have been accepted for CO_2 stream analysis in other Class VI projects. Gas chromatography is an established, reliable fluid analytical method. Table 4 in CTV's Quality Assurance Surveillance Plan (QASP) includes the testing methodology and is consistent with Table C-1 in the T&M Plan. CO_2 will be sampled at the transfer point from the source and between the final compression stage and the wellhead.

Samples will be collected at sampling stations into containers and sent to Airborne Labs International, a state-certified laboratory. CO_2 stream samples will be contained in one-liter tedlar bags for a maximum of 72 hours according to Table 16 of the QASP. Chain of custody procedures are described in the T&M Plan and in subsection B.3.e of the QASP.

As of July 2024, CTV is evaluating several potential CO_2 sources, which may include direct air capture or capture from existing and potential future industrial sources [redacted] Section 7.2 of the application narrative (Version 1, dated July 2024) describes two sets of potential CO_2 stream constituents. Table 7.2-1 provides the compositions of both potential injectate sources by mass percent, and Table 7.2-2 presents simplified injectate compositions for geochemical modeling for both sets of potential constituents. The analytes described in the T&M Plan are similar to the anticipated injectate composition, with the exception of water, which is expected to be present in Injectate 1. CTV notes that water would be kept in solution to ensure the absence of free-phase water in the injectate.

CTV proposes to conduct a baseline CO_2 stream analysis prior to injection, per *Attachment I,* to confirm the injectate composition and ensure the injectate will not react with the formation matrix. Regular sampling and analysis during the injection phase will begin three months after the start of injection and every three months thereafter. CTV proposes to increase the sampling frequency if there is a significant change in the chemical or physical characteristics of the CO_2 injectate, a change in the CO_2 injectate source, or if the facility or injection well experiences a downtime of more than 30 days. However, CTV did not indicate what threshold changes in the source or characteristics of the CO_2 would initiate a change in testing frequency.

Note that, while multiple CO_2 sources can be permitted for injection, EPA requires that every source be clearly identified and characterized to be authorized in the permit. EPA will also require that a sample of every fluid/source be analyzed prior to commencing its injection to ensure that its physical/chemical properties are consistent with the pre-permitting characterization. Note that any change in the injection fluid would require advance notice and written approval from EPA. Addition of a new injection fluid (source) not authorized by the permit would also require a permit modification. The information provided is acceptable at this point of the permit application review; however, CTV will need to update Table C-1 of the T&M Plan and Table 4 of the QASP once the specific CO_2 sources are identified.

Questions / Requests for CTV:

5. Please add H_2O as a CO_2 stream analyte on Table C-1 to provide information about the potential presence of free phase water.
6. Tables 7.2-1 and 7.2-2 of Section 7 of the Narrative indicate that sulfur trioxide (SO_3) may be a constituent of the CO_2 stream. Please update Table C-1 of the T&M Plan

with an appropriate analytical or alternative method for measuring SO_3 if it is determined to be a constituent of the final CO_2 stream.

7. Please clarify the types of CO_2 stream changes (including the threshold changes in physical/chemical characteristics) that would warrant a change in the proposed permit application (e.g., well material selection, sampling frequency, etc.). Please specify what the specific changes would be.
8. CTV will need to update Table C-1 of the T&M Plan and Table 4 of the QASP once the specific CO_2 sources are identified.

Continuous Recording of Operational Parameters

CTV proposes to use continuous recording devices in the seven proposed injection wells to monitor injection pressure, rate, and volume; the pressure on the annulus between the tubing and the long string casing; the annulus fluid volume added; and the temperature of the CO_2 stream as required by 40 CFR 146.88(e)(1), 146.89(b), and 146.90(b).

Table C-2 describes the operational recording devices, their locations, and minimum sampling and recording frequencies. CTV proposes to measure annulus fluid volume at least every 4 hours and record every 24 hours. For all other parameters, the minimum sampling frequency is 10 seconds and minimum recording frequency is 30 seconds. Table 6 of the QASP summarizes these measurement parameters for each type of field gauge and includes detection limits and ranges, typical measurement precision, and quality control (QC) requirements. Instrument sensitivities are described in Tables 8 through 14 of the QASP. This information is consistent with the planned operational monitoring.

CTV proposes to continuously monitor and record injection pressure, temperature, and annulus pressure from the CTV Central Command Facility using method ANSI Z540-1-1994. Injection pressure will be measured with surface and downhole pressure gauges that have a detection limit of 0.001 psi and range of 0 – 5,000 psi. Injectate temperature will be measured with surface and downhole temperature sensors that have a detection limit of 0.001°F and range of 0 – 500 °F. The injection rate will be measured with a surface Coriolis flowmeter calibrated to be accurate to within 0.1%. Injection volume will be calculated from the injection flow rate and density of CO_2 (as calculated by the PVTP fluid thermodynamics package). These instruments and sensitivities are suitable to the proposed operational parameters.

Annular pressure will be measured using a surface electronic pressure gauge with a detection limit of 0.001 psi and range of 0 – 5,000 psi. CTV notes that a SCADA alarm system will identify any decrease in pressure or annular fluid level. This is consistent with information in Section 2.1.1 of the Operations Plan (Appendix 4), and the monitoring approach is sufficient to detect any triggers for responses specified in the E&RR Plan (*Attachment F*). Data from continuous monitoring of annular pressure will be provided in CTV's semi-annual monitoring report to demonstrate internal mechanical integrity.

Questions / Requests for CTV:

9. Please describe the device CTV will use to measure annular fluid level in Section 3.4 (Page 4) and/or Table C-2. If this information is not currently available, it should be provided in the as-built schematics.
10. Please describe in Section 7.2 the steps CTV would take to identify and investigate any unexpected pressure deviations, or reference that CTV would implement the procedures described under "Injection well or monitoring equipment failure" in the E&RR Plan.
11. Please indicate what threshold change will trigger the SCADA alarm system described on page C-4.
12. Please propose the use of monitoring equipment for annular fluid volume that records more frequently than once per day.

Corrosion Monitoring

CTV proposes to monitor corrosion of wellbore materials using corrosion coupons beginning 3 months after injection begins and quarterly thereafter. The coupons will be installed in the pipeline that feeds CO_2 injectate to the wells, between the compressor and the wellhead.

CTV proposes to monitor the coupons for loss of mass, change in thickness, cracking, pitting, and other signs of corrosion. The coupons will be weighed, measured, and photographed prior to installation to establish a baseline. The coupons will then be photographed, measured, visually inspected, and weighed (in the custody of Eurofins according to Table 1 of the QASP) to a resolution of 0.1 milligrams. The samples will be handled and assessed in accordance with NACE TM0169/G31 and/or EPA 1110A SW846; these standards are appropriate for corrosion monitoring. The detection limit for these methods is 0.001 mg, and typical precisions are 10%. If the corrosion rate is greater than 0.3 mil/year, CTV proposes to consult with EPA. In addition, a casing inspection log may be run to assess the thickness and quality of the casing if the corrosion rate exceeds 0.3 mil/year.

Table C-3, replicated below, describes the compositions of the proposed coupons. There is some inconsistency between the materials described in the corrosion monitoring plan and on the construction diagrams for each injection well in Appendix 5 of the well construction plans (*Attachment G*), as shown in the table below.

Equipment	Coupon Material (T&M, Table C-3)	Construction Material (Appendix 5, Attachment G)
Pipeline	Carbon Steel	Standard alloy pipeline materials
Casing	N-80 Carbon steel and CRA	N-80[1], K-55[2], L-80[3], L-80 CRA[3]
Tubing	CRA consistent with final well construction	L-80 CRA
Packer	CRA consistent with final well construction	CRA or coating and hardened rubber elastomer element material
Wellhead	CRA consistent with final well construction	Stainless steel or other material consistent with accepted industry practices for corrosion mitigation based on injected CO_2 specification

1. Section 4.2 of *Attachment G* states that N-80 casing will be installed to be compatible with the CO_2 injectate.
2. Long String Casing
3. Surface Casing

CTV states that the corrosion coupon materials will be consistent with the final well construction materials. These will need to be incorporated into the final T&M Plan.

