

US EPA ARCHIVE DOCUMENT



Geologic Sequestration of Carbon Dioxide

Draft Underground Injection Control (UIC) Program Class VI Primacy Application and Implementation Manual for State Directors

June 2011

Office of Water (4606M)
EPA 816-D-11-001
June 2011
<http://water.epa.gov/drink>

Disclaimer

The Class VI injection well classification was established by the *Federal Requirements under the Underground Injection Control Program for Carbon Dioxide Geologic Sequestration Wells* (75 FR 77230, December 10, 2010). No previous guidance exists for this class of injection wells.

The Safe Drinking Water Act (SDWA) provisions and EPA regulations cited in this document contain legally-binding requirements. In several chapters this guidance document makes suggestions and offers alternatives that go beyond the minimum requirements indicated by the rule. This is done to provide information and suggestions that may be helpful for implementation efforts. Such suggestions are prefaced by “may” or “should” and are to be considered advisory. They are not required elements of the rule. Therefore, this document does not substitute for those provisions or regulations, nor is it a regulation itself, so it does not impose legally-binding requirements on EPA, states, or the regulated community. It may not apply to a particular situation based upon the circumstances.

EPA and state decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. Any decisions regarding a particular facility will be made based on the applicable statutes and regulations. Mention of trade names or commercial products does not constitute endorsement or recommendation for use. EPA is taking an adaptive rulemaking approach to regulating Class VI injection wells. The Agency will continue to evaluate ongoing research and demonstration projects and gather other relevant information as needed to refine the rule. Consequently, this guidance may change in the future without public notice.

While EPA has made every effort to ensure the accuracy of the discussion in this document, the obligations of the regulated community are determined by statutes, regulations or other legally binding requirements. In the event of a conflict between the discussion in this document and any statute or regulation, this document would not be controlling.

Note that this document only addresses issues covered by EPA’s authorities under SDWA. Other EPA authorities, such as Clean Air Act (CAA) requirements to report carbon dioxide injection activities under the Greenhouse Gas Mandatory Reporting Rule (GHG MRR) are not within the scope of this manual.

Executive Summary

The U.S. Environmental Protection Agency (EPA) *Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide Geological Sequestration Wells* found at 75 FR 77230, December 10, 2010, and codified in the U.S. Code of Federal Regulations [40 CFR 146.81 et seq.], are known as the UIC Class VI Rule or the Geologic Sequestration (GS) Rule. The UIC GS Rule establishes a new class of injection wells (Class VI) and sets minimum federal technical criteria for Class VI injection wells for the purposes of protecting underground sources of drinking water (USDWs). This manual is intended to be used in conjunction with a series of technical guidance documents that EPA is developing to support owners and operators of Class VI injection wells and the UIC Program permitting authorities.

The Safe Drinking Water Act (SDWA, 42 U.S.C. §300h et al.) authorizes EPA to review and approve UIC program applications for the delegation of primary enforcement responsibility (primacy) for the UIC Program. This *Draft UIC Program Class VI Primacy Application and Implementation Manual* outlines and describes the requirements for interested states, tribes, and territories to develop a UIC Class VI Program and submit a primacy application to EPA for approval under SDWA Section 1422. The manual also highlights several considerations a UIC Program Director may face when implementing an approved program. This document contains the following sections:

- Section 1 provides background on the federal UIC Program and summarizes the requirements of the GS Rule.
- Section 2 provides guidance to states, tribes, and territories on applying for UIC Class VI Program primacy.
 - *Independent Primacy.* Under the UIC GS Rule, states have the option to seek primacy for Class VI injection wells independent of other UIC injection well classes under SDWA Section 1422. Section 2 differentiates between the requirements for submitting:
 - 1) A New UIC Program application for states that currently do not have an existing UIC Program, or states that have primacy under SDWA Section 1425 only (e.g., the Class II injection well program); and
 - 2) A UIC Program Revision application to add the new UIC Class VI requirements to an existing state UIC Program operating under Section 1422 of SDWA.
 - *Regulatory Development.* Section 2 also discusses some considerations while drafting state, tribal, or territorial regulations governing Class VI injection wells that will be evaluated as part of the EPA primacy application review and approval process, including determinations on the stringency and equivalency of state and federal regulations.

- Section 3 provides information and considerations that UIC Program Directors may employ in evaluating proposed Class VI injection well permit applications and with implementing the UIC Class VI GS Rule.
 - *Permit Application Information.* Section 3 provides information for the UIC Program Director to use in evaluating Class VI permit applications. This includes information that the Program Director may receive from owners or operators with their permit applications, including the five (5) required project plans, and approaches to interpreting and evaluating this information and/or data, areas of Program Director discretion, and suggestions for when the Director may request additional information.
 - *Additional Considerations.* Section 3 also describes other program implementation topics such as Class VI permitting, the required re-permitting of existing Class I, II, or V injection wells as Class VI; environmental justice (EJ) considerations; public involvement and outreach associated with GS projects; and interstate communication and coordination efforts.

The appendices to this manual include a crosswalk for comparing federal and state Class VI requirements, sample letters and notifications as examples of primacy application elements, hypothetical primacy and permitting scenarios, and a recommended checklist for organizing the submitted Class VI injection well permit application information during an evaluation.

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Acronyms and Abbreviations

AoR	Area of Review
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
CAA	Clean Air Act
CBI	Confidential Business Information
CCS	Carbon Capture and Storage
CD	Compact Disc
CFR	Code of Federal Regulations
DOE	Department of Energy
DI	Direct Implementation
E&RR	Emergency and Remedial Response
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
ER	Enhanced Recovery
FR	Federal Register
GIS	Geographic Information System
GPD	Gallons per day
GS	Geologic Sequestration
GS DMS	Geologic Sequestration Data Management System
IGCC	Integrated Gasification Combined Cycle
m	Meter
mg/L	Milligram per Liter
MIT	Mechanical Integrity Test
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPRSA	Marine Protection, Research, and Sanctuaries Act
MRR	Mandatory Reporting Rule
NAICS	North American Industry Classification System
NOI	Notice of Intent
OAR	Office of Air and Radiation (EPA)
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OECA	Office of Enforcement and Compliance Assurance (EPA)
OGC	Office of General Council (EPA)
OW	Office of Water (EPA)
PDF	Portable Document Format
PFC	Perfluorocarbon
PISC	Post-Injection Site Care
ppm	Parts per million
ppmv	Parts per million by volume
PWS	Public Water System
PWSS	Public Water System Supervision Program (under SDWA)
RA	Regional Administrator (EPA)
SC	Specific Conductivity
SIC	Standard Industrial Classification

SDWA	Safe Drinking Water Act
TDS	Total Dissolved Solids
UIC	Underground Injection Control
USDW	Underground Source(s) of Drinking Water
USGS	United States Geological Survey

Definitions

Administrator: The Administrator of the United States Environmental Protection Agency, or an authorized representative.¹

Area of Review (AoR): The region surrounding the geologic sequestration project where USDWs may be endangered by the injection activity. The area of review is delineated using computational modeling that accounts for the physical and chemical properties of all phases of the injected carbon dioxide stream and displaced fluids, and is based on available site characterization, monitoring, and operational data as set forth in 40 CFR 146.84.²

Carbon dioxide plume: The extent underground, in three dimensions, of an injected carbon dioxide stream.²

Carbon dioxide stream: Carbon dioxide that has been captured from an emission source (e.g., a power plant), plus incidental associated substances derived from the source materials and the capture process, and any substances added to the stream to enable or improve the injection process. This does not apply to any carbon dioxide stream that meets the definition of a hazardous waste under 40 CFR 261.²

Class I well: A technologically sophisticated well that injects wastes into deep, isolated rock formations below the lowermost underground source of drinking water (USDW). Class I wells may inject hazardous waste, non-hazardous industrial waste, or municipal wastewater.⁴

Class II well: A well that injects brines and other fluids associated with oil and gas production, or storage of hydrocarbons. Class II well types include salt water disposal wells, enhanced recovery wells, and hydrocarbon storage wells.⁴

Class III well: A well that injects fluids associated with solution mining of minerals. Mining practices that use Class III wells include salt solution mining, in-situ leaching of uranium, and sulfur mining using the Frasch process.⁴

Class IV well: A well that injects hazardous or radioactive wastes into or above an underground source of drinking water (USDW). These wells are banned unless authorized under a federal or state ground water remediation project.⁴

Class V well: A well designed and constructed for injection, but not included in the definitions of Class I, II, III, IV or VI wells. Class V wells inject non-hazardous fluids into or above a USDW and are typically shallow, on-site disposal systems; however, this class also includes some deeper injection operations. There are approximately 20 subtypes of Class V wells.⁴

¹ Source: 40 CFR 144.3.

² Source: 40 CFR 146.81(d).

³ Source: 40 CFR 144.6(f) and 144.80(d).

⁴ Source: EPA's UIC website (<http://water.epa.gov/type/groundwater/uic/glossary.cfm>).

⁵ This definition was drafted for the purposes of this document.

⁶ Source: GS Rule Preamble (75 FR 77230).

Class VI wells: Wells that are not experimental in nature that are used for geologic sequestration of carbon dioxide beneath the lowermost formation containing a USDW; or, wells used for geologic sequestration of carbon dioxide that have been granted a waiver of the injection depth requirements pursuant to requirements at 40 CFR 146.95; or, wells used for geologic sequestration of carbon dioxide that have received an expansion to the areal extent of an existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption pursuant to 40 CFR 146.4 and 144.7(d).³

Confining zone: A geologic formation, group of formations, or part of a formation stratigraphically overlying the injection zone(s) that acts as barrier to fluid movement. For Class VI wells operating under an injection depth waiver, confining zone means a geologic formation, group of formations, or part of a formation stratigraphically overlying and underlying the injection zone(s).²

Corrective action: The use of UIC Program Director-approved methods to ensure that wells within the area of review do not serve as conduits for the movement of fluids into underground sources of drinking water (USDW).²

Enhanced Oil or Gas Recovery (EOR/EGR): For purposes of this manual, EOR/EGR means the process of injecting a fluid (e.g., water, brine, or carbon dioxide) into an oil or gas bearing formation to recover residual oil or natural gas. The injected fluid thins (decreases the viscosity) and/or displaces extractable oil and gas, which is then available for recovery. This is also used for secondary or tertiary recovery.⁶

Fluid: Any material or substance which flows or moves whether in a semisolid, liquid, sludge, gas or other form or state, and includes the injection of liquids, gases, and semisolids (i.e., slurries) into the subsurface.¹

Geologic sequestration (GS): The long-term containment of a gaseous, liquid, or supercritical carbon dioxide stream in subsurface geologic formations. This term does not apply to carbon dioxide capture or transport.²

Geologic sequestration project: An injection well or wells used to emplace a carbon dioxide stream beneath the lowermost formation containing a USDW; or, wells used for geologic sequestration of carbon dioxide that have been granted a waiver of the injection depth requirements pursuant to requirements at 40 CFR 146.95; or, wells used for geologic sequestration of carbon dioxide that have received an expansion to the areal extent of an existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption pursuant to 40 CFR 146.4 and 144.7(d). It includes the subsurface three-dimensional extent of the carbon dioxide

¹ Source: 40 CFR 144.3.

² Source: 40 CFR 146.81(d).

³ Source: 40 CFR 144.6(f) and 144.80(f).

⁴ Source: EPA's UIC website (<http://water.epa.gov/type/groundwater/uic/glossary.cfm>).

⁵ This definition was drafted for the purposes of this document.

⁶ Source: GS Rule Preamble (75 FR 77230).

plume, associated area of elevated pressure, and displaced fluids, as well as the surface area above that delineated region.²

Injection depth waiver: There are provisions at 40 CFR 146.95 that allow Class VI injection well owners or operators to seek a waiver from the injection depth requirements for GS in order to allow for carbon dioxide injection into non-USDW formations while ensuring that USDWs are protected from endangerment.⁵

Injection interval: The portion of the injection zone into which the injection well is screened, perforated, or otherwise allows for movement of injectate into the injection zone.⁵

Injection zone: A geologic formation, group of formations, or part of a formation that is of sufficient areal extent, thickness, porosity, and permeability to receive carbon dioxide through a well or wells associated with a geologic sequestration project.²

Mechanical integrity testing (MIT): A test performed on an injection well to confirm that it is maintaining internal and external mechanical integrity. MITs are a means of measuring the adequacy of the construction of an injection well and a way to detect problems within the well system.⁵

Multiphase flow: Flow in which two or more distinct physical phases of matter are present (e.g., liquid, gas, supercritical fluid).⁵

Multiphase flow parameters: Model parameters that describe the rate of fluid flow and fluid saturation for multiple immiscible fluids within a porous medium.⁵

Phased corrective action: There is a provision of the UIC GS Rule at 40 CFR 146.84(b)(2)(iv) afforded to Class VI injection well owners or operators to defer some identified corrective action activities within the delineated area of review (AoR), but farther away from the injection well, but farther away from the injection well, until after injection has commenced, but prior to carbon dioxide plume and pressure front movement into that particular area.⁵

Post-injection site care: The appropriate monitoring and other actions (including corrective action) needed following cessation of injection to ensure that USDWs are not endangered, as required by the Class VI regulations under 40 CFR 146.93.⁵

Pressure front: The zone of elevated pressure that is created by the injection of carbon dioxide into the subsurface. The pressure front of a carbon dioxide plume refers to a zone where there is a pressure differential sufficient to cause the movement of injected fluids or formation fluids into a USDW.²

Primacy (primary enforcement responsibility): The authority to implement the UIC Program. To receive primacy, a state, territory, or tribe must demonstrate to EPA that its UIC program is *at least as stringent* as the federal standards; the state, territory, or tribal UIC requirements may be more stringent than the federal requirements. (For Class II, states must demonstrate that their

programs *are effective* in preventing underground injection that endangers USDWs.) EPA may grant primacy for all or part of the UIC program, e.g., for certain classes of injection wells.⁴

Site closure: The specific point or time, as determined by the UIC Program Director following the requirements under 40 CFR 146.93, at which the owner or operator of a geologic sequestration site (Class VI injection well) is released from post-injection site care responsibilities.²

Transmissive fault or fracture: A fault or fracture that has sufficient permeability and vertical extent to allow fluids to move between formations.²

Underground Injection Control Program: The program that EPA, or an approved state, is authorized to implement under the Safe Drinking Water Act (SDWA) that is responsible for regulating the underground injection of fluids. This includes setting the minimum federal requirements for construction, operation, permitting, and closure of underground injection wells.⁵

UIC Program Director: The person responsible for permitting, implementation, and compliance of the UIC program. For UIC programs administered by EPA, the Director is the EPA Regional Administrator or his/her delegate; for UIC programs in Primacy States, the Director is the person responsible for permitting, implementation, and compliance of the state, territorial, or tribal UIC program.⁶

Underground Source of Drinking Water (USDW): An aquifer or portion of an aquifer which supplies any public water system or which contains a sufficient quantity of ground water to supply a public water system, and currently supplies drinking water for human consumption, or contains fewer than 10,000 mg/l total dissolved solids and is not an exempted aquifer.¹

¹ Source: 40 CFR 144.3.

² Source: 40 CFR 146.81(d).

³ Source: 40 CFR 144.6(f) and 144.80(f).

⁴ Source: EPA's UIC website (<http://water.epa.gov/type/groundwater/uic/glossary.cfm>).

⁵ This definition was drafted for the purposes of this document.

⁶ Source: GS Rule Preamble (75 FR 77230).

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Section 1

Introduction

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1.0 Introduction

This manual describes the recommended approaches for attaining primary enforcement responsibility (primacy) for the Underground Injection Control (UIC) Class VI Program and provides direction to UIC Program Directors in implementing the *Federal Requirements Under the Underground Injection Control Program for Carbon Dioxide Geological Sequestration Wells* [75 FR 77230, December 10, 2010] otherwise known as the UIC Class VI or GS Rule. The Class VI Rule was promulgated under the authority of the Safe Drinking Water Act (SDWA). The Rule outlines the federal requirements for a new class of injection wells, Class VI. SDWA (42 U.S.C. §300h et al.) authorizes the U.S. Environmental Protection Agency (EPA) to review and approve state UIC program applications for the delegation of primacy [SDWA Section 1422(b)(2) and 40 CFR 145.31(d)].

Throughout this document, the terms “state” and “states” are used to refer to every type of primacy entity that may implement the UIC Program, including states, U.S. territories, Indian tribes, and EPA Regional offices administering direct implementation (DI) programs. The term UIC Program Director refers to either: 1) the state Director or his/her authorized designee as identified in the state primacy submission; or, 2) the EPA Regional Administrator or his/her authorized designee responsible for directly implementing a UIC Program in a state, territory, or tribal area without primacy (DI program).

This manual is intended to provide procedural support to UIC Program Directors with:

1. Preparing the required UIC primacy application materials to submit to EPA for approval.
2. Evaluating Class VI permit applications and analyzing the technical data submitted by owners or operators of Class VI injection wells in order to determine the potential impacts to underground sources of drinking water (USDWs).

Section 2 describes the requirements for states without an existing UIC program (or with a Class II program only under SDWA Section 1425) when developing a New UIC Program application for Class VI primacy under SDWA Section 1422(a)(1)(A). This Section also describes the requirements for states with existing programs under SDWA Section 1422 when developing a UIC Program Revision application for Class VI primacy under SDWA Section 1422(b)(1)(B).

Section 3 provides a discussion of EPA recommended approaches for UIC Program Directors to consider when evaluating permit application materials submitted for review and approval. Specifically, this Section discusses each requirement of the Class VI GS Rule, clarifies the information that EPA anticipates the UIC Program Director will receive from proposed Class VI well owners or operators, and provides approaches to interpreting and evaluating this information and data, deciding on areas of discretion, and requesting additional information from owners or operators. This Section is not an exhaustive explanation of the technical attributes of Class VI wells, Class VI requirements, or of the unique situations that the UIC Program Director may encounter. Rather, references are made to various EPA technical guidance documents that will further support the UIC Program Director and contain more specific guidance on these topics. These documents are currently available, or will be in the future, on EPA’s website at <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm>.

The appendices of this manual provide additional tools for receiving approval for and maintaining a Class VI UIC Program; including suggested primacy application and Class VI permit application checklists, regulatory comparison crosswalk, and sample letters and primacy application materials. Additionally, within Appendix H, example scenarios pertaining to hypothetical Class VI wells are presented to illustrate key points and topics. The scenarios are intended to illustrate situations that a UIC Program Director may encounter during the permitting, implementation, and program evaluation processes. EPA acknowledges that these hypothetical scenarios do not represent all possible situations that will be encountered due to the variability of site-specific circumstances. Users of this manual that have suggestions for improving the scenarios, or on anything else related to its content, are encouraged to provide comments to the EPA Office of Ground Water and Drinking Water (refer to Appendix J for contact information).

1.1 UIC Program Background

Underground injection wells (including those in state territorial waters) are regulated by EPA's UIC Program under the authority of Part C of SDWA and through EPA's regulations found in 40 CFR Part 144 *et seq.* SDWA aims to protect the quality of drinking water in the United States, and all the surface and ground water sources of drinking water. SDWA Part C specifically mandates the regulation of underground injection of fluids through wells in order to protect USDWs.

EPA defines a fluid under the UIC Program as any material or substance which flows or moves, whether in a semisolid, liquid, sludge, gas or other form or state, and includes the injection of liquids, gases, and semisolids (i.e., slurries) into the subsurface [40 CFR 144.3]. Some examples of fluids currently injected into wells include: carbon dioxide for the purposes of enhancing recovery of oil and natural gas; water that is stored underground to meet water supply demands in dry seasons; or wastes generated by industrial users and injected deep into the subsurface as a means of disposal. USDWs are defined as underground aquifers with less than 10,000 milligrams per liter (mg/L) of total dissolved solids (TDS) and that supplies a public water system (PWS) or contains a sufficient quantity of ground water to supply a PWS [40 CFR 144.3].

Key components of SDWA Part C include:

- SDWA 1421 requires EPA to propose and promulgate regulations specifying the minimum requirements for state programs to prevent underground injection that endangers drinking water sources.
- SDWA Section 1422 provides that states may apply to EPA for primary enforcement responsibility (primacy) to administer the UIC Program and authorizes EPA to approve state programs and grant primacy. To be granted primacy under SDWA Section 1422, a state must, among other things, adopt UIC regulations that are at least as stringent as the federal requirements, as codified in 40 CFR Parts 144, 145 and 146, or adopt federal UIC requirements by reference. A state program can always be more stringent than the federal requirements.
- SDWA Section 1425 authorizes EPA to approve state programs for Class II injection wells (i.e., oil and gas wells). States seeking primacy under Section 1425 must

demonstrate that their Class II program is an effective program to prevent underground injection that endangers USDWs.

EPA is required, by statute under SDWA Section 1422(c) and by regulation, to prescribe and directly implement a UIC program for states that do not seek primacy or that fail to demonstrate meeting federal UIC requirements. Currently, EPA administers UIC DI programs in 10 states (in addition to two U.S. territories and the District of Columbia) for injection well Classes I, II, III, and V. For states that do not seek primacy for the Class VI Program, or that do not receive EPA approval for primacy, EPA will administer a Class VI Program on their behalf.

1.1.1 Applying for Primacy

During the primacy approval process, EPA will review and evaluate the proposed state program, which includes state regulations that are submitted with each primacy application. EPA will evaluate a state's UIC Program submission based on the stringency and equivalency of a state's regulations in order to determine whether the state may be granted primacy for the Class VI Program [SDWA Section 1422(b)(1)(A)(i)].

Under the GS Rule, EPA allows states to apply for UIC primacy for Class VI wells independently of other well classes under SDWA Section 1422 [40 CFR 145.1(i)]. Previously, EPA has not accepted primacy applications from states for individual well classes under SDWA Section 1422. However, EPA believes that allowing independent primacy for Class VI injection wells may encourage states to obtain primacy for Class VI wells and, in turn, develop a more comprehensive approach to managing GS projects and carbon capture and storage (CCS) issues which are outside the scope of SDWA.

1.2 Elements of the UIC Class VI Geologic Sequestration Rule

The UIC GS Rule defines a new class of well, Class VI, to be used for the injection of carbon dioxide for the purposes of GS [40 CFR 146.5(f)]. The GS Rule, published on December 10, 2010 [75 FR 77230], sets forth federal requirements for the permitting, siting, construction, operation, monitoring, and closure of Class VI injection wells, including those re-permitted as Class VI wells from other injection well classes [40 CFR 146.82 *et seq.*]. The Class VI requirements ensure the protection of USDWs, recognizing that an improperly managed GS project has the potential to endanger USDWs.

Requirements for Class VI injection wells, as described in 40 CFR 146 Subpart H, include the following:

- **The Class VI permit information** requirement establishes the information that owners or operators must submit to the UIC Program Director in order to obtain a permit for a Class VI well and subsequent approval for operation of that well [40 CFR 146.82].
- **The minimum criteria for siting** establishes that Class VI injection wells must be located in areas with a suitable geologic system, including: 1) the presence of an injection zone of sufficient areal extent, thickness, porosity, and permeability to receive the total anticipated volume of the carbon dioxide stream; and, 2) the presence

of confining zones free of transmissive faults or fractures and of sufficient areal extent and integrity to contain the injected carbon dioxide stream and displaced formation fluids and allow injection without initiating or propagating fractures [40 CFR 146.83].

- **The area of review (AoR) and corrective action** requirements provides that computational modeling must be used to delineate the AoR for proposed Class VI injection wells, and requires the preparation of and compliance with an AoR and Corrective Action Plan for delineating the AoR, performing all necessary corrective action, and periodically reevaluating the delineation and amending the Plan. The AoR determination is integral to assessing geologic site suitability because it requires the delineation of the expected extent of the carbon dioxide plume and associated pressure front and identification and evaluation of any penetrations that could result in the endangerment of USDWs [40 CFR 146.84].
- **The financial responsibility** requirements establish that owners or operators must demonstrate and maintain financial responsibility (FR) for performing corrective action on improperly abandoned wells located within the delineated AoR, injection well plugging, post-injection site care (PISC) and site closure activities, and emergency and remedial response (E&RR). This ensures that owners or operators have the resources to remediate GS sites through the site closure phase, such that USDWs are not endangered [40 CFR 146.85].
- **The injection well construction** requirements specify the design and construction of Class VI injection wells using materials that are compatible with the carbon dioxide stream over the life of the GS project to prevent movement of fluids into USDWs. The construction of Class VI injection wells must permit the use of appropriate testing and monitoring devices as well as continuous monitoring of the space between the injection tubing and long-string casing [40 CFR 146.86].
- **The logging, sampling, and testing prior to injection well operation** requirements outline activities that must be performed before the permitted injection of carbon dioxide commences. During the drilling and construction of a permitted Class VI injection well, the owner or operator must run appropriate logs, surveys, and tests to determine or verify the depth, thickness, porosity, permeability, and lithology of, as well as the salinity of any formation fluids in, all relevant geologic formations [40 CFR 146.87].
- **The injection well operating requirements** provide operational measures for Class VI wells which ensure that the injection of carbon dioxide does not endanger USDWs, as well as limitations on injection pressure and requirements for automatic shut-off devices [40 CFR 146.88].
- **The mechanical integrity** requirements build on an existing component of the UIC Program designed to ensure USDW protection. Routine mechanical integrity tests (MITs) enable owners or operators to ensure that Class VI injection well integrity is maintained throughout the life of the GS project. The UIC GS Rule requires

continuous monitoring to demonstrate internal mechanical integrity and annual external MITs [40 CFR 146.89].

- **The testing and monitoring** requirements define the elements that must be included in the required Testing and Monitoring Plan submitted with Class VI permit application and implemented throughout operation of the injection well. The Testing and Monitoring Plan must describe planned injectate monitoring, corrosion monitoring, pressure fall-off testing, ground water quality monitoring, MITs, carbon dioxide plume and pressure front tracking, and, at the UIC Program Director's discretion, surface air and/or soil gas monitoring [40 CFR 146.90].
- **The reporting requirements** establish the periodic timeframes and circumstances for the reporting of Class VI injection well testing, monitoring, and operating results. Permit application information and required reports must be submitted electronically to EPA at the specified times [40 CFR 146.91].
- **The injection well plugging** requirements specify that a Class VI injection well in the AoR must be properly plugged at the end of its operational lifetime to ensure that the Class VI well does not become a conduit for fluid movement into USDWs in the future. An Injection Well Plugging Plan must be submitted with the Class VI permit application (and updated as needed following cessation of injection), and a well plugging report must be submitted no later than 60 days following the plugging of a well [40 CFR 146.92].
- **The post-injection site care (PISC) and site closure** requirements address activities that occur following the plugging of Class VI wells. The owner or operator must continue to conduct monitoring for 50 years following the cessation of injection. For approval to conduct monitoring under an alternative timeframe, if allowed by the UIC Program Director, it must be demonstrated that the site no longer poses a risk to USDWs. Once the UIC Program Director approves site closure, the owner or operator is required to properly terminate injection operations. PISC and site closure must proceed according to the approved PISC and Site Closure Plan submitted with the Class VI operating permit application [40 CFR 146.93].
- **The emergency and remedial response (E&RR)** requirements specify that owners or operators of Class VI injection wells must develop and maintain an approved E&RR Plan. The Plan must describe the actions to be taken to address events that may cause endangerment to a USDW or other resources during the lifecycle of a Class VI injection well. Owners or operators must also periodically review and, if necessary, amend the Plan to incorporate changes that occur throughout the lifespan of the Class VI injection well [40 CFR 146.94].
- **The Class VI injection depth waiver** requirements provide Class VI injection well owners or operators the process under which to seek a waiver from the injection depth requirements for Class VI wells, while continuing to ensure that USDWs are protected. Additional information is required to inform a comprehensive assessment of the site-suitability for a Class VI well to inject carbon dioxide into non-USDWs that are located above or between USDW formations. These requirements are

designed to ensure that the owner or operator and the UIC Program Director consider, on a site-specific basis, the implications, benefits, and challenges associated with GS when applying for, or evaluating, an injection depth waiver for a Class VI injection well. States applying for primacy may choose whether to allow the use of injection depth waivers when drafting their state UIC Class VI regulations [40 CFR 146.95].

