

**ATTACHMENT F: EMERGENCY AND REMEDIAL RESPONSE PLAN  
40 CFR 146.94(a)**

**Elk Hills A1-A2 Storage Project**

**Facility Information**

Facility name: Elk Hills A1-A2 Storage  
357-7R

Facility contact: Kenneth Haney / CCS Project Manager  
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Well location: Elk Hills Oil Field, Kern County, CA  
35.32802963 / -119.5449982

This Emergency and Remedial Response Plan (ERRP) describes actions that Carbon TerraVault 1 LLC (CTV) shall take to address movement of the injection fluid or formation fluid in a manner that may endanger an underground source of drinking water (USDW) during the construction, operation, or post-injection site care periods.

If CTV obtains evidence that the injected CO<sub>2</sub> stream and/or associated pressure front may cause an endangerment to a USDW, CTV must perform the following actions:

1. Initiate shutdown plan for the injection well.
2. Take all steps reasonably necessary to identify and characterize any release.
3. Notify the permitting agency (UIC Program Director) of the emergency event within 24 hours.
4. Implement applicable portions of the approved ERRP.

Where the phrase “initiate shutdown plan” is used, the following protocol will be employed: CTV will immediately cease injection. However, in some circumstances, CTV will, in consultation with the UIC Program Director, determine whether gradual cessation of injection (using the parameters set forth in Attachment A of the Class VI permit) is appropriate.

**Local Resources and Infrastructure**

Resources in the vicinity of the Elk Hills A1-A2 Storage facility that may be affected as a result of an emergency event at the project site include:

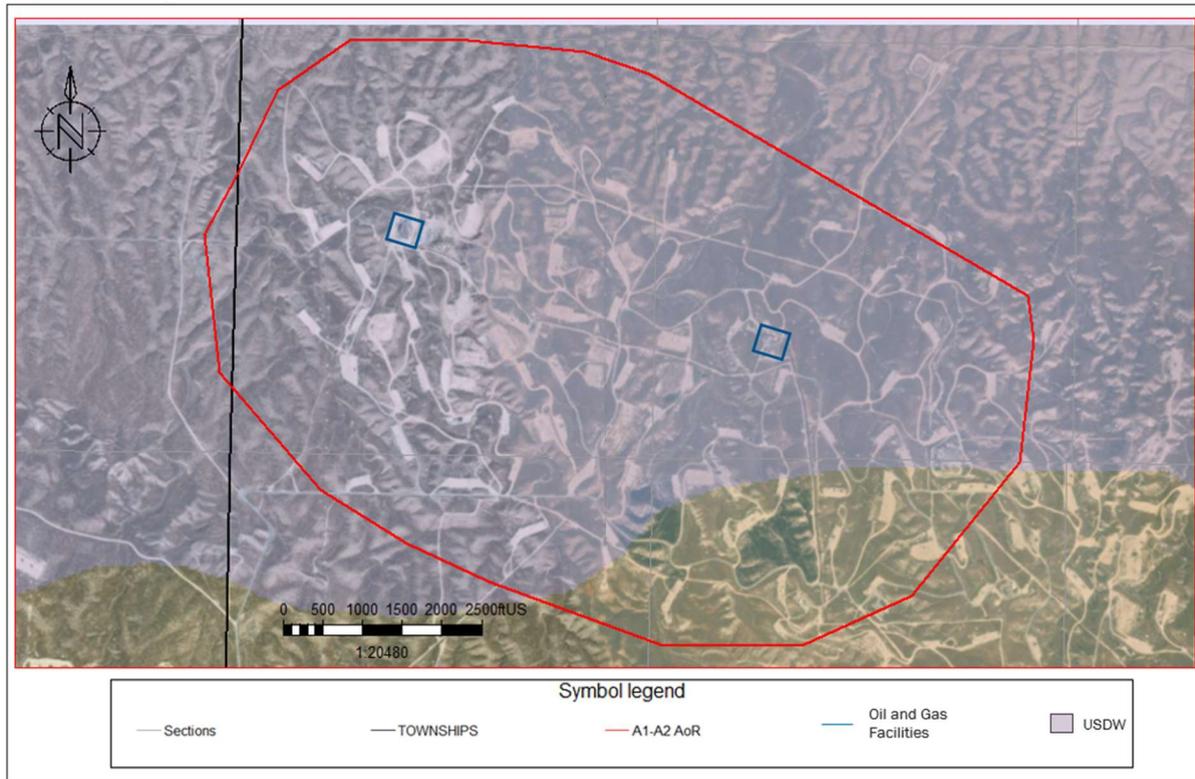
1. Elk Hills oil and gas production resources not associated with the Elk Hills A1-A2 Storage project. These oil and gas operations are operated by California Resources Corporation (CRC) an owner of the Elk Hills A1-A2 Storage project.
2. Upper Tulare USDW overlying the CO<sub>2</sub> plume. The USDW is not being utilized in the AoR and CTV does not expect usage in the foreseeable future.