Questions / Requests for CTV:

13. Please address the inconsistencies between the materials described in the corrosion monitoring plan and on the construction diagrams for each injection well in Appendix 5. For example, please modify the coupons on Table C-3 of the T&M Plan to include K-55 coupons to be consistent with the long string casing materials as described in Attachment G.
14. Please submit a demonstration that must include, at a minimum, corrosion modeling over the timescale of the project in addition to the provision of site-specific information required by 40 CFR 146.82. The corrosion modeling must consider the site-specific chemistry, including the CO_2 stream and formation fluids, as well as consider possible stress cases in addition to normal operations and any other relevant factors.
15. If the corrosion rate is greater than 0.3 mil/year, CTV will consult with EPA. In addition, a casing inspection log may be run to assess the thickness and quality of the casing if the corrosion rate exceeds 0.3 mil/year.
16. The corrosion coupon materials will need to be incorporated into the final T&M Plan.

Above Confining Zone Monitoring

CTV proposes to monitor groundwater quality and geochemical changes above the confining zone through quarterly fluid sampling and continuous temperature and pressure monitoring to meet the requirements of 40 CFR 146.90(d). Table 2 of the QASP provides a summary of the monitoring activities above the confining layer. CTV proposes to acquire baseline water samples for analysis per the POTP.

Figure C-1 shows the above confining zone monitoring well locations around the AoR. Monitoring above the confining zone will be performed in two intervals:

- Two monitoring wells [redacted] will be completed in [redacted]
- Two monitoring wells [redacted] will be completed [redacted]

The monitoring wells are placed in pairs with one monitoring in each interval: [redacted] The well locations are appropriate to monitor potential pressure and temperature changes above the confining zone; however, spatial coverage is lacking in [redacted] CTV states that surface access to the monitoring wells will be available for the duration of the project.

Table C-4 shows the planned monitoring activities, devices, locations, depth intervals, and frequencies for fluid sampling and continuous pressure and temperature monitoring above the confining zone. CTV proposes to perform fluid sampling in the USDW quarterly and will continuously monitor pressure and temperature in the USDW and [redacted] Table C-2 describes that, for continuous monitoring, the minimum sampling frequency will be 10 seconds, and the minimum recording frequency will be 30 seconds.

Table C-5 shows the field parameters and analytical methods for fluid samples. Detection limit/ranges, typical precisions, and QC procedures are presented in Table 3 of the QASP and are consistent with and appropriate to the planned monitoring and sampling. Table C-5 of the T&M Plan, Table 3 of the QASP, and Table E-2 of the PISC/SC Plan are generally consistent with each other (with the exceptions identified in the questions/requests below). This approach supports consistent monitoring throughout the injection and post-injection phases. The analytical methods CTV proposes are EPA-approved; however, fluid samples will be taken only from the lowermost USDW. Samples will be sent to Eurofins for analysis. Chain of custody procedures, sample containers, preservation techniques, and sample holding times are provided in Table 17 of the QASP and are consistent with and appropriate to planned monitoring.

Table 7 of the QASP describes actionable testing and monitoring outputs, where action will be taken if above-confining-zone pressure or water quality measurements deviate from the baseline analysis. Detection limits are provided for surface and downhole pressure, water quality in the USDW, and above-confining-zone pressure [redacted] however, specific actionable deviations from baseline analysis are not described.

Questions / Requests for CTV:

Spatial coverage is lacking in [redacted] Please describe how the proposed monitoring well locations would detect any CO_2 leakage above the confining zone in [redacted] or otherwise if additional monitoring wells are required for adequate spatial coverage.

17. CTV's application narrative describes [redacted] as a pressure dissipation zone (which reflects the California Air Resources Board CCS Protocol's definition of a dissipation interval, which is "a stratigraphic interval with hydrogeologic properties sufficient to attenuate pressure created by [carbon dioxide] or formation fluid migration along an unidentified leakage pathway through the confining system"), EPA does not expect migration of CO_2 to [redacted] or an increase in pressure due to injection operations. Any fluid migration from the injection zone to [redacted] would be unauthorized and should not be referred to as a pressure dissipation zone.
18. Please include fluid sampling and analysis in [redacted] during the injection and post-injection phases to provide earlier indication of chemical changes than would be detected via solely USDW fluid sampling
19. Please add cations of Sb to Table C-5 for consistency with the analytes for plume tracking in Table 3 of the QASP.
20. Please document in the AoR reevaluation schedule (Section 6.1 of the AoR and Corrective Action Plan [Page B-12]) that updates to the T&M plan may include additional USDW monitoring wells (e.g., if pressure increases are detected in [redacted] or USDW) or additional plume and pressure front monitoring.
21. On page C-6, where CTV proposes that "Additional groundwater monitoring wells will be drilled...," please add a statement that, if CTV detects evidence of USDW endangerment, it will implement the E&RR Plan in consultation with EPA.
22. Table E-3 of the PISC/SC Plan indicates that the minimum sampling and recording frequency for pressure gauges in the USDW monitoring wells will be 5 hours during the injection phase. However, this is not apparent in Table C-2 or C-4 in the T&M Plan. Please revise Table C-2 to clarify the minimum sampling and recording frequency for pressure in the USDW monitoring wells to be consistent with the PISC/SC Plan.
23. Please elaborate in Table 7 of the QASP the specific quantitative action limits above or below baseline analysis that would constitute actionable T&M outputs.

Internal Mechanical Integrity Testing

In addition to the continuous monitoring described above, CTV proposes to conduct internal MITs on all injection wells and monitoring wells that penetrate the confining zone and are configured with tubing and a packer prior to commencing injection and perform a standard annular pressure test (SAPT) any time the packer is replaced or reset. A summary of internal mechanical integrity monitoring, including depth, frequency, maximum injection pressure, and test pressure, is provided in Table C-6. The procedures for SAPT and the continuous monitoring of annular pressure are provided in Sections 6.1 and 6.2. The SAPT procedures, including the proposed pressure differential between the annulus and tubing (100 psi), test duration, measurement intervals, and allowable pressure change (no more than ±3%) are consistent with EPA guidance.

Prior to performing any SAPT, CTV will notify the UIC Program Director to provide the opportunity to witness the testing and use an EPA-approved Annular Pressure Test form to record the results of the SAPT if the test is not witnessed by EPA. CTV will report continuous annular pressure monitoring data to EPA semiannually to demonstrate internal mechanical integrity.

Questions / Requests for CTV:

24. Table C-6 lists fluid sampling as a monitoring activity, implying it is an internal MIT testing requirement. Please remove fluid sampling from Table C-6.
25. Please state on page 9 that, prior to any SAPT, CTV will provide EPA notice and the opportunity to witness the test at least 30 days in advance of the test.

External Mechanical Integrity Testing

CTV proposes to conduct external MITs on each injection well at least once per year using an approved testing method per 40 CFR 146.89(c). CTV states that they will, at a minimum, perform a temperature log on the injection wells, and may perform temperature logging with wireline, oxygen-activation, logging, noise logging, or Distributed Temperature Sensing (DTS) per Table C-7. Since CTV plans to perform at least a temperature log on the injection wells, the requirements of 40 CFR 146.89(c) are met. Descriptions of the procedures for temperature logging with wireline, oxygen-activation logging, noise logging, and DTS are provided in Sections 7.2-7.6 and are appropriate.

CTV notes that they may seek Director approval for use of DTS in the future, as it is not considered an approved MIT under the Class VI Rule, at CFR 146.89(c). This would be acceptable for a secondary MIT method.

CTV refers to performing MITs on the monitoring wells, but does not describe any specific MITs that would be performed to a schedule for conducting the tests.

Questions / Requests for CTV:

26. Please describe what external MITs CTV proposes to perform on monitoring wells.

Pressure Fall-Off Testing

CTV proposes to perform pressure fall-off tests (FOTs) in the injection wells every five years during the injection phase to meet the requirements of 40 CFR 146.90(f). CTV includes procedures for the FOTs in Section 8.1 and states that they will refer to EPA Region 9 UIC Pressure Fall-off Requirements for planning and conducting the testing and preparing the monitoring report. CTV proposes to use pressure transient analysis per Table 1 of the QASP and report FOT results to EPA in the following semiannual report. The procedures listed are consistent with the EPA Region 9 UIC Pressure Fall-Off Testing Requirements.

Carbon Dioxide Plume and Pressure Front Tracking

CTV proposed direct and indirect methods to track the extent of the CO_2 plume and the pressure front to meet the requirements of 40 CFR 146.90(g). Two wells Claimed as PBI [redacted] will be perforated to monitor all three injection zones. Monitoring well locations are shown in Figure C-2 (which shows the wells and the model-predicted plumes).