For specific, detailed information on a topic referenced in this subsection, refer to the GS Rule and Preamble in the *Federal Register* [75 FR 77230, December 10, 2010] and the accompanying series of technical guidance documents for Class VI wells available on EPA's website at: <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm>.

1.3 Additional Considerations for the Geologic Sequestration Rule

During Class VI regulation and program development, the UIC Program Director will need to consider additional factors, including: the re-permitting of existing Class I, II, or V wells used for GS as Class VI wells now that the regulations are final; other federal and state rulemakings and initiatives that are related to the Class VI Rule; interstate communication and coordination; environmental justice; and public involvement.

1.3.1 Other Related Federal Rulemakings on Geologic Sequestration

Sub-seabed carbon dioxide injection for GS may, in certain circumstances, be defined as ocean dumping and subject to regulation under the Marine Protection, Research, and Sanctuaries Act (MPRSA). Application of the MPRSA would entail coordination of the permitting processes under SDWA and MPRSA, pursuant to MPRSA Sections 106(a) and (d). The substantive environmental protection requirements of both statutes would need to be satisfied prior to the commencement of GS. The MPRSA was enacted in 1972 and implements the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the "London Convention"). In 1996, the Protocol to the London Convention (the "London Protocol") was established. The Protocol stipulates that sub-seabed GS may be approved provided that: 1) disposal is into a sub-seabed geologic formation; 2) the carbon dioxide stream consists overwhelmingly of carbon dioxide, with only incidental associated substances derived from the source material and capture and sequestration process used; and, 3) no wastes or other matter are added for the purpose of disposal. The United States has signed, but has not yet ratified, the Protocol. If the Protocol is ratified, and implementing legislation is enacted, EPA, in conjunction with other federal agencies, will develop any necessary regulations for implementing the provisions relevant to sub-seabed GS.

The Bureau of Ocean Energy Management, Regulation, and Enforcement, formerly the Minerals Management Service, an agency within the Department of the Interior, administers the Outer Continental Shelf Lands Act (OCSLA). As a result of recent OCSLA amendments by the Energy Policy Act of 2005, the OCSLA provides for the grant of leases, easements, or rights-of-way on the outer continental shelf to the extent that an activity "supports production, transportation, or transmission of energy from sources other than oil and gas" and complies with the other provisions of OCSLA Section 8(p). Offshore GS of carbon dioxide on the outer continental shelf may be subject to requirements under the OCSLA.

As indicated in the Report of the Interagency Task Force on Carbon Capture and Storage (2010), ratification of the London Protocol and associated amendment of the MPRSA as well as amendment of the OCSLA will ensure a comprehensive statutory framework for the storage of carbon dioxide on the outer continental shelf. The UIC Program Director will want to remain aware of any future MPRSA and OCSLA rulemakings for their potential implications on the Class VI Program.

1.3.2 Re-permitting of Injection Wells Currently Permitted as Class I, II, or V Wells

With the promulgation of the UIC GS Rule, owners or operators of existing injection wells permitted as Class I, II, or V wells may need to re-permit injection wells as Class VI wells to be used for GS. Re-permitting an existing GS well as a Class VI well will require that the owner or operator apply to the UIC Program Director for a Class VI permit and satisfy the requirements for Class VI wells. For more information on re-permitting injection wells to Class VI wells, refer to Section 3.2 of this manual.

1.3.3 Environmental Justice and Public Involvement

EPA published a draft plan in July 2010 (Plan EJ 2014) to strengthen efforts to integrate environmental justice into its programs and promote continuous, meaningful engagement with communities and stakeholders. The Agency defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. All federal agencies must make EJ part of their mission by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs on minority populations and low-income populations in the United States [Executive Order 13175 (65 FR 67249, November 9, 2000)]. EPA expects that UIC Program Directors will consider EJ issues during implementation of the Class VI Program by examining the potential risks of any proposed Class VI well in order to determine whether minority or low-income communities may be disproportionately affected. For more information on EJ considerations for UIC Program Directors and permit writers, refer to Section 3.3 of this manual.

The GS Rule requires that UIC Program Directors publically announce Class VI permit applications, hold public hearings, and conduct effective outreach and communications efforts with key stakeholders pursuant to regulations at 40 CFR Parts 25 and 124. In addition, there is a requirement for UIC Program Directors to mail a notice to state and local oil and gas regulatory agencies, state agencies regulating mineral exploration and recovery, the Director of the state Public Water Supply Supervision (PWSS) program, and all agencies that oversee injection wells in the state [40 CFR 124.10(c)(1)(xi)]. Effective communication on GS and on Class VI injection well permitting will facilitate information sharing and encourage safe, protective projects. For more information on public involvement and outreach, refer to Section 3.4.2 of this manual.

In addition, on EPA's UIC GS information webpage there are two UIC Quick Reference Guides entitled *Additional Tools for UIC Program Directors Incorporating Environmental Justice Considerations into the Class VI Injection Well Permitting Process*, and *Additional Considerations for UIC Program Directors on the Public Participation Requirements for Class VI Injection Wells*.

1.3.4 Interstate Communication and Coordination

Due to the potentially large AoRs associated with GS projects, interstate issues will need to be taken into account. The GS Rule requires the UIC Program Director to initiate notifications with neighboring state, tribal, and territorial agencies and to discuss how the Director plans to perform notifications of the Class VI permit applications [40 CFR 145.23(f)(13) and 40 CFR 146.82(b)]. The intent of the notification requirement is to inform the parties of any proposed Class VI injection well permit applications and to ensure that neighboring jurisdictions can provide input during the permit application review process. These interstate communications will facilitate information sharing and encourage safe, protective GS projects. Refer to Appendix G of this manual for a sample Class VI injection well interstate coordination letter. In addition, there is a UIC Quick Reference Guide entitled *Additional Considerations for UIC Program Directors on Interstate Coordination Requirements for the Class VI Injection Well Permitting Process* on EPA's UIC GS information webpage mentioned above.

1.4 Adaptive Approach to Rulemaking

Due to the potentially fast pace of GS deployment, EPA has adopted an adaptive approach to rulemaking for the Class VI Program to ensure the protection of USDWs. EPA plans, every six years, to review the rulemaking and data on GS projects to determine whether the appropriate amount and types of information and appropriate documentation are being collected, and to determine if modifications to the UIC GS Rule requirements are appropriate or necessary. This includes collection and review of information on any Class VI wells granted a waiver of the injection depth requirements [40 CFR 146.95] and any aquifer exemption expansions issued for Class II wells transitioning to Class VI GS [40 CFR 144.7 and 146.4]. This approach will be implemented by evaluating research as it becomes available and analyzing data and information gathered from early GS projects. Incorporation of new research, data, and information about GS and associated technologies (e.g., modeling, well construction) may increase the ability of the Class VI regulations to protect USDWs and also streamline implementation of the Class VI Program.

The adaptive approach provides regulatory certainty to owners and operators, promotes consistent permitting approaches, and ensures that permitting agencies are able to meet current and future demands for Class VI permits. As such, early Class VI wells can be permitted in a manner that ensures USDW protection during the early phases of carbon dioxide injection, while EPA is able to make adjustments to the regulations, if necessary, as new information and data are submitted by well owners and operators. If, in the future, EPA modifies any regulatory requirement through the adaptive approach, a state with primacy for the Class VI Program may need to modify their regulations to ensure that the state's Class VI requirements are at least as stringent as the federal requirements. States are not required to change their regulations until after EPA has promulgated any revisions through final rulemaking. For more information on the adaptive approach to rulemaking, refer to the UIC Class VI GS Rule Preamble.

Section 2

Class VI Primacy Application Considerations

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2.0 Introduction to the UIC Program Class VI Primacy Application

The Safe Drinking Water Act (SDWA) mandates that the U.S. Environmental Protection Agency (EPA) develop UIC program requirements that protect underground sources of drinking water (USDWs) from endangerment. SDWA Sections 1422 and 1425 also authorize EPA to grant UIC primary enforcement responsibility (primacy) to states that develop a UIC program meeting the federal UIC program requirements [SDWA 1421(b), 40 CFR 144-146, and 40 CFR 148]. States with an approved UIC program take full responsibility to implement and enforce that program.

Traditionally, EPA has approved primacy applications under SDWA Section 1422 for all injection well classes and under SDWA Section 1425 for Class II injection wells only. Under the UIC GS Rule [75 FR 77230, 40 CFR 145.1(i)], EPA is allowing states to apply for independent primacy for Class VI injection wells under SDWA Section 1422. Thus, states without UIC primacy, or states with only SDWA Section 1425 primacy for Class II wells, can apply for independent primacy for Class VI wells under SDWA Section 1422. EPA's willingness to accept independent primacy applications for Class VI wells applies only to Class VI well primacy and does not apply to any other well class under SDWA Section 1422 (i.e., I, II, III, IV, or V). EPA believes that allowing independent primacy for Class VI wells may encourage states to obtain primacy, and to also develop a more comprehensive approach to managing GS projects and the integration of carbon capture and storage (CCS) issues which may be outside the scope of SDWA.

At present, several states have already published GS statutes and regulations, while others are investigating and developing strategies to address GS issues (e.g., management of multi-purpose injection wells in oil and gas reservoirs). EPA recognizes the complexity and importance of the states' approaches to managing GS and is aware that states are in various stages of developing statutory frameworks, regulations, technical guidance, and strategies for addressing CCS and GS. While many of the primacy application and approval process elements are required (refer to Sections 2.1.1 and 2.1.2 below), EPA has included flexibilities in the UIC GS Rule and allowed for state discretion where possible to better address the unique concerns and characteristics of Class VI injection wells.

Class VI Primacy Options

EPA encourages interested states that already have SDWA Section 1422 primacy to submit a Section 1422 UIC Program Revision Application to EPA for review and approval. States that have SDWA Section 1425 primacy for Class II wells only, or do not have primacy for any UIC programs, can apply for Class VI primacy under SDWA Section 1422 (independently, or along with the other well classes) by submitting a New Section 1422 UIC Program Application to EPA. More details on the requirements of each type of primacy application are included later in this Section.

EPA also encourages states that are interested in applying for UIC Class VI primacy to contact the Agency in order to schedule "pre-application" discussions. For example, states may want to contact EPA to clarify Class VI primacy application or state program requirements in order to ensure complete and accurate application submissions that can assist EPA in conducting a faster review and approval process.

If a state chooses not to submit an application for a Class VI program or does not receive EPA approval for its Class VI program by September 6, 2011, then EPA will directly implement the UIC Class VI program on behalf of the state. If a state receives primacy approval after September 6, 2011, EPA will transfer the Class VI program to the state on the date that state Class VI program is approved.

2.1 Authority to Regulate Class VI Wells

There are fundamental differences in how SDWA Sections 1422 and 1425 are applied to state primacy program applications and approvals. Under SDWA Section 1422 (which applies to all injection well classes), states must demonstrate that their proposed UIC program requirements are at least as stringent as the federal requirements [SDWA 1421, 40 CFR 144-146, and 40 CFR 148] in order to ensure the protection of USDWs. Alternatively, states seeking primacy for Class II wells only may choose to demonstrate under SDWA Section 1425, in lieu of Section 1422, that their Class II program is an effective program to prevent underground injection that endangers USDWs.

Since Section 1425 only applies to Class II wells, primacy applications for Class VI wells must be evaluated under SDWA Section 1422. Thus, states seeking to obtain primacy for the UIC Class VI Program must follow the statutory requirements under SDWA Section 1422 and regulatory requirements under 40 CFR 124, and 40 CFR 144-146; however, states seeking to obtain primacy for all well classes under SDWA Section 1422 must follow the requirements under 40 CFR 124, 144-146, and 40 CFR 148. A state must demonstrate in its UIC Class VI primacy application that it has either:

1. Developed a New UIC Program for all well classes, including Class VI wells, in accordance with SDWA Section 1422 that is at least as stringent as the federal requirements found in 40 CFR 124, 144-146 and 40 CFR 148; or developed a New UIC Program for Class VI, independently of the other UIC well classes, in accordance with SDWA Section 1422 that is at least as stringent as the federal requirements found in 40 CFR 124, and 144-146. (See Section 2.1.1 below for additional information for states needing to develop a New UIC Program primacy application); or,
2. Revised its existing SDWA Section 1422 UIC program to include Class VI wells with regulations at least as stringent as the federal requirements found in 40 CFR 124 and 144-146 (See Section 2.1.2 below for additional information for states needing to develop a UIC Program Revision primacy application).

EPA recognizes that states may choose to develop a UIC program that is administered by multiple agencies. EPA believes that states are in the best position to identify the appropriate agency to oversee Class VI wells and recognizes that in some states both the oil and gas and the underground injection programs may administer some Class VI requirements. Note that 40 CFR 145.23 requires any agency responsible for administration of the program to have statewide jurisdiction over the class of injection activities for which it is responsible.

Federal regulatory requirements for Class VI wells can be found in 40 CFR 124 and 144-146, including the six core elements of a New UIC Section 1422 primacy application and the

substantive program provisions that a state must expand upon in those core elements. More detailed information on the state UIC Class VI primacy requirements of 40 CFR 145 is provided below.

2.1.1 Required Elements of a New UIC Section 1422 Program Primacy Application: For States Currently without SDWA Section 1422 Primacy or States with SDWA Section 1425 Primacy for Class II Wells Only

This Section focuses on the elements of the New UIC Section 1422 Program primacy application, including EPA's rulemaking under 40 CFR 147.

In addition, 40 CFR 145 specifies the primacy application submission requirements, as well as the procedures EPA will follow when approving, revising, and withdrawing state programs under SDWA Section 1422. The CFR can be found on the Internet at:

www.gpoaccess.gov/cfr/index.html. The GS Rule requirements can be found at 77 FR 77230 or on the Internet at: <http://federalregister.gov/a/2010-29954> and at <http://water.epa.gov/type/groundwater/uic/class6/gsregulations.cfm#fr>.

2.1.1.1 General Requirements for a New UIC Section 1422 Program Application

In accordance with 40 CFR 145.11, 145.12, and 145.13, a new state UIC Program must include certain substantive provisions before EPA can approve the state program. In the primacy application, a state must demonstrate that it has the following:

1. The legal authority to implement all required permit requirements found in 40 CFR 145.11 (including the requirements found in 40 CFR 124);
2. The necessary procedures pursuant to 40 CFR 145.12, for the state's compliance evaluation program
3. The necessary administrative, civil, and criminal enforcement penalty remedies pursuant to 40 CFR 145.13;
4. Regulations that are at least as stringent as those promulgated by EPA (e.g., permitting, inspection, operation, monitoring, and recordkeeping requirements, inspection and compliance monitoring requirements found in 40 CFR 145.12; and, reporting and record keeping requirements found in 40 CFR 144.54 and 146.91 for Class VI wells); and,
5. State-wide jurisdiction over underground injection projects.

Note that the requirements and provisions of a state's program do not need to be identical to the federal provisions; however, each requirement must be at least as stringent as the corresponding federal provision. To expedite the primacy review process, EPA recommends that the states incorporate the federal Class VI regulations by reference or to enact the federal Class VI regulation language verbatim so that each corresponding provision matches exactly.

2.1.1.2 Specific Elements of a New UIC Section 1422 Program Primacy Application

In accordance with the UIC GS Rule and to support states with the Class VI primacy application process, EPA is allowing the electronic submission of required primacy application information (e.g., letter from the Governor, program description, Attorney General's statement, MOA, etc.). For Class VI programs, the entire submission can be sent electronically. Electronic submissions will reduce the amount of paper used in applying to EPA for Class VI Program primacy; thereby reducing the state's cost in submitting a primacy application and expediting the application and approval processes. Electronic submissions are to be sent to: ClassVIPrimacy@epa.gov or uploaded to: <http://classviprimacy.cadmusweb.com>. In the event that a state cannot provide an electronic submission, hard copy submissions provided by mail will be accepted. Send hard copy submissions to the U.S. EPA Office of Ground Water and Drinking Water, 1200 Pennsylvania Avenue, NW (Mail Code: 4606M), Washington, D.C., 20460. Attention: UIC Class VI Primacy.

Core Primacy Application Elements for a New UIC Section 1422 Program:

Under 40 CFR 145.22, states seeking Class VI primacy under SDWA Section 1422 through a New UIC Program application must submit to EPA the following six core primacy application elements:

1. A letter from the Governor of the state requesting program approval [40 CFR 145.22(a)(1)];
2. A complete program description describing how the state intends to carry out its responsibilities [40 CFR 145.22(a)(2) and 145.23];
3. An Attorney General's statement [40 CFR 145.22 (a)(3) and 145.24];
4. A Memorandum of Agreement (MOA) with the Regional Administrator [40 CFR 145.22(a)(4) and 145.25];
5. A copy of all applicable state statutes and regulations, including those governing state administrative procedures [40 CFR 145.22(a)(5)]; and,
6. A demonstration of compliance with the public participation requirements [40 CFR 145.22(a)(6)].

The following sections of this manual describe in more detail the six core primacy application elements and the documentation needed for New UIC Program applications. There are two different Federal/State Regulatory Comparison Crosswalks currently under development to assist with New UIC Program primacy applications; one for all UIC Classes, including Class VI, and one for independent primacy for Class VI. Interested state UIC Program Directors can request a New UIC Program Regulatory Comparison Crosswalk by sending an e-mail to the primacy mail box at ClassVIPrimacy@epa.gov.

In addition to the comparison crosswalk, a sample MOA with the Regional Administrator and a sample Attorney General's statement are included as Appendices C and E of this manual.

1. New UIC Section 1422 Program – Primacy Application: Letter from the Governor

The Class VI UIC primacy application includes a letter from the Governor of the state officially requesting Class VI program approval for primacy. The letter also must specify that approval is sought under SDWA Section 1422 and affirm that the state is willing and able to carry out the program described in the application.

2. New UIC Section 1422 Program – Primacy Application: Program Description

A New UIC Program primacy application must also include a program description. Federal regulations in 40 CFR 145.23 list all of the information that must be submitted as part of the program description, although, some of the requirements will not be applicable to states that submit an application for independent primacy for Class VI wells. Therefore, the information a state is required to include in the primacy application program description will depend on:

- A state's current primacy status (i.e., either no UIC primacy or SDWA Section 1425 primacy for Class II wells only), or;
- If the state is applying now for primacy for all well classes under SDWA Section 1422 or for independent primacy for Class VI wells.

At a minimum, the program description must include:

- A narrative on the scope, structure, coverage, and process of the state program [40 CFR 145.23(a)].
- A description of the organizational structure of the agency administering the program, including a description of program staff, organization charts, and estimated costs and sources of funding for implementing the program for the first 2 years [40 CFR 145.23(b)].
 - EPA recognizes that states may choose to describe in their UIC primacy application a UIC Program that is administered by multiple agencies. For example, the state oil and gas agency could either exercise authority for the Class VI program through a Memorandum of Understanding (MOU) with the Class VI primacy agency, or primacy for the entire Class VI program could reside with the state oil and gas agency. Under 40 CFR 145.23, if more than one agency will have authority for the program, each agency must have statewide jurisdiction over each class of activity that will be administered, and the program description must set out the responsibilities of each agency and the procedures for coordination.
 - A sample MOU between two state agencies is included in Appendix D. The MOU provides an operating agreement for state agencies to execute their respective responsibilities concerning regulation of Class VI wells. The example MOU can be modified based on the state's specific circumstances (e.g., if the agencies will share responsibilities for other injection well classes).
- A description of permitting, administrative, and judicial review procedures [40 CFR 145.23(c)].

- Copies of permit, application, reporting, and manifest forms. For Class VI programs, the state can submit copies of the current forms in use by the state, if any [40 CFR 145.23(d)].
- A description of the state's compliance tracking and enforcement program [40 CFR 145.23(e)].
- A schedule for issuing Class VI permits within 2 years after program approval. For all other injection well classes, if any, the state must include a schedule for issuing permits within 5 years after program approval for all injection wells which are required to have permits [40 CFR 145.23(f)(1)].
- A statement of the state's priorities for issuing Class VI permits and the number of Class VI permits that will be issued during the first 2 years of program operation. For all other injection well classes, if any, include a description of the priorities (according to criteria set forth in 40 CFR 146.9) for issuing permits, including the number of permits in each class of injection well that will be issued each year during the first 5 years of program operation [40 CFR 145.23(f)(2)].
- A description of how the state will meet the mechanical integrity testing requirements of 40 CFR 146.8, including the frequency of testing that will be required and the number of tests that will be reviewed by the UIC Program Director each year [40 CFR 145.23(f)(3)]. For Class VI wells, a description of how the state will meet the new Class VI mechanical integrity requirements at 40 CFR 146.89 is required.
- A description of the state's procedures to notify owners and operators of injection wells of the requirement that they apply for and obtain a permit [40 CFR 145.23(f)(4)]. If the Class VI program is approved before December 10, 2011 the state must describe its procedures for notifying owners and operators of any Class I well previously permitted for GS, or any Class V experimental technology wells that are no longer experimental but will continue to inject carbon dioxide for GS, that they must apply for a Class VI permit within 1 year, or by December 10, 2012.

For Class VI programs approved after December 10, 2011, the state must describe its procedures for notifying the Class I and Class V well owners and operators described above, that they must apply for a Class VI permit within 1 year of state program approval [40 CFR 145.23(f)(4)].

For other injection well classes, if any, the notification must require well owners and operators to file a permit application as soon as possible, but no later than 4 years after state program approval for all injection wells requiring a permit.

- A description of any rule under which the Director proposes to authorize injections, including the text of the rule [40 CFR 145.23(f)(5)].
- A description of how the state will establish and maintain an injection well inventory [40 CFR 145.23(f)(7)].

- A description of aquifers, or parts thereof, which the UIC Program Director has identified under 40 CFR 144.7(b) as exempted aquifers, and a summary of supporting data. For Class VI programs, states must incorporate information related to any EPA approved exemptions expanding the areal extent of existing aquifer exemptions for Class II enhanced recovery (ER) wells transitioning to Class VI injection pursuant to new Class VI requirements at 40 CFR 146.4 and 144.7(d), including a summary of supporting data and the specific location of the aquifer exemption expansions [40 CFR 145.23(f)(9)].
- A description of the injection depth waiver program to be administered, if determined by the state to allow Class VI injection well owners and operators to apply for a waiver in a supplemental report concurrent with a permit application [40 CFR 146.95].
- A description of the state's procedures for notifying any states, tribes, and territories of Class VI permit applications where the area of review (AoR) crosses jurisdictional boundaries, and the procedures for documenting these consultations [40 CFR 145.23(f)(13)].
 - An example interstate coordination letter is included in Appendix G of this manual. This letter could be used to notify any states, tribes, and territories of trans-boundary issues when issuing a Class VI permit.
- See 40 CFR 145.23 for more details on **all of the required elements** of the program description for a New UIC Section 1422 Program primacy application program, especially if interested in applying for all UIC well classes, as not all of the requirements in the CFR are cited here.

Note that because the UIC GS Rule provides states with certain flexibilities to develop a Class VI program that addresses unique characteristics within the state, the program description may need to include additional information. For example, the Class VI regulations provide the UIC Program Director with certain discretion including options to issue injection depth waivers. These waivers, if authorized by state regulation, need to be described in the program description of the primacy application. In addition, EPA recommends the program description also provide information on how the state will implement the Class VI financial responsibility requirements.

3. New UIC Section 1422 Program – Primacy Application: Attorney General's Statement

An Attorney General's statement is a required component of a new program primacy application [40 CFR 145.24]. This statement is a certification by a qualified representative of the state, asserting that state statutes, regulations, and judicial decisions demonstrate adequate authority to administer the UIC Program. The Attorney General's statement also certifies that the state either does not have environmental audit privilege and/or immunity laws, or if there are environmental audit privilege and/or immunity laws, they will not affect the ability of the state to meet the enforcement and information gathering requirements under SDWA. In addition, in those states that elect to divide the program administration between more than one agency, the Attorney General's statement will need to designate a lead agency for administration of the UIC Program. An example Attorney General's statement is included in Appendix E of this manual.

4. New UIC Section 1422 Program – Primacy Application: Memorandum of Agreement

A memorandum of agreement (MOA) between the state and the EPA Regional Administrator is another required element of a new program primacy application [40 CFR 145.25]. The MOA is the central agreement setting the provisions and arrangements between the state and EPA concerning the administration, implementation, and enforcement of the state UIC Program. An example MOA is included in Appendix C of this manual and can be revised or amended based on the specific circumstances of the agreement (e.g., the transfer of permits) between the state and EPA.

5. New UIC Section 1422 Program – Primacy Application: Copies of all Applicable State Statutes and Regulations

Copies of all applicable state statutes and regulations, including those governing state administrative procedures, are a required element of a new program application. EPA is aware that several states have published GS or CCS regulations, and several more states are in the process of developing their statutory frameworks, regulatory authorities, technical guidance, and strategies for addressing CCS and GS. To facilitate the UIC Class VI Program application approval process, EPA encourages states to incorporate the federal Class VI requirements by reference, or to incorporate the federal language verbatim.

There are two different Federal/State Regulatory Comparison Crosswalks currently under development to assist with New UIC Program primacy applications; one for all UIC Classes, including Class VI, and one for independent primacy for Class VI. Interested state UIC Program Directors can request a New UIC Program Regulatory Comparison Crosswalk by sending an e-mail to ClassVIPrimacy@epa.gov.

A Federal/State Regulatory Comparison Crosswalk may be completed by the state in order to identify the statutory or regulatory provisions that correspond to each federal UIC requirement. A completed crosswalk will help EPA in reviewing the state's primacy application and may expedite the review and approval process. Note that 40 CFR 145.11(b)(1) says that "states need not implement provisions that are identical to the provisions listed in paragraphs (a)(1) through (a)(32) of this Section (i.e., Part 145). Implemented provisions must; however, establish requirements at least as stringent as the corresponding listed provisions. While states may impose more stringent requirements they may not make one requirement more lenient as a tradeoff for making another requirement more stringent." If the state provisions differ from the federal UIC requirements, the state will want to explain in the crosswalk how its requirements are no less stringent, in order to facilitate the EPA evaluation of the differences.

6. New UIC Section 1422 Program – Primacy Application: Demonstration of Compliance with the Public Participation Requirements

A demonstration of compliance with the public participation requirements pursuant to 40 CFR 145.31(a) is required for all New UIC Program primacy applications. All states seeking approval of a UIC Program must issue a public notice indicating the state's intent to adopt a UIC Program, provide at least a 30-day public comment period, and schedule a public hearing. The demonstration of compliance can be submitted once the notice, comment, and hearing requirements have been met. States must also include copies of all written comments received by

the state; a transcript, recording, or summary of any public hearings; and a “responsiveness summary” which identifies public participation activities conducted by the state, significant comments received by the state, and how the state responded to those comments.

This public notice must:

- Be circulated in a manner that attracts interested persons (e.g., publication in enough of the largest newspapers and mailing to persons on approved state mailing lists);
- Indicate when and where the state’s proposed program submission may be reviewed by the public;
- Indicate the cost of obtaining a copy of the program submission;
- Provide for a comment period for at least 30 days;
- Briefly outline the fundamental aspects of the state UIC program; and,
- Identify a person who can be contacted for further information.

After complying with these public notice requirements, states may submit their proposed UIC Program to EPA for approval.

2.1.1.3 Processing New UIC Section 1422 Program Applications

When EPA receives a state primacy application, EPA must first determine whether the application is complete. Once EPA determines that the state’s primacy application is complete, EPA’s statutory review period will be deemed to begin on the date of receipt of the state submission. If EPA finds that a state submission is incomplete, the statutory review period will not begin until all the necessary information is received. EPA will review; then either approve or disapprove the application through a rulemaking. For submissions including more than one class of well, EPA may approve the application in part or disapprove in part, as prescribed under SDWA Section 1422(b)(2) and 40 CFR 145.