Infrastructure in the vicinity of the Elk Hills A1-A2 Storage facility that that may be affected as a result of an emergency at the project site include:

1. Elk Hills infrastructure owned and operated by CTV that is associated with oil and gas operations.

Resources and infrastructure addressed in this plan are shown in Figure 1.

**Figure 1: Map of the site resources and infrastructure.**



### **Potential Risk Scenarios**

The following events related to the Elk Hills A1-A2 facility that could potentially result in an emergency response:

- Injection or monitoring (verification) well integrity failure;
- Injection well monitoring equipment failure (e.g., shut-off valve or pressure gauge, etc.);
- A natural disaster (e.g., earthquake, tornado, lightning strike);

- Fluid (e.g. brine) leakage to a USDW;
- CO<sub>2</sub> leakage to USDW or land surface; or
- Induced seismic event.

Response actions will depend on the severity of the event(s) triggering an emergency response. “Emergency events” are categorized as shown in Table 1.

**Table 1. Degrees of risk for emergency events.**

<b>Emergency Condition</b>	<b>Definition</b>
Major emergency	Event poses immediate substantial risk to human health, resources, or infrastructure. Emergency actions involving local authorities (evacuation or isolation of areas) should be initiated.
Serious emergency	Event poses potential serious (or significant) near term risk to human health, resources, or infrastructure if conditions worsen or no response actions taken.
Minor emergency	Event poses no immediate risk to human health, resources, or infrastructure.

### **Emergency Identification and Response Actions**

Steps to identify and characterize the event will be dependent on the specific issue identified, and the severity of the event. The potential risk scenarios identified in Part 2 are detailed below.

#### **Well Integrity Failure**

Integrity loss at the injection well and/or verification well may endanger USDWs. Integrity loss may have occurred if the following events occur:

- Automatic shutdown devices are activated:
  - Wellhead pressure exceeds the specified shutdown pressure specified in the permit.
  - Annulus pressure indicates a loss of external or internal well containment.
  - Pursuant to 40 CFR 146.91(c)(3), CTV must notify the UIC Program Director within 24 hours of any triggering of a shut-off system (i.e., down-hole or at the service).
- Mechanical integrity test results identify a loss of mechanical integrity.

**Severity:** Low to moderate, dependent on the magnitude of the event.

**Timing of event:** Injection

**Avoidance measures:** Well maintenance, monitoring and control of injection flow and pressure.

**Detection methods:** Mechanical integrity testing, unexpected injection wells pressure and rate changes, annulus pressure increase, and visual (CO<sub>2</sub> at surface).