The in-zone monitoring well locations lack adequate spatial coverage of the CO_2 plume based on the model-predicted expansion in the AoR/CA Plan. The wells are Claimed as PBI [redacted] No direct CO_2 plume or pressure front monitoring wells are planned in Claimed as PBI [redacted]

The perforations of each well per the well schematics are at the appropriate depths, consistent with the narrative.

Questions / Requests for CTV:

27. The in-zone monitoring well locations lack adequate spatial coverage of the CO_2 plume. Please explain how CTV proposes to directly monitor the plume and pressure front in Claimed as PBI [redacted]
28. The application lacks proposed 3D seismic surveys for tracking plume development. The updated T&M Plan for CTV IV includes a Scalable, Automated, Semipermanent Seismic Array (SASSA). Could this array design be applied to CTV VI?
29. The application does not include testing procedures for pulsed neutron logging. Please provide the pulsed neutron logging procedures to be used for plume monitoring.
30. The application does not include information about the location and depth of the installed seismometers per 40 CFR 146.82(c). Please provide information about the location and depth of seismometers, once available.

Surface Air and/or Soil Gas Monitoring

No surface air and/or soil gas data were submitted with the permit application.

Questions / Requests for CTV:

31. If, based on the results of planned pre-operational testing, uncertainties about the geologic setting are identified, the need for surface air and/or soil gas monitoring will be reconsidered; EPA could request surface air and/or soil gas monitoring, per 40 CFR 146.90(h).

Quality Assurance Procedures

All monitoring and testing activities proposed in the T&M and PISC/SC Plans are addressed in CTV's QASP, and that information is represented consistently between the submittals (except as noted below). The QASP provides all of the information and procedures recommended in EPA's template, and these are suitable to the T&M procedures and are acceptable.

The QASP describes sampling process design; sampling methods; sample handling and custody; analytical methods; quality control; instrument/equipment testing, inspection, and maintenance; instrument/equipment calibration and frequency; inspection/acceptance for supplies and consumables; non-direct measures; data management; and data review, verification, and validation procedures. CTV plans to rely on third-party service providers for data collection and interpretation; as such, the QASP does not list specific instruments or equipment and associated procedures. CTV does plan to maintain data storage internally by developing a GIS database.

Questions / Requests for CTV:

32. Please include H_2O as a CO_2 stream analyte in Table 4 of the QASP (Appendix 10: Page 6) for consistency with Table 7.2-1 of the permit application narrative.
33. Please add cations of Zn to Table 17 of the QASP (Appendix 10: Page 16) for consistency with the groundwater monitoring analytes in Table C-5 of the T&M Plan (Page 23).
34. Please revise Table 1 of the QASP to refer to Airborne Labs International for carbon dioxide stream analysis to be consistent with Section 2.4 of the T&M Plan (Page 2).

D. Post-Injection Site Care and Site Closure Plan

This evaluation covers the post-injection site care and site closure, submitted as *Attachment E: Post-Injection Site Care and Site Closure Plan* dated July 31, 2024 (Version 1).

Pre- and Post-Injection Pressure Differential

CTV refers to the computational modeling described in *Attachment B* (AoR and Corrective Action Plan), which predicts pressure trends over the project timeframe.

Based on the modeling of the pressure front as part of the AoR delineation, pressure at the injection well is expected to decrease to pre-injection levels beyond the 100-year timeframe of the modeling, as described below. Additional information on the projected post-injection pressure declines and differentials is presented in the permit application and the AoR and Corrective Action Plan.

From *Attachment B*, Figure 4.3 shows the average injection zone pressures across the AoR between each injection zone from the start of injection through Claimed as PBI [redacted] In the PISC/SC plan, Figures E-1, E-2, and E-3 show the modeled pressures relative to pre-injection pressures at the monitoring well locations within Claimed as PBI [redacted] from the start of injection through Claimed as PBI [redacted] post-injection. Based on the figures, it appears that injection zone pressures will reach their maximum at the cessation of injection.

Following the end of injection, the injection zone pressures will initially decrease rapidly to about 100 psi above pre-injection pressures at Claimed as PBI [redacted] post-injection. After that, CTV asserts that the injection pressures will stabilize Claimed as PBI [redacted] (around Year 50), where they appear to decline asymptotically to approximately 50 psi over pre-injection pressures in each injection zone by the end of the modeling period (around Year 130). CTV's assertion is supported by the trend that injection zone pressures decrease rapidly up to Claimed as PBI [redacted] post-injection, then asymptotically thereafter. However, it is unclear from CTV's modeling whether pressure will return to pre-injection levels.

Questions / Requests for CTV:

35. Per the requirement of 146.93(a)(2)(i), please discuss in Section 2 (page E-1) the maximum predicted injection pressure differential over the life of the project in each injection zone.
36. Given that it is unclear whether pressure will return to pre-injection levels, please discuss the point in time at which pressure at the injection wells is expected to decrease to pre-injection levels, and the rates at which pressure is expected to decline at the injection and monitoring wells.

Predicted Position of the CO_2 Plume and Associated Pressure Front at Site Closure

Figure E-4 illustrates the plume development in years 1, 5, 10, 30, 50, and 100. The plume is predicted to expand outwards from the injection wells until cessation of injection, after which the plume remains nearly stagnant, Claimed as PBI [redacted]

Questions / Requests for CTV:

37. Please provide a cross-sectional view of the plume evolution to display vertical plume progression over the duration of the project.

Post-Injection Monitoring

CTV's post-injection monitoring plan describes proposed above-confining-zone monitoring and plume, and pressure front tracking. All of the post injection monitoring activities are consistent with and a continuation of those that CTV proposes during the injection phase in the T&M Plan, except where noted below. CTV states that they will submit the results of PISC monitoring annually, within 90 days of the end of each year.

Table E-1 presents the methods, locations, and frequencies for above-confining-zone monitoring. Proposed monitoring activities in the lowermost USDW and Claimed as PBI [redacted] include continuous pressure and temperature monitoring. Additionally, annual fluid sampling will be conducted in the lowermost USDW. The methods in Table E-1 are consistent with Table C-4 of the T&M Plan. Table E-2 summarizes analytical and field parameters for above-confining-zone fluid sampling and is mostly consistent with Table C-5 of the T&M Plan, except that a different analytical method for hydrogen sulfide is proposed. Table E-3 provides continuous pressure monitoring frequencies in the lowermost USDW monitoring wells; these are not consistent with injection-phase monitoring as denoted in Table C-2 of the T&M plan (see the evaluation in the T&M Plan review).

Proposed post-injection plume tracking activities in the two in-zone monitoring wells completed through all three injection zones will include:

- Direct monitoring via continuous temperature and pressure monitoring; and
- Indirect monitoring via pulsed neutron logs every 5 years.

Table E-4 presents the methods, locations, and frequencies for direct and indirect plume monitoring in the injection zones. Table E-4 is consistent with Table C-8 of the T&M Plan. As noted in the T&M Plan evaluation, the locations of the two in-zone monitoring wells are insufficient to monitor the full extent of the CO_2 plume over the course of the project.

Pressure front tracking is proposed to be accomplished via:

- Direct monitoring via continuous pressure and temperature logging; and
- Indirect monitoring via continuous seismicity monitoring.

Table E-5 presents the methods, locations, and frequencies for injection zone direct and indirect pressure front tracking. Table E-5 is consistent with Table C-9 of the T&M Plan.

Questions / Requests for CTV:

38. Please correct the discrepancy in the analytical method for Hydrogen sulfide between Table E-2 and Table C-5 of the T&M Plan.
39. Please expand Table E-3 to include sampling and recording frequencies for continuous monitoring in [redacted]
40. Please edit the statement on page E-2 to say that CTV will submit the results of PISC monitoring annually, within 90 days of the anniversary date of cessation of injection, to be consistent with Section 4.3.

Alternative PISC Timeframe

CTV requests an alternative PISC timeframe of 20 years based on their geological analyses and computational modeling, which are presented in *Attachment A* and *Attachment B*.

Computational Modeling Results [40 CFR 146.93(c)(1)(i)]

CTV refers to the computational modeling results in *Attachment B,* which CTV describes in the following subsections.

