ATTACHMENT E: POST-INJECTION SITE CARE AND SITE CLOSURE PLAN 40 CFR 146.93(a)

CTV II – Storage Project

1. Version History

File Name	Version	Date	Description of Change
Att E – PISC_SC	1	5/3/22	Original submission as part of CTV II project
Att E – PISC_SC V2	2	12/14/22	Updated for CTV II project expansion
Att E – PISC_SC V2.1	2.1	2/2/23	Updated to address EPA request

2. Facility Information

Facility name: CTV II

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Well Location(s): Union Island, San Joaquin County, CA
37.868 / -121.420

This Post-Injection Site Care and Site Closure (PISC) plan describes the activities that Carbon TerraVault Holdings, LLC (CTV) will perform to meet the requirements of 40 CFR 146.93. CTV plans to monitor groundwater quality and track the position of the carbon dioxide (CO_2) plume and pressure front for 50 years post injection. CTV will not cease post-injection monitoring until a demonstration of non-endangerment of USDWs has been approved by the UIC Program Director pursuant to 40 CFR 146.93(b)(3). Following approval for site closure, CTV will plug all monitoring wells, restore the site to its original condition, and submit a site closure report and associated documentation.

3. Pre- and Post-Injection Pressure Differential [40 CFR 146.93(a)(2)(i)]

Injection limits will be based on the fracture pressure of the Winters Formation and final pressure post injection will target 90% of the initial reservoir pressure at the time of discovery. Additional information on the projected post-injection pressure declines and differentials is presented in the Narrative Permit Application, and the AoR and Corrective Action Plan.

The storage reservoir will be operated such that the pressure will not exceed the initial pressure at the time of discovery. This operating strategy was developed to minimize the potential for induced seismicity and to ensure confinement of the injectate.

The maximum pressure differential between the injection wellbore and the Winters Formation storage reservoir exists prior to the commencement of CO_2 injection. Through time, the injection pressure differential will shrink, until at the time of project abandonment when the reservoir pressure will be at 90% of the initial condition of the reservoir. Figure 1 shows the pressure of the Winters reservoir through time from computational modeling. In Figure 1 'Injectate 1' represents the results of a simulation assuming an injectate composition based on Direct Air Capture (DAC) or Post/Pre-combustion sources; 'Injectate 2' represents the results of a simulation assuming an injectate composition based on Biofuel capture sources. The composition of both injectates is covered in detail in section 7.2 of the project narrative document.

