APPLICATION NARRATIVE

40 CFR 146.82

AAC 400-8-1-.15(2)

PINE HILLS ALABAMA REGIONAL CO_2 STORAGE HUB

Prepared for

Reliant Southwest Alabama Storage, LLC

By

Advanced Resources International, Inc

February 2026

REVISION HISTORY

Document Version	Description	Dated
v1	Original submission	July 2025
v2	Claimed as PBI [redacted]	February 2026

FACILITY INFORMATION

Facility Name: Pine Hills Sequestration Hub (PHSH)

Facility Operator: Reliant Southwest Alabama Storage, LLC (Reliant)

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[redacted]

TABLE OF CONTENTS

LIST OF FIGURES

Claimed as PBI

Claimed as PBI [redacted]

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

°F	degrees Fahrenheit
1stdev	One standard deviation
2D	two-dimensional
3D	three-dimensional
40 CFR	Title 40 of the Code of Federal Regulations
AAC	Alabama Administrative Code
AoI	Area of Interest
AoR	Area of Review
API	American Petroleum Institute
Ar	Argon
ARI	Advanced Resources International, Incorporated
ASTM	American Society for Testing and Monitoring
BEG	Bureau of Economic Geology
BGL	Below Ground Level
BTC	Buttress Thread Coupled
Ca	Calcium
CAA	Clean Air Act
CALI	Caliper
CCS	Carbon Capture and Storage
CH_4	Methane
Cl	Chlorine
CO	Carbon monoxide
CO_2	Carbon dioxide
Cr	Chromium
cuft	cubic foot
CWA	Clean Water Act
dec	decimal
dtc	compressional sonic
dZ	thickness
EPA	(United States) Environmental Protection Agency
ERRP	Emergency and Remedial Response Plan
FA	Financial Assurance
Fm(s)	Formation(s)
ft	feet
ftMSL	feet below Mean Sea Level
g	Acceleration due to gravity
gAPI	gamma ray American Petroleum Institute units
GCCC	Gulf Coast Carbon Center
GIS	Geographic Information System
Gp	Group
gpm	gallons per minute
GR	Gamma Ray
g/cc	grams per cubic centimeter

H_2	Hydrogen
H_2O	Water
H_2S	hydrogen sulfide
HCl	Hydrochloric acid
HCO_3	Bicarbonate
ID	Inner Diameter
in	inches
IDUSGS	United States Geological Survey fluid sample IDentification number
k	permeability
lb	pounds
Claimed as PBI [redacted]	[redacted]
mD	milliDarcy
MD	Measured Depth
Mg	Magnesium
mg/l	milligrams per liter
Claimed as PBI [redacted]	[redacted]
MMSCF	Million Standard Cubic Feet
Mmt	Million metric tons
Mmtpa	Million metric tons per annum
mol%	mole percent
µs/ft	microsecond per foot
mt	metric tons
n.d.	no date
Na	Sodium
NOx	Nitrogen oxides
NPDES	National Pollution Discharge Elimination System
NPHI_LST	Neutron Porosity in a Limestone Matrix
N_2	Nitrogen
ohm.m	ohm-meter
O_2	Oxygen
OD	Outer Diameter
PBR	Packer Bore Receptacle
PEF	Photoelectric Factor
PGA	Peak Ground Acceleration
pH	potential of Hydrogen
PIA	Post-Injection Activities
phie	effective porosity
phit	total porosity
PHSH	Pine Hill Sequestration Hub
PISC	Post-Injection Site Care
por	porosity
ppf	pound per foot
ppg	pounds per gallon
ppm	parts per million

PSD	Prevention of Significant Deterioration program
psi	pound per square inch
PWDB	Produced Waters DataBase
RCRA	Resource Conservation and Recovery Act
R^2	Coefficient of determination
Reliant	Reliant Carbon Capture and Storage, LLC
resd	deep resistivity
resm	medium resistivity
ress	shallow resistivity
RHOB	Bulk Density
SEM	Static Earth Model
SG	Specific Gravity
sk	sack
SO_4	Sulfate
SP	Spontaneous Potential
TD	Total Depth
TDS	Total Dissolved Solids
Claimed as PBI [redacted]	[redacted]
[redacted]	[redacted]
UIC	Underground Injection Control
USDW(s)	Underground Source(s) of Drinking Water
USGS	United States Geological Survey
Vshale	shale Volume
WSP	Workers Safety Plan
Z	Depth

1. APPLICATION NARRATIVE

1.1. PROJECT BACKGROUND AND CONTACT INFORMATION

Project Background

Claimed as PBI [redacted]

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Reliant and its subsurface consultants, Advanced Resources International, Inc. (ARI), have conducted a thorough assessment of the regional and local geology, well infrastructure, injection site design, and overall project planning to support a UIC Class VI application. Legacy oil and gas well data, Underground Source of Drinking Water (USDW) data, and other publicly available data informed the development of computational models to determine the project's AoR and project designs.

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1.1.1. Partners and Collaborators

Claimed as PBI [redacted]

[redacted]

The State of Alabama Oil and Gas Board

Claimed as PBI [redacted]

1.1.2. Project Timeframe

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The post-injection timeframe was selected based on computational modeling results. Additional details on the post-injection timeframe are available in the **Area of Review and Corrective Action Plan** and the **Post-Injection Site Care and Site Closure Plan**.

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1.1.3. Proposed Injection Mass and CO_2 Source

Given the size of the property and the projected CO_2 injectivity of the underlying geology, Reliant's goal is to make the PHSH a regional CCS hub capable of storing CO_2 emissions from multiple sources in Alabama and the surrounding states. Claimed as PBI [redacted]

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1.1.4. Injection Depth Waiver and Aquifer Exemption

No depth waiver or aquifer exemption is requested for the project since the proposed injection interval is more than 3,000 ft deeper than the deepest USDW in the area, and the reservoir fluid in the proposed injection interval is highly saline, with total dissolved solids (TDS) greater than 110,000 milligrams per liter (mg/l).