**Potential response actions:**

- Notify the plant superintendent and project manager.
- Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).
- Determine the severity of the event, based on the information available, within 24 hours of notification.
- For a Major or Serious emergency:
  - Contact security to restrict access to the Elk Hills A1-A2 Storage site.
  - Initiate shutdown plan.
  - Shut-in injection well and vent CO<sub>2</sub> from surface facilities.
  - Continuously monitor well pressure, temperature, and annulus pressure to assess integrity loss and determine the root cause of failure.
  - If contamination is detected, identify, and implement appropriate remedial actions (in consultation with the UIC Program Director).
- For a Minor emergency:
  - Conduct assessment to determine whether there has been a loss of mechanical integrity.
  - If there has been a loss of mechanical integrity, initiate shutdown plan.
  - Contact security to restrict access to the Elk Hills A1-A2 Storage site.
  - Initiate shutdown plan.
  - Shut-in injection well and vent CO<sub>2</sub> from surface facilities.
  - Continuously monitor well pressure, temperature, and annulus pressure to assess integrity loss and determine the root cause of failure.
  - If contamination is detected, identify, and implement appropriate remedial actions (in consultation with the UIC Program Director).

**Response personnel:** Emergency response personnel, drilling crew, geotechnical professionals, and environmental or water treatment professionals.

**Equipment:** Drill rig, logging equipment, cement or casing and air and water testing equipment.

### **Injection Well Monitoring Equipment Failure**

The failure of monitoring equipment for wellhead pressure, temperature, and/or annulus pressure may indicate a problem with the injection well that could endanger USDWs.

**Severity:** Low

**Timing of event:** Injection

**Avoidance measures:** Well maintenance, and careful monitoring and control of injection flow and pressure.

**Detection methods:** Anomalies in monitoring data, and visual failure of equipment.

**Potential response actions:**

- Notify the plant superintendent and project manager.
- Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).
- Determine the severity of the event, based on the information available, within 24 hours of notification.
- For a Major or Serious emergency:
  - Contact security to restrict access to the Elk Hills A1-A2 Storage site.
  - Initiate shutdown plan.
  - Shut-in injection well and vent CO<sub>2</sub> from surface facilities.
  - Continuously monitor well pressure, temperature, and annulus pressure to assess integrity loss and determine the root cause of failure.
  - Identify and, if necessary, implement appropriate remedial actions (in consultation with the UIC Program Director).
- For a Minor emergency:
  - Conduct assessment to determine whether there has been a loss of mechanical integrity.
  - If there has been a loss of mechanical integrity, initiate shutdown plan.
  - Contact security to restrict access to the Elk Hills A1-A2 Storage site.
  - Initiate shutdown plan.
  - Shut-in injection well and vent CO<sub>2</sub> from surface facilities.
  - Continuously monitor well pressure, temperature, and annulus pressure to assess integrity loss and determine the root cause of failure.

**Response Personnel:** Emergency response personnel, drilling crew, geotechnical professionals, and environmental or water treatment professionals.

**Equipment:** Drill rig, logging equipment, cement or casing and air and water testing equipment.

**Potential Brine or CO<sub>2</sub> Leakage to USDW**

Elevated concentrations of indicator parameter(s) in groundwater sample(s) or other evidence of fluid (brine) or CO<sub>2</sub> leakage into a USDW.

**Severity:** Low

**Timing of event:** Injection

**Avoidance measures:** CTV will operate the project to ensure containment of CO<sub>2</sub>. Contamination to USDWs will be avoided by:

1. Ensuring injection well integrity through well maintenance and mechanical integrity testing
2. Maintaining the injection pressure below the fracture gradient of the confining Reef Ridge Shale and assessing data from seismic monitoring to ensure competency of the Reef Ridge confining layer.
3. Reviewing monitoring well data to understand plume extent.
4. Monitoring of the Lower Etchegoin dissipation interval that overlies the confining Reef Ridge Shale to establish leakage before migration to USDW.