In accordance with 40 CFR 145.31(c), once EPA determines that the state New UIC Program primacy application is complete, the Agency must issue public notice and provide a public comment period of at least 30 days. EPA must publish the public notice in the *Federal Register* and in the state’s largest newspapers, and mail it to interested persons. The public notice must include a summary of the proposed UIC program, note the availability of the submission for inspection and copying, and provide for a public hearing to be held if there is sufficient public interest.

After the public comment period has ended and all comments have been evaluated, the state UIC program will be either approved or disapproved by the EPA Administrator through a rulemaking process. If the EPA Administrator approves the state UIC program, the Agency will announce the program approval in the *Federal Register*, and the state program will become effective on the date the announcement is published. Concurrently, the state program will be codified under 40 CFR 147.

2.1.2 Required Elements of a UIC Section 1422 Program Revision Application: For States Currently With SDWA Section 1422 UIC Program Primacy

States that currently have primacy for UIC injection well classes authorized under SDWA Section 1422 have previously demonstrated that the state UIC Program contains the minimum requirements equivalent to the federal UIC requirements in order to prevent underground injection that endangers USDWs. These states do not need to submit all of the documentation described above in Section 2.1.1 (i.e., information that applies to all injection well classes), but do need to submit a UIC Program Revision application to EPA for approval to incorporate the Class VI requirements into the current state UIC Program.

EPA acknowledges that revisions to other UIC well class programs may be necessary in order to include Class VI injection wells into the state UIC program. EPA encourages states to revise their UIC programs as appropriate and to submit all program revision information along with the UIC Program Revision application to add Class VI. This subsection of the manual focuses solely on the Class VI primacy requirements, and states should refer to SDWA Section 1422 and 40 CFR 145.32 for the additional Program Revision application requirements that may apply.

2.1.2.1 General Requirements of a UIC Program Revision Application

The UIC Section 1422 Program Revision application must include:

1. A modified program description including, but not limited to, the new requirements of the GS Rule at 40 CFR 145.23(f).
2. A modified Attorney General's Statement
3. A modified Memorandum of Agreement
4. Copies of state's statutes and regulations, including administrative procedures for the Class VI UIC Program
5. A modified Governor's letter (if necessary)

The following Sections describe in more detail these five UIC Program Revision primacy application elements and the documentation needed for UIC Section 1422 Program Revision applications to add Class VI wells. A crosswalk for comparing federal/state Class VI requirements, a sample MOA with the Regional Administrator, and sample Attorney General's statement are included here as Appendices A, C, and E of this manual.

Pursuant to 40 CFR 145.32, the incorporation of the UIC Class VI GS Rule requires a substantial revision to state programs, whereby EPA will issue public notice once a complete state UIC Class VI program revision application is received. The public notice will be announced in the *Federal Register*, and provide for a 30-day opportunity for comment as well as the opportunity to request a public hearing. EPA will hold a public hearing on the UIC Program Revision application if there is sufficient public interest.

States are reminded of the application submission timeframe requirements as described below in Section 2.2 of this manual.

2.1.2.2 Specific Elements of a UIC Program Revision Application

1. UIC Section 1422 Program Revision – Primacy Application: Modified Program Description

A state revising its UIC program description to include a Class VI program must do, but is not limited to just the following:

- Provide a description of applicable revised state procedures, including any revised permitting procedures and any revised state administrative or judicial review procedures [40 CFR 145.23(c)];
- Provide any revised copies of the current permit form(s), application form(s), reporting form(s), and manifest format the state intends to employ in its revised program including Class VI [40 CFR 145.23(d)];
- Identify the regulatory authorities of the respective agencies, if the state elects to divide the administration of the UIC Program between agencies (i.e., whether the state oil and gas agency will exercise authority for Class VI through a MOU with the Class VI primacy agency, or by obtaining primacy for the entire Class VI program). The state must also submit the organization charts required under 40 CFR 145.23(b). An example MOU is included in Appendix D of this manual. The example can be modified if the agencies will share responsibilities for other injection well classes [40 CFR 145.23(b)].
- Include information regarding the schedule, priorities for, and number of permits to be issued in the first 2 years of program operation [40 CFR 145.23(f)(1) and 145.23(f)(2)].
- Describe how the state will meet the new mechanical integrity testing requirements of 40 CFR 146.89, including the frequency of testing that will be required and the number of tests that will be reviewed by the UIC Program Director each year [40 CFR 145.23(f)(3)].
- If the Class VI program is approved before December 10, 2011, the state must describe its procedures for notifying owners and operators of any Class I well previously permitted for GS, or any Class V experimental technology wells that are no longer experimental but will continue to inject carbon dioxide for GS, that they must apply for a Class VI permit within 1 year, or by December 10, 2012.
- For Class VI programs approved after December 10, 2011, the state must describe its procedures for notifying the Class I and Class V well owners and operators described above, that they must apply for a Class VI permit within 1 year of state program approval [40 CFR 145.23(f)(4)].
- Incorporate information related to any EPA approved exemptions expanding the areal extent of existing aquifer exemptions for Class II enhanced recovery (EOR/ERG) wells transitioning to Class VI injection for GS pursuant to GS Rule requirements at

40 CFR 146.4(d) and 144.7(d), including a summary of supporting data and the specific location of the aquifer exemption expansions [40 CFR 145.23(f)(9)].

- Describe the state's procedures for notifying any states, tribes, and territories of Class VI permit applications where the AoR is predicted to cross jurisdictional boundaries, as well as the procedures for documenting these consultations [40 CFR 145.23(f)(13)].
 - An example interstate coordination letter is included in Appendix G of this manual. This notice could be used to notify any states, tribes, and territories of trans-boundary issues when issuing a Class VI permit.
- A description of the injection depth waiver program to be administered, if determined by the state to allow Class VI injection well owners and operators to apply for a waiver in a supplemental report concurrent with a permit application [40 CFR 146.95].

Note that the above list focuses on the modified program description requirements from the UIC Class VI Rule. States are encouraged to consult 40 CFR 144.23 in its entirety for all additional program description requirements.

2. UIC Section 1422 Program Revision – Primacy Application: Modified Attorney General's Statement

An updated Attorney General's statement is a required component of a program revision application [40 CFR 145.24]. This statement is a certification by a qualified representative of the state, asserting that the state's statutes, regulations, and judicial decisions demonstrate adequate authority to administer the additional Class VI Program requirements. It also certifies that, since the state was granted primacy for the UIC Program, the state either still does not have environmental audit privilege and/or immunity laws, or if there are now environmental audit privilege and/or immunity laws, these laws will not affect the ability of the state to meet enforcement and information-gathering requirements under SDWA. In addition, in those states that elect to divide the program administration between more than one agency, the Attorney General's statement will need to designate a lead agency. An example Attorney General's statement is included in Appendix E of this manual.

3. UIC Section 1422 Program Revision – Primacy Application: Modified Memorandum of Agreement

A revised MOA, as required by 40 CFR 145.25 setting out the new provisions and arrangements between the state and EPA concerning the administration, implementation, and enforcement of the state's Class VI program is a required component of a program revision application. An example MOA is included in Appendix C of this manual and can be revised or amended based on the specific circumstances of the agreement (e.g., the transfer of permits) between the state and EPA.

4. UIC Section 1422 Program Revision – Primacy Application: Copies of all Applicable State Statutes and Regulations

Copies of all applicable state statutes and regulations, including those governing state administrative procedures are also required to be submitted. EPA is aware that several states have published GS regulations and several more are in the process of developing their statutory and regulatory authorities. EPA recognizes the complexity and importance of the states' approaches to managing GS and is aware that states are in various stages of developing statutory frameworks, regulations, technical guidance, and strategies for addressing CCS and GS.

EPA recommends that the Federal/State Regulation Comparison Crosswalk included in Appendix A, may be completed by the state to identify state statutory or regulatory provisions that correspond to each federal requirement. A completed crosswalk will help EPA in reviewing the state's application and may expedite the review process. Note that 40 CFR 145.11(b)(1) says that "states need not implement provisions that are identical to the provisions listed in paragraphs (a)(1) through (a)(32) of this Section. Implemented provisions must, however, establish requirements at least as stringent as the corresponding listed provisions. While states may impose more stringent requirements they may not make one requirement more lenient as a tradeoff for making another requirement more stringent." In order to facilitate the application approval process, EPA encourages states to incorporate the federal requirements by reference, or incorporate the federal language verbatim. If the state's provisions differ from federal requirements, the state will want to explain in the Crosswalk how its requirements are no less stringent, in order to facilitate EPA's evaluation of the differences, and help EPA in making a stringency determination.

5. UIC Section 1422 Program Revision – Primacy Application: Modified Governor's Letter

The Governor's letter may need to be modified to request Class VI program approval for primacy and affirm that the state is willing and able to carry out the revised program described in the application.

2.1.2.3 Processing UIC Section 1422 UIC Program Revision Applications

As discussed above, once EPA receives a state UIC Program Revision application to add Class VI wells to the current Section 1422 program, EPA will review the program revision application and announce the program revision for public notice and comment.

State UIC program revisions are determined by EPA to be either substantial or minor revisions. Adding a Class VI Program to an existing Section 1422 UIC Program has been determined to be a substantial program revision pursuant to 40 CFR 145.32. In accordance with 40 CFR 145.32(b)(2), EPA must issue public notice and provide an opportunity to comment for a period of at least 30 days. EPA must also publish the public notice in the *Federal Register*, and in enough of the largest newspapers in the state to provide statewide coverage, and also mail it to interested persons. The public notice must include a summary of the proposed state UIC Program revisions and provide for an opportunity for a public hearing to be held if there is sufficient public interest.

After the public comment period has ended, the state UIC Program revisions will be either approved or disapproved by the EPA Administrator through a formal rulemaking process. If the EPA Administrator approves the state UIC Program revisions, EPA will then announce the

approval in the *Federal Register*, and the revised state program becomes effective on the date it is published. The revised state program, incorporating all of the additional Class VI requirements, will be codified under 40 CFR 147.

2.2 Required Timeframes

Under SDWA Section 1422 and the Class VI regulations at 40 CFR 145.21(h), states have 270 days following publication of the UIC Class VI GS Rule (i.e., December 10, 2010 – September 6, 2011) to submit a complete UIC primacy application for Class VI wells. This timeframe is required by SDWA Section 1422, with an allowance for an additional 270-day extension at EPA’s discretion. EPA believes that in light of national priorities for promoting climate change mitigation strategies and Administration priorities for developing and deploying CCS projects in the next few years, it is important to have enforceable Class VI regulations in place nationwide as soon as possible. EPA also believes that a clear, nationally-consistent deadline will avoid potential confusion that may arise if some states have approved Class VI programs and others do not. Therefore, the Agency determined that it will not provide for an extension when applying for Class VI primacy.

EPA recognizes that states are in the best position to implement comprehensive GS and CCS programs. Therefore, EPA is streamlining and clarifying the process for submission of Class VI primacy applications (e.g., allowing electronic submission of required primacy application information and the use of existing reporting forms), providing tools designed to assist states with the development of their primacy application, and otherwise supporting states with the primacy application process as much as possible.

As a reminder, EPA is encouraging states interested in applying for UIC Class VI primacy to schedule “pre-application” discussions with the Agency at either the Regional or the HQ level, in order to ensure complete and accurate application submissions and assist in expediting the EPA review and approval process.

If a state does not submit a complete application during the 270-day period, or EPA has not approved a state Class VI primacy application during the 270-day period, then EPA will implement the UIC Class VI program on the state’s behalf, beginning on September 7, 2011 (i.e., day 271 following publication of the Class VI regulations). EPA will continue to administer the UIC Class VI program until such time as the state receives primacy.

Beginning on September 7, 2011, all Class VI permit applications in states without Class VI programs must be directed to the appropriate EPA regional office, which would evaluate the application and issue a Class VI permit when appropriate. Class I permits for carbon dioxide injection for GS may no longer be issued, and Class V permits may only be issued to experimental projects eligible for such permits.

It is important to note that, although the Agency is not accepting extension requests for primacy applications, a state may apply for primacy at any time and the same procedures and requirements apply. If a state receives primacy after September 6, 2011, EPA will publish a subsequent notice of the approval as required by SDWA, and at that point, the state, rather than EPA, will implement the UIC Class VI program. EPA will work closely with the state in order to

ensure an orderly transfer of responsibility to the approved state primacy agency at the appropriate time.

2.2.1 Timeframes: Issuing Class VI Permits for New UIC Program States

During the 270-day application period (December 10, 2010 – September 6, 2011), and prior to EPA approval of a Class VI primacy application, states without existing SDWA Section 1422 primacy programs must direct all Class VI permit applications to the appropriate EPA Region. EPA Regions will issue permits using existing authorities and well classifications (e.g., Class I or Class V), as appropriate. EPA suggests that Regions use Class I permits, because the GS Rule limits the use of the Class V experimental technology well sub-classification to wells that are of an experimental nature only (i.e., to test GS technologies and collect data).

Regions are encouraged to issue these interim permits with conditions that meet the requirements for Class VI wells to ensure that Class I and Class V wells previously used for GS can be re-permitted as Class VI wells without undue regulatory burden.

If the state has not received Class VI program approval by the close of the 270-day application period (by September 6, 2011), the EPA Region will directly implement the Class VI program on the state's behalf, including issuing Class VI permits, until the state receives primacy for Class VI. Figure 1 in Section 3 of this manual depicts the timing and responsibility for issuing Class VI permits.

In states where EPA directly implements the Class VI program, Class I permits for carbon dioxide injection for GS may no longer be issued and Class V experimental technology permits may only be issued to projects eligible for such permits, because the UIC GS Rule limits the use of the Class V experimental technology well sub-classification to wells that are of an experimental nature only (i.e., to test GS technologies and collect data).

All owners or operators of a previously permitted Class I or Class V well used to inject carbon dioxide for GS must apply for a Class VI permit within 1 year of publication of the UIC Class VI GS Rule (by December 10, 2011), pursuant to Class VI regulations at 40 CFR 146.81(c).

2.2.2 Timeframes: Issuing Class VI Permits for UIC Program Revision States

During the 270-day application period (December 10, 2010 – September 6, 2011), states with current SDWA Section 1422 primacy may consider using existing authorities (e.g., Class I) to issue permits for carbon dioxide injection for GS. EPA suggests using Class I permits, because the UIC GS Rule limits the use of the Class V experimental technology well sub-classification to wells that are of an experimental nature only (i.e., to test GS technologies and collect data). EPA encourages states to issue these interim permits with conditions that meet the requirements for Class VI wells to ensure that those Class I and Class V wells previously used for GS can be re-permitted as Class VI wells at the appropriate time without undue regulatory burden.

EPA adds that an owner or operator of a previously permitted Class I or Class V well used to inject carbon dioxide for GS must apply for a Class VI permit within 1 year of publication of the UIC Class VI GS Rule (by December 10, 2011), pursuant to requirements at 40 CFR 146.81(c).

States with previous SDWA Section 1422 primacy may begin issuing Class VI permits upon receiving approval from EPA for the state Class VI program. If the state has not received approval by the close of the application period, the EPA Region will issue Class VI permits until the state receives primacy (i.e., the state no longer needs to issue Class I or Class V permits for GS wells). Figure 1 in Section 3 of this manual depicts the timing and responsibility for issuing Class VI permits.

2.3 Additional UIC Program Primacy Application Tools

To help states apply for UIC program primacy for Class VI wells either as a new UIC Program or as UIC Program Revision, EPA has developed documents including a Class VI UIC primacy application checklist, federal and state Class VI regulations crosswalks, and templates that can be used in a state's Class VI primacy application (included as Appendices to this manual). EPA also provided Class VI primacy and implementation training workshops to interested state, tribal and territorial UIC Program Directors and will be updating Agency websites to include information specific to the Class VI program. The final Class VI Primacy Application and Implementation Manual will also be available at <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm>, and the UIC Program primacy application tools discussed in this manual, as well as the materials used in the training workshops will be available at <http://water.epa.gov/type/groundwater/uic/class6/gsinformation.cfm>.

The primacy application tools available to UIC Program Directors include:

- The UIC GS Rule Implementation Workshop MS PowerPoint Slides and speaker notes, which provide information on UIC Class VI primacy as well as the primacy application materials and templates included in the Appendices of this manual.
- A Federal/State Class VI Regulations Comparison Crosswalk for UIC Program Revision applications found in Appendix A of this manual. The Crosswalk identifies state Class VI UIC statutory and/or regulatory provisions that correspond to each federal requirement.
- Additional crosswalks still under development for comparing Federal/State Regulations for New UIC Programs. These crosswalks will be available by sending a request to the primacy e-mail box at ClassVIPrimacy@epa.gov.
- A Primacy Application Checklist is included in Appendix B of this manual.
- Other templates, such as an example MOA between two state agencies, example MOU between EPA and the state, and an example Attorney General's statement are found in Appendices C-E of this manual. An example interstate coordination letter is also included in Appendix G.

Section 3

Class VI Program Implementation Considerations

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3.0 Considerations for Permit Evaluation and Program Implementation

3.1 Permitting Authority

Class VI permit applications submitted by owners or operators of proposed Class VI injection wells will be reviewed by either the state UIC Program Director (for a state that has received primacy for the Class VI Program) or by the EPA Regional office for Direct Implementation (DI) programs in states that have not received primacy for Class VI. EPA recognizes that there is the possibility of a state UIC agency receiving a Class VI permit application before that state has been granted primacy for the Class VI Program. However, states may not issue Class VI permits until the Class VI program is approved by EPA through the rulemaking process. The process for approval of a Class VI permit application in such instances will depend on the current state status with regard to SDWA Section 1422 primacy, as explained below.

3.1.1 States without SDWA Section 1422 Primacy (New UIC Programs)

Prior to EPA approval of a Class VI primacy application, states without existing SDWA Section 1422 primacy programs must direct all Class VI permit applications to the appropriate EPA Regional office. EPA anticipates that no Class VI permits will be issued during the first 270 days after publication of the Class VI regulations (December 10, 2010 – September 6, 2011) in order to allow equal time for all interested states to apply for Class VI primacy. Therefore, in most cases during the 270-day application period, the EPA Regional offices may issue geologic sequestration (GS) project permits using existing UIC Program authorities and well classifications, as appropriate.

EPA will only approve Class V experimental technology permit applications for GS of carbon dioxide for those wells that are experimental in nature. Interested UIC Directors and potential Class VI injection well owners and operators may refer to the Revised UIC Program Guidance #83, to be made available on EPA's website at <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm>, for more information regarding the Class V experimental technology well subclass in light of the new Class VI program. Existing permits for Class V experimental technology wells will need to be examined prior to permit expiration, and a determination made by the owner or operator, in consultation with the UIC Program Director, as to whether the well can continue to be permitted as a Class V experimental technology well or must be re-permitted as a Class VI well for the long term storage of carbon dioxide.

Any other GS project permit applications submitted to EPA and approved during the first 270-days after publication of the Class VI regulations (December 10, 2010 - September 6, 2011) may be permitted as Class I wells. EPA encourages that any interim Class I permit for a GS project approved during the 270-day primacy application period meets the requirements for a Class VI injection well in order to facilitate the transition of re-permitting the injection well as a Class VI well once the primacy application period closes.

When a state currently without SDWA Section 1422 primacy receives approval for a New UIC Program application including Class VI, the state may begin issuing Class VI permits. If the state has not received approval for its Class VI program by the close of the 270-day primacy

application period (September 6, 2011), then the EPA Regional office will issue Class VI permits beginning on September 7, 2011, until such time as the state receives primacy for the Class VI program.

3.1.2 States with SDWA Section 1422 Primacy (UIC Program Revisions)

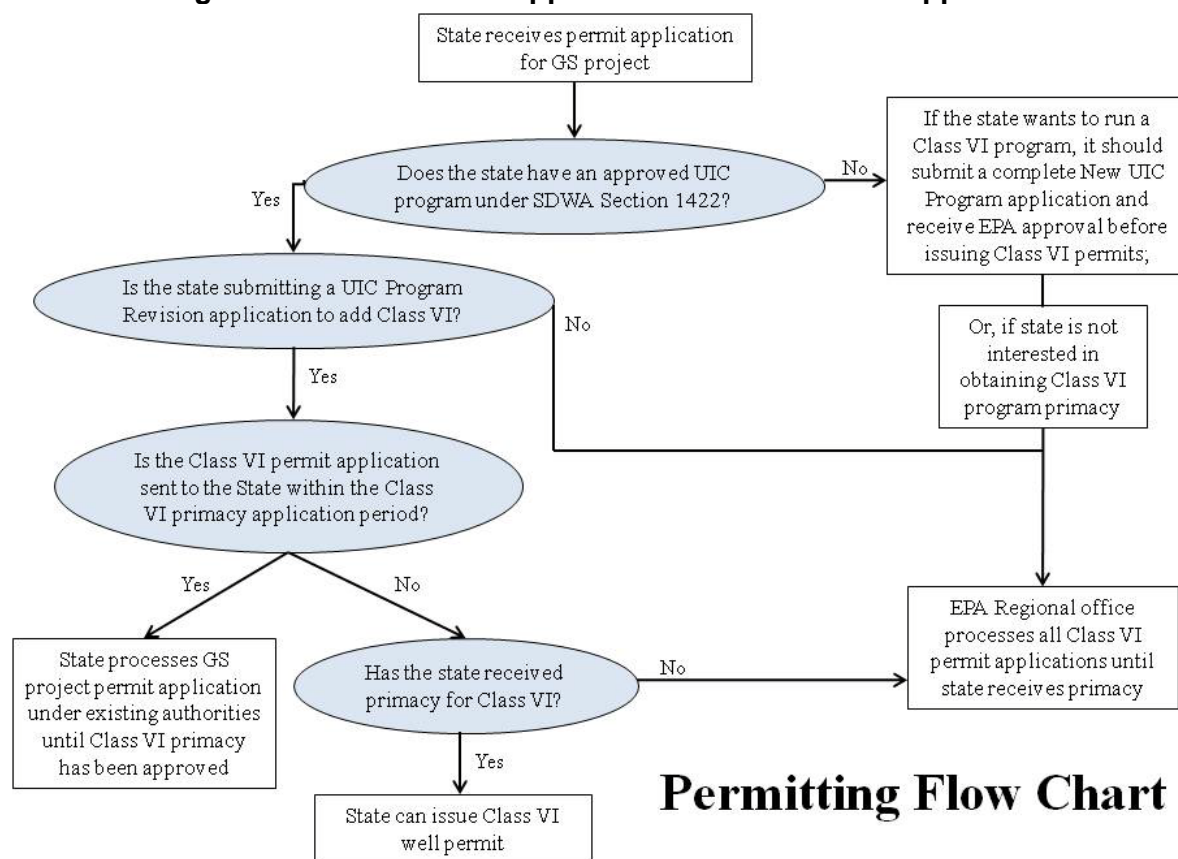
When states with previous SDWA Section 1422 primacy receive approval for their UIC Program Revision application to add Class VI, the state may begin issuing Class VI permits. If the state has not received approval by the close of the 270-day primacy application period, the EPA Regional office will issue Class VI permits until the state receives primacy for the Class VI program.

No Class VI permits will be issued by the states during the first 270 days after publication of the Class VI regulations (December 10, 2010- September 6, 2011) because most states will be preparing and submitting their primacy applications for the Class VI program during that timeframe. Therefore, a state that currently has SDWA Section 1422 primacy may consider using existing authorities (e.g., Class I) to issue permits for carbon dioxide injection for GS within the 270-day primacy application period. EPA encourages that any interim Class I permit for a GS project approved during the 270-day primacy application period meets the requirements for a Class VI injection well, in order to facilitate the transition of re-permitting the injection well as a Class VI well once the primacy application period closes.

On day 271 (September 7, 2011) and beyond, all permit applications in states without approved UIC Class VI programs must be directed to the appropriate EPA Regional office. As of September 7, 2011, Class I permits for carbon dioxide injection for GS may no longer be issued, and Class V experimental technology permits may only be issued to experimental GS projects eligible for such permits.

Figure 1 below provides a flowchart describing the timing for state or EPA Regional approval of Class VI permit applications. With the promulgation of the UIC Class VI GS Rule, owners or operators of existing injection wells permitted as Class I, II, or V may need to re-permit those injection wells to Class VI wells for GS, prior to the expiration of the original UIC permit, requiring that the owner or operator apply to the UIC Program Director for a Class VI permit and meet all the Class VI regulations. For more information on re-permitting existing injection wells as Class VI injection wells, refer to Section 3.2 of this manual, below.

Figure 1: State and EPA Approval of Class VI Permit Applications



As a state moves through the primacy application and approval process, the need for early and regular communication with EPA is essential. EPA's review and approval time could potentially be condensed if EPA is made aware of any issues surrounding the primacy application, and the state and EPA work cooperatively to resolve these issues. EPA is encouraging states interested in applying for UIC Class VI primacy to schedule "pre-application" discussions to ensure complete and accurate application submissions and assist in streamlining EPA's review and approval process.

3.2 Re-permitting of Injection Wells Currently Permitted as Class I, II, or V Wells

Owners or operators of existing Class I or Class II enhanced recovery (ER) injection wells or Class V experimental technology injection wells must apply for a Class VI permit (if the existing wells are intended to be used for GS) within one (1) year of the publication of the UIC Class VI GS Rule (i.e., apply to re-permit by December 10, 2011 since the regulations were published in the *Federal Register* on December 10, 2010). In addition, it is expected that owners and operators of wells injecting carbon dioxide for other purposes (e.g., enhanced oil recovery) may seek a Class VI permit when an increased risk to USDWs arises as compared to traditional Class II operations. In these cases, re-permitting the existing Class II wells as Class VI injection wells will also be necessary. EPA is developing a guidance document, *Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Class II to Class VI Well Transition Guidance for Owners, Operators, and State Directors*, that further explains the re-permitting of Class II wells to Class VI. EPA is also revising the existing UIC Program Guidance

#83 to provide clarity on the re-permitting of current Class V experimental technology wells as Class VI. Both of these documents will be available in the future on EPA's website.

When determining whether to approve the re-permitting of an existing well as a Class VI injection well, UIC Program Directors may review all information submitted for the existing injection well. This information may include, but is not limited to, the area of review (AoR) determinations, well construction details, permit conditions, and operating and monitoring data collected during operation of the well.

All Class VI requirements must be met by the owner or operator of the re-permitted injection well. However, the UIC Program Director has the option to grandfather the construction of existing wells to be re-permitted as Class VI if the owner or operator demonstrates that the well was engineered and constructed to achieve the goals for casing and cementing of Class VI wells [40 CFR 146.86(b)], for logging, surveying, and testing prior to injection well operation [40 CFR 146.87(a)]; and to ensure protection of USDWs in lieu of the Class VI construction requirements. If the owner or operator cannot make this demonstration, then grandfathering of the construction will not be allowed by the Program Director. Additionally, if the UIC Program Director finds that any aspects of the site characterization, well construction, well design, or operational features of the existing injection well could lead to USDW endangerment under carbon dioxide injection conditions, and these issues cannot be addressed by new permit conditions, then denial of the re-permitting as Class VI could be warranted.

If a Class VI permit is not approved, the owner or operator may decide to pursue other options for the injection well, such as re-permitting the well as a Class V experimental technology well for additional research and development (if applicable and if the well would continue to allow safe injection of the planned injection rates and volumes to protect USDWs to the satisfaction of the UIC Program Director), use as a monitoring well, or well closure.

Owners or operators seeking to re-permit a well may find it useful to begin a dialogue with UIC Program Directors in order to clarify expectations and information needs. Owners or operators can also use this information when preparing the application for re-permitting.