1.1.5. Applicable Permit Information

Table 1-2 provides information on activities conducted by Reliant that require permits under the Resource Conservation and Recovery Act (RCRA), UIC, the National Pollution Discharge Elimination System (NPDES) under the Clean Water Act (CWA), or the Prevention of Significant Deterioration (PSD) program under the Clean Air Act.

Table 1-2. Permit Information Required under 40 CFR 144.31(e)(1).

Regulation	Jurisdiction	Activity	Relevant Permits
Resource Conservation and Recovery Act	State	None	None anticipated
Underground Injection Control Program	Federal – U.S. Environmental Protection Agency – Region IV	Carbon dioxide injection well drilling and operation	Class VI Injection Well Permits
National Pollutant Discharge Elimination System – Clean Water Act	State	None	None anticipated
Prevention of Significant Deterioration – Clean Air Act	State	None	None anticipated

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1.1.5.3. Applicable SIC Codes

Per Title 40 of the Code of Federal Regulations (40 CFR) 144.31(e)(3), applicable SIC codes are listed below:

4610 – Pipelines, No Natural Gas.

1.1.5.4. Other permit information required under 40 CFR 144.31(e)(6)

The permits and authorizations under 40 CFR 144.31(e)(6) that will likely be required for the wells at PHSH, the permit/authorization jurisdictions, and the associated project development activities are provided in **Table 1-3** through

Table 1-5 below.

Table 1-3. Permits and authorizations required for development.

Permit/Authorization	Jurisdiction	Activity
Underground Injection Control Class VI Injection Well Permit to Construct	Federal – U.S. Environmental Protection Agency	Drilling of Injection Wells
Underground Injection Control Class VI Injection Well Authorization to Inject	Federal – U.S. Environmental Protection Agency	Injection of carbon dioxide
Permit for Geologic Storage of Carbon Dioxide	State - Oil and Gas Board of Alabama	Drilling of Wells and Approval of Storage Facility
Greenhouse Gas Rule Subpart RR Monitoring, Reporting, and Verification Plan Approval	Federal	Injecting carbon dioxide
National Pollutant Discharge Elimination System – Clean Water Act	State	Management of Stormwater During Construction
[redacted]	[redacted]	Claimed as PBI [redacted]

Table 1-4. Applicable permits as noted in 40 CFR 144.31(e)(6).

Permit	Jurisdiction	Activity

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Table 1-5. Applicable permits and construction approvals as noted in 40 CFR 144.31(e)(6).

Permit	Jurisdiction	Relevant Permits
Hazardous Waste Management Program under RCRA	Federal, state	None anticipated
United States Environmental Protection Agency (EPA) Underground Injection Control Program under SWDA	Federal	Class VI Injection Well Permits from EPA Region IV
National Pollution Discharge Elimination System (NPDES) under the Clean Water Act	State	NPDES Permit No. ALR100000
Prevention of Significant Deterioration Program under Clean Air Act (CAA)	State	Alabama Department of Environmental Management (ADEM) Permit #: 335-3-14-.04
Nonattainment Program under CAA	State	None anticipated
Dredge and Fill Permits under Section 404 of the Clean Water Act	Federal	None anticipated
Other permits	Federal, state, county, city	Building permits from county and city-level offices, Endangered Species Act Section 7 and Section 10 review, National Historic Preservation Act Section 106 review

1.1.5.5. Contact information for Applicable State, Tribe, and Territories within the Project AoR

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<u>Tribe or Territory in AoR</u>