**Detection methods:** Pressure or water composition change in USDW monitoring well.

**Potential response actions:**

- Notify the plant superintendent and project manager.
- Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).
- Determine the severity of the event, based on the information available, within 24 hours of notification.
- For all emergencies (Major, Serious, or Minor):
  - Initiate shutdown plan.
  - Contact security to restrict access to the Elk Hills A1-A2 Storage site.
  - Shut-in injection well and vent CO<sub>2</sub> from surface facilities.
  - If the presence of indicator parameters is confirmed, develop (in consultation with the UIC Program Director) a case-specific work plan to:
    - Install additional groundwater monitoring points near the affected groundwater well(s) to delineate the extent of impact; and
    - Remediate unacceptable impacts to the affected USDW.
  - Arrange for an alternate potable water supply, if the USDW was being utilized and has been caused to exceed drinking water standards.

- Proceed with efforts to remediate USDW to mitigate any unsafe conditions (e.g., install system to intercept/extract brine or CO<sub>2</sub> or “pump and treat” to aerate CO<sub>2</sub>-laden water).
- Continue groundwater remediation and monitoring on a frequent basis (frequency to be determined by CTV and the UIC Program Director) until unacceptable adverse USDW impact has been fully addressed.

**Response personnel:** Emergency response personnel, drilling crew, geotechnical professionals, and environmental or water treatment professionals.

**Equipment:** Drill rig, logging equipment, cement or casing and air and water testing equipment.

### **Natural Disaster**

Well problems (integrity loss, leakage, or malfunction) may arise as a result of a natural disaster affecting the normal operation of the injection well. An earthquake may disturb surface and/or subsurface facilities; and weather-related disasters (e.g., tornado or lightning strike) may affect surface facilities.

If a natural disaster occurs that affects normal operation of the injection well, CTV will perform the following:

**Severity:** Low

**Timing of event:** Injection

**Avoidance measures:** N/A

**Detection methods:** N/A

#### **Potential response actions:**

- Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).
- Determine the severity of the event, based on the information available, within 24 hours of notification.
- For a Major or Serious emergency:
  - Initiate shutdown plan.
  - Contact security to restrict access to the Elk Hills A1-A2 Storage site.
  - Shut-in injection well and vent CO<sub>2</sub> from surface facilities.
  - Continuously monitor well pressure, temperature, and annulus pressure to assess integrity loss and determine the root cause of failure.
  - If contamination or endangerment is detected, identify, and implement appropriate remedial actions (in consultation with the UIC Program Director).

- For a Minor emergency:
  - Conduct assessment to determine whether there has been a loss of mechanical integrity.
  - If there has been a loss of mechanical integrity, initiate shutdown plan.
  - Contact security to restrict access to the Elk Hills A1-A2 Storage site.
  - Shut-in injection well and vent CO<sub>2</sub> from surface facilities.
  - Continuously monitor well pressure, temperature, and annulus pressure to assess integrity loss and determine the root cause of failure.

**Response personnel:** Emergency response personnel, drilling crew, geotechnical professionals, and environmental or water treatment professionals.

**Equipment:** Drill rig, logging equipment, cement or casing and air and water testing equipment.

### **Induced Seismic Event**

Based on the project operating conditions, it is highly unlikely that injection operations would ever induce a seismic event outside the AoR. Therefore, this portion of the response plan is developed for any seismic event with an epicenter within the AoR, inclusive of a ¼ mile buffer.

To monitor the area for seismicity, CTV will install surface and shallow borehole seismometers to continuously record the Elk Hills A1-A2 site for seismic activity. In addition to the CTV seismic monitoring, the Southern California Earthquake Data Center has deployed a network to monitor natural seismicity in the area.

**Severity:** Low

**Timing of event:** Injection

An induced seismic event will occur when the reservoir stresses are altered, which would occur during the injection phase.

**Avoidance measures:** N/A

**Detection methods:** The seismic monitoring wells

**Potential response Actions:**

Based on the periodic analysis of the monitoring data, observed level of seismic activity, and local reporting of felt events, the site will be assigned an operating state. The operating state is determined using threshold criteria which correspond to the site's potential risk and level of seismic activity. The operating state provides operating personnel information about the potential risk of further seismic activity and guides them through a series of response actions.

The seismic monitoring system structure is presented in Table 2. The table corresponds each level of operating state with the threshold conditions and operational response actions.