Re-permitted Class VI wells will then be subject to all of the operational, testing and monitoring, reporting, injection well plugging, and PISC and site closure requirements set forth in 40 CFR 146 Subpart H. Prior to the re-permitting of an existing Class I, Class II, or Class V well to a Class VI well, the owner or operator must submit, and the UIC Program Director must consider, all of the permit information at 40 CFR 146.82(a) and (c). Note that, in general, Class VI well requirements are more stringent than those for Class I, II, and V wells. For Class VI wells: the AoR delineation requires sophisticated modeling (other wells classes may use a fixed radius AoR); well construction standards are more specific; more frequent mechanical integrity testing is required; monitoring of ground water quality and tracking the fate of the injectate and induced pressure front are required; PISC is required; and the use of area permits are not allowed. If a state is granted primacy for Class VI wells only, re-permitting as Class VI will be addressed on a case-by-case basis, and the state and EPA will need to work closely together to complete the well re-permitting process. Refer to Tables 3.5 and 3.6 of this manual for more information on the requirements for injection well construction and for logging, testing, and sampling prior to injection well operation.

3.2.1 *Re-permitting Wells from Class II to Class VI*

Owners or operators of existing Class II injection wells that inject carbon dioxide into an oil or gas reservoir for the primary purpose of long-term storage of carbon dioxide must apply for and secure a Class VI permit before injecting when there is an increased risk to USDWs compared to Class II operations [40 CFR 144.19(a)]. The UIC Program Director must determine, based on review of information provided by the owner or operator, when there is an increased risk to USDWs [40 CFR 144.19]. EPA has developed specific, risk-based factors to be considered by the UIC Program Director in making the determination to apply Class VI requirements to transitioning wells. In determining if there is an increased risk to USDWs, the UIC Program Director must consider the following information [40 CFR 144.19(b)]:

- Increase in reservoir pressure within the injection zone.
- Increase in carbon dioxide injection rates.
- Decrease in reservoir production rates.
- Distance between the injection zone and USDWs.
- Suitability of the Class II AoR delineation.
- Quality of abandoned well plugs within the AoR.
- The owner's or operator's plan for recovery of carbon dioxide at the cessation of injection.
- The source and properties of the injected carbon dioxide stream.
- Any additional, site-specific criteria required by the UIC Program Director.

Additional information regarding these criteria will be provided in the forthcoming *Draft UIC Class II to Class VI Transition Guidance*.

3.2.2 *Re-permitting Wells from Class V to Class VI*

The UIC Program Director will need to determine whether an existing Class V experimental technology well's operating activities qualify as an experimental technology. The *Revised UIC Program Guidance (UIC PG) #83: Using the Class V Experimental Technology Well Classification for Pilot Geologic Sequestration Projects - 2011 Version* clarifies the options available for owners or operators of existing Class V experimental technology wells used for GS. These options include:

1. Applying for a Class VI permit;
2. Discussing renewal of the existing Class V experimental technology permit with the UIC Program Director, if the well is intended to be used solely for experimental research; or

3. Ceasing injection and properly closing the Class V experimental technology well.

Prior to finalization of the Class VI regulations, a number of carbon dioxide injection projects were permitted as Class V experimental technology wells for the purpose of testing GS technology. As the permits for these experimental projects expire (and if injection of carbon dioxide for the purpose of GS continues), the Class V experimental technology wells must be re-permitted as Class VI wells and be subject to all of the Class VI requirements before injecting for long-term storage. EPA is allowing the constructed components of Class V experimental technology wells to be re-permitted as Class VI wells at the discretion of the UIC Program Director and pursuant to requirements at 40 CFR 146.81(c).

All wells used for the long-term containment of a gaseous, liquid, or supercritical carbon dioxide stream in subsurface geologic formations will need a Class VI permit. Only GS projects of an experimental nature (i.e., those projects whose primary purpose is to test new, unproven technologies and collect data) will continue to be permitted and regulated as Class V experimental technology wells. EPA does not consider it appropriate to permit carbon dioxide injection wells that are testing the injectivity or appropriateness of an individual formation (e.g., as a prelude to a commercial-scale operation) as Class V experimental technology wells. Such wells must be permitted as Class VI wells and the construction, operation, or maintenance of any non-experimental technology Class V well is prohibited at 40 CFR 144.15.

In determining whether to re-permit a GS well as Class V experimental technology well, the UIC Program Director may consider whether conditions that were part of the previous permit are still appropriate or whether additional conditions for the new permit are necessary to address the proposed research to be conducted and/or to address new considerations for GS projects resulting from the UIC Class VI GS Rule. The Revised UIC PG #83 will clarify the process of re-permitting of Class V experimental technology projects as Class VI wells and the future use of the Class V experimental technology well subclass for research and testing of new GS technology. Refer to EPA's website at: <http://water.epa.gov/type/groundwater/uic/class6/gsclass6wells.cfm> for additional information once the guidance is available.

3.2.3 Continuation of Expiring Permits

Under 40 CFR 144.37(a), EPA-issued permits for Class I, II, or V injection wells may be continued even if the permit has expired if the permittee has submitted a complete application in a timely manner. The continuance may only be issued for the original well class and for the purpose for which the injection well was originally approved. For example, an expiring Class V experimental technology well permit issued by EPA may be continued if the Class V well is still experimental in nature and the same permit conditions would apply to continued operation. Owners or operators may not utilize a continuance in order to avoid or delay submitting an application for a Class VI permit. If EPA finds that a well owner or operator seeking a continuance is actually operating as a Class VI injection well without an approved Class VI permit, the owner or operator would be in violation of 40 CFR 144.11 for injecting without a permit and will be subject to necessary actions taken under SDWA Section 1423.

3.3 Environmental Justice Considerations for UIC Program Directors and Permit Writers

EPA recommends that environmental justice (EJ) considerations become a routine part of implementing a UIC Class VI Program, including the UIC Program Director's evaluation of a Class VI permit application. EPA published a draft plan in July 2010 (Plan EJ 2014) to strengthen efforts to integrate EJ into EPA programs and promote continuous, meaningful engagement with communities and stakeholders, as EJ is one of the EPA Administrator's priorities.

As noted in Presidential Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7269, Feb. 16, 1994), "federal agencies shall make achieving environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations in the United States and its territories." While state agencies are not obligated to adopt the Executive Order, EPA is working on tools, strategies, and guidance to assist with incorporating EJ considerations into its programs, policies, and activities, including UIC direct implementation (DI) programs in states without UIC Program primacy.

EPA defines EJ as the fair treatment and meaningful involvement of all people during the development, implementation, and enforcement of environmental laws, regulations, and policies, regardless of race, color, national origin, or income. To help achieve EPA's goal for EJ, the Agency considers factors related to the public health and environmental conditions affecting minority and low-income populations when making decisions and developing regulations (www.epa.gov/compliance/environmentaljustice/index.html).

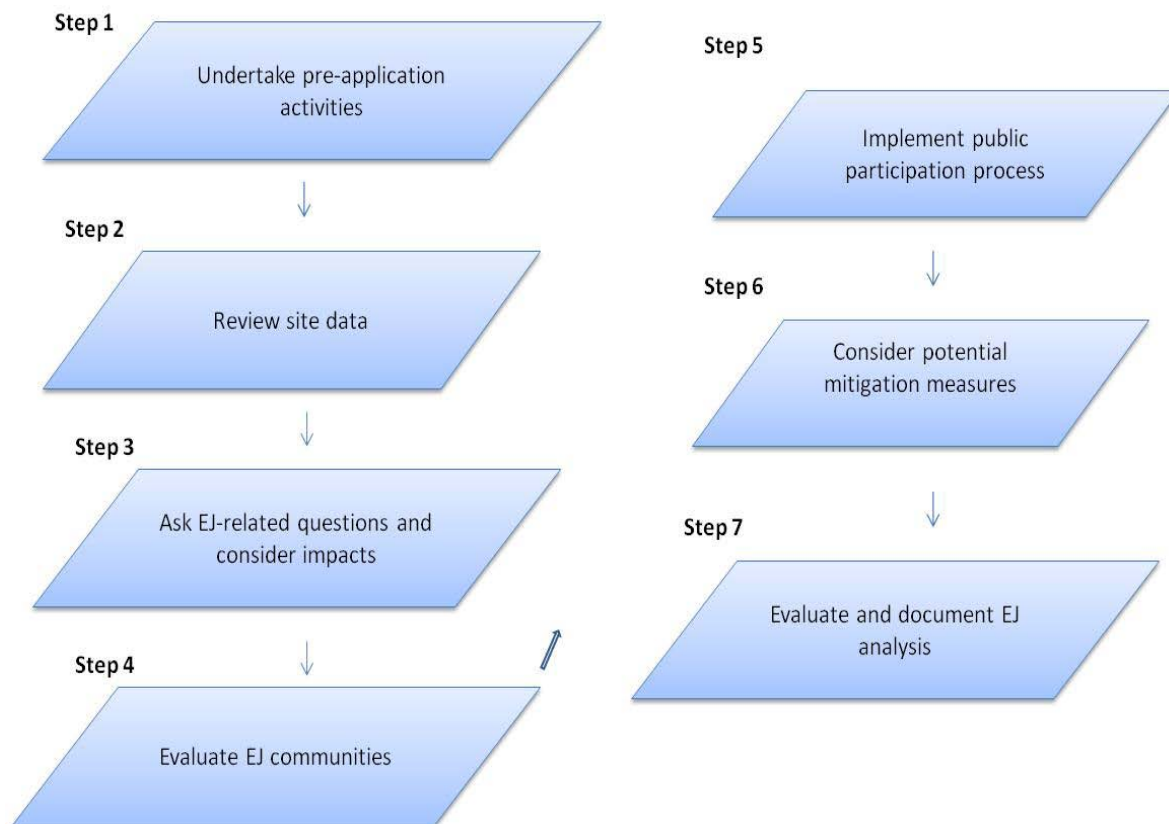
In developing the Class VI regulations, EPA examined EJ issues by considering the potential impact of future Class VI wells and corresponding GS operations on the public. EPA determined that the GS Rule will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it increases the level of environmental protection for all affected populations. The purpose of the GS Rule is to protect USDWs through permitting, siting, construction, operation, injection, post-injection site care (PISC), and site closure requirements for the underground injection of carbon dioxide. While the underground injection from carbon dioxide is currently a voluntary activity, the Class VI requirements are in place to minimize potential health risks to populations living in areas within or near the delineated injection well area of review (AoR) or in the anticipated direction of the carbon dioxide plume and pressure front. Therefore, the UIC Program Director has a public health protection role, and is recommended to examine the potential risks of a proposed Class VI injection well within his or her jurisdiction to identify and address any particular impacts on minority and low-income populations.

Any regulatory issues covered by the UIC Program – including the approval of the expansion of the areal extent of an aquifer exemption for a proposed Class VI injection well; the prevention of endangerment to USDWs; the delineated, computer-modeled AoR; and the required financial responsibility demonstration – will need to be factored into Class VI injection well permit applications, state UIC Program primacy applications, and the UIC Program Director's review and decision-making process for any proposed Class VI injection well.

3.3.1 Steps for UIC Program Directors and Permit Writers to Consider in Conducting EJ Analyses

EPA recommends the following steps when conducting an EJ analysis during the Class VI permit application review process. For a more detailed discussion of potential EJ analysis, see the UIC Quick Reference Guide *Additional Tools for UIC Directors Incorporating Environmental Justice Considerations into the Class VI Injection Well Permitting Process* on the EPA website at <http://water.epa.gov/type/groundwater/uic/class6/gsinformation.cfm>

Figure 2: Incorporating EJ Considerations into a Class VI Permit Application Review



Step 1. If the permitting agency learns of an incoming permit application prior to its official submittal, the UIC Program Director can undertake pre-application activities, such as working with the owner or operator to initiate discussions with the public. These pre-application activities can also help preliminary assessments of whether EJ issues may be present for a particular permit review. In addition, UIC Program Directors and permit writers may consider examining the geologic site characteristics identified in the permit application, including site maps, other characterization data, the proposed AoR computational model parameters, and the AoR and Corrective Action Plan (including any plan updates), to determine if any minority or low-income communities might be impacted by the proposed activity in the Class VI permit application.

Step 2. To understand whether there are communities with EJ concerns at a proposed injection well site, UIC Program Directors and permit writers may determine that an evaluation of the surrounding communities, which considers environmental hazards, potential exposure pathways, vulnerable sub-populations, and impacts, would provide useful information. This may include

conducting a demographic profile to assist in identifying minority or low-income communities that may be disproportionately impacted by a proposed injection well site. Directors could also determine whether, on a national or regional scale, the communities located in the area have been experiencing cumulative exposure risks that may need to be taken into consideration.

Step 3. UIC Program Directors and permit writers may choose to consider EJ-related questions when evaluating the permit application information submitted. Permit writers may also choose to raise EJ-related questions with the proposed Class VI injection well owner or operator. Sample EJ questions include:

- Will siting the proposed Class VI injection well at the proposed location exacerbate any existing disproportionate impacts to minority and low-income communities within the delineated AoR?
- Will there be any additional environmental or health impacts on minority and low-income communities from the siting of this proposed Class VI injection well with respect to exposure and susceptibility to potential environmental hazards?
- What is the likely distribution of any identified environmental and public health benefits from this proposed Class VI injection well in communities within the delineated AoR?
- Are there maps or other tools available that may assist with communicating to the communities about the proposed injection well, and with soliciting input on the proposal from these communities?
- If minority and low-income communities might be affected by the proposed Class VI injection well, can the owner or operator or UIC Program Director undertake any potential mitigation measures to reduce exposure and improve community security and acceptance of the proposal?

Step 4. To gauge whether there are communities with EJ considerations at or near a proposed Class VI well site, UIC Program Directors and permit writers might consider an evaluation of the demographic composition of surrounding communities. Any potential benefits or impacts from the proposed GS project on these communities should be included in the evaluation. An evaluation may also consider the presence of existing environmental hazards, potential exposure pathways, and susceptible sub-populations.

There are tools available to assist with conducting a demographic profile of a particular geographic location. The EPA Office of Environmental Justice (OEJ) recently released EJVIEW. The EJVIEW mapping tool is a Geographic Information System (GIS) platform designed to supply the public, EPA, and partners with information about communities including demographics, environmental conditions, and health. Currently, the tool enables users to select and overlay social, environmental, economic, health, and other topographical data about a place to examine potential environmental burdens and other socioeconomic characteristics. In addition, relevant U.S. Census data can be used to help conduct a demographic analysis for a particular geographic location.

OEJ has highlighted some key factors that may assist UIC Program Directors and owners or operators of proposed Class VI injection wells in evaluating whether a community may be disproportionately impacted by the proposed activity. EPA recently published the *Interim Guidance on Considering Environmental Justice during the Development of an Action*, located on EPA's website at www.epa.gov/environmentaljustice/resources/policy/ej-rulemaking.html. Information on these factors can be found on page 6 of the *Interim Guidance*. Also, additional information on EJ analysis tools can be found on page 12 of the *Interim Guidance*. A review of the OEJ *Interim Guidance* may help UIC Program Directors and permit writers identify EJ issues and challenges that could occur during implementation of a UIC Class VI Program.

Some of the relevant factors to evaluate for a proposed GS site include:

- Cumulative impacts of all the permitted facilities in the area.
- Proximity and exposure to existing and potential additional environmental hazards.
- Unique exposure pathways.
- Vulnerable sub-populations.

Step 5. UIC Program Directors should consider that creating opportunities for meaningful involvement of community residents potentially impacted by the Class VI well operation can increase public confidence and acceptance of the project. This may involve implementing an inclusive public participation process that presents opportunities for communities to receive early notice of proposed Class VI activities, participating in “pre-application” discussions that may take place between the proposed Class VI injection well owner or operator and the UIC Program Director, or to provide face-to-face or written feedback on the permit application, as well as participate in public hearings and other forms of participation in the permitting process. The UIC Program Director shall also provide a response to comments presented by community residents participating in the process.

To improve feedback (face-to-face and/or written) on the permit application, as well as participation in public hearings and other forms of public involvement, the UIC Program Director may translate informational materials into other languages spoken in the affected communities, put flyers up in key community gathering locations, provide sufficient time for the word to spread on public comment and hearings, and decide to reach out directly to individual communities to set up a process for successful meaningful community involvement. UIC Program Directors may choose to work with proposed injection well owners or operators to provide targeted outreach and information to communities (EJ and other) residing within the delineated AoR of a proposed Class VI well. In particular, UIC Program Directors must ensure early and meaningful public input and participation from the most affected communities as soon as possible in the permit evaluation and approval process (pursuant to requirements at 40 CFR 124). The public, including potentially affected communities, must have an opportunity to: be notified of pending permit actions, review public notices on Class VI permit applications, provide input that may shape permitting decisions, participate in hearings related to permit determinations, and inform permit writers of any concerns associated with a proposed Class VI injection well. Section 3.3.2., below, includes further information on public participation requirements.

Step 6. UIC Program Directors can work with owners or operators during the application review process to develop any appropriate measures that would reduce or mitigate any potential impacts of a proposed Class VI injection well. Additionally, UIC Program Directors can work with owners or operators to help reduce any adverse impacts from construction and operational activities or by requiring additional monitoring in areas with identified communities that may be impacted by the activities. Other mitigation measures can involve encouraging owners or operators to improve environmental amenities for the communities identified within the delineated AoR (e.g., provide resources for clean-up of degraded public areas), or requesting that the owner or operator ensure broad advertisement in all communities about potential employment opportunities at the proposed project site.

Step 7. Once the core activities for an EJ analysis and the required public participation activities have been completed, UIC Program Directors and owners or operators can evaluate any lessons learned throughout the process. One way to accomplish this is to conduct surveys and focus groups in the identified EJ communities to assess what information about the proposed Class VI project site was absorbed, and to determine if any community concerns about the environment, health, and economic well-being still exist.

UIC Program Directors might also consider documenting the following:

- Any EJ analysis processes conducted during the permit review;
- Steps taken to ensure meaningful public involvement; and
- Any mitigation measures implemented within identified EJ communities within the AoR.

Documenting the response to public comments received during the public participation process is required at 40 CFR 124.17. Documenting the EJ analysis undertaken and any lessons learned can also improve any future Class VI permit review, and help improve community understanding and acceptance of future projects.

3.3.2 UIC Public Participation Requirements for Implementing Class VI Programs and Evaluating Proposed Class VI Permit Applications

The GS Rule adopts the existing public participation requirements at 40 CFR 25 and permitting procedures at 40 CFR 124. These requirements discuss: 1) providing public notice to interested parties of pending actions via newspaper advertisements, radio, mailings, or e-mails; 2) holding public hearings; soliciting and responding to public comment; and, 3) involving a broad range of stakeholders [40 CFR 124.10].

EPA amended the public notice and comment requirements at 40 CFR 124.10 in the UIC Class VI GS Rule to clarify that, in addition to notifying the general public, the UIC Program Director must provide public notice of Class VI permitting activities to state and local oil and gas regulatory agencies, state agencies regulating mineral exploration and recovery, the Director of the Public Water System Supervision (PWSS) program in the state, and all other agencies that may have jurisdiction over injection activities within the state [40 CFR 124.10(c)(1)(xi)]. The

UIC Program Director must send copies of public notification materials (e.g., notice of public hearing, transcripts of hearings) to EPA.

The UIC Program Director may choose to achieve economies of scale by conducting the public notification process for several proposed Class VI permits simultaneously, if allowed by state law. However, local community residents potentially impacted by Class VI well operations should still be confident of government transparency and meaningful involvement during the permit review and evaluation process. Combined public notification for several permits may improve the efficiency of the evaluation process as well as public understanding of the potential impacts of multiple wells within the same general AoR. For each public hearing or meeting, the UIC Program Director may choose to coordinate with the proposed injection well owners or operators to organize and announce any scheduled hearings. Refer to Section 3.5 of this manual for additional information on communication planning.

The UIC Class VI GS Rule states that UIC Program Directors must also apply the public notice and participation requirements to all supplemental applications for Class VI injection depth waivers [40 CFR 146.95(c)]. Refer to Table 3.14 of this manual for more information on the contents of a supplemental waiver application. The UIC Program Director must give public notice that a waiver application has been submitted, and the notice must state:

- Depth of proposed injection zone.
- Location of injection well.
- Name and depth of all USDWs within the delineated AoR.
- Map of the AoR.
- Names of any public water supplies affected, reasonably likely to be affected, or served by USDWs in AoR.
- Results of UIC-PWSS Directors consultation pursuant to 40 CFR 146.95(b)(2).

Following the public notice, the UIC Program Director must provide all information received through the waiver application process to the appropriate EPA Regional Administrator (RA) [40 CFR 146.95(d)]. If the RA determines that additional information is required to support a determination on the proposed Class VI injection well, the UIC Program Director will need to provide the information, and the RA may require additional public notice based on the new information.

3.3.3 Basic Steps for Effective Public Involvement

Public involvement in permitting decisions is a critical component of GS Rule implementation, particularly because GS is a relatively new technology. EPA defines public involvement as the full range of activities that can be used to engage the American people in environmental decision making processes. Providing all affected communities, including minority, low-income, and indigenous communities, with the means to affect the decision making processes that impact their communities can:

1. Educate the community about GS and the proposed Class VI injection well – both the benefits and risks – as a potential climate change mitigation technology.
2. Allow the UIC Program Director, and owners or operators, to become aware of public preferences, perceptions, and EJ concerns, in order to work towards addressing these issues in the final permit.

As noted above, the UIC Class VI GS Rule (75 FR 77230) adopts the existing UIC Program public participation requirements at 40 CFR 25 and permitting procedures at 40 CFR 124 for Class VI injection wells. However, in addition to meeting the GS Rule requirements, EPA strongly encourages UIC Program Directors to work with owners or operators to provide information on the proposed Class VI injection well permit application as early as possible in the evaluation and approval process. EPA expects that there will be high levels of public interest in GS. Therefore, UIC Program Directors can increase the likelihood of Class VI injection well permitting success by integrating the social, economic, and cultural concerns of the community into the permit decision-making process.

The EPA public involvement policy and public involvement web pages are additional resources designed to assist in addressing community issues. See www.epa.gov/publicinvolvement, as well as the International Association for Public Participation materials at www.IAP2.org.

EPA's 7 Basic Steps for Effective Public Involvement: (Source: EPA Public Involvement Policy available at: www.epa.gov/publicinvolvement/public/index.htm)

1. Plan and budget for public involvement activities.
2. Identify interested and affected communities.
3. Consider providing technical or financial assistance to facilitate public involvement.
4. Provide information to the public.
5. Conduct public consultation and involvement activities.
6. Use public input as appropriate and provide feedback to the public.
7. Evaluate public involvement activities to help inform the next public involvement process.

For more guidance on public involvement and the GS Rule, also see the UIC Quick Reference Guide *Additional Tools and Considerations for UIC Directors on the Public Participation Requirements for Class VI Wells* found on the EPA website at <http://water.epa.gov/type/groundwater/uic/class6/gsinformation.cfm>

3.4 Class VI Program Communication

Because of the unique nature of Class VI wells, EPA encourages UIC Program Directors to undertake effective communications efforts with other states, tribes, local officials, the public, and other stakeholder groups regarding GS projects and Class VI injection. For instance, UIC

Program Directors may choose to work more closely than they have in the past with their state public water system supervision (PWSS) program counterparts when USDWs that supply drinking water systems are determined to be located under the injection site. UIC Program Directors may also choose to develop communication plans for any permit decisions involving interstate considerations, such as when the delineated AoR of a Class VI injection well involves more than one jurisdiction or where an allowance for an injection depth waiver in one location may impact USDWs in other jurisdictions. EPA has developed a template for assistance in developing a communication plan. The communication plan template is available along with the issue paper mentioned above on the public participation requirements for the Class VI injection well permitting process.

3.4.1 Interstate Communication

The UIC Class VI GS Rule requires that UIC Program Directors work with owners or operators to identify all state, tribal, and territorial boundaries located within the delineated AoR for a Class VI well. Based on the information provided by the state in its primacy application, and by the owner or operator in a Class VI injection well permit application, the UIC Program Director, pursuant to requirements at 40 CFR 146.82(b), must provide written notification to all states, tribes, and territories in the AoR to inform them of pending permit application decisions and to ensure that these neighboring jurisdictional officials are involved in any necessary processes during permit approval and/or injection well operations (e.g., development of the Emergency and Remedial Response (E&RR) Plan).

These permit application notification requirements are intended to help begin the dialogue across jurisdictional boundaries, as both the AoR and injection volumes for Class VI wells are anticipated to be larger than in other UIC practices. Transparency in the permitting process is encouraged by EPA. Effective communication among states, tribes, and local governments on GS permitting will facilitate information sharing and encourage safe, protective projects. For additional information, refer to Appendix G of this manual for an example interstate coordination letter from the UIC Program Director to neighboring jurisdictional officials, and refer to the UIC Quick Reference Guide, *Additional Considerations for UIC Directors on the Interstate Coordination Requirements for the Class VI Injection Well Permitting Process* found at <http://water.epa.gov/type/groundwater/uic/class6/gsinformation.cfm>

3.4.2 Public Communication

UIC Program Directors can use various outreach tools to communicate with stakeholders about GS projects, including pending permit applications. For instance, in addition to direct communication, UIC Program Directors may choose to conduct broad outreach through traditional methods such as newspapers, public service announcements, and web pages. In addition, UIC Program Directors can use new forms of information technology to improve communication, public involvement, and understanding of GS projects. For instance, UIC Program Directors may want to realize the potential value of social media as a public outreach tool. Social media, which are primarily Internet and mobile based technologies for disseminating and discussing information, can help provide accessibility and transparency to a wide audience. Some social media tools that may be useful for sharing information on GS projects include blogs, social networks, podcasts, and webcasts. EPA encourages UIC Program Directors to use the Internet and other forms of social media to explain potential GS projects, describe GS

technologies, and post information on the latest developments related to a GS project, including schedules for hearings, briefings, and other opportunities for involvement. Note that outreach efforts cannot be performed in lieu of the public participation requirements found at 40 CFR 124.

UIC Program Directors may choose to work with owners or operators to develop a communications plan for each Class VI well that could describe: potentially affected parties (e.g., PWSs, other states or tribes, landowners); potential audiences (e.g., public, community leaders); communication methods (e.g., newspapers, Internet); key messages; and agreed upon approaches to any trans-boundary considerations that will need further coordination and good communication (e.g. implementation of any emergency response).

For more information, refer to the *Underground Injection Control (UIC) Class VI Program Public Participation Considerations for Geologic Sequestration Projects Fact Sheet* on EPA's website at <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm> and the UIC Quick Reference Guides *Additional Tools and Considerations for UIC Directors on the Public Participation Requirements for Class VI Wells* and *Additional Considerations for UIC Directors on the Interstate Coordination Requirements for the Class VI Injection Well Permitting Process* mentioned previously, and found on the EPA website at <http://water.epa.gov/type/groundwater/uic/class6/gsinformation.cfm>

In addition, Section 6.0 of the *Draft UIC Class VI Program Project Plan Development Guidance for Owners and Operators*, available on EPA's website at <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm> will provide more information clarifying the development of the required Class VI injection well Emergency and Remedial Response Plan.

3.5 Permit Modifications

After a Class VI permit is issued, certain circumstances may arise that require modification of the permit. The UIC Class VI regulations differentiate between permit modifications pursuant to 40 CFR 144.39 and minor modifications pursuant to 40 CFR 144.41. Permit modifications require additional public notification procedures according to 40 CFR 124, including: 1) public review of both the existing permit and the new information; 2) solicitation and consideration of public comments; and, 3) public hearings. Refer back to Section 3.3.2 for information on public notification and participation procedures.

The UIC Class VI GS Rule clarifies that changes to any of the five required project plans (AoR and Corrective Action, Testing and Monitoring, Emergency and Remedial Response, Injection Well Plugging, and PISC and Site Closure) may warrant permit modifications pursuant to 40 CFR 144.39(a)(5). For example, amended project plans that must be incorporated into the Class VI operating permit would constitute a modification of the permit and trigger requirements under 40 CFR 144.39. Unless the modification to the permit is a minor modification as defined at 40 CFR 144.41, a draft permit must be prepared and other procedures in 40 CFR 124 must be followed. The UIC Program Director will need to determine whether a modification to the permit is necessary, and through consultation with the owner or operator, can choose to provide public notice of permit modifications either individually or collectively, concurrently with the 5-year AoR reevaluation and subsequent permit review schedule (i.e., the UIC Program Director may announce multiple permit modifications at once, at a minimum of every 5 years).