Tribe: Not Applicable
Territory: Not Applicable

1.2. SITE CHARACTERIZATION

1.2.1. Regional Geology

40 CFR 146.82(a)(3)(vi) and Alabama Administrative Code (AAC) 400-8-1-.15(2d(ii(n)))

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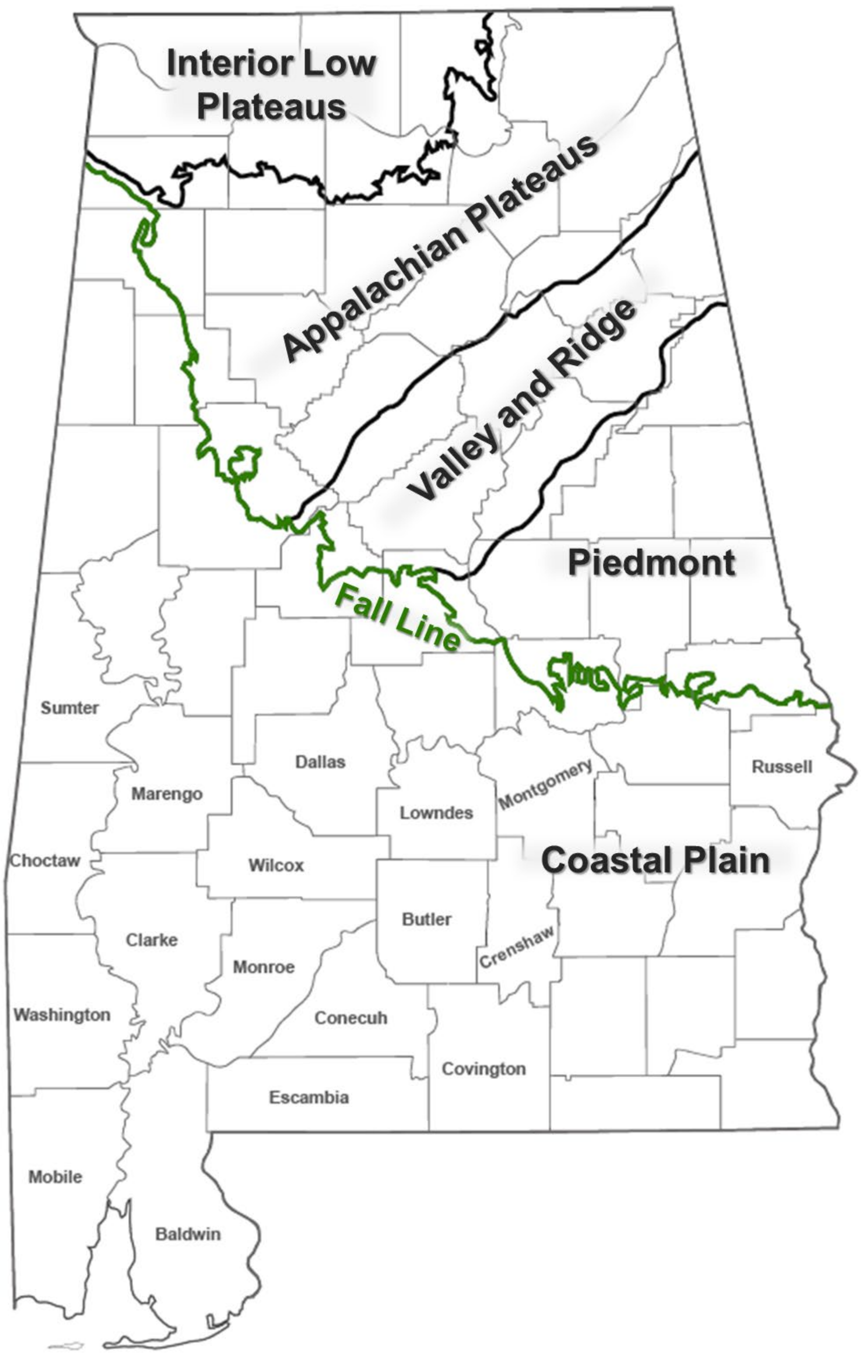

Figure 1-3. Physiographic provinces of Alabama with relationship to Covington County, showing the extent of Coastal Plain sediments. Modified from Raymond et al., 1988. Named counties are referenced in this Project Narrative.

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1.2.1.1.1 Early Triassic - Jurassic

The record of Alabama Coastal Plain sedimentation begins with the deposition of several thousand ft of sediments ranging in age from Late Triassic to Early Cretaceous that are deeply buried and not exposed at the surface (**Figure 1-7**).

The earliest known Coastal Plain sediments are of the Late Triassic Eagle Mills Formation (Fm), which were deposited as fine and coarse siliciclastic red beds in grabens on the rifted margin of the developing Gulf of America basin (Raymond et al., 1988). The Eagle Mills red beds are mainly silty to sandy calcareous mudstone, red cross-bedded sandstone, and thin zones of conglomerate deposited in continental oxidizing environments. Assumed Triassic sediments in southeast Alabama are mostly red beds of arkosic sandstone and mudstone and are associated with mafic igneous rocks of basaltic or diabasic composition (Raymond et al., 1988). Early sedimentation patterns in the Triassic and Jurassic were strongly controlled by topographic prominences in the area (Raymond et al., 1988).

Arid conditions persisted in part throughout most of Jurassic time, and evaporite minerals are common in Middle Jurassic rocks and Upper Jurassic rocks. The deposition of formations of Jurassic age was confined to embayments in southwest Alabama. Red beds in eastern Alabama that overlie the probable Triassic beds may be of Jurassic age, but lithologic units suitable for palaeontologic determinations have not been located (Raymond et al., 1988).

Massive beds of salt (Louann Salt) of undetermined thickness were deposited above the Werner. In the Late Jurassic, as overlying sediments began to accumulate, salt flow affected the deposition of Upper Jurassic and later sediments. Above the Louann is a sandstone (Norphlet Fm), which in updip areas of Choctaw, Clarke, and Monroe Counties (**Figure 1-3**) is mainly fluvial and includes beds of shale and conglomerate. Downdip the Norphlet sandstones are quartz-rich (Denkman Sandstone Member) and consist of gray and brown very fine- to medium-grained sub-arkose sandstones deposited mainly as dune and interdune sediments with wadi and playa lake sediments in interdune areas (Raymond et al., 1988).

Following the deposition of the Norphlet, the Gulf Basin deepened and widened, and more open marine conditions prevailed. Carbonate rocks were deposited in the central parts of the embayments, and mixed carbonates and evaporites were deposited in restricted shallow water areas and along the margins of the embayments (Smackover and Haynesville Fms) (Raymond et al., 1988).

In the later stages of the Jurassic, land masses to the north of the Gulf basin were uplifted, and large volumes of mostly red clastics--Cotton Valley Group (Gp)--were spread southward by an extensive prograding delta. Cotton Valley sediments are widespread in southwest Alabama and extend further north than the underlying Smackover and Norphlet. The mostly red Cotton Valley fine and coarse clastics were deposited in paralic environments that reflect terrestrial, marginal marine, and shallow sea conditions. Deposition of the fine and coarse clastics continued into the Early Cretaceous. The updip limit of the Cotton Valley is indistinct. The group thickens rapidly to the south to 2,000 to 3,000 ft in thickness in the coastal counties (Raymond et al., 1988).

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1.2.1.1.5 Eocene

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1.2.2. Maps and Cross Sections of the AoR

40 CFR 146.82(a)(2), 146.82(a)(3)(i) and AAC 400-8-1-.15(2d(ii))

Structural maps, isochore maps, property maps, and cross-sections showing structure and property distribution are provided and discussed in **Section 1.2.4. Injection and Confining Zone Details**.

Cross-sections illustrating the hydrogeology are shown and discussed in **Section 1.2.7. Hydrology**.