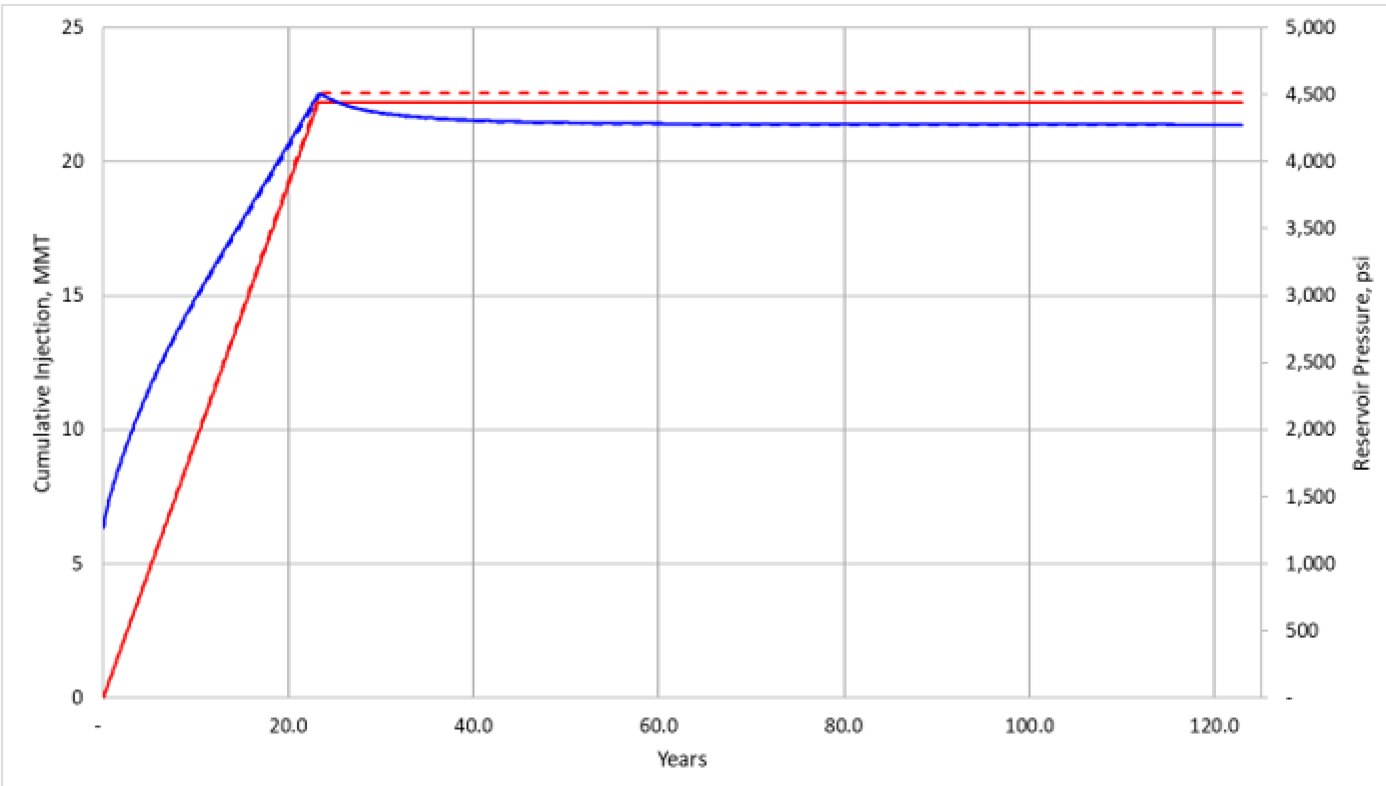

Figure 1: Cumulative Injection in MMT (Red) and Average Reservoir pressure (Blue) versus time over the injection period and 100 years post injection period for Base Case with Injectate 1 (Solid Line) and Injectate 2 (Dotted Line). Reservoir pressure trends are almost identical, with pressure mostly stabilized roughly 15 years after the end of injection (rate of pressure change < 0.01 psi/day)

4. Predicted Position of the CO_2 Plume and Associated Pressure Front at Site Closure [40 CFR 146.93(a)(2)(ii)]

Figure 2 shows the predicted extent of the plume and pressure front at the end of the PISC timeframe, representing the maximum extent of the plume and pressure front. This map is based on the final AoR delineation modeling results submitted pursuant to 40 CFR 146.84.

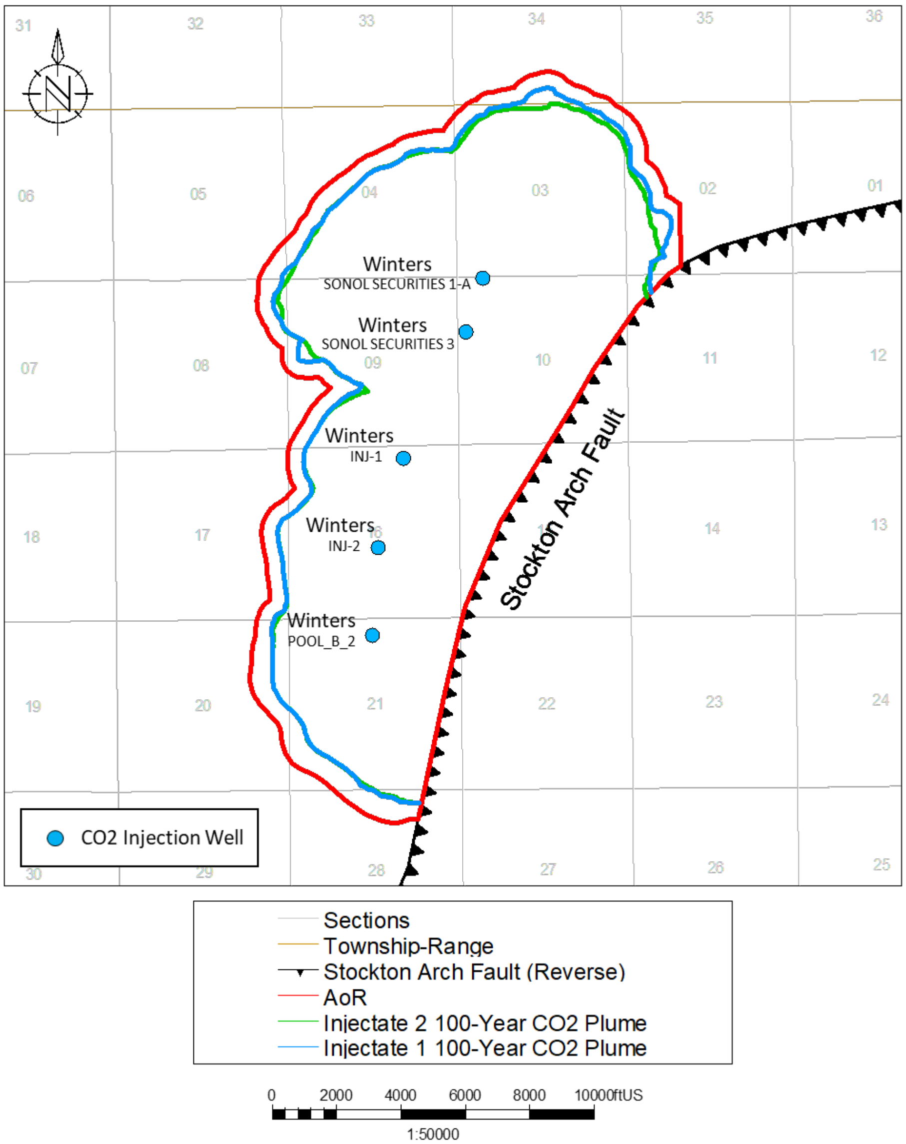

Figure 2. Map of the predicted extent of the CO_2 plume at site closure.