Predicted Timeframe for Pressure Decline [40 CFR 146.93(c)(1)(ii)]

CTV describes AoR delineation modeling-predicted formation pressure in each injection zone:

- [redacted] injection zone pressure is predicted to be approximately 2,600 psi at cessation then decline to approximately 2,450 psi at 20 years post-injection. The average initial reservoir pressure in [redacted] injection zone is approximately 2,360 psi.
- [redacted] injection zone pressure is predicted to be approximately 4,100 psi at cessation then decline to approximately 3,830 psi at 20 years post-injection. The average initial reservoir pressure in [redacted] injection zone is approximately 3,700 psi.
- [redacted] injection zone pressure is predicted be approximately 4,460 psi at cessation, then decline to approximately 4,190 psi at 20 years post-injection. The average initial reservoir pressure in [redacted] injection zone is approximately 4,100 psi.

The modeled pressure curves are displayed in Figures E-1, E-2, and E-3, demonstrating pressure degradation to approximately 100-150 psi above pre-injection levels within the proposed alternative PISC timeframe.

A demonstration of an alternative PISC timeframe must include consideration and documentation of the predicted timeframe for pressure decline within the injection zone, and any other zones, such that formation fluids may not be forced into any USDWs (i.e the critical pressure); and/or the timeframe for pressure decline to pre-injection pressures. The application does not clearly meet either criterion.

Predicted Rate of Plume Migration [40 CFR 146.93(c)(1)(iii)]

Figure E-4 shows map and cross-sectional views of predicted migration of the plume through 100 years [redacted] CTV's modeling predicts that the plume will migrate [redacted] from the end of injection onwards, reaching a [redacted] CTV states that the plumes will be moving at a negligible rate compared to the location of any sensitive receptors within 20 years post-injection.

CTV performed and described sensitivity analyses in Section 4.2.2 of *Attachment B*. These analyses predict that plume migration is not significantly affected by assumed changes to injectate composition, and that variations of 10% in porosity or permeability resulted in only minimal impact to the sizes of the plumes. Figure 4.7 of *Attachment B* supports this assessment. Each sensitivity case results in a similar footprint as the base case (with the exception of Case C – tripling the formation permeability – which must be confirmed with planned pre-operational logging and core testing).

Site-Specific Trapping Processes [40 CFR 146.93(c)(1)(iv)-(vi)]

CTV's modeling indicates that the primary trapping occurs through capillary trapping and CO_2 dissolution in the brine. CTV performed equilibrium geochemical modeling (described in *Appendix 3*) showing minor CO_2 mineralization as compared to other trapping processes. Figure 4.4 in *Attachment B* shows the cumulative storage for each of the trapping processes.

[redacted]

Assessment of Fluid Movement Potential [40 CFR 146.93(c)(1)(viii)-(ix)]

Per *Attachment B*, there are two wells in the AoR that penetrate either injection zone. CTV plans to perform corrective action on these two wells prior to commencing injection (EPA's evaluation of this is discussed under "**Error! Reference source not found.**"). No transmissive faults were identified through the confining zone at or near the project site.

CTV's PISC monitoring plans described in "Post-Injection Monitoring" above are satisfactory for monitoring for potential fluid leakage into a USDW, pending resolution of requests provided above. Proposed construction schematics for the monitoring wells are provided in Appendix 5. However, missing from CTV's permit application are monitoring well construction procedures, as noted in the Well Construction evaluation. This information will need to be reviewed as part of the alternative PISC timeframe evaluation.

Location of USDWs [40 CFR 146.93(c)(1)(x)]

As described in the permit application narrative, the base of the lowermost USDW at the project site has been mapped to Claimed as PBI [redacted] and Claimed as PBI [redacted] in the project area based on well log correlation and sampling data.

CTV asserts that the minimum distance between the injection zone and the base of the lowermost USDW within the AoR is approximately 700 feet.

Non-Endangerment Demonstration Criteria

CTV proposes to provide a report demonstrating non-endangerment of USDWs to the Director to gain authorization of site closure per 40 CFR 146.93(b)(2) or (3). CTV proposes that the non-endangerment demonstration report include the following:

- A summary of monitoring data from the injection and post-injection phases, computational modeling results of the CO_2 plume and pressure front, and evaluations of reservoir pressure, potential conduits, and seismic monitoring.
- A narrative that explains the monitoring activities, dates of all monitoring events, changes to the monitoring program over time, a discussion of all monitoring information collected at the site, and how the monitoring data from injection and PISC phases have varied from the baseline data collected during site characterization. The narrative will also describe any emergencies that occurred, how they were resolved, and demonstrate that there is no endangerment to USDWs.
- Calibration of computational modeling results with monitoring data to demonstrate the lack of CO_2 leakage over the project timeframe, how accurately the original model predicted and represented the storage reservoir, and whether the computational model adequately defined the AoR.
- Evaluation of reservoir pressure to demonstrate that plume migration is minimal and reservoir pressure changes are less than 10 psi/year. CTV proposes to support this demonstration with the calibrated computational model.
- A review of wells that either required or will require corrective action (including injection and monitoring wells) to demonstrate that natural or artificial conduits will not allow fluid migration from the storage reservoir.

- Seismic monitoring data to demonstrate plume stabilization, negligible pressure change (less than 10 psi change per year), and seal integrity.

CTV's description of the non-endangerment demonstration report is consistent with EPA's recommendations, appears adequate to support the demonstration of plume stability and negligible year over year pressure changes, and will support a common understanding with EPA about the criteria that will be used for the non-endangerment demonstration. If the requested revisions to the injection and post-injection phase testing and monitoring are made, adequate data must be collected to support modeling updates and the development of a non-endangerment demonstration.

Site Closure Plan

CTV proposes to notify EPA of its intent to close the site at least 120 days prior to site closure pursuant to 40 CFR 146.93(d). After gaining approval to close the site, CTV proposes to plug the injection and monitoring wells (plugging procedures are evaluated separately), restore the site, and submit a site closure plan to EPA. CTV does not describe the specific activities it will perform to restore the site.

CTV plans to submit the site closure report within 90 days following site closure pursuant to 40 CFR 146.93(f). The report will include verification of injection and monitoring well plugging, notifications to state and local authorities per 40 CFR 146.93 (f)(2), composition and volume of the injected CO_2, and post-injection monitoring records. CTV proposes to record a notation to the property's deed that the property was used for CO_2 sequestration, the period of injection and the volume of CO_2 injected, the formation that the fluid was injected, and the name of the local agency to which a plat of survey with injection well locations was submitted. This information CTV proposes to report is consistent with 40 CFR 146.93(f).

Questions / Requests for CTV:

41. Please correct the first sentence of Section 6 (page E-5) to state that CTV will submit a demonstration of non-endangerment of USDWs to the Director per 40 CFR 143.93(b)(2) **and** (3).
42. Clarify how the PISC timeframe meets the 40 CFR 146.93(c)(1)(ii) requirement of the pressure decline within the injection zone, and any other zones, such that formation fluids may not be forced into any USDWs; and/or the timeframe for pressure decline to pre-injection pressures.
43. Case C – tripling the formation permeability – must be confirmed with planned pre-operational logging and core testing.
44. If the requested revisions to the injection and post-injection phase testing and monitoring are made, adequate data must be collected to support modeling updates and the development of a non-endangerment demonstration.
45. CTV does not describe the specific activities it proposes to perform to restore the site. Please describe the site restoration activities referenced in Section 7 that CTV proposes to perform.
46. Please indicate in Section 7 that CTV will maintain the PISC records and site closure report for 10 years, per 40 CFR 146.93(h), and that CTV will deliver PISC records to the UIC program director.
47. Please correct the typo in the first sentence of Section 7; it should read 40 CFR 146.93(d).

E. Proposed Emergency and Remedial Response Plan

This evaluation covers the Emergency and Remedial Response, submitted as *Attachment F: E&RR Plan* dated July 31, 2024 (Version 1).

CTV's E&RR Plan describes responses to various emergency scenarios that could occur during the injection and post-injection phases of the project, including a well integrity failure, an injection or monitoring well equipment failure, a natural disaster, potential CO_2 or brine leakage to a USDW or the surface, or an induced or natural seismic event. Table F-1 defines the degrees of risk and is consistent with EPA guidance. Table F-2 clarifies the operating states, threshold conditions, and response actions for the seismic monitoring system and is mostly consistent with EPA guidance (except where noted in "Section 4.5 Induced or Natural Seismic Event" below).