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1.2.5. Geomechanical and Petrophysical Information

40 CFR 146.82(a)(3)(iv) and AAC 400-8-1-.15(2d(ii(l)))

There are only a few well penetrations in the immediate area of the PHSH site. There is a lack of geomechanical and petrophysical log data. Data acquired before injection, throughout the drilling and construction of the PHSH project wells, as described in the **Pre-Operational Testing Plan**, will address any data gaps. This data will generate a better understanding of the site-specific geomechanical and petrophysical rock properties.

Site-specific properties of the storage complex, such as bulk density, porosity, permeability, Young's modulus, Poisson's ratio, and failure strength, will be used to determine:

- Fracture and parting pressure of the sequestration zone and primary confining layer, and their corresponding fracture gradients.
- Rock compressibility for the sequestration zone and primary confining layer.
- Rock strength and the ductility of the primary confining layer.
- *In-situ* fluid pressures within the primary confining layer.

For additional information on the data to be collected before injection, please refer to the **Pre-Operational Testing Plan**.

1.2.6. Seismic History

40 CFR 146.82(a)(3)(v) and AAC 400-8-1-.15(2d(ii(m)))

Data sources used for characterizing the seismic history of the storage site are the Geological Survey of Alabama Geospatial Hazards Data page[1] and the historical records of the United States Geological Survey (USGS)[2].

Southern Alabama is nearly aseismic (Gomberg & Wolf, 1999) and has a low chance of slightly damaging natural earthquake shaking in 100 years (Petersen, et al., 2024) (**Figure 1-41**). The Peak Ground Acceleration (PGA) that has a 2% chance of being exceeded in 50 years falls in the 4-6% of the acceleration due to gravity (g) range (United States Geological Survey, 2014) (**Figure 1-42).** Such ground motion only causes some broken dishes and windows and unstable objects to be overturned, and will not pose a threat to CO_2 containment.

[1] https://gsa.state.al.us/gsa/geologic/hazards/earthquakes/alquakes

[2] https://www.usgs.gov/programs/earthquake-hazards/earthquakes

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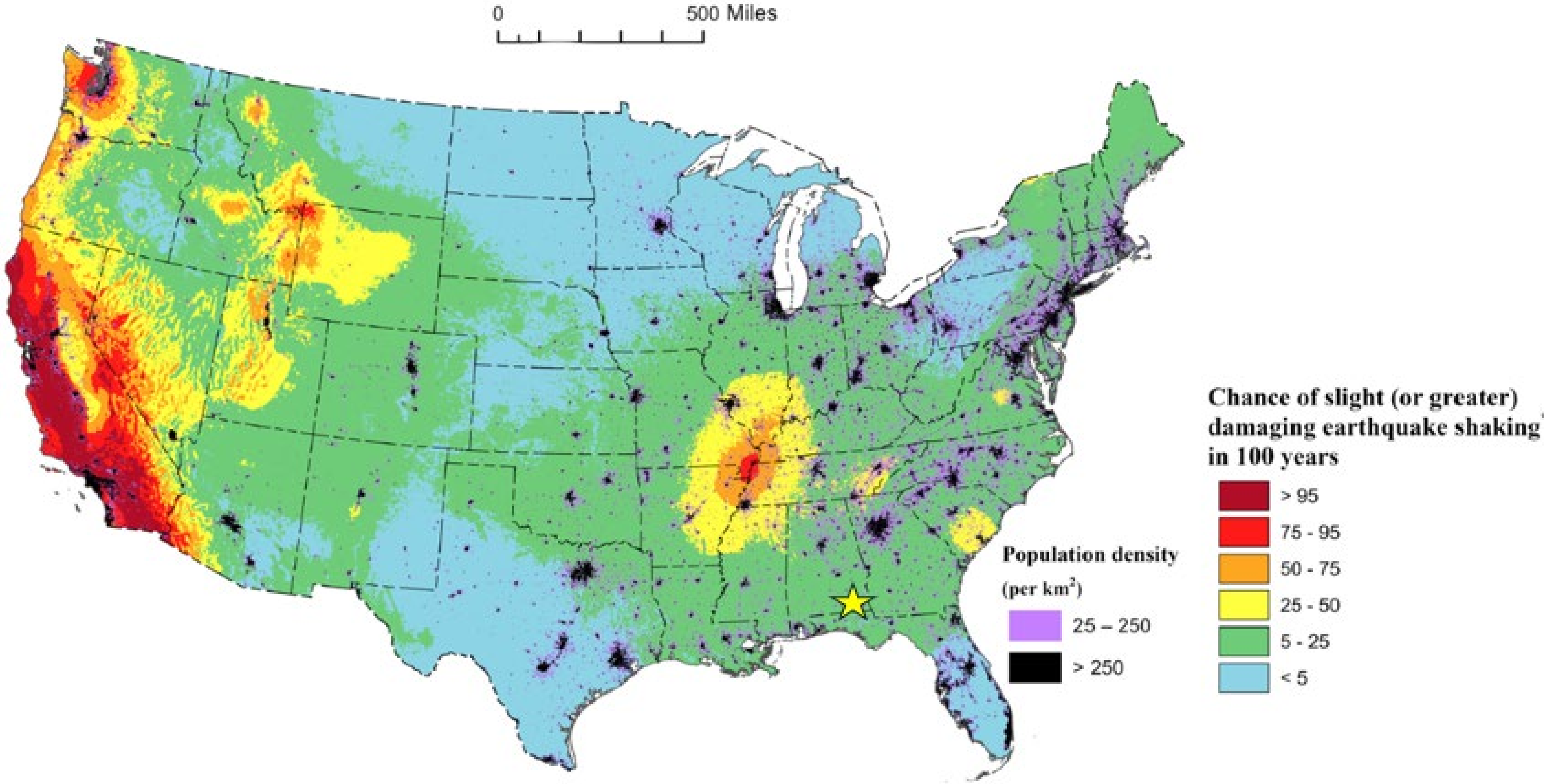

Figure 1-41. Seismic hazard map of the United States of America. The map shows the chance of any level of damaging earthquake shaking in 100 years (Petersen, et al., 2024).* Equivalent to Modified Mercalli Intensity VI, identified as: "Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Slight damage." The yellow star indicates the location of the project site.