5. Post-Injection Monitoring Plan [40 CFR 146.93(b)(1)]

Monitoring during the post-injection phase will include pressure monitoring and fluid composition monitoring in the storage reservoir and reservoirs above the injection zone. Post-injection monitoring, as described in the following sections, will meet the requirements of 40

CFR 146.93(b)(1). The results of all post-injection phase testing and monitoring will be submitted annually, within 90 days, as described under “Schedule for Submitting Post-Injection Monitoring Results,” below.

The Testing and Monitoring Plan describes the monitoring strategies within the injection zone, above the injection zone, and within the USDW-containing reservoir. In addition to monitoring the zones above the injection zone for stabilized pressure and absence of CO_2, the injection zone will be monitored for pressure stabilization as the best method to confirm confinement within the storage reservoir. If pressure in the reservoir trends lower post injection and is inconsistent when compared to computational modeling results, CTV will assess for potential leakage.

A quality assurance and surveillance plan (QASP) for all testing and monitoring activities during the injection and post injection phases is provided in the Appendix to the Testing and Monitoring Plan.

Pressure monitoring of the Winters Formation storage reservoir will monitor for pressure stabilization. This is the best method to confirm confinement of the reservoir. If pressure in the reservoir trends lower post injection and is inconsistent when compared to computational modeling results, CTV will assess for potential leakage. Throughout the AoR there are USDWs. As such, ongoing groundwater monitoring of the USDWs will assess potential impacts. Groundwater samples will be analyzed annually for indicators of CO_2 movement into the USDWs.

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

5.1. Monitoring Above the Confining Zone

Table 1 presents the monitoring methods, locations, and frequencies for monitoring above the confining zone. Table 2 identifies the parameters to be monitored and the analytical methods CTV will employ. Table 3 presents sampling and recording frequencies for continuous monitoring.

Table 1. Monitoring of ground water quality and geochemical changes above the confining zone.

Target Formation	Monitoring Activity	Device	Monitoring Location(s)	Spatial Coverage or Depth	Frequency (Post Injection Phase)
Undifferentiated non-marine	Fluid Sampling	Pump	USDW Monitoring wells: US-1 US-2 US-3	USDW Monitoring wells: 2105' - 2147' MD/VD 2141' - 2183' MD/VD 2122' - 2164' MD/VD	Annual
	Pressure	Pressure Gauge			Continuous
	Temperature	Temperature Sensor			Continuous
	Temperature	Fiberoptic cable (DTS)	Injection Zone Monitoring wells: SONOL SECURITIES 4 Brooks 10-1 RD1 M-1 Yamada Brothers 2	Injection Zone Monitoring wells: 2379' MD/VD 2338' MD/VD 2416' MD/VD 2517' MD/VD	Continuous
Mokelumne River Formation	Fluid Sampling	Sampling Device	Above Confining Zone Monitoring Wells: SONOL SECURITIES 2 Phillips Yamada Bros 1	Above Confining Zone Monitoring Wells: 5731' - 5792' MD 6265' - 6317' VD	Annual
	Pressure	Pressure Gauge			Continuous
	Temperature	Temperature Sensor			Continuous
	Temperature	Fiberoptic cable (DTS)	Injection Zone Monitoring wells: SONOL SECURITIES 4 M-1 Yamada Brothers 2	Injection Zone Monitoring wells: 4200' - 4280' MD/VD 5860' - 5950' MD/VD 5510' - 5600' MD/VD	Continuous

Table 2. Summary of analytical and field parameters for ground water samples.

Parameters	Analytical Methods
USDWs and Mokelumne River Formation	
Cations (Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb Se, Zn, Tl)	ICP-MS EPA Method 6020
Cations (Ca, Fe, K, Mg, Na, Si)	ICP-OES EPA Method 6010B
Anions (Br, Cl, F, NO3, SO4)	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration ASTM D513-11
δ13C	Isotope ratio mass spectrometry
Hydrogen Sulfide	ISBT 14.0 (GC/SCD)
Oxygen, Argon and Hydrogen	ISBT 4.0 (GC/DID) GC/TCD
Total Dissolved Solids	Gravimetry; Method 2540 C
Alkalinity	Method 2320B
pH (field)	EPA 150.1
Specific Conductance (field)	APHA 2510
Temperature (field)	Thermocouple

Table 3. Sampling and recording frequencies for continuous monitoring.