**Table 2. Seismic monitoring system, for seismic events > M1.0 with an epicenter within a two-mile radius of the injection well.**

<b>Operating State</b>	<b>Threshold Condition<sup>1,2</sup></b>	<b>Response Action<sup>3</sup></b>
<b>Green</b>	Seismic events less than or equal to M1.5	1. Continue normal operation within permitted levels.
<b>Yellow</b>	Five (5) or more seismic events within a 30-day period having a magnitude greater than M1.5 but less than or equal to M2.0	1. Continue normal operation within permitted levels. 2. Within 24 hours of the incident, notify the UIC Program Director of the operating status of the well.
<b>Orange</b>	Seismic event greater than M1.5 and local observation or felt report	1. Continue normal operation within permitted levels. 2. Within 24 hours of the incident, notify the UIC Program Director, of the operating status of the well. 3. Review seismic and operational data. 4. Report findings to the UIC Program Director and issue corrective actions.
	Seismic event greater than M2.0 and no felt report	
<b>Magenta</b>	Seismic event greater than M2.0 and local observation or report	1. Initiate rate reduction plan. 2. Vent CO <sub>2</sub> from surface facilities. 3. Within 24 hours of the incident, notify the UIC Program Director, of the operating status of the well. 4. Limit access to wellhead to authorized personnel only. 5. Communicate with facility personnel and local authorities to initiate evacuation plans, as necessary. 6. Monitor well pressure, temperature, and annulus pressure to verify well status and determine the cause and extent of any failure; identify and implement appropriate remedial actions (in consultation with the UIC Program Director). 7. Determine if leaks to ground water or surface water occurred. 8. If USDW contamination is detected: a. Notify the UIC Program Director within 24 hours of the determination. b. Contact environmental and geotechnical professionals for expertise and advice. 9. Review seismic and operational data. 10. Assess monitoring plans and where necessary intensify the monitoring plan to ensure containment. 11. Report findings to the UIC Program Director and issue corrective actions.

<sup>1</sup> Specified magnitudes refer to magnitudes determined by local Southern California Earthquake Data Center or USGS seismic monitoring stations or reported by the USGS National Earthquake Information Center using the national seismic network.

<sup>2</sup> “Felt report” and “local observation and report” refer to events confirmed by local reports of felt ground motion or reported on the USGS “Did You Feel It?” reporting system.

<sup>3</sup> Reporting findings to the UIC Program Director and issuing corrective action will occur within 25 business days (five weeks) of change in operating state.

Operating State	Threshold Condition <sup>1,2</sup>	Response Action <sup>3</sup>
<b>Red</b>	Seismic event greater than M2.0, and local observation or report, and local report and confirmation of damage <sup>4</sup>	<ol style="list-style-type: none"> <li>1. Initiate shutdown plan.</li> <li>2. Vent CO<sub>2</sub> from surface facilities.</li> <li>3. Within 24 hours of the incident, notify the UIC Program Director of the operating status of the well.</li> <li>4. Limit access to wellhead to authorized personnel only.</li> <li>5. Communicate with facility personnel and local authorities to initiate evacuation plans, as necessary.</li> <li>6. Monitor well pressure, temperature, and annulus pressure to verify well status and determine the cause and extent of any failure; identify and implement appropriate remedial actions (in consultation with the UIC Program Director).</li> <li>7. Determine if leaks to ground water or surface water occurred.</li> <li>8. If USDW contamination is detected:               <ol style="list-style-type: none"> <li>a. Notify the UIC Program Director within 24 hours of the determination.</li> <li>b. Contact environmental and geotechnical professionals for expertise and advice.</li> </ol> </li> <li>9. Review seismic and operational data.</li> <li>10. Report findings to the UIC Program Director and issue corrective actions.</li> </ol>
	Seismic event >M3.5	

**Response personnel:** Emergency response personnel, California Geological Survey, drilling crew, geotechnical professionals, and environmental or water treatment professionals.