See Figure 3, below, for an example list of the types of permit modifications; note that Figure 3 is not an exhaustive list of all permit modifications the UIC Program Director may encounter. Minor changes to the five required project plans (e.g., correction of typographical errors) would constitute a minor permit modification. Any modification to a permit must be approved by the UIC Program Director before incorporation, regardless of whether the modification results in public notification procedures.

Figure 3: Class VI Permit Modifications

<p style="text-align: center;">Examples of Modifications Pursuant to 40 CFR 144.39(a)</p> <ul style="list-style-type: none"> • Alterations or additions to the facility. • Additional information which was not available at the time of permit issuance which would have justified different permit conditions. • Modification of compliance schedule due to an event over which the permittee has little or no control and for which there is no reasonably available remedy (e.g., flood). • Revision of the site computational model and AoR delineation during AoR reevaluation, based on new monitoring, site characterization, or operational data. • Revisions to the AoR and Corrective Action Plan, Testing and Monitoring Plan, Injection Well Plugging Plan, PISC and Site Closure Plan, or Emergency and Remedial Response Plan that serve to substantially change the plan as determined by the UIC Program Director. • A review of operational monitoring and/or testing results by the UIC Program Director highlights that a permit modification is necessary.
<p style="text-align: center;">Examples of Minor Modifications Pursuant to 40 CFR 144.41</p> <ul style="list-style-type: none"> • Correct typographical errors. • Require more frequent monitoring or reporting. • Change in interim compliance date; as long as the new date is not more than 120 days after the date specified in the existing permit, and must not interfere with the attainment of the final compliance date. • Change in quantities or types of fluids injected; as long as the change would not interfere with the operation of the facility, or its ability to meet the conditions of the original permit, and the change would not change the UIC well classification of the permitted injection well. • Change in ownership of operational control of facility; as long as no other permit change is necessary, and a written agreement between Class VI injection well owners is submitted to the UIC Program Director with the specific date for transfer of permit responsibility, financial responsibility demonstration, and liability. • Change in construction requirements. • Revisions to the AoR and Corrective Action Plan, Testing and Monitoring Plan, Injection Well Plugging Plan, PISC and Site Closure Plan, or Emergency and Remedial Response Plan that serve only to clarify, correct, or update the plan as determined by the UIC Program Director.

3.6 UIC Program Director Evaluation of Permit Application Information and Supplemental Data Submissions

The UIC Program Director is responsible for evaluating data and information submitted by owners or operators of proposed Class VI injection wells to determine whether the requirements set forth in the GS Rule have been met. For each GS Rule Class VI requirement under 40 CFR

146 Subpart H, this series of tables below provides information to the UIC Program Director on the required information and data to expect to see, acceptable information collection, evaluation of methods and technologies, and other special considerations. The information addressed in the tables below includes permit applications, aspects of AoR evaluations/reevaluations and project plan reviews, and other prescribed data and/or reports submitted. Actions both required and recommended under the UIC Class VI GS Rule will be explained to support the UIC Program Director in effectively implementing and executing the Class VI Program.

The UIC Program Director must evaluate permit applications submitted by owners or operators to determine whether the application is complete and may be approved [40 CFR 146.82]. The UIC Program Director may consider undertaking “pre-application” discussions with a proposed Class VI injection well owner or operator to gain a better understanding of the site-specific conditions and the permit application to be submitted. In addition to the information required by the GS Rule, the UIC Program Director has the discretion to request any additional information that will better inform his or her determination concerning permit completeness and accuracy [40 CFR 146.82(a)(21) and 146.82(c)(10)]. Appendix I of this manual includes a checklist of all required Class VI permit application materials.

3.6.1 General Information about Class VI Permits

Class VI permits are issued for the operating life of the GS facility and the PISC period. The UIC Program Director must review each Class VI operating permit at least once every 5 years to determine whether it needs to be modified, revoked and reissued, or terminated [40 CFR 144.36(a)]. Permits can be subject to modifications; for an explanation of permit modifications and their associated requirements, refer back to Section 3.5 of this manual.

Permitting for Class VI wells differs from that of other injection well classes in various ways, and the UIC Program Director will need to be aware of these differences when evaluating Class VI permit applications:

- Area permits are not allowed for Class VI wells [40 CFR 144.33(a)(5)].
- Aquifer exemptions may only be used for Class VI injection wells if the owner or operator or UIC Program Director requests, and the EPA Administrator approves, an expansion of the areal extent of an existing Class II aquifer exemption for a Class VI well [40 CFR 144.7 and 146.4].
 - The areal extent of an aquifer exemption for a Class II well may only be expanded for Class VI injection if: 1) the aquifer does not currently serve as a source of drinking water; 2) the total dissolved solids (TDS) content of the ground water is more than 3,000 milligrams per liter (mg/L) and less than 10,000 mg/L; and, 3) the aquifer is not reasonably expected to supply a public water system. Other than EPA-approved expansions to the areal extent of an aquifer exemption that meet the criteria in 40 CFR 146.4(d), new aquifer exemptions must not be issued for Class VI injection wells.
 - The owner or operator of a Class II well that requests an expansion of the areal extent of an existing aquifer exemption must define and describe all aquifers or

partial aquifers to be exempted. In their request, the owner or operator must use narrative descriptions, illustrations, maps, or other means to define the aquifer and also utilize clear geographic and geometric terms, including but not limited to, vertical and lateral limits and gradients to describe the aquifer. In evaluating an aquifer exemption request, the UIC Program Director must determine that the request meets the criteria for exemptions. To evaluate the requested aquifer exemption, the UIC Program Director must consider the following (in the context of the Class VI permit information previously submitted):

- The current and potential future use of the exempted aquifers as drinking water resources.
 - The predicted extent of the injected carbon dioxide plume, and any mobilized fluids that may result in degradation of water quality, over the lifetime of the GS project. This demonstration is made using computational modeling performed for the AoR delineation and is intended to ensure that injection operation will not endanger USDWs or non-exempted portions of the injection formation.
 - Whether the areal extent of the expanded aquifer exemption is sufficiently large to account for any possible revisions to the computational model identified during AoR reevaluations.
 - Any information submitted to support an injection depth waiver request, if applicable (see Table 3.14 for more information).
- Class VI permits may not be automatically transferred from the permittee to a new owner or operator [40 CFR 144.38(b)].
 - If allowed by the state, injection depth waivers that enable injection above or between the lowermost USDW must be applied for, and submitted with, the permit application and approved by the Regional Administrator [40 CFR 146.82(d) and 146.95] (refer to Table 3.14 of this manual for more information regarding the evaluation of injection depth waiver applications, i.e., the supplemental report for the injection depth waiver application).

Upon receipt of the initial permit application materials required by 40 CFR 146.82(a), the UIC Program Director must notify any state, tribe, or territorial government representative, located within the AoR for the proposed Class VI injection well, of the Class VI permit application submitted by an owner or operator [40 CFR 146.82(b)]. For more information on public notification and participation requirements, refer back to Section 3.3.2 of this manual.

3.6.2 Required Class VI Data and Information

The remainder of Section 3 includes tables explaining the requirements of the major parts of the GS Rule at 40 CFR 146 Subpart H. There is a separate table for each part which states the requirement or submission and the GS Rule citation and explains the requirement in regards to: 1) the details of the submission; and, 2) the UIC Program Director's evaluation of the

submission, including situations for the UIC Program Director to request additional information. These tables can be used by the UIC Program Director as useful reference materials when evaluating Class VI permit applications and Class VI operations.

Table 3.1: Required Class VI Permit Information (40 CFR 146.82)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
<p>The GS Rule specifies separate requirements for information that must be submitted with the permit application [40 CFR 146.82(a)] and information that must be submitted before well operation is authorized [40 CFR 146.82(c)].</p> <p>The UIC Program Director will receive a series of comprehensive site-specific project plans with a Class VI permit application, including: an AoR and Corrective Action Plan; a Testing and Monitoring Plan; an Injection Well Plugging Plan; a Post-Injection Site Care and Site Closure Plan; and an Emergency and Remedial Response Plan. If any of the plans are missing or incomplete, the UIC Program Director will need to contact the owner or operator for a copy of the missing plan. The UIC Program Director will need to evaluate all of the comprehensive site-specific plans in the context of site characterization data, proposed construction information, and proposed operating data. This will ensure that planned activities at the facility meet all GS Rule requirements, are appropriate to the site-specific circumstances, and address all risks to USDWs.</p>				
Owner/operator submissions required with Class VI permit application [40 CFR 146.82(a)]				
1.	General application information	40 CFR 146.82(a)(1)	<p>The owner or operator must submit information required in 40 CFR 144.31 (e)(1) through (6), including:</p> <ul style="list-style-type: none"> • Facility name, location, and mailing address. • Operator's name, address, and telephone number. • Proposed permitted activities. • Authorization status (i.e., whether the well operator is also the well owner). • Ownership status. • Permit action type and date. • Up to four SIC/NAICS codes. • Status as a federal, state, private, public, or other entity. • Whether the facility is located in Indian country. 	<p>The UIC Program Director must evaluate permit applications submitted by owners or operators to determine whether the application is complete and may be approved. If the owner or operator does not provide all of this information, the UIC Program Director will not have enough information to make a determination on the permit application.</p> <p>In addition to the information required by the Class VI regulations, the UIC Program Director has the discretion to request any additional information that will better inform his or her determination concerning permit completeness and accuracy [40 CFR 146.82(a)(21) and 146.82(c)(10)].</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
2.	Map showing the injection well(s) for which the permit is sought and the applicable AoR	40 CFR 146.82(a)(2)	<p>The map of the injection well(s) and accompanying data and information will need to show the location and characteristics of all artificial penetrations (e.g., wells) that are located within the AoR. The information will need to demonstrate that no artificial penetrations exist that could serve as conduits for fluid movement and that any deficiencies will be addressed through corrective action (i.e., the proper plugging of these wells). The map must include the number, name (e.g., UIC permit well ID number, if previously assigned), and location of all:</p> <ul style="list-style-type: none"> • Injection wells. • Producing wells (e.g., oil and gas wells). • Abandoned wells. • Plugged wells. • Dry holes. • Deep stratigraphic boreholes. • State or EPA approved subsurface cleanup sites. • Surface bodies of water. • Springs • Mines (surface and subsurface). • Quarries. • Drinking water wells (may include Public Water System ID number). • Other pertinent surface features including structures intended for human occupancy, state, tribal, and territory boundaries, and roads. • Faults (known or suspected). 	<p>The UIC Program Director may ensure that all of the items are included on the map by verifying the sources of information used by the owner or operator to generate the map.</p> <p>In addition to the information required by these Rule subparts, the UIC Program Director has the discretion to request any additional information that will better inform his or her determination concerning permit completeness and accuracy [40 CFR 146.82(a)(21) and 146.82(c)(10)].</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>Only information of public record is required for the map. While only publicly-available information is required, EPA recommends that the owner or operator provide non-public records that will provide additional, pertinent information about the proposed GS site.</p> <p>It is recommended that the number, name, and location of all wells needing corrective action also be included.</p>	
3.	Maps and cross sections of the AoR	40 CFR 146.82(a)(3)(i)	<p>These materials must show the vertical and lateral extent of all USDWs within and around the AoR, the location of drinking water wells and springs within the AoR and relative to the injection zone(s), and the direction of ground water flow where known (including both the vertical and horizontal components of flow of all USDWs and aquifers). Maps and stratigraphic cross sections, along with accompanying materials, enable geologic assessments of USDWs and aquifers relative to the location of the injection and confining zones in support of the demonstration that the stratigraphy (the sequence of subsurface formations, aquifers, and USDWs) is appropriate for GS.</p>	<p>The UIC Program Director may verify the submitted information for consistency and may compare it against other available regional geologic maps and information. Cross sections are somewhat subjective because they are constructed by interpolating between available data points (e.g., well logs). It is recommended that the UIC Program Director be alert to potential alternative interpretations of the cross sections and other similar map information.</p> <p>The UIC Program Director may request additional information if, among other things, he or she observes inconsistencies among the submitted information or suspects that a cross section or other piece of information may not accurately represent the subsurface. The UIC Program Director may ask for additional information on geophysical surveys:</p> <ol style="list-style-type: none"> 1. If correlation between seismic survey lines, cross sections, borehole data (i.e., cores and logs), and other data sources is ambiguous or appears inadequately justified. 2. If lithologies or other features in the area known to complicate geophysical surveys are present. 3. If alternate explanations of non-unique data (e.g., electromagnetic, gravity) are also available.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
4.	Location, orientation, and properties of known or suspected faults and fractures and a determination that they would not interfere with containment	40 CFR 146.82(a)(3)(ii)	<p>The owner or operator must submit to the UIC Program Director information to indicate the location and orientation of known or suspected faults and fractures that may transect the confining zone(s) in the AoR and a determination that they would not interfere with containment. This information may be presented and assessed with the same maps and cross sections used to characterize the injection zone. The results of geophysical surveys (e.g., gravity or seismic surveys) may also help to characterize the confining units.</p> <p>It is recommended that the owner or operator provide an evaluation of the transmissive properties of any major faults that penetrate the confining zones. Through assessment of the associated data, the evaluation will determine if a fault is transmissive. Transmissive faults are not sealing and may allow the movement of fluids; non-transmissive faults are sealing and impermeable to fluid movement. There are several approaches for evaluating fault sealing, including analysis of fault gouge.</p>	<p>When reviewing the submitted evaluation, EPA recommends that the UIC Program Director consider whether faults or fractures penetrate the entire confining zone or if they occur as a series of smaller faults or fractures that may collectively provide a conduit for fluids.</p> <p>In their approach to performing an analysis of fault sealing ability, the UIC Program Director will ensure that he or she agrees with the method selected and that the data used for the analysis are sound. Details of these methods are provided in the <i>Draft UIC Program Class VI Well Site Characterization Guidance</i>.</p> <p>When characterization of the confining zones and subsurface geology reveals previously unknown faults, fractures, or other features that were unexpected or anomalous for the region or geologic regime, additional data may be needed to ensure that the previously unknown features are adequately characterized and that other unexpected features have not been overlooked.</p>
5.	Data on the depth, areal extent, and thickness of the injection formation and confining zone(s)	40 CFR 146.82(a)(3)(iii)	The owner or operator must provide data on the depth, areal extent, and thickness of the injection formation and confining zone(s). Geophysical surveys are likely to be used to determine or support many of the site characterization requirements that relate to structure or lithology. Seismic, gravity, electromagnetic, and magnetic surveys are the most commonly used	The UIC Program Director will need to verify that the lateral extent of the injection formation is greater than the AoR. The UIC Program Director may use his or her best professional judgment to determine how much of a margin of safety is needed when estimating the areal extent of the injection formation. EPA recommends that the margin of safety be sufficiently large at the beginning of the GS project, and may reduce in size over the lifespan of the project, as appropriate. Site and regional cross sections will help the UIC Program

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			types of geophysical surveys. They may be deployed aerially, on the surface, or in the subsurface through boreholes or other penetrations. EPA recommends that the rationale for any geophysical surveys used be clearly explained to the UIC Program Director. In addition, descriptions of any site-specific processing or data-collection methods used to overcome sources of interference or data error will be useful to the UIC Program Director in determining the applicability and suitability of the survey.	<p>Director confirm that the injection formation lies at a depth below the lowermost USDW and is overlain by a confining unit of suitable lithology and areal extent. Results of geophysical surveys will be useful for the UIC Program Director for verifying the thickness and extent of the injection formation and the confining zone(s).</p> <p>Geophysical methods are described in the <i>Draft UIC Program Class VI Well Site Characterization Guidance</i>. Geologic logs from wells or boreholes can be used to better understand the lithology and estimate the thickness of the various units. If provided, the potential survey resolution will help the UIC Program Director determine if the survey is capable of imaging features of interest at an appropriate scale.</p>
6.	Data on the mineralogy, porosity, permeability, and capillary pressure of the injection and confining zones	40 CFR 146.82(a)(3)(iii)	<p>Additional data are needed to demonstrate that the injection zone can accommodate the proposed injection rates and quantities, and that the confining zone will provide adequate confinement. The owner or operator must submit data and information that characterize solids in both the injection and confining zones. This information may be obtained through laboratory testing based on cuttings and samples collected during drilling. Mineralogical analyses that the UIC Program Director may encounter include:</p> <ul style="list-style-type: none"> • Petrographic analysis that identifies minerals, textures, and grain sizes. • Scanning electron microscopy pictures that identify minerals by chemical composition. • Potential drinking water contaminant laboratory reports (e.g., arsenic, lead). 	<p>The UIC Program Director may ensure that the methods of analysis are specified and that quality assurance information (e.g., duplicate measurements) is provided, where applicable. The UIC Program Director may consider whether an appropriate number of data points were submitted. For example, if other data suggest significant facies changes in the injection zone, the permeability may be spatially variable, and the UIC Program Director will want to verify that he or she agrees that the number and locations of samples collected adequately demonstrate the permeability, injectivity, and storage capacity of the injection zone. Because laboratory analyses are point measurements, it is recommended that the UIC Program Director consider whether samples were taken at different points along the core to obtain a range of values.</p> <p>The UIC Program Director may verify that the values of porosity and permeability are high enough in the injection zone to allow injection at pressures that will not fracture the confining zone and low enough in the confining zone to prevent migration of carbon dioxide or brine out of the injection zone. Typical values of permeability and porosity for various lithologies are</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<ul style="list-style-type: none"> • X-ray diffraction analysis that identifies mineral structure. <p>Because confining zone materials (e.g., clays, shales) have very fine grain sizes, x-ray diffraction analyses may be specifically requested to provide a more complete evaluation of the mineralogy in such fine materials.</p> <p>The owner or operator will also need to provide data and information that characterize the porosity, permeability, and capillary pressure of the injection and confining zones. Porosity may be measured by neutron logging in the field and by laboratory analyses of core samples. Permeability may be measured by laboratory analyses of core samples using gas or liquid permeability testing methods (steady state or non-steady state). Field methods, such as pump tests, can also be considered for determining permeability, if the depth of the formation to be tested does not prohibit use of these field methods. Capillary pressure may be measured in situ using down-hole logs or by laboratory testing of core samples. It is recommended that calculations for injectivity and pore volume be provided (minus irreducible water saturation). Refer to Table 3.6 for additional information on the testing used to provide this information.</p>	<p>available in the literature and can be used for reference. A high capillary pressure in the confining zone provides a better seal; discussions of appropriate capillary pressure values are also available in the literature. The UIC Program Director may also consider limitations of the various methods and be cognizant whether any of the methods tend towards underestimating or overestimating porosity or permeability. Porosity measurements are further described in the <i>Draft UIC Program Class VI Well Site Characterization Guidance</i>.</p> <p>It is recommended that the UIC Program Director ensure that this information is adequately accounted for in computational modeling of the AoR.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
7.	Data on geology/facies changes based on field data	40 CFR 146.82(a)(3)(iii)	<p>Facies changes can signal important changes in properties of the injection and/or confining zones, such as porosity and permeability, and the presence of mineral constituents that may leach drinking water contaminants. Therefore, facies analysis can help anticipate such potential changes and determine whether interbedded layers of lower permeability material are located within the target formation (“compartmentalization”) that can negatively affect injectivity, permeability, and storage capacity. The owner or operator may submit data for facies analysis from cores (e.g., mineralogy, lithology, grain size, texture), borehole logs (e.g., density or gamma ray logs), and possibly seismic survey data to determine the characteristics of the rock units and their depositional environments. The owner or operator may also submit geologic maps and accompanying stratigraphic cross sections and columns, well logs, and wireline logs. Correlation of the various data sources can provide a 3-dimensional (3D) representation of the subsurface stratigraphy.</p> <p>Refer to Table 3.6 for additional information on the testing used to provide this information.</p>	<p>To assess the accuracy of the data, the UIC Program Director will need to ensure that the methods of analysis are specified and applicable quality assurance information is provided by the owner or operator of the proposed Class VI injection well. In support of areas of noted facies changes, appropriate quality assurance information will be useful. It is recommended that the UIC Program Director consider whether an appropriate number of data points were submitted for a site with complex geology.</p> <p>It is recommended that the UIC Program Director ensure that this information is adequately accounted for in computational modeling of the AoR.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
8.	Geomechanical information on fractures, stress, ductility, rock strength, and in situ fluid pressures within the confining zone(s)	40 CFR 146.82(a)(3)(iv)	<p>The owner or operator must submit data regarding pore pressure, in situ stresses (e.g., magnitude and orientation of the vertical stress, minimum and maximum horizontal stress), rock strength, and faults and fractures. Information and data provided may include:</p> <ol style="list-style-type: none"> 1. Stress tensor (e.g., vertical stress, minimum and maximum horizontal stress). 2. Geomechanical model, including wireline logs and well bore imaging (e.g., formation microresistivity imager logs). 3. Subsurface pressure measurements and leak-off tests. 4. Laboratory measurements of rock strength. 5. Evaluation and interpretation of available data (e.g., frictional limit calculations, development of stress profiles and maps, failure plots, fault slip tendency calculations). <p>Methods used to predict geomechanical effects of carbon dioxide injection include failure plots, fault slip tendency estimates, and critical pore fluid pressure increase estimates. Refer to Table 3.6 for additional information on the testing used to provide this information.</p>	<p>The UIC Program Director may verify the usefulness of field pressure-testing data as a good measure of least principal stress by comparing site results to acceptable industry standards. The UIC Program Director may confirm predictions of the geomechanical effects of carbon dioxide injection on fault stability, reservoir rock stability, and top seal integrity by reviewing the methods that were used to develop these predictions. For more information on methods used to predict geomechanical effects of carbon dioxide injection, refer to the <i>Draft UIC Class VI Program Well Site Characterization Guidance</i>.</p> <p>It is recommended that the UIC Program Director ensure that this information is adequately accounted for in computational modeling of the AoR. The UIC Program Director will also consider this information to calculate or verify the owner or operator's proposed injection pressure.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
9.	Information on seismic history, including the presence and depth of seismic sources, and a determination that the seismicity would not interfere with containment	40 CFR 146.82(a)(3)(v)	<p>The owner or operator must submit information on seismicity, including a history of any seismic events in the region, depths of focus, and whether they caused movement along faults that intersect the injection and/or confining zones. It is recommended that the magnitude and epicenters of seismic events also be included. Seismic history information and seismic hazard information may be available from USGS, state geologic surveys, or universities with seismology programs. USGS, in particular, has historical information as well as material on earthquake hazards.</p> <p>Fault analysis using existing data may help in determining whether faults are non-transmissive (i.e., sealing and impermeable) or have remained non-transmissive, even with evidence of subsequent periods of seismic activity and/or fault displacement.</p>	<p>In evaluating seismic risk, the UIC Program Director may consider the magnitude, frequency, displacement, and locations of historical seismic events relative to the project site. Concern may be raised if the proposed project site is located close to a major fault system with anticipated seismic activity of a large magnitude. If the confining zone is intersected by faults, the UIC Program Director may consider if those faults have experienced recent seismic activity and if they experienced significant displacement.</p> <p>The UIC Program Director may request additional information if he or she believes that the owner or operator has not obtained all relevant, available seismic information for the region.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
10.	Geologic and topographic maps, cross sections, and illustrations of regional geology, hydrology, and geologic structure of the local area	40 CFR 146.82(a)(3)(vi)	<p>As part of a comprehensive site characterization effort, the owner or operator must submit maps and cross sections that describe and support assessments of the geology and hydrogeology of the region and the geologic structure of the local area. EPA recommends that the owner and operator also provide detailed information on the geology and hydrology of the injection and confining zones. Regional geological characterizations will rely primarily on existing published information obtained from the United States Geological Survey (USGS), state geological surveys, and other state and published literature and reports on general geology and water, mineral, and/or energy resources.</p> <p>The regional geologic and hydrogeologic information is intended to put the proposed injection site into a regional context. While regional information can initially indicate whether the proposed injection formation is potentially viable as a GS site, additional detailed site-specific information may be needed to conclusively demonstrate site suitability for GS.</p>	<p>The UIC Program Director will be able to compare the submitted information for consistency with other available maps and geologic information.</p> <p>The UIC Program Director may use this information to more thoroughly understand the geology of the injection site and how injected carbon dioxide will remain confined. He or she may consider the relationship between the injection zone, confining zone(s), and any USDWs in the AoR.</p> <p>The UIC Program Director may request additional information if inconsistencies are observed.</p>
11.	Tabulation of all wells within the AoR which penetrate the injection or confining zone(s)	40 CFR 146.82(a)(4)	The tabulation of wells (e.g., artificial penetrations) and associated information document that no artificial penetrations exist that could serve as conduits for fluid movement (i.e., proper plugging has occurred). This table of information on all located wells within the AoR must include a	The UIC Program Director must ensure that the submission is both complete and accurate. The table may incorporate additional information required by the UIC Program Director. The UIC Program Director will want to ensure that this information is addressed in the AoR and Corrective Action Plan.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>description of each well's:</p> <ul style="list-style-type: none"> • Type. • Construction. • Date drilled. • Location. • Depth. • Record of plugging/completion. <p>It is recommended that the number, name, and location of all wells needing corrective action also be included.</p>	The UIC Program Director may request additional information if the submission appears incomplete or inaccurate.
12.	Maps and stratigraphic cross sections indicating the general vertical and lateral limits of all USDWs, water wells and springs within the AoR, their positions relative to the injection zone(s), and the direction of water movement	40 CFR 146.82(a)(5)	Maps and stratigraphic cross sections, along with accompanying materials, demonstrate that the stratigraphy (the sequence of subsurface formations) is appropriate for GS. They also demonstrate that the injection zone can safely receive, and the confining zone(s) can effectively contain, carbon dioxide. These materials must show the vertical and lateral limits of all USDWs within and around the AoR, the drinking water wells and springs within the AoR and their positions relative to the injection zone(s), and the direction of ground water flow, where known (including both vertical and horizontal flow in all USDWs and aquifers).	<p>The UIC Program Director must ensure that the submission is both complete and accurate.</p> <p>If the maps or cross sections appear to be inaccurate or incomplete, the UIC Program Director may request further information from the owner or operator.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
13.	Baseline geochemical data for subsurface formations, including all USDWs, in the AoR	40 CFR 146.82(a)(6)	<p>The owner or operator must submit geochemical data on subsurface formations, including all USDWs in the AoR. This information can be used to identify the geochemical compatibility of the injection zone and the carbon dioxide stream, the potential well corrosion conditions, and the potential for leaching and mobilization of contaminants from the injection zone. Additionally, these data provide a baseline for subsequent geochemical monitoring.</p> <p>Typical data that may be submitted include: pH, specific conductivity (SC), total dissolved solids (TDS), salinity, dissolved oxygen, major cations (Na^+, K^+, Ca^{2+}, Mg^{2+}), major anions (Cl^-, NO_3^-, SO_4^{2-}), and alkalinity. Based on lithology, it is recommended that the owner or operator submit analyses for any elements of concern (e.g., arsenic, lead). Data may be submitted in tables and may also be plotted on Piper or Stiff diagrams.</p> <p>Information on sample collection methods, analytical methods, and quality assurance information will preferably be submitted by the owner or operator (such information may be limited for chemical analyses taken from preexisting data sources).</p>	<p>EPA recommends that the UIC Program Director verify that samples were taken in a manner that preserves down-hole pressure conditions and that samples were analyzed using EPA-approved methods, American Society for Testing and Materials (ASTM) methods, or Standard Methods for the Examination of Water and Wastewater (Standard Methods).</p> <p>When evaluating the geochemistry of the injection zone, the UIC Program Director will consider analyses of the formation solids in conjunction with fluid analyses. The owner or operator may have conducted geochemical modeling to predict dissolution or precipitation of minerals that have the potential to affect injectivity or leach drinking water contaminants.</p> <p>If geochemical modeling is used, the UIC Program Director's review of the capabilities of the model(s), as well as the data used for model input, is recommended. Also recommended is the UIC Program Director's consideration of whether the fluid chemistry and mineralogy in the injection formation are likely to mitigate any decrease in pH that may occur when injected carbon dioxide mixes with formation water. When data and modeling suggest the potential for significant mineral dissolution and/or precipitation, changes in permeability and injectivity can result.</p> <p>For more information on typical data that may be submitted, refer to the <i>Draft UIC Program Class VI Well Site Characterization Guidance</i>.</p> <p>It is recommended that the UIC Program Director evaluate whether interactions among the formation fluids, solids, and carbon dioxide injectate will result in the leaching of drinking water contaminants. If leaching causes maximum contaminant levels for drinking water to be exceeded in the injection zone, it is recommended that the owner or operator notify the UIC Program Director. The UIC Program Director, in turn, may choose to consult with the state PWS manager or take other</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
				<p>appropriate action. For more information on drinking water contaminants and their acceptable measurable limits in drinking water, see EPA's website at http://water.epa.gov/type/groundwater/uic/wells_sequestration.cfm.</p> <p>Because sampling conducted for preparation of the permit application will serve as the baseline for monitoring during the injection phase, it is important that the UIC Program Director requests additional data if the submitted data appear to be of poor quality, or if they were taken from an area not representative of the injection zone.</p>
14.	Proposed injection well operating data	40 CFR 146.82(a)(7)	<p>The submission of the Class VI injection well operating data can be used to evaluate if the planned operations will: be appropriate to the injection zone (e.g., maintain adequate injectivity and the planned injection rate); be appropriate to the confining zone(s) (e.g., will not fracture formations in the confining zone or cause faults or fractures to be transmissive); identify potential well corrosion issues; and identify leaching and mobilization of contaminants. Proposed operating data must include:</p> <ul style="list-style-type: none"> • Average and maximum daily rate and volume (mass) and total anticipated volume (mass) of the carbon dioxide stream. • Average and maximum injection pressure. • Source of the carbon dioxide stream. • Analysis of chemical and physical characteristics of the carbon dioxide 	<p>The UIC Program Director must ensure that the submission is both complete and accurate. For example, the UIC Program Director may verify the proposed injection pressure against geomechanical data required at 40 CFR 146.82(a)(3)(iv). The UIC Program Director may request additional information, if the submission appears incomplete or inaccurate. Refer to Injection Well Operation in Table 3.7 for more information.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>stream.</p> <p>The source of the supplied carbon dioxide must be specified, if known, and may be generated from one (or multiple) of the following sources: carbon dioxide production wells, electric generating units, ethanol plants, pulp and paper mills, natural gas processing plants, other anthropogenic sources, or unknown sources.</p>	
15.	Proposed pre-operational formation testing program	40 CFR 146.82(a)(8)	<p>The owner or operator must submit a proposed formation testing program that describes the planned collection and analysis of the chemical and physical characteristics of fluids in the injection and confining zones and meets the requirements at 40 CFR 146.87 (refer to Table 3.6). Data collected will be used to evaluate whether the subsurface formation can safely receive and confine carbon dioxide and whether the formation fluids are compatible with carbon dioxide or carbon dioxide mixtures. The formation testing plan specifies the formations in which testing (and eventually monitoring) will take place, including sampling depths and the anticipated depths of the screened intervals of monitoring wells</p> <p>The proposed plan will need to include sampling and analysis methods for fluid as well as solid samples collected during drilling. It is recommended that the owner or operator also develop plans for</p>	<p>The UIC Program Director must ensure that the submission is both complete and accurate. For more information on the proposed formation testing program, the UIC Program Director can consult:</p> <ul style="list-style-type: none"> • The <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i> for further discussion of the appropriate placement and number of monitoring wells based on site-specific conditions. • The <i>Draft UIC Program Class VI Well Site Characterization Guidance</i> for discussion of sampling and analysis of solids samples. • Table 3.9 in this document and the <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i> for information regarding expected fluid analyses.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			analyzing the chemical composition of the solids in the injection and confining zones. Physical characteristics to be measured for the solids include porosity, permeability, capillary pressure, mineralogy, and geomechanical properties.	
16.	Proposed stimulation program	40 CFR 146.82(a)(9)	<p>Well stimulation is an operation performed to improve the flow of carbon dioxide from the injection well into the receiving formation (the injection zone). Stimulation can increase well injectivity and provide better performance for some GS projects.</p> <p>It is recommended that owners or operators seeking to use an in situ formation stress test indicate this in the proposed stimulation program submitted as part of the permit application. The proposed program will need to demonstrate that any in situ formation stress testing stimulation activities will not compromise the integrity of the confining zone.</p> <p>The owner or operator must notify the UIC Program Director before any stimulation activities are undertaken [40 CFR 146.91(d)(2)]. Such notice will provide the UIC Program Director an additional opportunity to review stimulation plans, assess the description of stimulation fluids to be used, determine that stimulation will not interfere with containment, assess plan appropriateness, and potentially witness the stimulation activity. During stimulation,</p>	<p>The UIC Program Director's evaluation of the proposed stimulation program must determine that stimulation activities will not interfere with containment and not cause transmissive faults or fractures in the confining layer(s). The UIC Program Director will need to evaluate and approve the owner's or operator's proposed stimulation plan in the context of all information about the site, and the owner or operator must perform stimulation only as approved. Models are available to help determine appropriate pressures and times to obtain sufficient injectivity without damaging the confining layer.</p> <p>Although the stimulation plan will be approved by the UIC Program Director as part of the permit application process, notification prior to all stimulation activities (i.e., throughout the life of the GS project) will give the UIC Program Director an opportunity to reassess the proposed stimulation activities in light of any new information.</p> <p>The UIC Program Director may request additional information, if the submission appears incomplete or inaccurate.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			typically the formation pressure is raised to induce fractures that can lead to greater permeability surrounding the well bore and increased injectivity. Fracture pressure will be exceeded using in situ formation stress testing methods; however, these testing methods must not fracture the confining layer.	
17.	Proposed procedure for conducting injection operation	40 CFR 146.82(a)(10)	The submission of the proposed procedures for operating the Class VI injection well will help to ensure that the planned injection activities will not exceed the fracture pressure of the confining zone, so that subsurface formations can safely receive and confine carbon dioxide as planned. The proposed injection well operation procedures must outline the steps necessary to conduct injection operations.	The UIC Program Director must ensure that the submission is both complete and accurate. For example, the UIC Program Director may evaluate the proposed injection procedures in the context of geomechanical data and proposed operating data [required at 40 CFR 146.82(a)(3)(iv) and 146.82(a)(7), respectively]. The UIC Program Director may request additional information, if the submission appears incomplete or inaccurate. Refer to Injection Well Operation in Table 3.7 of this document for more information.
18.	Schematics or other drawings of the surface and subsurface construction details of well and injection well construction procedures	40 CFR 146.82(a)(11) – (a)(12)	Well schematics and drawings are required to support an evaluation of proper well materials, design, and construction. Improper well construction can not only result in the failure of the well and loss of the owner's or operator's ability to inject carbon dioxide, but can also create conduits for the migration of carbon dioxide out of the injection zone in violation of 40 CFR 144.12.	The UIC Program Director will need to review the construction information to ensure that well design and construction are appropriate for the injection of carbon dioxide and the lifespan of the GS project. Refer to Injection Well Construction Requirements in Table 3.5 of this document for more information. The UIC Program Director may request additional information, if the submission appears incomplete or inaccurate.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
19.	Demonstration that the owner or operator has met financial responsibility requirements	40 CFR 146.82(a)(14)	The owner or operator of a proposed Class VI well must submit a demonstration of financial responsibility to the UIC Program Director that meets the requirements of 40 CFR 146.85.	Refer to Financial Responsibility in Table 3.4 for a discussion of the requirements for 40 CFR 146.85.
20.	Proposed project plans	40 CFR 146.82(a)(13), (a)(15), (a)(16), (a)(17) & (a)(19)	The owner or operator must a series of comprehensive site-specific project plans with the permit application, including: an AoR and Corrective Action Plan; a Testing and Monitoring Plan; an Injection Well Plugging Plan; a Post-Injection Site Care and Site Closure Plan; and an Emergency and Remedial Response (E&RR) Plan.	<p>The UIC Program Director will need to evaluate all of the comprehensive site-specific plans in the context of site characterization data, proposed construction information, and proposed operating data. This will ensure that planned activities at the facility meet all GS Rule requirements, are appropriate to the site-specific circumstances, and address all risks to USDWs. Refer to the following sections of this document for more information:</p> <ul style="list-style-type: none"> • Table 3.3 for the AoR and Corrective Action Plan. • Table 3.9 for the Testing and Monitoring Plan. • Table 3.11 for the Injection Well Plugging Plan. • Table 3.12 for the Post-Injection Site Care and Site Closure Plan. • Table 3.13 for the E&RR Plan. <p>If any of the plans are missing or incomplete, the UIC Program Director will need to contact the owner or operator for a copy of the missing plan. For more information on Class VI project plans, refer to the <i>Draft UIC Class VI Program Project Plan Development Guidance</i>.</p>
21.	Demonstration of an alternative post-injection site care timeframe	40 CFR 146.82(a)(18)	The owner or operator must provide a demonstration of an alternative post-injection site care timeframe required by 40 CFR 146.93(c) with the permit application, if required by the UIC Program Director. For more information, refer to Table 3.12.	The demonstration of an alternative post-injection site care timeframe may be required at the UIC Program Director's discretion. For more information, refer to Table 3.12.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
22.	List of contacts	40 CFR 146.82(a)(20)	The owner or operator must submit a list of contacts for states, tribes, and territories within the AoR.	The UIC Program Director will need to use the contact information to fulfill the public notification requirements of 40 CFR 146.82(b).
<i>UIC Program Director requirements upon receipt of Class VI permit application [40 CFR 146.82(b)]</i>				
23.	Public notification of permit application	40 CFR 146.82(b)	Upon receipt of the initial permit application materials, the UIC Program Director must notify, in writing, any state, tribe, or territory within the AoR (in the United States or internationally) of the Class VI permit application.	Based on the information provided at 40 CFR 146.82(a), entities within the AoR must be notified. For more information on public notification requirements, refer to Section 3.2.2 of this document.
<i>Owner/operator submissions required prior to authorization of well operation [40 CFR 146.82(c)]</i>				
24.	Data available after preliminary testing and related data	40 CFR 146.82(c)(1) – (c)(10)	Certain data and information will not be available to the UIC Program Director until after preliminary testing and related data gathering are conducted. To submit this additional required information, the owner or operator will conduct the following tests on injection wells: formation testing; logging, sampling, and testing of the well and surrounding formations prior to injection pursuant to 40 CFR 146.87; and mechanical integrity testing as required by 40 CFR 146.89. Some of this information will be collected after approval of the project plans (e.g., AoR delineation per the AoR and Corrective Action Plan, demonstration of mechanical integrity per the Testing and Monitoring Plan). The UIC Program Director will then determine whether to authorize operation of a proposed Class VI injection well based on the following additional information:	<p>The UIC Program Director will base his or her determination whether to authorize operation of a Class VI injection well on all information submitted.</p> <p>The UIC Program Director may request additional information, if the submission appears incomplete or inaccurate.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<ul style="list-style-type: none"> • Final AoR delineation. • Any relevant updates to information on the geologic and hydrogeologic properties of the proposed storage site and of the injection and confining zones in particular. • Information on the compatibility of the carbon dioxide stream with fluids in the injection zone and with the petrology of the formations comprising the injection and confining zone. • Results of formation testing. • Final injection well construction procedures. • The status of corrective action on the improperly plugged wells located within AoR. • All available logging and testing program data. • Demonstration of mechanical integrity. • Any necessary updates to the proposed project plans to address new information collected. • Any updates to the alternative PISC timeframe demonstration. • Any other information required by the UIC Program Director. 	