Parameter	Device(s)	Location	Min. Sampling Frequency	Min. Recording Frequency
During active injection	Pressure Gauge	USDW Monitoring Wells	5 hours	5 hours
Post injection	Pressure Gauge	USDW Monitoring Wells	12 hours	12 hours

Notes:

- Sampling frequency refers to how often the monitoring device obtains data from the well for a particular parameter. For example, a recording device might sample a pressure transducer monitoring injection pressure once every two seconds and save this value in memory.
- Recording frequency refers to how often the sampled information gets recorded to digital format (such as a computer hard drive). For example, the data from the injection pressure transducer might be recorded to a hard drive once every minute.

5.2. Carbon Dioxide Plume and Pressure Front Tracking [40 CFR 146.93(a)(2)(iii)]

CTV will employ direct and indirect methods to track the extent of the carbon dioxide plume and the presence or absence of elevated pressure.

Table 4 presents the direct and indirect methods that CTV will use to monitor the CO_2 plume, including the activities, locations, and frequencies CTV will employ. The parameters to be analyzed as part of fluid sampling in the Winters Formation (and associated analytical methods) are presented in Table 5.

Table 6 presents the direct and indirect methods that CTV will use to monitor the pressure front, including the activities, locations, and frequencies CTV will employ.

Fluid sampling will be performed as described in B.1. of the QASP; sample handling and custody will be performed as described in B.3. of the QASP; and quality control will be ensured using the methods described in B.5. of the QASP.

Table 4. Post-injection phase plume monitoring.

Monitoring Category and Class VI Rule Citation	Target Formation	Monitoring Activity	Data Collection Location(s)	Spatial Coverage or Depth	Frequency (Post Injection Phase)
Plume Monitoring [40 CFR 146.90(g)] **DIRECT MONITORING**	Winters	Fluid Sampling	SONOL SECURITIES 4	9665' - 9924' MD	Annual
		Pressure		9560' MD	Continuous
		Temperature		9560' MD	Continuous
	Winters	Fluid Sampling	M-1	10010' - 10220' MD	Annual
		Pressure		9910' MD	Continuous
		Temperature		9910' MD	Continuous
	Winters	Fluid Sampling	Yamada Brothers 2	10006' - 10326' MD	Annual
		Pressure		9935' MD	Continuous
		Temperature		9935' MD	Continuous
Plume Monitoring [40 CFR 146.90(g)] **INDIRECT MONITORING**	Winters	Pulsed Neutron Log	SONOL SECURITIES 4	9665' - 9924' MD	Every 5 years
			M-1	10010' - 10220' MD	
			Yamada Brothers 2	10006' - 10326' MD	

Table 5. Summary of analytical and field parameters for fluid sampling in the injection zone.

Parameters	**Analytical Methods**
Winters Formation	
Cations (Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb, Se, Zn, Tl)	ICP-MS EPA Method 6020

Parameters	Analytical Methods
Cations (Ca, Fe, K, Mg, Na, Si)	ICP-OES EPA Method 6010B
Anions (Br, Cl, F, NO3, SO4)	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration ASTM D513-11
δ13C	Isotope ratio mass spectrometry
Hydrogen Sulfide	ISBT 14.0 (GC/SCD)
Oxygen, Argon and Hydrogen	ISBT 4.0 (GC/DID) GC/TCD
Total Dissolved Solids	Gravimetry; Method 2540 C
Alkalinity	Method 2320B
pH (field)	EPA 150.1
Specific Conductance (field)	APHA 2510
Temperature (field)	Thermocouple

CTV will employ indirect and direct methods to monitor the pressure front (Table 6). Direct monitoring will include pressure gauges to monitor the pressure of the CO_2 plume in the three Winters Formation monitoring wells. Additionally, seismic monitoring via installed surface and/or shallow borehole seismometers will be utilized to detect micro seismic events. Figures 3a and 3b show the location of the monitoring wells and the predicted extent of the CO_2 plume in plan view for the two modeled injectates. Figures 4a and 4b show the location of the monitoring wells and the predicted extent of the CO_2 plume in cross-section for the two modeled injectates.

Table 6. Post-injection phase pressure-front monitoring.

Monitoring Category and Class VI Rule Citation	Target Formation	Monitoring Activity	Data Collection Location(s)	Spatial Coverage or Depth	Frequency (Post Injection)
Pressure-Front Monitoring [40 CFR 146.90(g)] **DIRECT MONITORING**	Winters	Pressure	SONOL SECURITIES 4	9665' - 9924' MD	Continuous
		Temperature			Continuous
	Winters	Pressure	M-1	10010' - 10220' MD	Continuous
		Temperature			Continuous
	Winters	Pressure	Yamada Brothers 2	10006' - 10326' MD	Continuous
		Temperature			Continuous
	Winters	Pressure	Brooks 10-1 RD1	9,578’ – 9,654’ MD	Continuous
		Temperature			Continuous

Monitoring Category and Class VI Rule Citation	Target Formation	Monitoring Activity	Data Collection Location(s)	Spatial Coverage or Depth	Frequency (Post Injection)
Pressure-Front Monitoring [40 CFR 146.90(g)] **INDIRECT MONITORING**	All Formations	Seismicity	Seismic Monitoring Network	Full AOR	Continuous

5.3. Schedule for Submitting Post-Injection Monitoring Results [40 CFR 146.93(a)(2)(iv)]

All post-injection site care monitoring data and monitoring results collected using the methods described above will be submitted to EPA in annual reports submitted within 90 days following the anniversary date on which injection ceases. The reports will contain information and data generated during the reporting period; i.e. well-based monitoring data, sample analysis, and the results from updated site models.