Response personnel are described in Section 5 and Table F-3. CTV's Emergency Communications Plan (Section 6) and the proposed review process for the E&RR Plan (Section 7) are consistent with EPA guidance. CTV states that all CTV staff and contractors at the CO_2 sequestration facilities or working in the AoR will be subject to trainings for facility and infrastructure security, maintenance, and operations, CO_2 detection equipment, CO_2 hazards, and emergency response.

CTV's plan incorporates EPA's recommendations for the contents of E&RR Plans and addresses scenarios that may potentially occur at the project. While the plan appears to be complete, EPA has several recommendations to clarify CTV's plan and make it more consistent with EPA's template.

Questions / Requests for CTV:

48. Section 3: Potential Risk Scenarios
    a. Please include a table that describes the degrees of risk of emergency events and their severities (i.e., Minor, Major, and Serious) to align with the severities referenced in the Potential Response Actions.
49. Section 4: Emergency Identification and Response Actions
    b. Please correct the typo. It should read, "The potential risk scenarios identified in Part 3…" (not "Part 2).
50. Section 4.1: Well Integrity Failure
    c. Please indicate that a well integrity failure can have a severity from minor to serious.
    d. Please fix the typo for "preform" to "perform" under both major and minor emergencies (pages F-3 and F-4).
51. Section 4.2: Injection Well Monitoring Equipment Failure
    e. Please revise the title of Section 4.2 to read "Injection Well <u>or</u> Monitoring Equipment Failure" to reflect the list of potential risk scenarios identified in Section 4.0.

52. Section 4.3: Potential Brine or CO_2 Leakage to the USDW
    f. Please broaden the introduction to this scenario (Page F-5) to encompass any evidence of CO_2 or fluid movement out of the injection zone (i.e., not necessarily to a USDW) to address events associated with unanticipated fluid movement pathways, any potential USDW endangerment / unacceptable changes in water quality, and CO_2 leakage to the surface. This would also more directly address the identified potential risk scenarios in Section 4.0.
    g. Under detection methods (Page F-6), please identify specific triggers for a response (e.g., pressure gauge detection limits). Also, reference the actionable testing and monitoring outputs in Table 7 of the QASP.
    h. Please refer to shutting in the injection wells (plural) rather than "the injection well" in the response actions for this scenario, since there are multiple wells at the site, and all would need to be shut-in.
53. Section 4.4: Natural Disaster
    i. Please indicate the severity on Page F-7 to be Minor to Catastrophic.
    j. Please move the sentence "If a natural disaster occurs that affects normal operation of the injection well, CTV will perform the following:" from the introduction on Page F-7 to immediately under "Potential Response Actions."
    k. Please refer to shutting in the injection wells (plural) rather than "the injection well" in the response actions of this scenario, since there are multiple wells at the site, and all would need to be shut-in.
54. Section 4.5 Induced or Natural Seismic Event
    l. Under Timing of event (Page F-8), please edit the sentence to read, "An induced seismic event ~~will~~ could occur when the reservoir stresses are altered, which would occur during the injection or post-injection phase" to reflect that this is a conditional statement and the stated timing of any such event.
    m. Please make the following revisions to the response activities in Table F-2:
        i. Refer to shutting in the injection wells (plural) rather than "the injection well" throughout the table since there are multiple wells at the site.
        ii. Edit, "Report findings to the UIC Program Director and perform corrective actions" in item # 5 under the **orange** operating state, # 11 in the **magenta**, and #9 in the **red** operating states.
        iii. Edit items #9 under the **magenta** and #7 of the **red** operating states to read, "If USDW contamination is detected, endangerment and/or CO_2 leaked" (so the response applies to either situation).

iv. Add a response to the **red** operating state: “Assess monitoring plans and, where necessary, intensify the monitoring plan to ensure containment.”

55. Section 8: Staff Training and Exercise Procedures
    n. Please describe or attach the CO_2 Facilities and Safety Trainings mentioned in this section (Page F-10).

F. Well Construction and Plugging Plans

This evaluation covers the well construction design and plugging procedures, submitted as *Attachments G1 through G7: Injector Construction and Plugging Plans* dated July 31, 2024 (Version 1), and *Appendix 5: CTV VI Injection and Monitoring Well Schematics*.

Injection Well Construction

Three of the injection wells Claimed as PBI [redacted] are proposed to be installed to inject into Claimed as PBI [redacted] three injection wells Claimed as PBI [redacted] are proposed to be installed to inject into Claimed as PBI [redacted] and one well Claimed as PBI [redacted] is proposed to be installed to inject into Claimed as PBI [redacted] The locations of the injection wells are depicted in Figure G-1.

CTV indicates that the wells will be constructed to withstand exposure to the CO_2 injectate composition (when confirmed) and be designed of sufficient strength to withstand the anticipated loading over the duration of the project operations and include an acceptable safety factor. The well construction plan proposes materials for each casing string, which CTV states will be finalized once the CO_2 injectate composition is ascertained. CTV must inform the EPA should this result in any modification to the materials described in the construction plans.

All of the wells are proposed to have similar designs, using similar materials, including:

- A conductor casing to be set from 14 ft to a depth of 54 ft. (CTV recently clarified in response to questions about another project that the 14 ft depth referenced in the casing details is depth from Kelly Bushing, KB.) No information was provided for the material grade of the conductor casing.
- A surface casing constructed of K-55 grade steel.
- An intermediate casing constructed of N-80 grade steel in Claimed as PBI [redacted] wells; no intermediate casing is proposed in Claimed as PBI [redacted] well.
- A long string casing to be installed in two sections, with the upper portion constructed of L-80 grade steel and the lower portion constructed of L-80 corrosion resistant alloy (CRA) grade steel.
- A 4 ½ inch tubing and a packer constructed of L-80 CRA.
- Perforations within the injection wells are proposed to be installed at depths consistent with those as described in the narrative.

The proposed depth of the surface casings do not cover the base of the lowermost USDW as required by 146.86(b)(2). Otherwise, the proposed depths of the conductor, surface, intermediate, and long string casing are suitable to relevant formations applicable to the injection formations.

The casing, tubing, and packer details are provided in Tables G#-1 and G#-2 of each well construction plan and include all specifications recommended in EPA's Well Construction Guidance. The casing material specifications in Appendix 5 are consistent with the tables of the construction plans. The well schematics also show the depth of the base of the lowermost USDW and the top and bottom depths of each key formation at the wells' locations.

The casing, tubing, and packer materials appear to be suitable for the purposes of CO_2 injection, using corrosion resistant materials for the components that will be exposed to injectate. CTV asserts that construction and materials used on the wells will adhere to various American Petroleum Institute (API) and industry standard practices and be resistant to corrosion. CTV asserts that the proposed well design meets structural requirements suitable for geologic sequestration proposed for the facility.

The construction plans state that Class G Portland cement will be used for cementing the casing strings from their bottom depth to the surface. There is no reference to any enhanced cement blends with additives proposed for the lower long string casing sections that would be exposed to the CO_2 injectate. CTV references Class G Portland's long-standing use in enhanced oil recovery wells and non-deleterious properties with CO_2. However, EPA research has identified potential concerns about the corrosion of Class G cement in the presence of CO_2-water mixtures and recommends the use of corrosion-resistant additives in the sections of the injection and monitoring wells that may be exposed to CO_2. Further, the CO_2 will be collected from multiple sources with nitrogen and light-end hydrocarbons considered to be the primary impurities, and injectate water solubility may be a factor given the depth, temperature, and pressure conditions. This makes CO_2-water-resistant design particularly important, specifically the use of CRA materials for sections of the wells that will be in direct contact with the injectate.

Each well will be completed with wellhead controls to monitor injection operational parameters, and emergency shut off and communication controls. An automatic shut off valve will be installed at the surface of each well to shut in the well in the event of a triggered tubing or annular threshold alarm. The proposed well schematics show the surface equipment, location and depth of the distributed temperature sensing (DTS) equipment, temperature gauge, and injection pressure gauge described in the T&M Plan.

Burst and collapse strength ratings provided in Tables G#-1 and G#-2 are all sufficient to withstand the proposed maximum injection pressures for each injection well as summarized in *Appendix 4: Operational Procedures* of the Narrative.

Monitoring Well Construction

CTV did not provide construction plans for the four new planned monitoring wells but did include construction schematics in *Appendix 5: Injection and Monitoring Well Schematics*. The schematics include the material specifications for the casing strings, tubing, and the packer. Similar to the injection well schematics, the surface equipment, location and depth of the DTS equipment, and the depths of key formations are shown, as applicable. Additional details for the monitoring wells are also provided in *Attachment C: Testing and Monitoring Plan*.