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
<i>Injection depth waiver supplemental report [40 CFR 146.82(d)]</i>				
25.	Injection depth waiver supplemental report	40 CFR 146.82(d)	Owners and operators seeking a waiver of the requirement to inject below the lowermost USDW must submit a supplemental report that meets the requirements of 40 CFR 146.95. Note that the supplemental report is not part of the permit application.	For more information on injection depth waivers and the associated supplemental report, refer to Table 3.14 of this manual.
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Site Characterization Guidance for Owners and Operators • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Area of Review Evaluation and Corrective Action Guidance for Owners and Operators • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Project Plan Development Guidance for Owners and Operators • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Class VI Program Well Testing and Monitoring Guidance for Owners and Operators <p><i>All of the above guidance documents are either currently available or will be available in the future on EPA's website at:</i></p> <p>http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>				

Table 3.2: Minimum Criteria for Siting (40 CFR 146.83)

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
1.	Owners or operators of Class VI wells must demonstrate to the satisfaction of the UIC Program Director that the wells will be sited in areas with a suitable geologic system	40 CFR 146.83(a)(1) – (a)(2)	<p>The owner's or operator's site characterization demonstration must support that the geologic system includes:</p> <ul style="list-style-type: none"> • An injection zone of sufficient areal extent, thickness, porosity, and permeability to receive the total anticipated volume of the carbon dioxide stream. • Confining zones free of transmissive faults or fractures and of sufficient areal extent and integrity to contain the injected carbon dioxide stream and displaced formation fluids and allow injection at proposed maximum pressures and volumes without initiating or propagating fractures in the confining zones. 	<p>With the Class VI permit application, the UIC Program Director will receive maps, geologic cross sections, and other data describing the subsurface geology and the general vertical and lateral limits of all USDWs within the AoR. The site characterization process identifies potential risks and eliminates unacceptable sites (i.e., sites with potential seismic risk or sites that contain transmissive faults or fractures). For information on the required permit application materials related to site characterization, refer to Table 3.1 of this manual. Note that in order to conduct certain site characterization activities (e.g., drilling of a stratigraphic well) additional requirements, such as obtaining a permit, may be necessary which are outside the scope of the GS Rule's requirements.</p> <p>Any geologic site information provided by the owner or operator may be checked by the UIC Program Director for consistency, as well as compared against available industry standards or regional geologic information. The UIC Program Director may also ensure that the methods of analysis are specified and that quality assurance information (e.g., duplicate measurements) is provided where applicable.</p> <p>The UIC Program Director may request additional information if he or she observes inconsistencies in the submitted information or suspects that information may not accurately represent the subsurface.</p> <p>Note that the data and information collected during site characterization is used to inform the development of well construction and operating plans, provide a variety of geologic input for use in the AoR delineation models, and establish information for comparison to geochemical, geophysical, and hydrogeologic site monitoring data collected over the life of the injection project.</p>

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
2.	The UIC Program Director may require owners or operators of Class VI wells to identify and characterize additional confining zones	40 CFR 146.83(b)	In certain geologic settings, additional zones may be appropriate to ensure USDW protection, impede vertical fluid movement, and allow for pressure dissipation. Additional confining zones may also provide further opportunities for monitoring, mitigation, and remediation	<p>If the UIC Program Director determines that known or suspected faults and fractures may transect the confining zone(s) and interfere with containment of the storage site, then he or she may require that the owner or operator identify and characterize secondary, additional confining zones.</p> <p>Additional confining zones are evaluated in the same manner as the primary initial confining zone(s).</p> <p>The UIC Program Director may request additional information if he or she observes inconsistencies in the submitted information or suspects that information may not accurately represent the subsurface.</p>
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Site Characterization Guidance for Owners and Operators <p><i>The above guidance document is currently available on EPA's website at:</i> http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>				

Table 3.3: Area of Review (AoR) and Corrective Action (40 CFR 146.84)

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
AoR and Corrective Action Plan				
1.	AoR and Corrective Action Plan	40 CFR 146.84(b)	Owners or operators must submit an AoR and Corrective Action Plan that describes how they will delineate and periodically reevaluate the AoR and perform all necessary corrective action on improperly plugged or abandoned artificial penetrations located within the AoR. The AoR and Corrective Action Plan must be submitted to the UIC Program Director with the permit application.	<p>The UIC Program Director will need to evaluate the proposed AoR and Corrective Action Plan in connection with the geologic and proposed operating data submitted with the permit application in determining whether to approve the plan. The UIC Program Director will also need to verify that all required data are present and that they take into account up-to-date, site-specific conditions to ensure USDWs are protected from endangerment. In particular, EPA recommends that the UIC Program Director consider the following questions:</p> <ul style="list-style-type: none"> • Is the delineation model sufficient to accurately predict movement of the carbon dioxide plume and pressure front? Do the model assumptions incorporate all site-specific data on geology, other influences on subsurface pressures and fluid movement (e.g., other injection operations), or other data submitted with the permit application (e.g., proposed operating data)? • Are all artificial penetrations within the AoR accounted for and is all planned corrective action (i.e., methods and schedule) sufficient to ensure that all improperly plugged wells in the AoR are addressed and will not serve as conduits for fluid movement to USDWs? • Are the proposed AoR reevaluation schedule and the conditions that would warrant a reevaluation of the AoR prior to the next scheduled reevaluation appropriate to address any changes in operational conditions or monitoring data? Are the schedule and conditions sufficient to make necessary adjustments to the project to protect USDWs and adequately account for available operational and monitoring data for the site? <p>The UIC Program Director has the discretion to require any additional information necessary to support the AoR and</p>

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
				Corrective Action Plan. For example, additional information regarding an owner's or operator's plans for drilling might be useful in some situations such as very deep wells in complex or challenging geologic conditions. If the Plan is missing or incomplete, the UIC Program Director will need to contact the owner or operator for a copy of the missing Plan or information.
2.	Method for delineating the AoR	40 CFR 146.84(b)(1)	<p>The owner or operator must submit the following general information about the model used for the AoR delineation as part of the AoR and Corrective Action Plan. More specific model information will be included with the AoR delineation, which is submitted prior to authorization of well operation. The required information includes:</p> <ul style="list-style-type: none"> • The model to be used. • Assumptions that will be made. • Site characterization data on which the model will be based. <p>For more information on AoR delineations, refer to rows 8-11 of this Table.</p>	<p>The UIC Program Director will need to evaluate:</p> <ul style="list-style-type: none"> • The computational code to be used and any code attributes (e.g., governing equations, code verification), as required by the UIC Program Director. • Relevant modeling assumptions that will be made and the physical processes that will be included in AoR delineation model. • Site characterization and anticipated operational data on which the model will be based. • Any additional general modeling approaches that the owner or operator plans on utilizing, as required by the UIC Program Director. <p>The UIC Program Director will need to ensure that the method for delineating the AoR, including the modeling approach, is appropriate and complies with the GS Rule. At this point, the UIC Program Director will need to verify that the delineation model is sufficiently robust to accurately predict movement of the carbon dioxide plume and pressure front. For example, the computational model must account for multiphase flow of carbon dioxide and native fluids, as well as geologic heterogeneities. In addition, the modeling approach must incorporate all site-specific data on geology, the influences on subsurface pressures and fluid movement of other injection projects, and operating conditions submitted with the permit application [40 CFR 146.84(a)].</p>

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
3.	AoR reevaluation frequency and description of conditions warranting a reevaluation of the AoR	40 CFR 146.84(b)(2)(i) – (b)(2)(ii)	<p>The AoR and Corrective Action Plan prepares for AoR reevaluations by requiring descriptions of the following:</p> <ul style="list-style-type: none"> • The fixed frequency, at least once every five years, for reevaluating the AoR and why this is appropriate based on site-specific information. • Potential triggers for an AoR reevaluation prior to the next scheduled reevaluation (e.g., changes to the facility). 	It is recommended that the UIC Program Director verify that the proposed AoR reevaluation schedule is appropriate for addressing any changes in operational conditions or monitoring results (data). Also, verification is recommended regarding the appropriateness of the specific operational or monitoring parameters (or “triggers”) to be used to identify the need for an AoR reevaluation. Appropriate AoR reevaluation schedules and operating/monitoring “triggers” serve to enable timely and necessary adjustments to the project to protect USDWs. The UIC Program Director will ensure that he or she agrees with the specific conditions that will warrant an AoR reevaluation, and the type, frequency, and spatial distribution of monitoring data that will be compared to the AoR delineation. The UIC Program Director may request additional information from the owner or operator regarding how monitoring data will be quantitatively compared to model results for reevaluations of the AoR.
4.	How monitoring, site characterization, and operational data will be used to inform an AoR reevaluation	40 CFR 146.84(b)(2)(iii)	The owner or operator must submit a description of how monitoring, site characterization, and operational data will be used to inform an AoR reevaluation. The description may include: monitoring or other site-specific data that will be collected and compared against the AoR delineation, and/or changes in operational conditions that may impact the AoR delineation.	It is recommended that the anticipated model calibration process be clearly explained by the owner or operator. The UIC Program Director may require specific calibration or model parameterization procedures based on the review of the anticipated modeling and monitoring. The UIC Program Director may choose to evaluate these data in the context of other information submitted (e.g., proposed operating data, Testing and Monitoring Plan) to ensure that sufficient types and amounts of data will be collected to inform the AoR reevaluation.
5.	How corrective action will be conducted	40 CFR 146.84(b)(2)(iv)	<p>The owner or operator will submit the following information pertaining to corrective action with a complete AoR and Corrective Action Plan:</p> <ul style="list-style-type: none"> • Methods that will be used to identify improperly plugged or abandoned artificial penetrations (e.g., wells) within the AoR. 	It is recommended that the UIC Program Director evaluate the proposed methods for identifying and assessing abandoned wells and performing corrective action to ensure that appropriate methods will be used, including the use of plugging materials that are compatible with the carbon dioxide stream, particularly in the presence of water. For identification of wells, the UIC Program Director may choose to ensure that all pertinent well databases are accessed, and at his or her discretion, aerial and/or ground surveys may be required to

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<ul style="list-style-type: none"> • Methods that will be used to assess the integrity of the known abandoned wells and determine which wells are in need of corrective action. • Methods that will be used to perform corrective action, including acquisition of site access. • Whether the owner or operator plans to use phased corrective action at the site, or alternatively plans to perform all corrective action prior to injection. • If phased corrective action is planned, then the approach for defining and addressing the regions of the phased corrective action must be included. 	<p>identify and locate additional improperly plugged wells.</p>
			<p>In accordance with the GS Rule, the UIC Program Director has discretion to allow phased corrective action. Due to the large size of the AoR for Class VI wells, owners or operators may want to perform corrective action on a phased basis during the lifetime of the project. This phased approach is not allowed under other injection well classes. If phased corrective action is employed, corrective action would not need to be conducted throughout the entire AoR prior to injection. Rather, corrective action would only be necessary in areas in the vicinity of an injection well with a high certainty of carbon dioxide exposure during the first several years of the project, as informed by site characterization data and model predictions. Artificial penetrations in areas farther from the injection well, not</p>	<p>In determining whether to allow phased corrective action at a GS site, the UIC Program Director may choose to consider the number and spatial density of wells within the region that will likely be encompassed by the AoR, the known quality of abandoned well plugs in that vicinity, whether corrective action for each well will be completed in advance of the predicted intersection of the carbon dioxide plume and pressure front, the number of wells that need corrective action, and possible “work load” and site accessibility issues in addressing all wells in a large or densely penetrated AoR. Furthermore, based on available site characterization data, the UIC Program Director may choose to evaluate the potential presence of high-permeability conduits that have the potential to cause unanticipated fluid movement beyond AoR delineations. In cases where the UIC Program Director determines that there is reason to believe that phased corrective action may result in the carbon dioxide plume and/or pressure front intersecting areas that have not been subject to corrective action, or identifies other restrictions (e.g., administrative or local restrictions) that may inhibit use of phased corrective action, he</p>

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			anticipated to come into contact with the carbon dioxide plume or pressure front for several years, would be addressed after injection has commenced, but well before the carbon dioxide plume and pressure front move into that area. The details regarding how corrective action will be phased must be included in the UIC Program Director-approved AoR and Corrective Action Plan. The most recent AoR delineation model will provide predictions of when the plume will move into a certain region and will be the basis for the phased corrective action schedule.	<p>or she may choose to deny a phased corrective action approach, and require all correction to take place at once.</p> <p>If the UIC Program Director approves of phased corrective action, he or she must ensure that the method used by the owner or operator to demarcate what regions of the AoR will be accessed on a phased basis will provide sufficient protection to USDWs [40 CFR 144.12(b) and 40 CFR 146.84(b)(2)(iv)]. For example, the owner or operator may want to address only those regions of the AoR predicted to come into contact with the carbon dioxide plume and pressure front within a certain number of years (e.g., 5 years), based on site computational modeling. The UIC Program Director, however, may decide to lengthen the “buffer” timeframe for use of phased corrective action to provide additional protection to USDWs.</p>
AoR delineation				
6.	AoR delineation	40 CFR 146.84(a)	<p>Following approval of the AoR and Corrective Action Plan and prior to authorization of well operation, the owner or operator will submit an initial delineation of the AoR, overlaid on a regional map. The AoR for Class VI injection wells must be delineated using sophisticated computational modeling that accounts for multiphase flow and the buoyancy of carbon dioxide, and is informed by site characterization data [40 CFR 146.84(a)]. Any computational model that meets the requirements stated in the GS Rule, and is acceptable to the UIC Program Director, may be used by the owner or operator, including proprietary models. It is recommended that proposed Class VI well owners or operators disclose code assumptions, relevant equations, and the</p>	<p>The UIC Program Director will have several options for evaluating the AoR delineation and input and output data used for the delineation. The UIC Program Director may conduct a separate AoR delineation exercise for comparison to the owner’s or operator’s submittal, and in cases of significant differences, may choose to require additional information or justification from the owner or operator. This exercise may include the UIC Program Director employing either a sophisticated computational model or a simpler analytical or semi-analytical approach at the UIC Program Director’s discretion.</p> <p>The UIC Program Director may decide to utilize outside services to perform an independent AoR evaluation or critically evaluate the owner’s or operator’s modeling submittal. Outside resources available to the UIC Program Director may include the contracting of a modeling consultant or coordination with a qualified national Department of Energy (DOE) or EPA laboratory, with a state geological survey, or other EPA regional offices. EPA recommends that any independent AoR</p>

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>scientific basis of the model to the satisfaction of the UIC Program Director. For proprietary models, the model code can be submitted to the UIC Program Director under the provisions of confidential business information (CBI).</p> <p>Note that the initial AoR delineation, based on initial site characterization data and projected operational data, will likely require more conservative assumptions in AoR modeling than in later AoR modeling reevaluations. Based on additional operational and monitoring data collected during operations, it is possible that some modeling assumptions could justifiably be less conservative (more realistic) over time for subsequent AoR reevaluation modeling. The use of area permits to delineate the AoR for Class VI wells is not permitted by the GS Rule [40 CFR 144.33(a)(5)].</p>	<p>evaluation be performed by a qualified modeling expert with previous experience in multiphase fluid computational modeling and without any conflict-of-interest regarding the proposed GS site (e.g., the UIC Program Director will not want to employ modeling services from the same firm used by the owner or operator).</p> <p>The UIC Program Director's model evaluation, including possible revisions of the AoR delineation based on any model or input changes required by the UIC Program Director, may warrant a response by the owner or operator. The general basis for model evaluation is described in the <i>Draft UIC Class Program Class VI Well AoR Evaluation and Corrective Action Guidance</i>, available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>
7.	Predicted lateral and vertical migration of the carbon dioxide plume and formation fluids	40 CFR 146.84(c)(1)	<p>The owner or operator must submit an initial AoR delineation. The delineation will need to be performed as described in the approved AoR and Corrective Action Plan.</p> <p>The AoR delineation submittal provided by the owner or operator may include, but is not limited to, the following:</p> <ul style="list-style-type: none"> • A figure showing the delineated AoR overlaid on a regional map. This figure, or a supplementary figure, may also show all artificial penetrations in the AoR • A schematic conceptual site model that serves as the basis for the AoR 	<p>EPA recommends that the UIC Program Director conduct a detailed critical evaluation of the model assumptions and parameterization used to delineate the AoR, including the appropriate and complete use of site characterization data. Examples of information the UIC Program Director may want to evaluate include ensuring that sensitivity analyses incorporate the full range of reasonable model input parameters and that model assumptions are reasonable based on site conditions.</p>