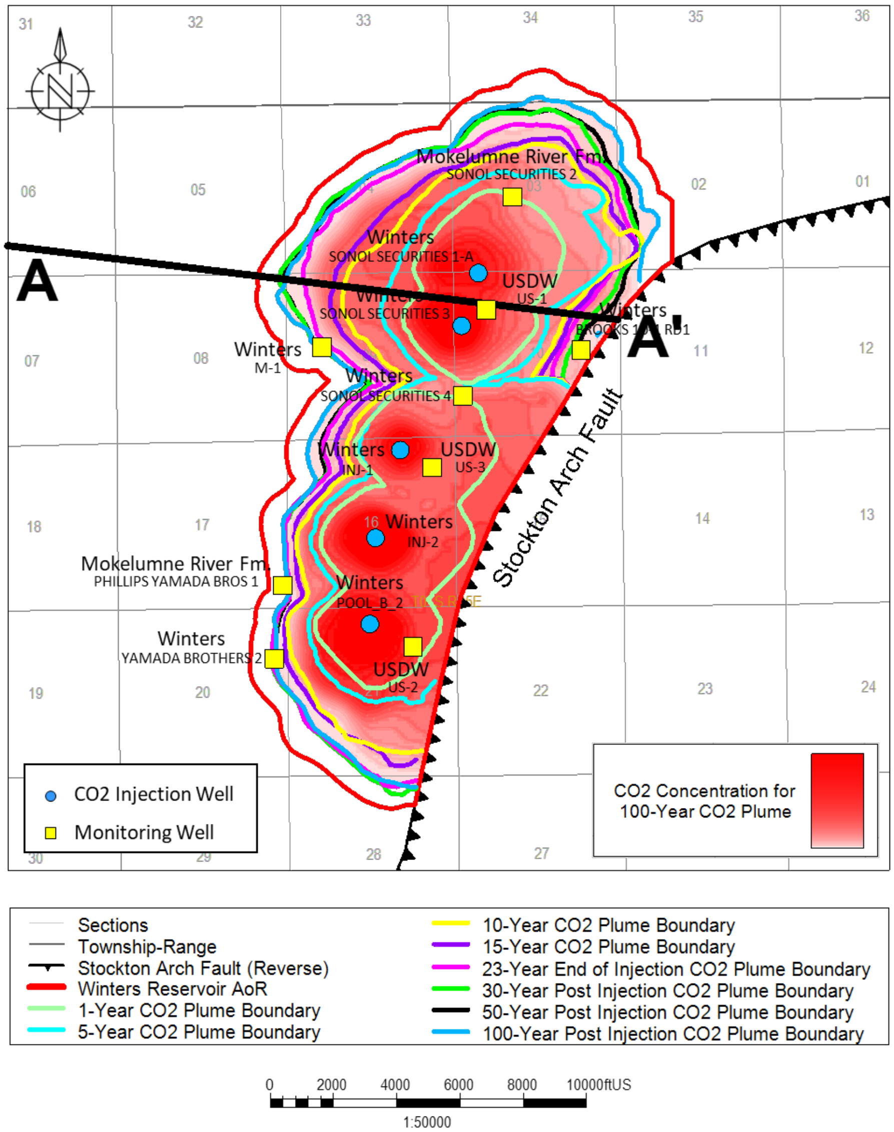

Figure 3a. Map showing the AoR, Injectate 1 plume development through time, and well locations for injectors and post-injection monitoring.