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1.2.8. Geochemistry

40 CFR 146.82(a)(6) and AAC 400-8-1-.15(2d(iii(g)))

1.2.8.1. Fluid Phase Geochemistry

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Additional fluid-phase geochemical data will be collected as part of the **Pre-Operational Testing Plan** to bridge the gap in site-specific data. Fluid samples will be collected from the storage zone reservoirs and hydrogeologic units. The fluid-phase geochemical data indicate that the storage reservoirs are saturated with saline brines and that the reservoirs are likely elevated above 110,000 parts per million (ppm) TDS. The fluid-phase geochemical data do not suggest that any adverse reactions will occur, and that the storage reservoir pore fluids are compatible with the CO_2 injectate.

1.2.8.2. Solid Phase Geochemistry

The storage reservoirs are primarily composed of quartz, which is stable when exposed to CO_2 and has low reactivity under the conditions created by CO_2 dissolution in brine (Rochelle et al., 2004). The mineralogy data indicate that the storage reservoirs are likely compatible with the CO_2 injectate.

Additional mineralogical and geochemical data for the storage zone reservoirs will be acquired through wireline logging, coring, and fluid sampling, as discussed in the **Pre-Operational Testing Plan**.

1.2.9. Site Suitability

40 CFR 146.83 and AAC 400-8-1-15

Claimed as PBI [redacted]

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1.3. AOR AND CORRECTIVE ACTION PLAN

40 CFR 146.82(a)(13), 146.84 and AAC 400-8-1-.15(2)(a) – (2)(e), (2)(l), 400-8-1-.22, 400-8-1-.26(15), 400-8-1-.23

The information and files submitted in the **AoR and Corrective Action Plan** satisfy the requirements of 40 CFR 146.84(b). This plan addresses the details of computational modeling to delineate AoR, corrective action in the AoR, and triggers for AoR re-evaluation. The AoR is delineated from the calculated threshold pressure buildup extent at which injection-zone fluids would displace fluid initially present in a hypothetical open borehole and establish hydraulic equilibrium with the USDW under hydrostatic conditions. Claimed as PBI [redacted] Computer Modeling Group's General Equation of State Model, widely known as GEM, was used as the simulator. A multi-component and multi-phase fluid flow process was employed to assess the development of the CO_2 plume, the pressure front, and the long-term fate of the injection.

Claimed as PBI [redacted] threshold pressure was calculated using the equilibrium approach described by Nicot et al., consistent with U.S. EPA guidance and based on site-specific data. Updating reservoir architecture and petrophysical properties as necessary upon importing geophysical logs from drilled project wells. Details of the computational modelling, assumptions that are made, and the site characterization data that the model is based on satisfy the requirements of 40 CFR 146.84(c).

Claimed as PBI [redacted]

Within the AoR, there are no federal tribal lands, U.S. EPA cleanup sites, springs, or quarries present (**Figure 1-56).** Basement faults from the Geological Survey of Alabama are shown for just Alabama (Geological Survey of Alabama. (n.d.), as the mapping of them does not continue into Florida. No basement fault maps of Florida exist in the public domain.

The basement faults do not extend through the storage complex. This will be confirmed with seismic data.

Figure 1-57 shows the same features as **Figure 1-56,** but legacy oil and gas wells, as well as water wells in the AoR, are labeled with a Unique ID (01 through 1886), which corresponds to the Unique ID columns in the spreadsheets for the **Tabulation of Wells**, allowing for their identification on the map.

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1.4. FINANCIAL ASSURANCE DEMONSTRATION

40 CFR 146.82(a)(14), 146.85, and AAC 400-8-1-.15(2)(m), 400-8-1-.26(16), 400-8-1-.29

Claimed as PBI [redacted]

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1.5. INJECTION WELL CONSTRUCTION PLAN SUMMARY

40 CFR 146.82(a)(9), (a)(11), (a)(12), 146.86 and AAC 400-8-1-.15(2)(d)(vii), (2)(k), 400-8-1-.26(9), 400-8-1-.30

Reliant seeks to drill and construct 36 Class VI CO_2 injection wells to support CO_2 storage operations and has designed its well construction plan under 40 CFR §146.82, 40CFR §146.86, and AAC 400-8-1-.15(2)(d)(vii), (2)(k), 400-8-1-.26(9), 400-8-1-.30. Reliant has implemented well design strategies and materials focused on:

1. Preventing movement of fluids into or between USDWs or into any authorized zones.
2. Permitting the use of appropriate testing devices and workover tools.
3. Permit continuous monitoring of the annulus space between the tubing and long string casing.

Any necessary changes to the **Injection Well Construction Plan** due to logistical or geological conditions encountered within the field will be communicated to the Director prior to well construction.

Claimed as PBI [redacted]

Each type well was designed to accommodate the strictest design criteria across the expected injection wells. For instance:

- The greatest construction stresses are encountered in the deepest well. The depth of the deepest well was used for casing design.
- The maximum allowable surface pressure is determined by 90% of the fracture pressure at the top perforation. The shallowest well was used to determine this pressure limit.