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>computational model.</p> <ul style="list-style-type: none"> • The name of the computational code used to delineate the AoR and any code attributes (e.g., governing equations, code verification), as required by the UIC Program Director. • A description of the computational model, including physical processes, site characterization data, anticipated operational data, model areal extent, modeled timeframe, and grid spacing. • Any relevant model assumptions, including relative permeability/saturation relationships, intrinsic permeability descriptions, carbon dioxide physico-chemical properties, and equations of state. • Figures detailing model sensitivity analyses. • Relevant calculations showing how the AoR was delineated based on pressure and carbon dioxide plume predictions calculated by the computational model. • As required by the UIC Program Director, any model input and output files, including raw code-specific files, output data transformed to site coordinates, and interpolated Geographic Information System (GIS) files. <p>Elements of the AoR delineation are described in further detail in the <i>Draft UIC Program Class VI Well AoR Evaluation and Corrective Action Guidance</i>, available on EPA's website at</p>	

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm .	
8.	Identification of all artificial penetrations within the AoR	40 CFR 146.84(c)(2)	<p>Similar to other injection well classes, owners or operators of proposed Class VI injection wells must identify and evaluate all artificial penetrations located within the AoR. Based on this review, owners or operators must identify the wells that need corrective action to prevent the movement of carbon dioxide or other fluids into or between USDWs [40 CFR 146.84(c)(3)].</p> <p>Using methods approved by the UIC Program Director, the owner or operator must identify all penetrations, including active and abandoned wells and underground mines, in the area of review that may penetrate the confining zone(s) and provide a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the Director may require. Methods approved by the UIC Program Director for collecting this information may include review of local well databases or performing aerial or ground geophysical surveys. The UIC Program Director may require the owner or operator to provide the sources of information with the submitted list of penetrations.</p>	<p>The UIC Program Director will be able to assess the completeness and accuracy of the submitted information by cross-referencing with available well databases. In certain cases, the UIC Program Director may want to direct field reconnaissance or other follow-up activities to verify submitted penetration information. The UIC Program Director will need to determine that the owner or operator has taken adequate action to identify the presence of penetrations within the AoR by accessing all available databases and performing geophysical well surveys as necessary.</p> <p>In cases where the owner or operator has not performed sufficient activities to identify all penetrations, or the UIC Program Director is aware of penetrations within the AoR that have not been identified by the owner or operator, the UIC Program Director may choose to require further action.</p>

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
9.	Identification of wells that have been plugged or require corrective action	40 CFR 146.84(c)(3)	<p>The owner or operator must determine which abandoned wells in the AoR have been plugged in a manner that prevents the movement of carbon dioxide or other fluids that may endanger USDWs. The owner or operator must also determine whether materials that are compatible with the carbon dioxide stream have been used.</p> <p>The owner or operator may submit available plugging records, including records of plugging materials, for abandoned wells within the delineated AoR for a proposed Class VI well that penetrate the primary confining zone, or any other zones as determined by the UIC Program Director. Based on well plugging records, the owner or operator will need to identify all artificial penetrations within the AoR that require corrective action (e.g., remedial cementing). Wells requiring corrective action include those:</p> <ul style="list-style-type: none"> • With insufficient records. • With records indicating improper plugging activities. • With records indicating the use of materials that are not compatible with the carbon dioxide stream. • Which penetrate the injection zone and go through it and do not have plugs sealing off lower formations. <p>The owner or operator will submit the basis for the corrective action determination for each artificial penetration within the AoR that penetrates the primary</p>	<p>The UIC Program Director will be able to evaluate this list against available plugging records to ensure that all wells requiring corrective action have been identified and that appropriate and timely corrective action is performed. The owner or operator will need to gain physical access to wells with insufficient plugging records; the UIC Program Director will need to be made aware of this access [40 CFR 146.84(b)(2)(iv)].</p> <p>The UIC Program Director may request additional information from the owner or operator regarding wells with insufficient plugging records. Furthermore, the UIC Program Director may choose to require additional information regarding wells that penetrate zones above the primary confining zone. This determination is based on the thickness of the primary confining zone, the presence of additional zone(s), and the distance to the lowermost USDW.</p>

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			confining zone and a list of all those artificial penetrations within the AoR that require corrective action.	
10.	Corrective action	40 CFR 146.84(d)	<p>The owner or operator must perform corrective action on all wells in the AoR that are determined to need corrective action according to 40 CFR 146.84(c)(3). The owner or operator will submit records of corrective action activities to the UIC Program Director.</p> <p>Owners or operators must perform corrective action to address deficiencies in any wells, regardless of ownership, that are identified as potential conduits for fluid movement into USDWs [40 CFR 146.84(d)].</p> <p>Following corrective action, the owner or operator may submit to the UIC Program Director a description of all corrective action activities that have been performed, including remedial cementing of artificial penetrations. The data submitted may include: a description of any well reconnaissance activities that were performed to assess the integrity and specifications of the well, and a description of the plugging materials and plugging methods that were employed.</p>	<p>The UIC Program Director will review the submitted corrective action records to determine that all wells identified as needing corrective action have had corrective action performed. The UIC Program Director will also want to ensure that the corrective action was performed is adequate.</p> <p>The UIC Program Director may ensure that corrective action is properly implemented by verifying that the materials used to plug the identified wells are compatible with the carbon dioxide stream and that approved Class VI injection well plugging methods were utilized. The presence of impurities in the carbon dioxide stream and the potential impact of those impurities on carbon dioxide-compatible cements may be considered in the evaluation of appropriate Class VI injection well plugging materials.</p>
11.	AoR delineation reevaluation	40 CFR 146.84(e)(1) – (e)(3)	The AoR delineation must be reevaluated every 5 years, when monitoring data and modeling predictions differ significantly, or there have been changes to the facility, (e.g., addition of new wells). If the carbon dioxide plume and pressure front are	The UIC Program Director will periodically (at least once every 5 years) receive reevaluations of the AoR delineation from owners or operators that incorporate monitoring and operational data. AoR modeling and reevaluation are a key component of the overall strategy to track the carbon dioxide plume and pressure front through an iterative process of site

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			<p>moving as predicted, the burden of the AoR reevaluation requirement will be minimal. In cases where the observed monitoring data agree with model predictions, an AoR reevaluation may simply consist of a demonstration to the UIC Program Director that monitoring data are consistent with modeled predictions. Information that is recommended for the owner or operator to submit for the reevaluation of the AoR delineation includes:</p> <ul style="list-style-type: none"> • All available monitoring data on which the demonstration is based, including any relevant supplementary material (e.g., quality assurance documents, raw data), as required by the UIC Program Director. • Descriptions of any site characterization data collected since the last AoR delineation and a comparison of these data to the data used to inform model development. • Graphs and maps that directly compare monitoring data (i.e., pressure and carbon dioxide concentration) to model predictions. • Tables comparing existing and planned operational data to those used as model inputs. <p>In other cases, the AoR delineation may need to be revised as a result of the AoR reevaluation. Supplemental information that the UIC Program Director may require</p>	<p>characterization, modeling, and monitoring. This approach addresses the unique and complex movement of carbon dioxide at GS sites.</p> <ol style="list-style-type: none"> 1. For a review of a confirmed reevaluation of the AoR delineation, the UIC Program Director may choose to independently evaluate the owner's or operator's modeling demonstration by comparing monitoring and modeling data and ensuring that all available monitoring, operational, and site characterization data have been utilized by the owner or operator. The UIC Program Director may cross-validate any monitoring, site characterization, and operational data submitted with the reevaluation against other data submittals to ensure completeness and accuracy. 2. For a review of a revised reevaluation of the AoR delineation includes, the UIC Program Director may independently evaluate the model calibration exercise and request additional justification or information from the owner or operator when necessary. The UIC Program Director may request model documentation, as described above, and may cross-validate any monitoring, site characterization, and operational data submitted with the reevaluation against other data submittals to ensure completeness and accuracy. <p>If the UIC Program Director determines that any monitoring, operational, or site characterization data are inconsistent with those used to perform the AoR delineation, the UIC Program Director may require that the owner or operator re-perform the AoR reevaluation and revise the AoR delineation accordingly.</p>

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>to be submitted by the owner or operator includes:</p> <ul style="list-style-type: none"> • A figure showing the revised AoR overlaid on a regional map. This figure, or supplementary figures, may also show all artificial penetrations in the AoR and compare the previous and current AoR delineations. • All available monitoring data for which the new delineation is based, including any relevant supplementary material (e.g., quality assurance documents, raw data), as required by the UIC Program Director. • Graphs and/or maps that display the model calibration to available monitoring data and express the quality of the model fit to monitoring data. • A table detailing all relevant model input parameters and parameter values for the previous and current AoR delineation. • Tables comparing existing and planned operational data to those used as model inputs. • Descriptions of any site characterization data collected since the last AoR delineation, and how these data were used to inform model development. • Any additional documentation related to modeling, as required by the UIC Program Director. 	

	Requirement or Submission	Federal Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
<i>Plan reviews and data retention</i>				
12.	AoR and Corrective Action Plan review	40 CFR 146.84(e)(4)	Owners or operators must periodically update the AoR and Corrective Action Plan to incorporate operational and monitoring data and information from any previous AoR reevaluation [40 CFR 146.84(e)(1)]. This AoR and Corrective Action Plan review must take place within 1 year of the AoR reevaluation, following significant changes to the facility, or when required by the UIC Program Director [40 CFR 146.84(e)]. Reviews and revisions of the AoR and Corrective Action Plan based on AoR reevaluations may impact testing and monitoring activities on site and, therefore, support the development of effective testing and monitoring programs for GS projects.	The UIC Program Director will need to evaluate the proposed AoR and Corrective Action Plan in connection with the site characterization (geologic) and proposed operating data submitted with the permit application in determining whether to approve the plan. The UIC Program Director will also need to verify that all required data are provided and that the most up-to-date, site-specific data and conditions are evaluated in the assessment that ensures USDWs are protected from endangerment.
13.	Plan revision	40 CFR 146.84(f)	The owner or operator must base revisions to the Emergency and Remedial Response Plan and the financial responsibility demonstration on the most recently delineated AoR.	The UIC Program Director will review the Emergency and Remedial Response Plan and the financial responsibility demonstration to ensure that they correspond with the latest AoR evaluation.
14.	Data retention	40 CFR 146.84(g)	The owner or operator shall retain all data used in determining the AoR for 10 years.	The UIC Program Director will want to periodically review the owner's or operator's files to ensure that data is retained for the required time period.
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Area of Review Evaluation and Corrective Action Guidance for Owners and Operators Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Project Plan Development Guidance for Owners and Operators <p><i>All of the above manuals and technical guidance documents are either currently available at:</i></p> <p>http://water.epa.gov/type/groundwater/uic/class6/gsquidedoc.cfm.</p>				

Table 3.4: Financial Responsibility (40 CFR 146.85)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
1.	Demonstration of financial responsibility	40 CFR 146.85(a) & (c)	<p>The owner or operator of each facility must establish financial assurance for each proposed and existing Class VI well under 40 CFR 146.85. The qualifying financial responsibility instrument must comprise conditions of coverage [40 CFR 146.85(a)(4)]. These conditions include cancellation provisions, renewal, continuation provisions, and requirements for the provider to meet a minimum rating, minimum capitalization and ability to pass the bond rating when applicable. The instruments must also specify when the provider becomes liable following a notice of cancellation if there is a failure to renew with a new qualifying financial instrument. In addition, the instrument must be sufficient to address endangerment of USDWs [40 CFR 146.85(a)(4)].</p> <p>The UIC Program Director must receive a financial responsibility demonstration from the owner or operator of the Class VI well and must ensure that coverage satisfies the requirements of 40 CFR 146.85. The demonstration must provide: 1) a cost estimate; and, 2) documented proof of a third-party or self-insurance instrument [40 CFR 146.85(a)(1) and 146.85(c)]. The financial responsibility demonstration must cover the entire life of the GS project [40 CFR 146.85(b)(1)]. The cost estimate is a detailed written estimate, in current dollars,</p>	<p>All aspects of the financial responsibility demonstration are subject to the UIC Program Director's discretion. The UIC Program Director may find that the financial responsibility demonstration is unsatisfactory for any reason, as long as that reason is not arbitrary or capricious. The UIC Program Director may exercise discretion in particular to negotiate a satisfactory financial responsibility demonstration or to deny a demonstration (e.g., with regard to pay-in periods or financial tests). Instances in which the UIC Program Director may request additional information from the owner or operator include, but are not limited to, the following:</p> <ul style="list-style-type: none"> • The UIC Program Director determines during the annual evaluation of the qualifying financial responsibility instrument that the original demonstration is no longer adequate to cover the cost of corrective action. • The event of bankruptcy of the owner or operator. • A revision to the cost estimate increases to a greater amount than the face amount of a financial instrument currently in use. • A revision to the cost estimate decreases the expected costs, and the owner or operator wants to withdraw funds from a trust fund or decrease the coverage in their policy. <p>The UIC Program Director's goal in reviewing a financial responsibility demonstration is to ensure that USDWs are protected and that the potential risks of instrument failure and possible costs to the public are minimized. A successful financial responsibility demonstration will establish instruments that guarantee that the owner or operator will pay if coverage is needed for environmental obligations. This approach will ensure that no costs for GS projects will be passed on to the public while ensuring that USDWs are protected.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>of the cost of performing corrective action on wells in the AoR, plugging injection wells, conducting PISC and site closure, and fulfilling emergency and remedial response (E&RR). The cost estimate must be performed for each phase separately, and the owner or operator must indicate which instrument or combination of instruments they plan to use to cover the costs of each phase [40 CFR 146.85(a)(6)(i) and 146.85(c)(1)].</p> <p>The cost estimate informs the submission requirements for the financial responsibility instrument(s). The qualifying financial responsibility instrument(s) must be sufficient to cover the cost of corrective action, injection well plugging, PISC and site closure, and E&RR [40 CFR 146.85(a)(2)]. The cost estimates will need to be based on the actual costs of contracting a third party to conduct the activities and all related costs. Specific instructions on how to determine total plugging liability are found in the <i>Draft UIC Class VI Program Financial Responsibility Guidance</i>, available on EPA's website.</p> <p>Additionally, the cost estimate must be sufficient to address endangerment of USDWs, such as costs associated with remediating or replacing USDWs [40 CFR 146.85(a)(3)].</p> <p>The owner or operator must demonstrate and maintain financial responsibility</p>	<p>The UIC Program Director has the discretion to reject instruments that are determined to be insufficient, if the financial instrument is:</p> <ul style="list-style-type: none"> • Not sufficient as a qualifying instrument. • Not sufficient to cover the costs to properly plug and abandon, remediate, and manage wells. • Not sufficient to address endangerment of USDWs. • Not comprised of the required conditions of coverage that facilitate enforceability and prevent gaps in coverage for the life of the GS project. <p>Additional information on evaluating financial responsibility demonstrations, including third-party instruments and self-insurance, is available in the <i>Draft UIC Class VI Program Financial Responsibility Guidance</i>, available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>utilizing, but not limited to, one of the following qualifying instruments [40 CFR 146.85(a)(1)]:</p> <ul style="list-style-type: none"> • Trust Funds. • Surety Bonds. • Letter of Credit. • Insurance. • Escrow Accounts. • Self Insurance. • Any other instrument(s) satisfactory to the UIC Program Director. <p>In Class VI UIC Programs implemented by a state or tribe, the surety bond or letter of credit may name a state, tribal, or local government as a recipient of funds or a beneficiary, if authorized by applicable law. In these cases a standby trust is not needed.</p> <p>The choice of instrument(s) may be submitted electronically to the UIC Program Director for review via the electronic data system managed by EPA. The GS Rule requires that the qualifying financial responsibility instrument(s) comprise protective conditions of coverage [40 CFR 146.85(a)(4)].</p>	
2.	Maintaining financial responsibility	40 CFR 146.85(b)	According to the GS Rule, the owner or operator must maintain financial responsibility and resources until the UIC Program Director: 1) receives and approves the completed PISC and Site Closure Plan and, 2) determines and	<p>If the new instrument is sufficient, the UIC Program Director will provide written approval in acceptance of the new financial instrument and release the owner or operator from the previous financial instrument.</p> <p>Refer to Table 3.12 for information on determining when the</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			approves an end to the PISC period. To be released from a financial instrument, the owner or operator is required to have completed the phase of the GS project for which the financial instrument was required and to have fulfilled all its financial obligations as determined by the UIC Program Director. Otherwise, the owner or operator is required to submit a replacement financial instrument.	end to PISC can be approved.
3.	Annual inflation update and adjustments to the cost estimate	40 CFR 146.85(c)(2) – (c)(4) & (e)	<p>The owner or operator must prepare an annual submission of an updated financial responsibility demonstration and an updated written cost estimate. The financial instrument(s) used to fulfill the demonstration may require adjustments based on any updates to the cost estimate, including regular updates resulting from inflation.</p> <p>Written updates of adjustments to the cost estimate are also required 60 days after the UIC Program Director's approval of any amendments to the required project plans, and 60 days after the establishment of or any adjustment to the financial instrument. Additionally, if the UIC Program Director determines that the original financial responsibility demonstration is no longer adequate to cover the cost of well plugging and PISC and site closure, adjustments to the cost estimate must be made within 60 days.</p>	<p>The UIC Program Director will need to review this information to confirm that the financial instrument(s) are sufficiently adequate and to approve an increase or decrease in the initial cost estimate.</p> <p>Any delay in receiving updates to the financial instruments and cost estimates may serve as a warning to the UIC Program Director that the owner or operator may be no longer be able to meet the financial responsibility requirements.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
4.	Notification of adverse financial conditions	40 CFR 146.85(d)	<p>The owner or operator must notify the UIC Program Director by certified mail in the event of financial distress that would prevent them from fulfilling their environmental obligations or after filing for bankruptcy [40 CFR 146.85(d)]. Specifically, the GS Rule requires that the owner or operator:</p> <ul style="list-style-type: none"> • In the event of bankruptcy, notify the UIC Program Director within 10 days after commencement of the proceeding. • In cases where a guarantor of a corporate guarantee is named as debtor, make the notification under the terms of the corporate guarantee. • Establish other financial assurance or liability coverage within 60 days after bankruptcy or other such events. 	<p>The UIC Program Director must ensure that the timeframe for notifying the UIC Program Director of adverse financial conditions (e.g., bankruptcy, suspension or revocation of a trustee) in the instrument language is consistent with GS Rule requirements.</p> <p>Upon notification of any adverse financial conditions, it is recommended that the UIC Program Director initiate discussions with the owner or operator to resolve the problem.</p>
5.	Approval of pay-in periods	40 CFR 146.85(f)	The owner or operator must indicate pay-in periods for trust funds or escrow accounts if they are to be used to fulfill financial responsibility requirements.	The UIC Program Director will review the pay-in periods to determine adequate funding and approve or disapprove them.
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> • Draft Underground Injection Control (UIC) Class VI Program: Financial Responsibility Guidance <i>The above guidance document is currently available on EPA's website at:</i> http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm. 				

Table 3.5: Injection Well Construction Requirements (40 CFR 146.86)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
1.	General construction requirements	40 CFR 146.86(a)(1) – (a)(3)	<p>Proper injection well construction has been the cornerstone of EPA's UIC Program and is also a critical component of the Class VI well requirements. These requirements ensure that proper well construction will result in: 1) lack of fluid movement into or between USDWs or other unauthorized zones; 2) the ability to perform required injection well operations (i.e., use of testing devices and workover tools and monitoring of the annulus space); and, 3) permit continuous monitoring of the space between the injection tubing and long string casing.</p> <p>The depth of the injection zone, injection pressure, formation pressure, temperature, axial loading, and the materials to be used are all necessary to make a determination of the suitability of well design.</p> <p>Temperature is also a key component affecting the ability of well materials to withstand the stresses of the down-hole environment. The down-hole temperatures are compared to the rated temperatures of all well materials.</p>	<p>After construction of a proposed Class VI well and prior to authorizing injection, the UIC Program Director's review of construction records needs to ensure that the well was constructed in a way that prevents migration of fluids out of the injection zone. For detailed information on the construction of Class VI wells, refer to the <i>Draft UIC Program Class VI Well Construction Guidance</i>, available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p> <p>The materials used for well casing, cement, tubing and packer must be evaluated to ensure compatibility with down-hole operational pressures and stresses, as well as any potential corrosivity encountered during operations from either the carbon dioxide stream or native formation fluids. The information submitted must be reviewed by the UIC Program Director in three important areas to determine the adequacy of the Class VI well:</p> <ol style="list-style-type: none"> 1. Sufficiency of well material strength. 2. Compatibility of materials with the carbon dioxide stream. 3. Appropriateness of isolation of the injection zone from USDWs. <p>Sufficient well material strength</p> <p>The UIC Program Director must ensure the proposed Class VI well will be constructed to withstand anticipated stresses and last the lifespan of the GS project. Several pieces of the information submitted by the owner or operator will be used to determine if the well can withstand the stresses of the down-hole environment.</p> <p>A comparison of certain factors will aid the UIC Program Director in determining the appropriateness of well material</p>
2.	Casing and cementing construction requirements	40 CFR 146.86(b)(1) – (b)(5)	<p>The following must be considered in selecting materials for casing and cementing:</p> <ul style="list-style-type: none"> • Depth to the injection zone. • Proposed injection pressure, external pressure (formation pressure), internal 	

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>pressure (annular pressure), and axial loading.</p> <ul style="list-style-type: none"> • Hole size. • Size and grade of all casing strings (wall thickness, external diameter, nominal weight, length, joint specification, and construction material). • Down-hole temperatures. • Lithology of the injection and confining zones. • Type or grade of cement and cement additives. • Quantity, chemical composition, and temperature of the carbon dioxide stream. <p>Additional information regarding cement:</p> <ul style="list-style-type: none"> • In cases where the cement cannot be recirculated to the surface and an alternative cementing method is required, a demonstration, based on well logs, that the cement will not allow fluid movement behind the well bore. • An evaluation of the cement (and cement additives) quality radially and identification of the locations of channels. <p>Additional information regarding the carbon dioxide stream and injection formation fluids:</p> <ul style="list-style-type: none"> • Characteristics of the carbon dioxide stream (chemical content, corrosiveness, temperature, and 	<p>strength. For example, the UIC Program Director may compare:</p> <ol style="list-style-type: none"> 1. Formation (external) pressure to collapse strength of the materials. 2. Injection pressure to burst strength of the materials. 3. Axial loading to the tensile strength of the materials. <p>EPA recommends that the load of the formation on the casing and cement be considered in horizontal wells. EPA also recommends that owners or operators supply temperature ratings for all materials used in well construction.</p> <p>If injection will not be continuous, it is important that the UIC Program Director consider the effects of cyclic stress on well components. Cyclic changes in stress and temperature may cause failure of some well components. Additives (e.g., latex) can be added to cement to improve its resistance to cyclic stress.</p> <p>If the owner or operator does not provide burst, collapse, and tensile strengths of the casing materials, it is recommended that the UIC Program Director request this information.</p> <p><i>Compatibility of materials with the carbon dioxide stream</i></p> <p>The UIC Program Director must confirm that all materials used are compatible with the injectate and all other fluids which they may come into contact with, including formation fluids. The first step in determining the compatibility of the materials with the injectate is to review data on the composition of the injectate and formation fluids provided with the permit application.</p> <p>A key component for review is the water content of the carbon dioxide stream. When carbon dioxide is in the presence of water, carbonic acid is formed, which can be corrosive to</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>density).</p> <ul style="list-style-type: none"> Characteristics of formation fluids (geochemistry/chemical content and corrosiveness). <p>Software (computer) programs are available that can calculate the various stresses to be expected on the casing and cement during both installation and operation of the well. Data on the strength of cements are available in materials manuals and guidelines published by the American Petroleum Institute (API). Also, the ASTM publishes techniques for testing various materials strengths.</p>	<p>certain types of metals and cement. In general, carbon dioxide with less than 50 parts per million (ppm) water content is considered “dry,” and is relatively non-corrosive. A carbon dioxide stream with more than 50 ppm of water content is considered “wet” and is corrosive to certain metals and cement. Impurities found in the carbon dioxide stream (as a result of the source of the carbon dioxide and the capture process) can also have an effect on injectate corrosivity and materials compatibility. Hydrogen sulfide, nitrate, and sulfate can all be corrosive to both metals and cements. EPA recommends that the UIC Program Director check the stream composition data submitted with the permit application [40 CFR 146.82(a)(7)(iv)] to determine if any of these compounds are present (or may potentially be present). If corrosive compounds are present, it is recommended that well materials compatible with these compounds be considered for use.</p>
3.	Tubing and packer construction requirements	40 CFR 146.86(c)(1) – (c)(3)	<p>The following will need to be considered in selecting tubing and packer:</p> <ul style="list-style-type: none"> Depth of setting. Maximum proposed injection (internal) pressure. Maximum proposed annular (external) pressure. Proposed injection rate (intermittent or continuous) and volume (mass) of the carbon dioxide stream. Size of tubing and casing. Tubing tensile, burst, and collapse strengths. 	<p>Corrosivity tests submitted by the owner or operator can also help the UIC Program Director make the determination of whether appropriate materials have been used. There are several sources available that provide information on compatibility of well construction materials with carbon dioxide. For more details, refer to the <i>Draft UIC Program Class VI Well Construction Guidance</i>, available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p> <p>If the carbon dioxide is dry (contains less than 50 ppm water), then standard well construction materials such as carbon steel and Class G or H cement can generally be used above the packer. The chance that well materials below the packer will come into contact with carbon dioxide-saturated brine at some point in the GS project is higher so these well components will require more corrosion resistance. Typical materials used in these situations include 316 stainless steel and Class G or H cement with additives to increase carbon dioxide resistance.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
				<p>Non-Portland cements (e.g., phosphate cement) may be used. As an alternative to stainless steel, carbon steel lined with coatings such as glass reinforced epoxy, plastic, or fiberglass can be used. Note that lined materials may require special handling procedures to prevent damage to the lining.</p> <p>While the Rule does not specify the type of cement that must be used, EPA recommends that the UIC Program Director consider requiring the use of cement additives or non-Portland-based cement to lower susceptibility to carbon dioxide attack for those wells exposed to the following conditions: wet carbon dioxide; high temperatures; presence (or potential presence) of sulfate, nitrate, or sulfide; and high flow rates of formation fluids (containing injected carbon dioxide) contacting the exterior of the injection well.</p> <p>Ideally, corrosivity data will involve tests performed on actual construction materials with fluids matching the composition of the injectate. The UIC Program Director may consider requesting this information if it is not submitted or if the compatibility of the injectate with the construction materials is not clear.</p> <p><i>Appropriate isolation of the injection zone from USDWs</i></p> <p>The UIC Program Director must review proposed construction specifications submitted with the permit application [40 CFR 146.82(a)(11)-(a)(12)] to ensure that the well will be constructed as designed and prevent the migration of fluids out of the injection zone. The well must be cased for its entire depth [40 CFR 146.86(b)(2)]. The UIC Program Director must verify that both the surface casing and long-string casing were cemented to the surface with the surface casing extending from below the lowermost USDW to the surface. The long-string casing must extend from the confining zone (which lies above</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
				<p>the injection zone) to the surface [40 CFR 146.86(b)(3)]. Well perforations must lie wholly within the injection zone, and the packer must be located in the confining zone immediately above the injection zone. Refer to the <i>Draft UIC Program Class VI Well Construction Guidance</i>, available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm, for descriptions of the tests and techniques employed to verify well component construction. The depths of the perforations and their location in the injection zone can be verified by the UIC Program Director using logging records required at 40 CFR 146.87 (refer to Table 3.6 for more information). The depth of the packer will need to be checked by the UIC Program Director to ensure it is located in the confining layer immediately above the injection zone.</p> <p>In addition to the extent of cement, the emplacement and resulting quality of the cement job is also important. Cement bond logs, temperature logs, and noise logs are recommended well tests that provide data to determine if the emplaced cement is continuous and that no channels exist that would allow fluid migration out of the injection zone (refer to Table 3.6 for more information). In wells that are very deep or that intersect weak formations, cementing the well to the surface in a single stage may not be possible. In these cases, the UIC Program Director may allow cementing in stages; the first stage will need to terminate below the cement collar so the cement does not harden over the openings and prevent cementing of the second or subsequent stages. The cement bond logs will need to be reviewed by the UIC Program Director to ensure that the cement is continuous and evenly distributed around the casing. Zones of thin cement can be areas subject to the formation of channels that may result in failure of the well.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
				<p><i>Re-permitted injection wells</i></p> <p>For carbon dioxide injection wells re-permitted from a Class I or Class II, or a Class V experimental permit to a Class VI permit, the same materials compatibility issues discussed above will need to be reviewed by the UIC Program Director. The UIC Program Director will need to review cement records to determine if the well is cemented to the surface. Materials incompatible with carbon dioxide will need to be replaced. If replacement is not possible, re-permitting as a Class VI well for the long-term storage of carbon dioxide injection may not be appropriate. Approving the construction of a Class I well, or a Class V experimental well under the GS Rule may be appropriate, at the discretion of the UIC Program Director, if, among other things, the cement is in good condition and will prevent the migration of fluids into any unauthorized zones. To prevent migration out of the injection zone:</p> <ol style="list-style-type: none"> 1. The well needs to be cemented in the confining layer with cement in good condition with no channeling. 2. The packer must be set in the confining layer opposite the cement. 3. The well will preferably be cemented through all USDWs. <p>For more information on the re-permitting of injection wells to Class VI wells, refer to Section 3.3 of this manual.</p> <p><i>Logging and workovers</i></p> <p>It is recommended that the UIC Program Director review all well construction plans to determine if well design allows for use of the appropriate equipment for logging and workovers. Logging is an essential activity for: 1) ensuring that the injection zone is adequate to contain the planned amount of carbon dioxide; 2) tracking the carbon dioxide plume; and, 3) verifying the mechanical integrity of the well. Periodic workovers will be necessary to maintain the well in functioning condition. It is</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
				recommended that the UIC Program Director review the proposed well casing diameter and compare it to the size of equipment proposed for logging, monitoring, and testing of the well. If the well is horizontal or highly deviated, it is recommended that the UIC Program Director also review the length of the equipment as very long pieces of equipment may be unable to easily negotiate bends in the well casing. If the equipment dimensions are not provided, the UIC Program Director may request it.
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Construction Guidance for Owners and Operators • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Testing and Monitoring Guidance for Owners and Operators <p><i>All of the above guidance documents are either currently available or will be available in the future on EPA's website at:</i></p> <p>http://water.epa.gov/type/groundwater/uic/class6/qsquidedoc.cfm.</p>				