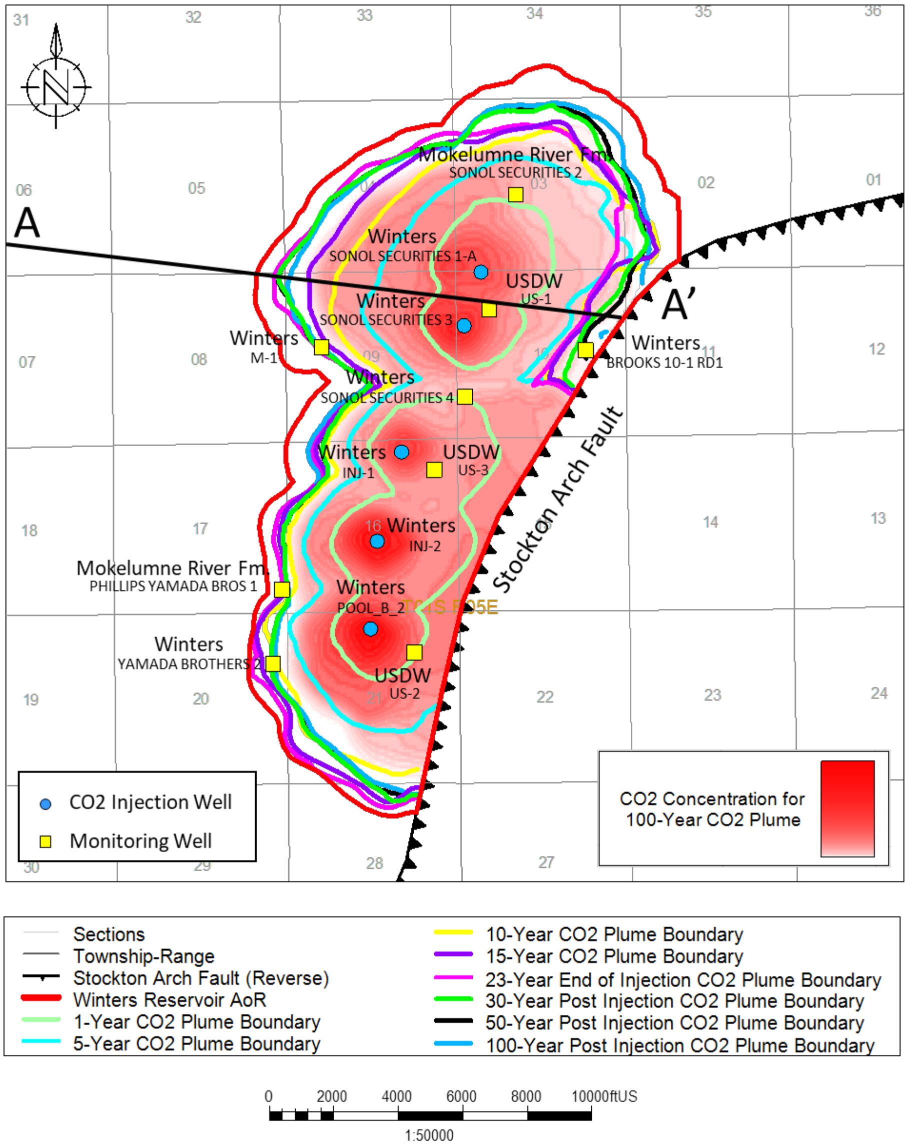

Figure 3b. Map showing the AoR, Injectate 2 plume development through time, and well locations for injectors and post-injection monitoring.