The injection wells will be drilled in nested well locations with an injection well for each zone drilled on the same pad. The type wells' names, target injection intervals, and target injection rates are summarized in **Section 4.3 Nodal Analysis and Operational Injection Pressure** of the **Injection Well Construction Plan.**

1.5.1. Proposed Stimulation Program

After perforation of all injection wells, an acid wash will take place. This will be done with 10- to 15-percent hydrochloric acid (HCl) and fresh water. This will be done at low pressures and will not endanger the confining zone or create a leakage pathway while improving the injectivity of the near-wellbore and allowing for the injection of CO_2 to take place at lower startup pressures. No other stimulation is proposed.

1.5.2. Construction Procedures

The PHSH well design and construction procedures were based on offset well history records acquired from the AOGB. The well histories were analyzed for potential drilling hazards and common practices for the area.

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1.5.3. Casing and Cementing

According to 40 CFR 146.86(b)(1)/AAC 400-8-1-.30(1), the metallurgy for each casing string was selected to be compatible with the fluids and stresses anticipated, along with meeting and/or exceeding American Petroleum Institute (API), American Society for Testing and Materials (ASTM), or equivalent standards. All borehole diameters are considered conventional sizes for the casing sizes selected and will allow for ample clearance between the outside of the casing and the borehole wall to ensure that a continuous cement seal can be emplaced along the entire length of the casing string.

Each casing string will be cemented to the surface in one or more stages. Please refer to **Table 1-12** for a summary of the cement types, cement additives, quantities, and staging depths for each casing string. Per 40 CFR 146.86(b)(3)/AAC 400-8-1-.30(2), a sufficient number of centralizers will be utilized on all casing strings in the open hole to ensure cement can surround the casing along the entirety of the pipe; the cement service providers will complete centralizer placement modeling to ensure at least a 70% standoff minimum. Except for the conductor casing, a guide or float shoe, and a float collar will be run on the top and bottom of the bottom joint of the casing to ensure the casing is set and cemented properly.

Once casing is set and cemented, wireline logging tools will be utilized to inspect cement integrity to ensure a proper seal; please refer to the **Pre-Operational Testing Plan** for detailed information on the testing activities to be performed throughout well construction. Please refer to the following subsections for the specific properties and placement of each casing string. All casing sizes referenced in the text throughout the following casing subsections refer to outer diameter (OD) measurements.

1.5.3.1. Conductor Casing

The conductor casing will be installed before mobilization of the drilling rig. It will be installed to +/-150 ft and pressure grouted in place. The casing will be comprised of standard 0.375-in wall SPC line pipe and welded at the joints. Due to the minimal loads and the fact that this installation follows industry standard practices, no additional details on the conductor pipe are provided.

1.5.3.2. Surface Casing

The surface casing will be installed to the top of the Selma group (approximately 2,400 ft) following the drilling and logging of the surface hole. Its purpose is to isolate the wellbore from shallow drilling hazards such as reactive clays (locally known as gumbo) and protect the lowermost USDW from contamination. The casing installed will be at a minimum of 13 3/8-in 61 ppf J55 BTC and will be cemented from installation depth to surface in a single stage. Details on the cement program are provided in **Section 4.5. Injection Well**

Cementing Program of the **Injection Well Construction Plan**. Additional details on the surface casing strength and material are provided in **Table 1-11**. The surface casing will be cemented in place using a single cement stage to surface with a conventional 14.5 ppg Class C neat cement to isolate the lowermost USDW.

1.5.3.3. Long String Casing

Claimed as PBI [redacted]

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[redacted]

Claimed as PBI [redacted]

1.5.3.4. Tubing and Packer

Claimed as PBI [redacted]

The selected packer for the PHSH injection well packer is a Baker Hughes Advantage Series HS hydraulic set packer or equivalent. The packer will be set at a measured depth of approximately 50 ft above the end of the tubing. The packer setting depths for the PHSH type wells are listed in **Table 1-14.** The packer will be connected to a Shear Release Packer Bore Receptacle (PBR) for easy workover operations. Both the packer and locator seal assembly will feature premium couplings matched to the tubing and will be comprised of 22Cr80 or Inconel alloy to be compatible with expected reservoir fluids. Please refer to **Table 1-14** for additional information on the packer selected for PHSH injection wells.

Claimed as PBI

[redacted]

1.6. PRE-OPERATIONAL TESTING PLAN

40 CFR 146.82(a)(8), 146.87 and AAC 400-8-1.15(2)(d)(vi), 400-8-1-.32

The **Pre-Operational Testing Plan** describes how Reliant will characterize each CO_2 injection well and all relevant geologic formations at the PHSH site prior to injection operations under 40 CFR 146.87 and AAC 400-8-1-.32. Pre-injection testing will produce datasets that will be used to confirm proper well construction and determine/verify, the depth, thickness, porosity, permeability, mineralogy, geomechanical, and geochemical profiles of formations of interest. The **Pre-Operational Testing Plan** is organized into two sections: (1) **Pre-Operational Formation Testing Program** and (2) **Baseline Testing and Monitoring Plan**.

The **Pre-Operational Formation Testing Program**, required by 40 CFR 146.82(a)(8) and AAC 400-8-1-.15(2)(vi), describes the activities that will be performed in PHSH injection wells during drilling, construction, and completion operations to comply with the injection well construction requirements under 40 CFR 146.86 and AAC 400-8-1-.30 and the pre-operational testing requirements under 40 CFR 146.87 and AAC 400-8-1-.32. Claimed as PBI [redacted] The **Pre-Operational Formation Testing Program** includes:

- Deviation checks (40 CFR 146.87(a)(1) and AAC 400-8-1-.32(1)(a));
- Open- and cased-hole well logging (40 CFR 146.87(a)(2), (a)(3) and AAC 400-8-1-.32(1)(b) and (1)(c));
- Mechanical integrity testing (40 CFR 146.87(a)(4) and AAC 400-8-1-.32(1)(d));
- Rock coring (40 CFR 146.87(b) and AAC 400-8-1-.32(2));
- Fluid sampling (40 CFR 146.87(b), (c), (d)(3) and AAC 400-8-1-.32(2), (3), and (4)(c));
- Formation and fracture pressure testing (40 CFR 146.87(c), (d) and AAC 400-8-1-.32(3) and (4)); and
- Hydrogeologic testing (40 CFR 146.87(e) and AAC 400-8-1-.32(5)).