USDW Monitoring Wells

USDW monitoring wells Claimed as PBI [redacted] are proposed to be constructed as follows:

- A conductor casing constructed of H-40 grade steel will be set from 14 ft to a depth of 54 ft.
- Another casing constructed of J-55 grade steel will be installed from 14 ft to a depth that covers the base of the lowermost USDW and ranges from approximately 3,640 to 3,777 ft. This casing will be open above the lowermost USDW around the 3,435 to 3,628 ft depth range to accommodate collection of fluid samples.

Injection Zone/Above Zone Monitoring Wells

Wells Claimed as PBI [redacted] will be installed to monitor the injection zones and are proposed to be constructed as follows:

- A conductor casing will be set from 14 ft to a depth of 54 ft. No information was provided for the material grade of the conductor casing.
- A surface casing constructed of K-55 grade steel will be installed from 14 ft to 800 ft. This does not cover the base of the lowermost USDW.
- An intermediate casing constructed of N-80 grade steel will be installed from 14 ft to depths ranging from 3,555 to 3,728 ft, which does cover the base of the lowermost USDW.
- A long string casing will be installed in two sections:
  - The upper portion will be installed from 14 ft to a depth within the Claimed as PBI [redacted] confining zone and constructed of L-80 grade steel.
  - The lower portion will be installed from the base of the upper long string casing to a depth ranging from Claimed as PBI [redacted] and constructed of L-80 CRA grade steel.
- Specific sections of the long string casing have a different green coloring designation that appears to be sections that are left open and uncemented to possibly allow monitoring of the in-zone injection sections Claimed as PBI [redacted] however, these are not identified on the schematics.
- No tubing or packer will be installed in these wells.

- External DTS, temperature gauges, and injection pressure gauges will be installed along the wellbore to monitor the specified intervals. The schematics for these wells indicate that the DTS will be along the wellbore to the packer but there is no indication that a packer or tubing will be part of the well construction.

No information was provided on the cement to be used for the monitoring well casing strings. Based on the T&M Plan, CTV proposed to perform internal MITs in the form of a standard casing pressure test (SCTP) on the monitoring wells that penetrate the confining zone Claimed as PBI [redacted]

Questions / Requests for CTV:

56. Pursuant to 146.86(b)(2), the surface casing must extend through the base of the lowermost USDW and be cemented to the surface through the use of a single or multiple strings of casing and cement. EPA is continuing to evaluate this item and may request additional information further in the review process.
57. The application is missing monitoring well construction procedures and plugging procedures for the four new planned monitoring wells. This information will need to be reviewed as part of the alternative PISC timeframe evaluation. For completeness, please provide the proposed monitoring well construction procedures, including the type and placement of cement, corrosion control, how the casings near surface will be cut and capped. Additionally, describe MITs that will be performed on the in-zone monitoring wells.
58. Please describe how the casings will be cemented in place, including the type of cement proposed.
59. Because of potential concerns about the corrosion of Class G cement in the presence of CO_2-water mixtures, please modify the well construction plan to include corrosion-resistant additives in the sections of the injection and monitoring wells that are most likely to be exposed to CO_2.
60. Once the CO_2 injectate composition is ascertained, CTV must inform EPA if the CO_2 injectate composition results in any modification to the materials described in the construction plans.
61. Please describe the material proposed to be used on the conductor casing for the injection and monitoring wells.
62. Please explain the significance of the green sections of the long string casings on the injection zone and above zone monitoring well schematics.
63. All of the injection wells are proposed to have a conductor casing to be set from 14 ft to a depth of 54 ft. Please clarify that the 14 foot depth refers to KB.
64. Please include the procedure or reference applicable guidance for the SCTP in Attachment G.

Injection Well Plugging

CTV submitted information regarding injection well plugging procedures in *Attachment D: Injection Well Plugging Plan (Version 1, dated 7/31/2025)* and Section 6.0 of *Attachments G1 through G7: Injector Construction and Plugging Plans (Version 1, dated July 31, 2024)*. The plugging schematics for the injection wells are included in *Appendix 5: Injection and Monitoring Well Schematics*.

Prior to plugging each injection well, CTV proposes to, in accordance with 40 CFR 146.92(b)(1), use data from bottomhole pressure gauges in the injection wells to ascertain the reservoir pressure and determine the appropriate pressure to squeeze cement into the well. Prior to plugging the well, CTV proposes to perform an external MIT (a temperature log). Following completion of the external MIT, CTV proposes that the well would be "killed" using a fluid of sufficient density to block fluid flow and flush the wellbore of CO_2. Then, the down-well equipment including the tubing and packer would be removed.

CTV proposes that the injection wells would be plugged using a Portland cement blend equivalent to the properties of a Glass G Portland cement, having a minimum compressive strength of 1,000 psi and a maximum liquid permeability of 0.1 millidarcies (mD). Tables G1-5 through G7-5 of the construction and plugging plans summarize plug details, including the volume, weight, and depth of emplacement. CTV proposes that five cement plugs will be emplaced in the Claimed as PBI [redacted] wells Claimed as PBI [redacted] using a coil tube unit (CTU) as follows:

- Plug 1 will be the bottomhole plug that will be squeezed into and seal off the perforated zones covering from the total depth of the well to within Claimed as PBI [redacted]
- Plug 2 will seal off the top of Claimed as PBI [redacted] up into the bottom of the surface casing.
- Plug 3 will be set on top of Plug 2 and overlap the base of the lowermost USDW.
- Plug 4 will be a surface plug emplaced from 39 ft to the surface.

The Claimed as PBI [redacted] injection wells Claimed as PBI [redacted] will incorporate six plugs emplaced at the same intervals as above along with two additional plugs as these wells will be drilled deeper. The two additional plugs will be emplaced as follows:

- Plug 2 will be squeezed into and seal off Claimed as PBI [redacted] perforated zone covering the entire injection zone depth to within Claimed as PBI [redacted]
- Plug 1 will be the bottomhole plug emplaced from total depth to above the top of Claimed as PBI [redacted]

Sufficiently weighted abandonment mud will be placed in the annulus between the cement plugs. The plugging plan does not describe how long the cement plugs will be allowed to set before emplacing the next plug. The plugging details summarized in Tables G1-5 through G7-5 of the plans are consistent with those included in the schematics.

The plugging procedures, including the placement and depth of each plug, appear to be appropriate to the depth of formations as described in the narrative. Any changes to the understanding of these formation depths (i.e., based on pre-operational testing) should be incorporated into final plugging plans. However, as noted in the well construction evaluation, EPA has concerns about the use of Class G cement in corrosive environments.

Monitoring Well Plugging

Monitoring well plugging procedures are not described in the permit application, but plugging details are included in the plugging schematics in *Appendix 5: Injection and Monitoring Well Schematics*. Similar to the injection wells, Class G cement will be emplaced using a CTU, with abandonment mud emplaced in the annulus between the cement plugs. Due to differences in their depth and construction, the plugging procedures will vary among the types of monitoring wells. The deeper in-zone/above zone monitoring wells Claimed as PBI [redacted] will follow the same six plug approach as the deeper injection wells and target the same depth/formation intervals.

CTV proposes that the USDW monitoring wells will be plugged with Portland cement as follows:

- Plug 1 will be the bottomhole plug that will be squeezed into and seal off the perforated interval covering from the total depth of the well to approximately 100 ft above the base of the lowermost USDW.
- Plug 2 will be a surface plug emplaced from 39 ft to the surface.

Questions / Requests for CTV:

65. Please describe how long the cement plug intervals will be allowed to set for curing prior to emplacing the abandonment mud and next cement stage.
66. To address concerns about corrosion, please modify the injection and monitoring well plugging plans to refer to engineered Class G cement or incorporate additives to the Class G cement in plugs that will be exposed to CO_2.

G. Financial Responsibility Demonstration

This evaluation covers the financial responsibility, submitted as *Attachment H: Financial Responsibility Demonstration*, which includes the cost estimate dated July 25, 2024 (Version 1), and *Appendix 5: CTV VI Injection and Monitoring Well Schematics*.

Pursuant to 40 CFR 146.85, Class VI permit applicants must demonstrate financial responsibility for performing corrective action on deficient wells in the area of review (AoR), plugging the injection well, post-injection site care (PISC) and site closure, and emergency and remedial response (E&RR). To make this demonstration, applicants must estimate the cost of each of these activities and provide qualifying financial instruments.