**Equipment:** Depending on the operating state drill rig, logging equipment, cement or casing and air and water testing equipment.

### **Response Personnel and Equipment**

Site personnel, project personnel, and local authorities will be relied upon to implement this ERRP.

Site personnel to be notified (not listed in order of notification):

1. Project Manager

Ken Haney (661- 763-6101)

2. Field Manager

David Hauptman (661-858-3864)

3. Environmental Manager

Brian Pellens (661-321-6240)

4. Security and Emergency Response Director

Bill Blair (562-743-8336)

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<sup>4</sup> Onset of damage is defined as cosmetic damage to structures, such as bricks dislodged from chimneys and parapet walls, broken windows, and fallen objects from walls, shelves, and cabinets.

## 5. Public and Media Liaison

Joe Ashley (661-301-6551)

A site-specific emergency contact list will be developed and maintained during the life of the project. CTV will provide the current site-specific emergency contact list to the UIC Program Director.

**Table 3. Contact information for key local, state, and other authorities.**

<b>Agency</b>	<b>Phone Number</b>
Local police	9-1-1 (Emergency) 661-861-3110 (Non-emergency)
California Governor's Office of Emergency Services (Cal OES)	(916) 845-8506
UIC Program Director (CalGEM)	661-322-4031
EPA National Response Center (24 hours)	800-424-8802
California Geological Survey	(916) 322-1080
Kern County Fire Department	9-1-1 (Emergency) 661-324-6551 (Non-emergency)
California Air Resources Board (CARB)	800-242-4450

Equipment needed in the event of an emergency and remedial response will vary, depending on the triggering emergency event. Response actions (cessation of injection, well shut-in, and evacuation) will generally not require specialized equipment to implement. Where specialized equipment (such as a drilling rig or logging equipment) is required, CTV shall be responsible for its procurement.

### **Emergency Communications Plan**

CTV will communicate to the public about any event that requires an emergency response to ensure that the public understands what happened and whether or not there are any environmental or safety implications. The amount of information, timing, and communications method(s) will be appropriate to the event, its severity, whether any impacts to drinking water or other environmental resources occurred, any impacts to the surrounding community, and their awareness of the event.

CTV will describe what happened, any impacts to the environment or other local resources, how the event was investigated, what responses were taken, and the status of the response. For responses that occur over the long-term (e.g., ongoing cleanups), CTV will provide periodic updates on the progress of the response action(s).

CTV will also communicate with entities who may need to be informed about or take action in response to the event, including local water systems, CO<sub>2</sub> source(s) and pipeline operators, landowners, and Regional Response Teams (as part of the National Response Team).

## **Plan Review**

This ERRP shall be reviewed:

- At least once every five (5) years following its approval by the permitting agency;
- Within one (1) year of an area of review (AOR) re-evaluation;
- Within three months following any significant changes to the injection process or the injection facility, or an emergency event; or
- As required by the permitting agency.

If the review indicates that no amendments to the ERRP are necessary, CTV will provide the permitting agency with the documentation supporting the “no amendment necessary” determination.

If the review indicates that amendments to the ERRP are necessary, amendments shall be made and submitted to the permitting agency within three months following an event that initiates the ERRP review procedure.

## **Staff Training and Exercise Procedures**

All CTV staff and contractors operating at the CO<sub>2</sub> sequestration facilities, or working in the AoR will be subjected to the following training either prior to deployment in the field or annually:

### **CO<sub>2</sub> Facilities Training**

Onsite and classroom training for facility and infrastructure security, maintenance, and operations.

### **CO<sub>2</sub> Safety Training**

**Carbon dioxide detection equipment:** Operation and maintenance of personal monitors, portable multi-gas monitors and stationary monitors throughout the facility.

**Carbon Dioxide Hazards:** Accidental exposure, adverse health effects, workplace exposure limits and first aid.

**Emergency Response:** Training in the event of CO<sub>2</sub> leakage and exercises and drills simulating potential emergency situations.