The **Baseline Testing and Monitoring Plan** describes the activities to be performed in the CO_2 injection wells, monitoring wells, and on the surface of the PHSH site prior to injection operations according to 40 CFR 146.82, 146.87, 146.90, and AAC 400-8-1-.15, 400-8-1-.32, and 400-8-1-.34. Testing and monitoring prior to injection operations will provide baseline profiles of parameters that will be used to inform subsequent injection and post-injection phase testing and monitoring activities. Baseline testing and monitoring will include:

- Mechanical integrity testing;
- CO_2 stream analysis;
- Corrosion monitoring;
- Pressure fall-off testing;
- Groundwater quality and geochemical monitoring;
- Geophysical imaging and characterization; and
- Pressure monitoring.

Reliant will provide the U.S. EPA Region 4 UIC Program Director and the state of Alabama Oil and Gas Board (AOGB) Supervisor with the opportunity to witness all injection well logging and testing, along with a schedule of the activities, 30 days before commencing the first test. The UIC Program Director will be promptly notified of any updates to the testing and logging schedule upon further project development. The results of proposed testing activities discussed throughout the **Pre-Operational Testing Plan** will be summarized in a report and submitted to the UIC Program Director and AOGB Supervisor. Refer to the **Pre-Operational Testing Plan** for detailed information on logging, sampling, and baseline testing and monitoring activities to be performed before injection operations.

1.7. INJECTION WELL OPERATIONS PLAN SUMMARY

40 CFR 146.82(a)(7), 146.88 and AAC 400-8-1-.15(2)(iv), (2)(v), 400-8-1-.30, 400-8-1-.33

Reliant prepared the PHSH **Injection Well Operations Plan** to describe the planned operation of the CO_2 injection wells for PHSH. The summary provided here provides key data related to the injection well operations.

1.7.1. Operational Procedures

The PHSH injection wells will be constructed as described in the **Injection Well Construction Plan** and will [redacted] Injection will be facilitated through a tubing set in the long string casing and a packer set above perforations in the respective injection zones. Please refer to **Table 1-15** and **Sections 6.3.1. Injection Rates** and **6.3.2. Injection Pressures** of the PHSH **Injection Well Operations Plan** for a summary of PHSH's proposed operating conditions under 40 CFR 146.82(a)(10) and AAC 400-8-1-.15(2)(d)(viii).

[redacted]

1.7.2. Proposed Carbon Dioxide Stream

Claimed as PBI [redacted]

Claimed as PBI [redacted]

1.8. TESTING AND MONITORING PLAN

40 CFR 146.82(a)(15), 146.90 and AAC 400-8-1-.15(2)(n), 400-8-1-.26(7), 400-8-1-.34

The **Testing and Monitoring Plan** describes how Reliant will monitor the PHSH site under 40 CFR 146.90 and AAC 400-8-1-.34, for the duration of the project's injection phase of 23 years. The **Testing and Monitoring Plan** has been designed to evaluate project performance, verify compliance with permitted conditions, detect risks and demonstrate USDW non-endangerment and, if in the unlikely event of loss of containment from the storage complex, allow for early detection of out-of-zone CO_2 and/or storage reservoir fluids prior to them reaching overlying USDWs. Additionally, testing and monitoring related data will be used to support AoR reevaluations in accordance with 40 CFR 146.84(e). The **Testing and Monitoring Plan** includes:

- CO_2 stream analysis (40 CFR 146.90(a) and AAC 400-8-1-.34(1)(a));
- Continuous monitoring of operational injection and annulus parameters (40 CFR 146.90(b) and AAC 400-8-1-.34(1)(b));
- Corrosion monitoring (40 CFR 146.90(c), AAC 400-8-1-.34(1)(c), and AAC 400-8-1-.41);
- Groundwater quality and geochemical monitoring above the confining zone (40 CFR 146.90(d) and AAC 400-8-1-.34(1)(d));
- Mechanical integrity testing (40 CFR 146.90(e) and AAC 400-8-1-.34(1)(e));
- Pressure fall-off testing (40 CFR 146.90(f) and AAC 400-8-1-.34(1)(f)); and
- CO_2 plume and pressure front tracking (40 CFR 146.90(g) and AAC 400-8-1-.34(1)(g)).

Claimed as PBI [redacted]

[redacted]

[redacted]

Claimed as PBI [redacted]

[redacted] All amended plans will be sent to the U.S. EPA Region 4 UIC Program Director and to the AOGB Supervisor for approval as outlined in the permit modification requirements under 40 CFR 144.39, 144.41, 146.90(j) and AAC 400-8-1-.37, 400-8-1-.38, and 400-8-1-.34(1)(j). Results of the activities described throughout the **Testing and Monitoring Plan** may trigger action according to the **Emergency and Remedial Response Plan and Workers Safety Plan** (ERRP & WSP). For detailed information on PHSH's testing and monitoring strategy, including the activities, locations, and frequencies of activities, refer to the **Testing and Monitoring Plan**.

1.9. INJECTION WELL PLUGGING PLAN

40 CFR 146.82(a)(16), 146.92 and AAC 400-8-1-.15(2)(o), 400-8-1-.26(10), 400-8-1-.36

Reliant will conduct injection well plugging and abandonment for PHSH according to the procedures outlined in the **Injection Well Plugging Plan.** This includes demonstrating mechanical integrity before plugging operations to ensure no pathway has been established between the injection zone and the underground sources of drinking water (USDWs) or the ground surface, according to 40 CFR 146.82(a)(16)/AAC 400-8-1-.15(2)(o) and 40 CFR 146.92(b)/AAC 400-8-1-.36. This will be accomplished with approved methods of external mechanical integrity tests, such as oxygen activation logging or temperature measurements.