PART 1: Cost Estimate Evaluation

The CTV VI project consists of seven injection wells, which are projected to inject a total of Claimed as PBI [redacted] According to maps in the permit application, Claimed as PBI [redacted] and a USDW is present within the AoR.

To evaluate CTV's financial responsibility demonstration, EPA compared the cost estimates they provided in their Class VI permit application to those generated by EPA's Cost Estimation Tool for Class VI Financial Responsibility Demonstrations (the Cost Tool). EPA developed the Cost Tool to provide an "acceptable range of costs" (including a high-end, middle range, and low-end cost estimate) for Class VI financial responsibility activities based on information submitted with a permit application.

These inputs include the size of the AoR, the presence/absence of USDWs in the AoR, the amount of CO_2 to be injected, the duration of the PISC period, the depths and diameters of the injection and monitoring wells, and the characteristics of any deficient wells in the AoR requiring corrective action. Exhibit 1 presents the Cost Tool inputs EPA used, and Appendix A identifies the source of the inputs based on the permit application.

As noted below, the specific activities that the Cost Tool assumes will be employed may differ from those in the approved project plans that describe specific activities that CTV proposes to perform. However, because the goal of the financial responsibility requirements is to ensure that sufficient resources are available to cover the costs of EPA engaging a third party to complete the activities (i.e., if CTV were to become financially insolvent), the activities do not need to be identical. Where they differ, the ranges of estimates generated by the Cost Tool can be considered appropriate for evaluation purposes. The particular activities that CTV must perform are specified in the approved project plans that will be attached to the permit.

Exhibit 1. Cost Tool Inputs.

Project Information

Variable Name	Value
Project Name (Corporate entity)	CTV-VI
Project Address/Location	
Contact Name	
Contact Information for Project Operator	

Project Data

Variable Name	Value	Units (Click in Cell for Dropdown List)
Size of Area of Review (AoR)	[redacted] Claime	Square Miles
Are There Underground Sources of Drinking Water (USDWs) in the AoR?	Yes	
Mass of CO_2 to be Injected	[redacted] Claimed as PBI	Metric Tons
Duration of Post-Injection Site Care	20	Years
Depth of Injection Well	9,663	Feet
Diameter of Injection Well	6.276	inches

Information on Monitoring Wells:

4 ←Number of Monitoring Wells

Enter the names, depths (feet), and diameters (inches) of monitoring wells in the table below.

Well Name	[redacted] Claimed as PBI	[redacted]			
Well Depth (feet)	9,446	9,660	3,481	3,653	
Well Diameter (inches)	6.3	6.3	4.0	4.0	

Information on Deficient Wells in the AoR Requiring Corrective Action

2 ←Number of Deficient Wells in the AoR that will be Remediated

Enter in the names, depths (feet), and diameters (inches) of deficient wells in the aor requiring corrective action in the tab

Well Name	[redacted] Claimed as PBI	[redacted]			
Well Depth (feet)	7,907	5,716			
Well Diameter (inches)	7.875	11.75			

Comparison of Financial Responsibility Cost Estimates

Exhibit 2 compares the financial responsibility cost estimates provided by CTV (Column A) to the estimates EPA generated using the Cost Tool (Column B).

Exhibit 2. Comparison of Cost Estimates Provided by CTV and Generated by EPA

Financial Responsibility Categories	A. CTV Submission (2024$)	B. EPA Cost Tool Estimate (2021$)
Corrective Action	[redacted] Claimed as PBI	\$124,000 to \$517,000
Injection Well Plugging	[redacted] Claimed as PBI	\$157,000 to \$364,000
PISC and Site Closure	[redacted] Claimed as PBI	\$15,327,000 to \$29,403,000
E&RR	[redacted] Claimed as PBI	\$16,294,000 to \$105,457,000
Total Amount Needed to Show FR	[redacted] Claimed as PBI	\$31,902,000 to \$135,741,000

Notes:

(1) Numbers may not appear to add due to rounding.

(2) CTV estimated plugging costs for 7 injection wells; EPA's Cost Tool only estimates the cost to plug one injection well.

(3) The differences between costs in 2024$ and 2021$ are considered negligible for the purposes of this comparison.

(4) The PISC and Site Closure estimate shown combines separate cost estimates for PISC and site closure, which are discussed below.

The following subsections discuss the assumptions that may contribute to differences between these cost estimates.

Performing Corrective Action on Deficient Wells in the AoR

CTV estimates the cost of corrective action on the two deficient wells in the AoR to be [redacted] This is above the range of estimates generated by the Cost Tool, which ranges between $124,000 and $517,000, with a middle-range estimate of $233,000.

CTV's corrective action estimate includes the cost of plugging each well ($239,000/well), plus the costs associated with model revisions, CalGEM database searches, and project management. The cost estimate is acceptable.

Plugging the Injection Wells

CTV estimates the total cost of plugging their seven Class VI injection wells to be [redacted] They estimate the cost to plug each well to be between $176,917 and $299,553, plus $260,363 for project management associated with all seven wells.

The Cost Tool estimate reflects the cost of plugging only a single well, which is commensurate with the fact that financial responsibility will be permit-based, i.e., for each Class VI well. The Cost Tool estimates the cost to plug Well CTVW-IB3 (the deepest of the 7 wells) to be between $157,000 and $364,000, with a middle-range estimate of $233,000.

The table below compares the Cost Tool estimate for each injection well to CTV's (the difference in the estimates reflects different well depths).

Injection Well	Depth	Diameter	CTV Estimate*	Cost Tool Estimate
[redacted]	[redacted]	6.276	[redacted]	$116,000 to $296,000
[redacted]	[redacted]	6.276	[redacted]	$113,000 to $290,000
[redacted]	[redacted]	6.276	[redacted]	$114,000 to $291,000
[redacted]	[redacted]	6.276	[redacted]	$156,000 to $363,000
[redacted]	[redacted]	6.276	[redacted]	$156,000 to $363,000
[redacted]	[redacted]	6.276	[redacted]	$157,000 to $364,000
[redacted]	[redacted]	6.276	[redacted]	$156,000 to $363,000

* The CTV estimate shown includes plugging costs only (i.e., not reporting).

CTV's cost estimate is sourced from a drilling/service company. The per-well estimates by EPA and CTV are similar, and the well plugging cost estimate appears to be acceptable.

Post-Injection Site Care and Site Closure

EPA estimates the costs of all PISC and site closure activities to range between $15,327,000 and $29,403,000, with a middle-range estimate of $22,201,000. This is higher than the sum of CTV's estimate for these activities (which is [redacted]). The Class VI

Rule, at 40 CFR 146.85(a)(2)(iii), requires permit applicants to show adequate financial coverage for PISC and site closure activities combined; the assumptions underlying the PISC and site closure cost estimates are discussed separately below.

Post-Injection Site Care

CTV estimates the cost of PISC to be Claimed as PBI. This is significantly lower than the Cost Tool estimate, which is between $14,757,000 and $28,013,000, with a middle-range estimate of $21,362,000.

In their PISC and Site Closure Plan, CTV proposes to perform monitoring above the confining zone, including:

- Annual fluid sampling and continuous pressure and temperature monitoring in the two USDW monitoring wells, and
- Continuous pressure and temperature monitoring in Claimed as PBI in the injection wells and in-zone monitoring wells.

Proposed plume and pressure front monitoring includes:

- Direct plume and pressure front monitoring via continuous pressure and temperature monitoring in the in-zone monitoring wells,
- Indirect plume monitoring via pulsed neutron logging in the in-zone monitoring wells every 5 years, and
- Indirect pressure front monitoring via continuous seismic monitoring network across the AoR.

The differences between the Cost Tool estimates and CTV's estimate are likely due to differences in the following assumptions:

- The Cost Tool assumes annual geochemical sampling and analyses in all monitoring wells, while CTV's cost estimate and PISC and Site Closure Plan describes fluid sampling only in the two USDW monitoring wells.
- The estimates also differ regarding the cost of operations and maintenance (O&M) on the monitoring wells. CTV assumes a total of O&M "events" over the 20-year proposed PISC timeframe in two wells. While this is not documented in the financial responsibility demonstration, CTV has indicated for other projects that this refers to maintenance/refurbishment activities, while the Cost Tool estimate reflects the cost of maintenance and energy costs, which can be significant particularly in deep monitoring wells.
- CTV estimates the cost of pulsed neutron logging for indirect plume monitoring every 5 years (for a total of 4 events). However, in their PISC and Site Closure Plan, they propose pulsed logging in two wells (for a total of 8 logs).
- EPA's Cost Tool assumes that seismic surveys will be performed over the extent

of the AoR for indirect monitoring. CTV proposes to install a continuous seismic monitoring network across the AoR, but this is not included in their cost estimate.