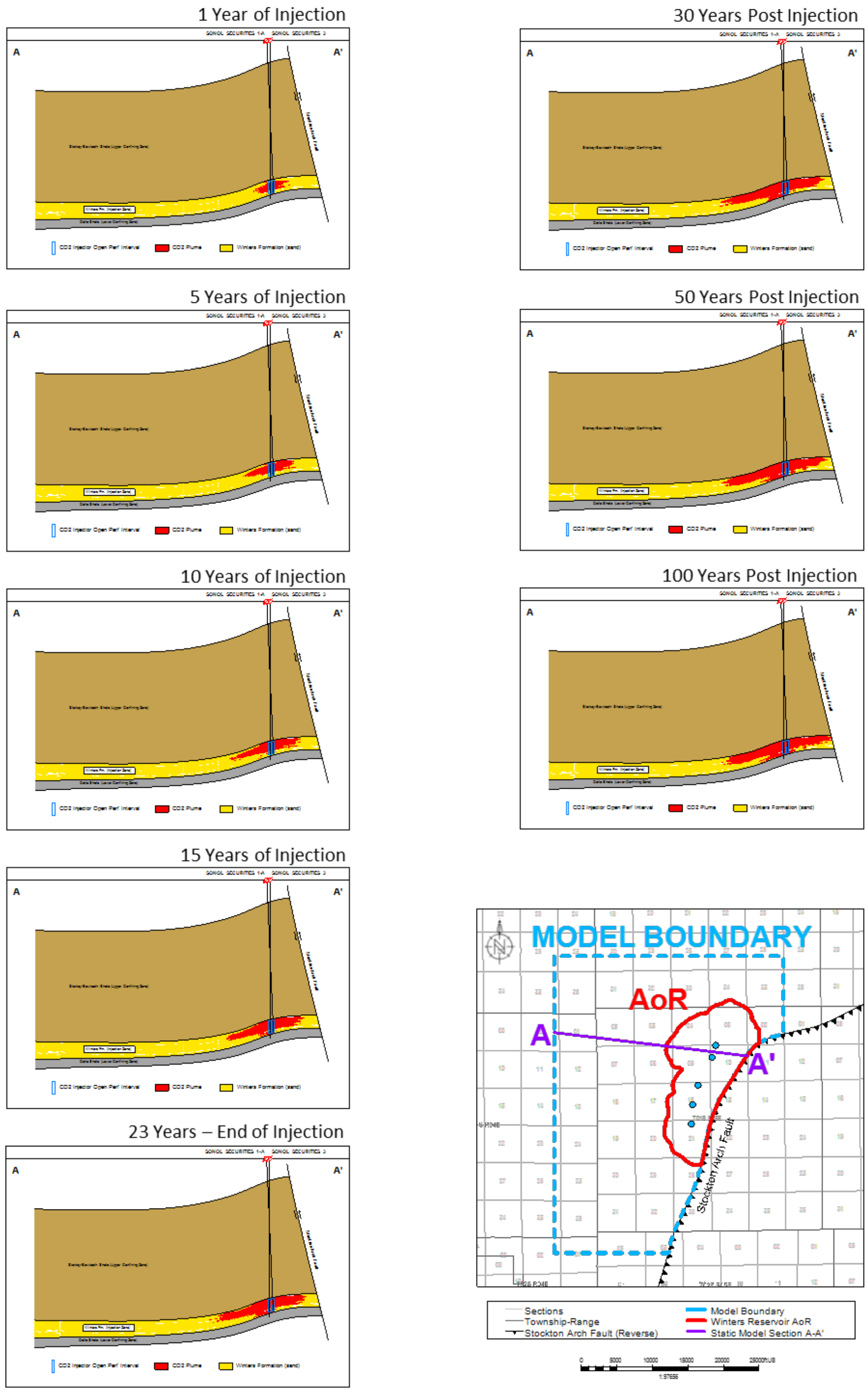

Figure 4a. Section showing proximity of CO2 (Injectate 1) to the Stockton Arch Fault and lateral dispersion of CO2 throughout time and confinement under the overlying Starkey-Sawtooth through time for the five injector modeled Base scenario. As the sections show, plume growth over time is driven by the reservoir anticlinal structure, and is thus representative of the plume growth at all injector locations.