The Injection Well Plugging plan provides specific details on well plugging procedures, plugged intervals, and casing to be left in the hole.

1.10. POST-INJECTION SITE CARE AND SITE CLOSURE PLAN

40 CFR 146.82(a)(17), 146.93 and AAC 400-8-1-.15(2)(p), 400-8-1-.26(17), 400-8-1-.54, 400-8-1-.55, 400-8-1-.56

The **Post-Injection Site Care** (PISC) **and Site Closure** (SC) **Plan** describes the modeling, testing and monitoring, and site closure activities to be performed to meet the requirements of 40 CFR 146.93 and AAC 400-8-1-.54, 400-8-1-.55, and 400-8-1-.56. The purpose of the plan is to demonstrate CO_2 plume and pressure front stability, along with non-endangerment of USDWs throughout the post-injection phase up to site closure of the PHSH. Additionally, the plan provides a general overview of the steps that Reliant will take to close the Class VI geologic storage site properly. The **Post-Injection Site Care and Site Closure Plan** covers:

- Pre- and post-injection pressure differential (40 CFR 146.93(a)(2)(i) and AAC 400-8-1-.54(1)(a));
- Predicted position of the free-phase CO_2 plume and associated pressure front (40 CFR 146.93(a)(2)(ii) and AAC 400-8-1-.54(1)(b));
- Post-injection testing and monitoring plan (40 CFR 146.93(a)(2)(iii), (a)(2)(iv), and (b), and AAC 400-8-1-.54(1)(c), (1)(d), (6) and (7));
- USDW non-endangerment demonstration (40 CFR 146.93(b), AAC 400-8-1-.54 and 400-8-1-.55); and
- Site closure plan (40 CFR 146.93(d) through (h) and AAC 400-8-1-.54).

Claimed as PBI [redacted]

In addition to modeling exercises, various post-injection testing and monitoring activities will be performed to track the position of the CO_2 plume and pressure front and to ensure there is no endangerment of USDWs. Post-injection phase testing and monitoring includes: (1) external mechanical integrity testing, (2) groundwater quality and geochemical monitoring, and (3) CO_2 plume and pressure front tracking. External mechanical integrity testing in each remaining CO_2 injection well throughout the PISC phase will verify the absence of fluid leakage through channels adjacent to the wellbore or long string casing that may endanger USDWs. Claimed as PBI [redacted] will demonstrate USDW non-endangerment and allow for early detection of any out-of-zone fluids in the unlikely event there is loss of containment. Lastly, monitoring of the CO_2 plume and pressure front will verify that the injectate and associated pressure front are migrating throughout the storage complex as predicted and are not endangering USDWs.

Once CO_2 plume stabilization and USDW non-endangerment are demonstrated, the U.S. EPA Region 4 UIC Program Director will be provided with a notice of intent for site closure. Additionally, in compliance with AAC 400-8-1-.55, Reliant will petition the AOGB for approval of the closure of PHSH. Once the UIC Program Director authorizes site closure, all remaining project wells used for monitoring will be plugged according to 40 CFR 146.92, 146.93(e), and AAC 400-8-1-.36 and 400-8-1-.54, the project site will be restored to a condition agreed upon with the UIC Program Director, and a site closure report, required by 40 CFR 146.93(f) and AAC 400-8-1-.55, will be submitted along with any other required documentation. Refer to the **Post-Injection Site Care and Site Closure Plan** for additional information on PISC-related modeling, testing and monitoring, and a generalized overview of the site closure procedures.

1.11. EMERGENCY AND REMEDIAL RESPONSE PLAN AND WORKERS' SAFETY PLAN

40 CFR 146.94(a) and AAC 400-8-1-.40

The ERRP & WSP detail actions that Reliant shall take to address an unexpected movement of the injection fluid or formation fluid that may endanger an USDW during the construction, operation, or post-injection site care periods, under 40 CFR 146.94 and AAC 400-8-1-.40.

Examples of potential risks include: (1) injection or monitoring well integrity failure, (2) injection well monitoring equipment failure, (3) natural disaster, (4) fluid leakage into a USDW, (5) CO_2 leakage to USDW or land surface, or (6) an induced seismic event. In the case of one of the listed risks, site personnel, project personnel, and local authorities will be relied upon to implement this ERRP & WSP.

If Reliant obtains evidence that the injected CO_2 stream and associated pressure front may cause an endangerment to a USDW, the environment, or the public, Reliant will:

- Immediately cease injection.
    - In some circumstances, Reliant will, in consultation with the UIC Program Director, determine whether gradual injection cessation is more appropriate.
- Take all steps necessary to identify and characterize any CO_2 release.
- Notify the UIC Program Director within 24 hours.
- Implement applicable portions of the approved ERRP & WSP.

Reliant will communicate to the public about any event that requires an emergency response to ensure that the public understands what happened and whether there are any environmental or safety implications. This will include a detailed description of the event, any impacts on the environment or other local resources, how the event was investigated, what actions were taken, and the remediation status.

The ERRP & WSP will be reviewed at least once every five years following its approval, within one year of an AoR reevaluation, within the timeframe indicated by the Region IV UIC Program Director following any significant changes to the injection process or the injection facility, or an emergency event, or as required by the permitting agency.

Periodic training will be provided to well operators, plant safety and environmental personnel, the plant manager, the plant superintendent, and corporate communications staff to ensure that the personnel have been trained and possess the required skills to perform their relevant emergency response activities described in the ERRP & WSP.

1.12. REFERENCES

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