Site Closure

CTV estimates the cost of site closure to be [redacted] this is within the range of estimates generated by the Cost Tool, which are between $570,000 and $1,390,000, with a middle-range estimate of $839,000.

Both CTV's and the Cost Tool's site closure estimates itemize the cost of plugging two injection zone monitoring wells and two USDW monitoring wells. CTV's estimate also includes the cost of developing the non-endangerment demonstration report and project management.

Emergency and Remedial Response[1]

CTV estimates the cost of E&RR to be [redacted] which is within the range of estimates generated by the Cost Tool ($16,294,000 to $105,457,000, with a middle-range estimate of $32,863,000).

CTV's E&RR Plan describes a list of emergency scenarios that could occur during the injection and post-injection phases of the project. These scenarios include injection or monitoring well or equipment failures, CO_2 or brine leakage to a USDW or the surface, a natural disaster, or an induced or natural seismic event.

Their financial responsibility cost estimate assumes the costs of repairing an injection well; investigating the cause of groundwater contamination (i.e., drilling monitoring wells and investigating abandoned wells and injection wells); and performing remedial activities (drilling pumping wells and extracting and treating groundwater via aeration to remove CO_2). This is similar to the activities assumed by the Cost Tool for projects where a USDW is present, which include activities to remediate mechanical integrity failures and treat contaminated USDWs (i.e., ceasing injection, creating a hydraulic barrier to contain fluid movement upward and/or laterally, installing chemical sealant to stop the CO_2 leak, and treating contaminated water).

[1] Although only a small fraction of GS sites are expected to require E&RR, all sites need to be financially capable of facing an emergency (40 CFR 146.84(a)(2)(iv)). As such, the Cost Tool will overestimate the actual E&RR costs incurred by most sites, but not overestimate the funds required for financial responsibility for E&RR.

PART 2: Financial Instrument Demonstration

CTV plans to provide financial assurance for corrective action, injection well plugging and PISC and site closure by posting a letter of credit (LOC), and CTV will provide financial assurance for E&RR via an insurance policy.

CTV provided no other information about the instruments, however, EPA will require CTV to provide additional information and draft financial instruments as the time for issuance of any Class VI permits for the facility nears.

In addition, regarding the Letter of Credit, EPA requests that CTV clarify whether other liabilities (including for other CTV Class VI projects) are covered using the same line of credit and, if so, how the funds specified for Class VI financial responsibility under the LOC will be protected from other liabilities.

Appendix A

EPA Cost Estimation Tool Inputs[1]

Parameter	EPA Input	Source/Notes
Size of Area of Review (AoR)	Claimed as PBI	AoR and Corrective Action Plan, Figure 5.1.
Are there USDWs in the AoR?	Yes	Narrative (V1), pg. 18: "…the Santa Margarita Sandstone (assumed to be base of the lowermost USDW)."
Mass of CO_2 to be Injected	Claimed as PBI	Narrative (V3), pg. 1: "CTV forecasts the potential CO2 stored in the Injection Zone Claimed as PBI [redacted] on average for Claimed as PBI for a total of Claimed as PBI
Duration of PISC	20 years	PISC and Site Closure Plan (V1), pg. E-3.
Depth of Injection Well	Claimed as PBI	Appendix 5, Figure 12 (the deepest of the 7 injection wells - Injector Claimed as PBI
Diameter of Injection Well	6.276 in.	Appendix 5, Figure 12 (the deepest of the 7 injection wells - Injector Claimed as PBI
Monitoring Well Plugging		
Depth of Claimed as PBI	Claimed as PBI	Appendix 5, Figure 16.
Diameter of Claimed as PBI	6.276 in.	Appendix 5, Figure 16.
Depth of Claimed as PBI	Claimed as PBI	Appendix 5, Figure 18.
Diameter of Claimed as PBI	6.276 in.	Appendix 5, Figure 18.
Depth of Claimed as PBI	Claimed as PBI	Appendix 5, Figure 20.
Diameter of Claimed as PBI	4 in.	Appendix 5, Figure 20.
Depth of Claimed as PBI	Claimed as PBI	Appendix 5, Figure 22.
Diameter of Claimed as PBI	4 in.	Appendix 5, Figure 22.
Wells Needing Corrective Action		
Depth of Claimed as PBI	Claimed as PBI	AoR and Corrective Action Plan, Appendix 7 (V1), Table 1.
Diameter of Claimed as PBI	7.875 in.	AoR and Corrective Action Plan, Appendix 7 (V1), Table 1.
Depth of Claimed as PBI	Claimed as PBI	AoR and Corrective Action Plan, Appendix 7 (V1), Table 2.
Diameter of Claimed as PBI	11.75 in.	AoR and Corrective Action Plan, Appendix 7 (V1), Table 2.

[1] All Cost Tool inputs for EPA's evaluation are based on the permit application and are preliminary; the final cost estimates will reflect the UIC permit conditions.

Questions / Requests for CTV:

67. Please revise the post-injection site care cost estimate (Table 4) to include a total of 8 pulsed neutron logs (i.e., two in each of the in-zone monitoring wells over the PISC timeframe).
68. Please include the cost of maintaining the seismic monitoring network that will track the plume and pressure front.
69. Regarding the letter of credit, please clarify whether other liabilities (including for other CTV Class VI projects) are covered using the same line of credit and, if so, how the funds specified for Class VI financial responsibility under the letter of credit will be protected from other liabilities.
70. EPA requests that CTV consult the UIC Program *Class VI Financial Responsibility Guidance*[2] as it develops the instruments, including:
    a. The recommended specifications for a letter of credit (beginning on page 31) and insurance (on page 32), and
    b. The recommended financial instrument language provided in Appendix B of the Guidance (on page B-2 for a LOC and page B-17 for a certificate of insurance).
71. Potential changes to various Cost Tool inputs (e.g., the dimensions of the injection or monitoring wells, the size of the AoR based on final modeling, the total volume of CO_2 to be injected, the final approved PISC timeframe, and corrective action needs at the time the permit is issued) would affect financial responsibility needs, and therefore financial responsibility may need to be updated before a final permit decision is made.

[2] https://www.epa.gov/sites/default/files/2015-06/documents/uicfinancialresponsibilityguidancefinal072011v.pdf

H. Pre-Operational Testing Plan

This evaluation covers the pre-operational testing, submitted as *Attachment I: Pre-Operational Testing Plan* dated July 31, 2024 (Version 1), *Attachment C: Testing and Monitoring Plan* dated July 31, 2024 (Version 1), and *Attachments G1 through G7* dated July 31, 2024 (Version 1).

CTV proposes to perform a variety of open hole and cased hole wireline logging in the injection and monitoring wells to verify well integrity. The testing aims to confirm the depth, thickness, mineralogy, lithology, porosity, permeability, and geomechanical attributes of the Injection Zone and Confining Zone. Additionally, well integrity objectives involve evaluating the mechanical integrity of the injection wells through tests such as annulus pressure tests, casing pressure tests, and external mechanical integrity tests using logs like oxygen activation, noise, and temperature logs. The integrity of the Injection and Confining Zones is further assessed by evaluating fracture pressures using site-specific step rate testing and diagnostic fracture injection tests.

Prior to running the well casings in the injection wells, the following wireline logs will be run for the surface, intermediate, and long-string sections: spontaneous potential, dual induction laterolog, gamma ray, and caliper logs. Deviation checks will be completed in the uncased boreholes of the injection wells at 120 ft intervals. The following wireline logs will be run for the intermediate and long-string sections, prior to running the casing: image, compensated neutron, formation density, and mud logs.

Logging to be performed after casing installation will include cement bond log and casing inspection logs.

Logging tools and procedures are described in the T&M Plan and QASP. This logging is consistent with EPA's guidance and the Class VI requirements and is sufficient to demonstrate proper construction.

Questions / Requests for CTV:

72. Please describe in the POTP the specific logs to be conducted in each of the monitoring wells.
73. For clarity, in Section 4.3 (Page I-3), please move external mechanical integrity test to a separate bullet from the second bullet.