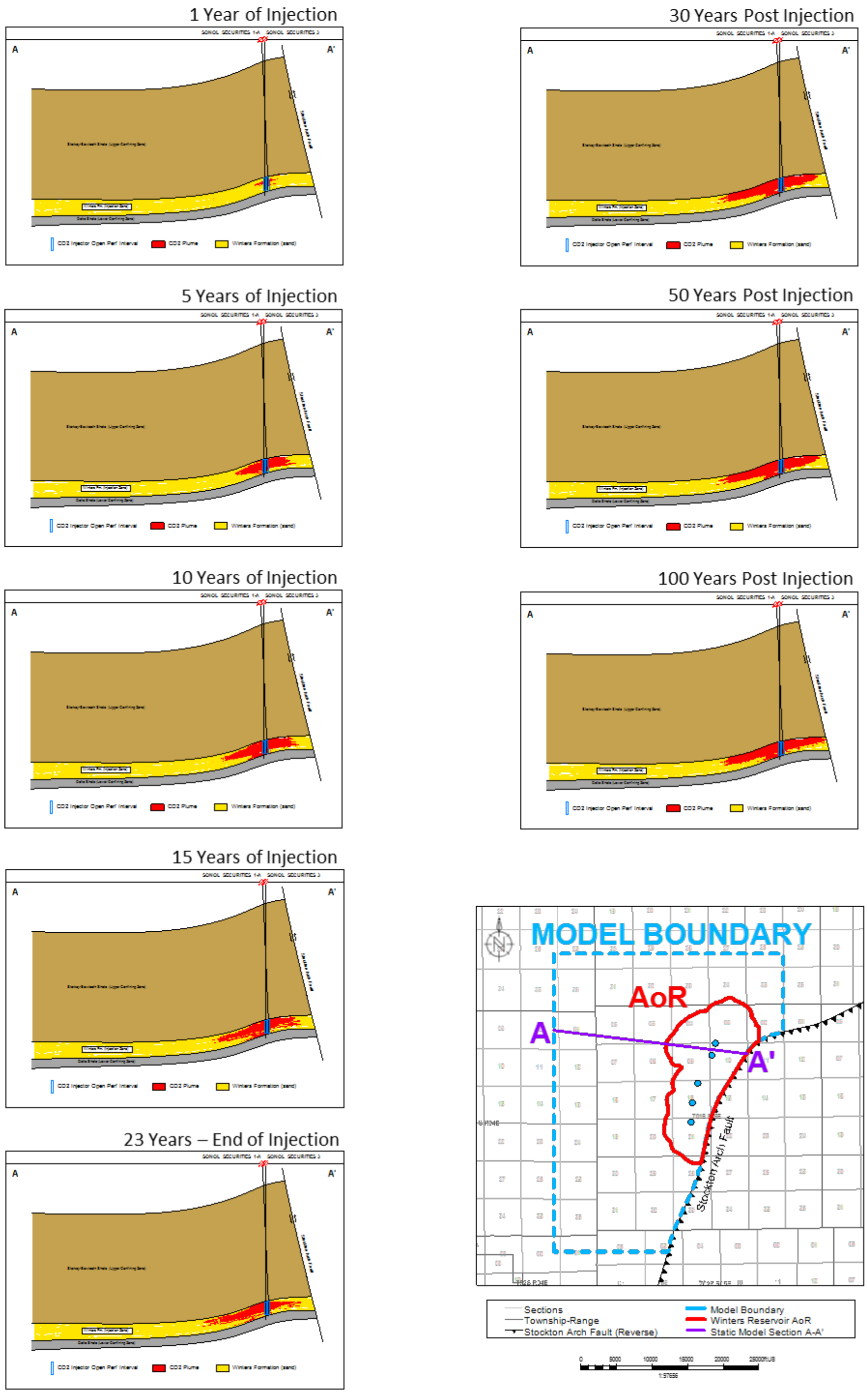

Figure 4b. **Section showing proximity of CO2 (Injectate 2) to the Stockton Arch Fault and lateral dispersion of CO2 throughout time and confinement under the overlying Starkey-Sawtooth through time for the five injector modeled Base scenario. As the sections show, plume growth over time is driven by the reservoir anticlinal structure, and is thus representative of the plume growth at all injector locations.**

6. Non-Endangerment Demonstration Criteria

Prior to authorization of site closure, CTV will submit a demonstration of non-endangerment of USDWs to the Director as per 40 CFR 143.93(b)(2) or (3).

CTV will provide a report to the Director that demonstrated USDW non-endangerment based on the evaluation of site monitoring data. The report will detail how the non-endangerment determination is based on site-specific conditions, supported with the computational model. All relevant monitoring data and interpretations will be provided.

6.1. Summary of Monitoring Data

A summary of the site monitoring data, pursuant to the Testing and Monitoring Plan and this PISC and Site Closure Plan, including data collected during the injection and PISC phases of the project. Data submission will be in a format acceptable to the Director and will include:

1. A narrative that explains the monitoring activities,
2. Dates of all monitoring events,
3. Changes to the monitoring program over time,
4. An explanation of all monitoring information that has existed at the site,
5. Explanation of how the monitoring data from injection and PISC has varied from the baseline data during site characterization, and
6. Summary of any emergencies that occurred during the injection and post-injection phases of the project. Included will be a description of how any issues have been resolved and that there is no endangerment to the USDW.

6.2. Evaluation of the CO_2 Plume and the AoR

Computational modeling results calibrated with monitoring data (e.g., pressure) will be used to support that the plume has stabilized and that the pressure change is negligible (less than 10 psi per year) and poses no risk for potential vertical migration. Computational modeling results calibrated with monitoring data from storage reservoir, USDW and above zone will be used to demonstrate:

1. The lack of CO_2 leakage over the project timeframe,
2. The accuracy of the model to predict and represent the storage reservoir, and
3. The computational model adequately defined the AoR.

6.3. Evaluation of Reservoir Pressure

Monitoring data will be reviewed to ensure that the CO_2 plume has stabilized post-injection and that the reservoir pressure change is negligible (less than 10 psi per year). This demonstration will be supported by the computational model that has been calibrated with the most recent monitoring data. The plume is trapped by structure and pinch-out of the reservoir sands. Plume migration is minimal, as such pressure stabilization will be used for non-endangerment assessment.

6.4. Evaluation of Potential Conduits for Fluid Movement

Wells that require corrective action will be reviewed and assessed prior to PISC and Site Closure, this includes monitoring wells, injection wells and other wells that penetrate within the AoR and the confining layer. Final demonstration will be made that natural and artificial conduits will not allow fluid migration from the storage reservoir.

6.5. Evaluation of Seismicity Monitoring

Demonstration will be made that the plume has stabilized and the pressure change is negligible (less than 10 psi per year), minimizing the risk for induced seismicity after site closure. Final review will be made with the seismicity monitoring to demonstrate seal integrity and that there is no further endangerment of to the USDW.

7. Site Closure Plan

CTV will conduct site closure activities to meet the requirements of 40 CFR 146.93(e), with notification to the permitting agencies at least 120 days prior to its intent to close the site. Upon approval of the permitting agencies, CTV will plug the injection and monitoring wells, restore the site and submit a site closure plan to the EPA.

A site closure report will be prepared and submitted within 90 days following site closure supported by the following:

1. Verification of injector and monitoring well plugging,
2. Notifications to state and local authorities as per 40 CFR 146.93 (f)(2),
3. Composition and volume of the injected CO_2, and
4. Post-injection monitoring records

CTV will record a notation to the property's deed that will indicate:

1. The property was used for CO_2 sequestration, the period of injection and the volume of CO_2 injected,
2. The formation that the fluid was injected, and
3. The name of the local agency to which a plat of survey with injection well locations was submitted.