Table 3.6: Logging, Sampling, and Testing Prior to Injection Well Operation (40 CFR 146.87)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
1.	The owner or operator is required to conduct several tests of the injection well and surrounding formations prior to injection	40 CFR 146.87(a)	<p>The purposes of these testing activities are to: 1) determine or verify the depth, thickness, porosity, permeability, lithology, and salinity of any formation fluids in all relevant geologic formations to assure conformance with the injection well construction requirements; 2) establish accurate baseline data against which future measurements (for monitoring and testing purposes) may be compared; and 3) verify construction specifications of the injection well.</p> <p>The owner or operator is required to submit to the UIC Program Director a descriptive report of well logs conducted prior to injection, a detailed report regarding cores and formation fluid samples taken during well construction, and the results of additional tests, as presented in the following rows of this Table. The descriptive report of well logs and the detailed report regarding cores and formation fluid samples must be prepared by a knowledgeable log analyst.</p>	<p>Following review of this data, and in consideration of all other submitted data and site-specific conditions, the UIC Program Director may make a determination regarding whether injection is authorized.</p> <p>For carbon dioxide injection wells re-permitted from a Class I, Class II, or Class V experimental permit to a Class VI permit, wells must be engineered and constructed to meet the Class VI requirements of 40 CFR 146.86(a) and ensure protection of USDWs, in lieu of requirements at 40 CFR 146.86(b) and 146.87(a). UIC Program Directors will need to review the logging conducted prior to the permitting of the wells as Class I, Class II, or Class V experimental wells to ensure that sufficient information is available so that a determination can be made that USDWs will be protected. For more information on the re-permitting of injection wells to Class VI wells, refer to Section 3.2 of this manual.</p>
<i>Descriptive report of well logging</i>				
2.	Results of deviation checks for wells constructed by enlarging a pilot hole	40 CFR 146.87(a)(1)	In cases where the injection well borehole is constructed by enlarging a pilot hole, a deviation check is recommended to ensure that the enlarged well bore does not diverge from the pilot well bore and inadvertently create potential conduits for fluid flow. The owner or operator must	<p>The UIC Program Director may evaluate the results of deviation checks, including the quality and quantity of data provided, and independently assess the presence of divergences within the holes.</p> <p>If the UIC Program Director suspects divergences may exist, he or she may request further action be taken by the owner or</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			submit the results of deviation checks, which may include testing that measure the path of the well bore in three dimensions, and/or the depth, inclination, and hole direction at certain intervals through the hole. In the case of horizontal wells, techniques that allow measurements to be taken while drilling are typically used. Modern instrumentation used for deviation checks includes accelerometers, magnetometers, and gyroscopes. Another instrument for consideration is an inclinometer.	operator.
3.	Results of well logging conducted before and upon installation of the surface and long-string casings	40 CFR 146.87(a)(2) – (a)(3)	<p>The owner or operator must submit to the UIC Program Director results of the following tests</p> <ul style="list-style-type: none"> • Resistivity, spontaneous potential, and caliper logs before surface casing is installed. • Cement bond and variable density log and a temperature log after surface casing is set and cemented. • Resistivity, spontaneous potential, caliper, gamma ray, and fracture finder logs, and any other logs before the long-string casing is installed. • Cement bond and variable density log and a temperature log after long-string casing is set and cemented. 	<p>The UIC Program Director may want to ensure that all well logs were conducted properly and use the best available techniques (as are described in industry standard practices and technical guidance publications. Furthermore, the UIC Program Director may need to independently evaluate the formation and injection well properties based on the results of well logging for comparison to the owner's or operator's interpretation. Additional details regarding conducting and interpreting well logs are available in the <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i>, available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
4.	Internal and external mechanical integrity tests	40 CFR 146.87(a)(4)	The owner or operator must submit a report on the results of initial internal and external mechanical integrity tests. The report will include results from tests such as pressure tests with liquid or gas, tracer surveys, oxygen-activation logging, temperature or noise logs, casing inspection logs, or any alternative tests approved by the UIC Program Director. For more information regarding mechanical integrity tests, refer to Table 3.8 of this manual.	For more information regarding mechanical integrity tests, refer to Table 3.8 of this manual.
Report on rock cores and formation fluids				
5.	Data on cores collected in the injection and confining zones	40 CFR 146.87(b)	The owner or operator must submit a report regarding whole cores or sidewall cores of the injection and confining zones, and any other zones determined by the UIC Program Director, collected during construction of the injection well. If cores from the injection well cannot be obtained, data based on cores from nearby wells may be accepted by the UIC Program Director. The report will need to detail characteristics of the collected cores, including permeability, porosity, and mineralogical characteristics.	The UIC Program Director may ensure that adequate cores have been collected, and interpretative tests have been conducted on the cores. Furthermore, the UIC Program Director may independently evaluate characteristics of the injection, confining, and any additional zones, based on data regarding the collected cores and the results of well logging.
6.	Data on formation fluid samples collected from the injection zone	40 CFR 146.87(c)	The owner or operator must submit the temperature, pH, conductivity, reservoir pressure, and static fluid level of fluids collected from the injection zone.	The UIC Program Director will need to ensure that the injection zone is not a USDW, based on the measured conductivity. Additional data regarding formation fluids may be used by the UIC Program Director in future comparisons to monitoring data and to assess the impact of the injection project on fluid characteristics and pressures and the suitability of proposed well construction materials.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
Results of additional tests run prior to injection				
7.	Hydrogeologic and physical properties of the injection and confining zones	40 CFR 146.87(d) – (e)	The owner or operator must submit results of fracture pressure testing, as well as other physical and chemical characteristics, pertaining to the injection and confining zones. Hydrogeologic tests of the injection zone, including a pump or injectivity test, must also be submitted to the UIC Program Director.	This information is critical for determining key aspects of the viability of GS site related to suitable injection pressures, the adequate storage capacity of the injection zone, and the demonstration of integrity of the confining zone(s).
Schedule				
8.	Schedule of testing activities	40 CFR 146.87(f)	The owner or operator must provide the UIC Program Director with the opportunity to witness all logging and testing activities. The owner or operator must submit a schedule of such activities to the UIC Program Director 30 days prior to conducting the first test and submit any changes to the schedule 30 days prior to the next scheduled test. The UIC Program Director may approve or disapprove of the proposed schedule or any changes to the schedule.	The UIC Program Director may choose to witness logging and testing activities in cases, for example, where a particular logging or testing activity has proven challenging under similar geologic conditions at other GS sites or when the analytical findings based on the logging and testing to be conducted will provide pivotal information regarding a key aspect of the permit and/or GS operations. These types of considerations, among others, may influence UIC Program Director approval or disapproval of scheduling.
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Testing and Monitoring Guidance for Owners and Operators <p><i>The guidance document above will be available in the future on EPA's website at:</i> http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>				

Table 3.7: Injection Well Operating Requirements (40 CFR 146.88)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation
1.	The owner or operator must inject carbon dioxide at a pressure less than 90 percent of the injection formation fracture pressure, except during stimulation	40 CFR 146.88(a)	<p>If the injection pressure approaches the formation fracture pressure, the confining layer could potentially fracture, allowing carbon dioxide to escape. Fracture pressure calculations will be submitted to the UIC Program Director with the site characterization data as well as calculations that demonstrate that the proposed injection pressure is less than 90% of the fracture pressure (refer to Table 3.2 for more information).</p> <p>The fracture pressure and injection pressure are based on site-specific geologic and geomechanical data collected during the site characterization process. Available pressure measurement tests include step-rate tests, in situ formation stress tests, and a combination of a long spaced sonic log with laboratory measurement of the mechanical properties of cores. Note that all formation stimulation programs must be approved by the UIC Program Director as part of the permit application [40 CFR 146.82(a)(9)].</p>	<p>The UIC Program Director will need to review the planned injection pressure to ensure that it is less than 90 percent of the formation fracture pressure of the injection zone. To meet the GS Rule requirements, the UIC Program Director will set the injection pressure limit at 90 percent of fracture pressure. If the proposed injection pressures are acceptable based on site characterization data, they may be included as permit conditions.</p> <p>During injection operations, it is recommended that the UIC Program Director review operating reports of injection pressure in order to ensure that the actual injection pressure remains below the limit. If injection pressure is measured using a surface gauge, then the bottom-hole injection pressure is calculated using the density of the injected fluid and well depth to determine the added pressure due to the height of the fluid column.</p>
2.	Injection between the outermost casing and the well bore is prohibited	40 CFR 146.88(b)	In general, the UIC Program Director must verify that injection between the outermost casing and the well bore does not occur.	It is recommended that the UIC Program Director review well construction schematics to ensure that injection well is constructed in a manner that will not allow injection between the outermost casing and the well bore and is not endangering USDWs.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation
3.	The owner or operator must operate the Class VI well such that the annulus pressure is greater than the injection pressure; this will be specified in the permit; and the annulus between the tubing and the long string casing is filled with a non-corrosive fluid approved by the UIC Program Director	40 CFR 146.88(c)	<p>The owner or operator must maintain on the annulus a pressure that exceeds the injection pressure, unless the UIC Program Director determines that such requirement might harm the integrity of the well or endanger USDWs. This ensures that fluid from leaks in the tubing will flow from the annulus into the tubing instead of from the tubing into the annulus. The positive pressure also acts as a continuous integrity test. If a leak occurs in the tubing or casing, the annulus pressure will start to drop. The annulus pressure and fluid volume must be monitored using an installed continuous recording device.</p> <p>The UIC Program Director must verify that the annulus between the tubing and casing is filled with a non-corrosive fluid (with the fluid type approved by the UIC Program Director).</p>	<p>It is recommended that the UIC Program Director review documented operating information to ensure that injection well operation is proceeding as planned and is not endangering USDWs.</p> <p>Documentation of actual well operation parameters will be provided in required reports for review by the UIC Program Director (refer to reporting in Table 3.10 of this manual for more information). Specific Class VI well operating requirements that the UIC Program Director must consider include annulus pressure.</p> <p>The UIC Program Director can adjust the requirement that the annulus pressure be greater than the injection pressure in circumstances where damage to the well or endangerment of USDWs may occur. EPA recommends that the UIC Program Director review the burst pressure of the casing and the collapse pressure of the tubing submitted with the well construction data. If either the burst pressure or collapse pressure are close in value to the injection pressure, the UIC Program Director may allow a lower annulus pressure. Alternatively, the UIC Program Director may require that stronger materials be used. If a lower pressure is allowed, the annulus pressure will still function to detect leaks. A lower pressure will not, however, prevent carbon dioxide from moving out of the tubing and into the annulus and potentially into surrounding formations if a leak in the casing develops.</p>
4.	Maintaining mechanical integrity at all times	40 CFR 146.88(d)	Other than during periods of well workover (maintenance) approved by the UIC Program Director in which the sealed tubing-casing annulus is disassembled for maintenance or corrective procedures, the owner or operator must maintain mechanical integrity of the injection well at all times. If the owner or operator decides	The UIC Program Director may choose to witness or evaluate the planned activity in the context of new information received since permit approval and correspond with the owner or operator, if necessary, regarding any suggested modifications to the planned activity or to place additional conditions on the planned activity if necessary. It is recommended that the UIC Program Director oversee tests and inspect completed work as necessary, based on the notifications received.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation
			to perform workovers or maintenance, the UIC Program Director must be notified 30 days in advance [40 CFR 146.91(d)]. Refer to Table 3.10 for more information on required notifications.	
5.	Required equipment	40 CFR 146.88(e)(1)	The owner or operator must use continuous recording devices to monitor: injection pressure; rate, volume and/or mass, and temperature of the carbon dioxide stream; and pressure on the annulus between the tubing and the long string casing and annulus fluid volume.	The injection pressure and rate, volume, and temperature of the carbon dioxide stream must be monitored using an installed continuous recording device. The UIC Program Director will need to verify, using reports submitted, that all required parameters are accounted for. See Table 3.12 for information on required reports.
6.	Shutdown devices	40 CFR 146.88(e)(2) – (e)(3)	<p>For onshore wells, the owner or operator must use alarms and automatic surface shut-off systems. The UIC Program Director may require the use of down-hole shut-off systems (e.g., automatic shut-off check valves) or other mechanical devices that provide equivalent protection.</p> <p>For wells located offshore but within state territorial waters, the owner or operator must use alarms and automatic down-hole shut-off systems to alert the operator and shut off the well when operating parameters (e.g., annulus or injection pressure) diverge beyond permitted ranges as specified in the Class VI permit.</p>	<p>The UIC Program Director must verify that the appropriate alarms and shut-off systems are installed and operating correctly.</p> <p>The down-hole shut-off system is typically comprised of subsurface safety valves controlled on the surface. The system consists of either a ball or flapper type valve which is held open by pressure applied through control tubing from the surface. If the tubing is severed or monitored parameters (e.g., flow, pressure) exceed pre-programmed limits, the valve closes, thereby preventing the flow of fluids out of the well.</p>
7.	Events of shutdown or loss of mechanical integrity	40 CFR 146.88(f)	If a shutdown system triggers a shutdown, or a loss of mechanical integrity is discovered, the owner or operator must immediately cease injection, determine if a release has been made into any unauthorized zones, and notify the UIC	The UIC Program Director will need to verify that the appropriate measures were taken to ensure protection of USDWs. In particular, the UIC Program Director may refer to the Emergency and Remedial Response (E&RR) Plan submitted with the permit application.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation
			Program Director within 24 hours. Restoration and demonstration of mechanical integrity satisfactory to the UIC Program Director must be performed prior to resuming injection. The UIC Program Director must be notified when injection is expected to resume.	
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Construction Guidance for Owners and Operators <p><i>The above guidance document is currently available on EPA's website at:</i> http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>				

Table 3.8: Mechanical Integrity (40 CFR 146.89)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
1.	Maintaining mechanical integrity	40 CFR 146.89(a)(1) – (a)(2) & (e) – (g)	Owners or operators must perform tests to verify the internal and external integrity of injection wells. Internal mechanical integrity refers to the absence of significant leaks in the tubing, casing, or packer. External mechanical integrity refers to the absence of significant fluid movement into a USDW through vertical channels adjacent to the injection well bores. Owners or operators must maintain mechanical integrity at all times except during periods of well workover approved by the UIC Program Director. The results of MITs must include a description of the test(s) and the method(s) used.	Any additional or alternatives tests may be required by the UIC Program Director to demonstrate mechanical integrity.
<i>Internal mechanical integrity</i>				
2.	Results of initial annular pressure test for internal mechanical integrity	40 CFR 146.89(b)	<p>The owner or operator is required to conduct an initial annular pressure test prior to injection. The standard annulus pressure test is the most common means used to demonstrate internal mechanical integrity. The test is based on the principle that pressure applied to fluids filling a sealed vessel will persist and provides an immediate demonstration of whether leaks exist.</p> <p>EPA recommends that pressure measurements be made using a gauge sensitive enough to detect any pressure changes that would result in failure of the test. Prior to conducting the test, the injection tubing and annulus will be</p>	The owner or operator must submit results of the annular pressure test, and the UIC Program Director may ensure that the well has demonstrated internal mechanical integrity and that the test was conducted correctly before authorizing injection.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			completely filled with liquid. Temperature stabilization also needs to be achieved. After stabilization, the annulus will be pressurized and then isolated for a period of at least 1 hour. During isolation, measurement of pressure will ideally be made at regular intervals. A change in pressure that exceeds a previous UIC Program Director-approved critical pressure change indicates that the well has failed to demonstrate internal mechanical integrity. If a significant amount of liquid is returned after the isolation period, the annulus may be blocked at a shallow depth.	
3.	Results of continuous annulus pressure monitoring for internal mechanical integrity	40 CFR 146.89(b)	During injection, the owner or operator is required to continuously monitor the pressure on the annulus to verify internal mechanical integrity. The purpose of continuous pressure monitoring is to demonstrate that no pressure changes are occurring. A drop in annulus pressure provides an early indication that attention is needed to prevent a loss of mechanical integrity or unacceptable fluid movement. Any change in the pressure on the annulus between tubing and long-string casing, regardless of what the annulus pressure is relative to injection pressure, can indicate a possible leak. In the event of a casing leak opposite a permeable zone, the pressure will normally fall. In the event of a tubing or packer leak, the annulus pressure will track injection pressure.	When a loss of internal mechanical integrity is suspected, the UIC Program Director may require an annulus pressure test to confirm mechanical integrity. If the well demonstrates mechanical integrity, the UIC Program Director may allow continued operation.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>Unless a leak will result in an unimpeded pressure change, leaks may not be evident in pressure monitoring. To enhance the value of maintaining a positive pressure differential, Class VI regulations require volume measurements of all liquid additions from the annulus systems to be collected and accumulated. A continuing need to add or remove fluid to maintain a set pressure is evidence of a leak in the well, although not necessarily an absence of mechanical integrity.</p> <p>The owner or operator must submit results of continuous pressure monitoring and any fluid addition or losses to the annulus.</p>	
External mechanical integrity				
4.	Periodic external mechanical integrity tests	40 CFR 146.89(c)	<p>During injection, the owner or operator must perform an external MIT at least once per year and report results to the UIC Program Director. Acceptable tests include an oxygen activation log, radioactive tracer survey, temperature log, or noise log. Execution and interpretation of these tests are described in the forthcoming <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i>, to be available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm. Generally, these methods consist of measurements made along the depth of the well via a wireline geophysical tool.</p> <p>The owner or operator must submit results</p>	The UIC Program Director may require additional information regarding tests, or that additional tests be run, if, among other things, loss of mechanical integrity is suspected.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>of external MITs, which will typically take the form of detailed logs of the testing instrument as a function of depth and an interpretation of the log to verify mechanical integrity. The UIC Program Director may independently evaluate the results of the external MIT to verify integrity.</p> <p>The UIC Program Director may require the use of a tracer in situations where it would provide valuable information about the movement of the carbon dioxide plume. Tracers can be used to help determine the location of the plume and detect leaks in the well. The tracer is added to the injected stream and is then monitored to determine where the injectate is traveling.</p>	
5.	Results of casing inspection logs, if required by the UIC Program Director	40 CFR 146.89(d)	<p>If required by the UIC Program Director, the owner or operator must run a casing inspection log. The purpose of the casing inspection log is to determine the presence or absence of corrosion in the long-string casing. Casing evaluation logs are in situ measurements of casing thickness and integrity. Casing inspection logs differ from external mechanical integrity tests by measuring properties of the tubing and casing, not properties indicative of flow outside the casing.</p> <p>Log data can be collected with mechanical, acoustic, or electrical techniques. Generally, a device is run down the well on a wireline and collects data as it moves</p>	The UIC Program Director may independently assess the presence of corrosion, and the potential for corrosion to cause loss of mechanical integrity, through interpretation of the casing inspection logs and external MITs. The UIC Program Director may require that additional logs be run if corrosion is suspected based on the submitted data.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>along the casing. Caliper logs, ultrasonic calipers, and electrode pairs are all acceptable forms of casing inspection logs.</p> <p>The owner or operator will need to submit results of the casing inspection logs and an interpretation of the logs to determine the presence of corrosion.</p>	
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Testing and Monitoring Guidance for Owners and Operators <p><i>The above guidance document will be available in the future on EPA's website at:</i></p> <p>http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>				

Table 3.9: Testing and Monitoring Requirements (40 CFR 146.90)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
Testing and monitoring are important components of the Class VI Program that ensures that USDWs are not endangered. Information generated through a rigorous testing and monitoring regime will provide information about site performance that can be compared against baseline information or previous monitoring results. Monitoring data can demonstrate whether the GS project is performing as predicted. For example, these data can verify that the injectate is confined in the target formation; identify potential corrosion of well materials; signal the need for mechanical integrity adjustments; show changes in the formation fluid geochemistry; or verify the predicted direction of the carbon dioxide plume and pressure front.				
Testing and Monitoring Plan				
1.	Testing and Monitoring Plan	40 CFR 146.90 & 146.90(j)	<p>The Testing and Monitoring Plan is a descriptive report of all planned monitoring and testing on site. The Plan must be submitted with the permit application for review and approval by the UIC Program Director. The Testing and Monitoring Plan requirements allow for site specificity and selection of the most suitable monitoring technologies. Once approved, the Testing and Monitoring Plan is enforceable. In the Testing and Monitoring Plan, owners or operators must describe the testing techniques, equipment, sampling and/or testing frequency, plans to record and report, and quality assurance and surveillance measures for:</p> <ul style="list-style-type: none"> • Injectate monitoring. • Continuous monitoring of injection pressure, rate, and volume; pressure on the annulus between the tubing and the long-string casing; and annulus fluid volume. • Corrosion monitoring. • Ground water quality monitoring, including periodic monitoring of 	<p>The UIC Program Director will review the Testing and Monitoring Plan to ensure that the planned testing meets the requirements in the Rule (e.g., frequencies) while accounting for site-specific circumstances.</p> <p>The UIC Program Director will evaluate the proposed Testing and Monitoring Plan in connection with geologic and proposed operating data submitted with the permit application to verify that all required elements at 40 CFR 146.90 are present, and that they account for all site-specific conditions to ensure USDWs are protected from endangerment. In particular, the UIC Program Director may consider:</p> <ul style="list-style-type: none"> • Is the planned testing and monitoring (e.g., frequency, parameters) sufficient to provide early warning if a USDW becomes endangered? • Are all potential risks identified in the site characterization addressed (e.g., nearby USDWs, faults or fractures)? • Will the Testing and Monitoring Plan provide the necessary data and model inputs to verify predictions of plume movement and reevaluate the AoR? • Is appropriate monitoring in place to address additional risk associated with use of an injection depth waiver (if applied for)? <p>The UIC Program Director may require more frequent review of the Testing and Monitoring Plan to incorporate operational and</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>geochemical changes above the confining zone(s).</p> <ul style="list-style-type: none"> • Mechanical integrity testing. • Pressure fall-off testing. • Carbon dioxide plume and pressure front tracking via direct and indirect methods. • Surface air monitoring and/or soil gas monitoring, if required by the UIC Program Director. • Any additional monitoring necessary to support, upgrade, and improve computational modeling of the area of review (AoR) evaluation and to determine compliance with standards, as required by the UIC Program Director. <p>The Testing and Monitoring Plan must be reviewed and, if necessary, updated within 1 year of each reevaluation of the AoR, following any significant changes to the facility (e.g., addition of monitoring wells or newly permitted injection wells within the AoR), or when required by the UIC Program Director [40 CFR 146.90(j)]. Owners or operators may coordinate with the UIC Program Director and use the results of the AoR reevaluation, along with monitoring/operational data collected since the last AoR reevaluation, to assess the need for amending the Testing and Monitoring Plan. Any amended Plan must be approved by the UIC Program Director and would then be incorporated into the permit.</p>	<p>monitoring data and the most recent AoR reevaluation. The UIC Program Director has the discretion to require any additional information necessary to support the Testing and Monitoring Plan.</p> <p>For monitoring wells, EPA recommends that the UIC Program Director ask for additional information if he or she is not certain whether monitoring wells will accurately characterize zonal isolation or if the monitoring plan does not include adequate sampling in both the injection and confining zones.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
2.	Analysis of the carbon dioxide stream	40 CFR 146.90(a)	<p>The owner or operator must submit analyses of the carbon dioxide stream. This information is needed to anticipate the potential for corrosion of well materials and interactions with formation fluids and solids. Data will generally be reported as percentages or as parts per million by volume (ppmv). Analytes of interest include carbon dioxide (%), water vapor, hydrocarbons, sulfur dioxide, hydrogen sulfide, nitrous oxides, methane, carbon monoxide, mercury, arsenic, and hydrochloric acid.</p> <p>Analyses may be performed using any of a variety of methods, including electrochemical sensors, gas chromatography, infrared sensors, Fourier-transform infrared spectroscopy, sulfur chemiluminescent detector, total hydrocarbon content analyzer, and ultraviolet-visible spectrometry. Further information on the various methods of analysis can be found in the forthcoming <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i>, to be available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>	<p>The UIC Program Director may verify that quality assurance data have been submitted with the analyses and request further information if there are problems with quality assurance samples.</p> <p>Impurities found in the injectate can guide needs for ground water monitoring or corrosion monitoring (refer to rows 4-5 of this Table). In evaluating data on the carbon dioxide stream, EPA advises that the UIC Program Director be alert to significant water vapor in the carbon dioxide stream as this has implications for corrosion of well materials. Hydrogen sulfide is not expected to cause a drop in pH in the subsurface, but sulfur dioxide has been predicted to potentially generate acidity.</p> <p>If unacceptable concentrations of water vapor or other impurities are found, the UIC Program Director may request a repeat analysis to determine if the problem is persistent. Deterioration of the injectate quality may indicate a problem with the infrastructure transporting the carbon dioxide or a change in the quality of the output from the carbon dioxide source; the UIC Program Director may want to investigate such causes.</p>
3.	Continuous recording of operational parameters	40 CFR 146.90(b)	<p>The owner or operator must continuously record:</p> <ul style="list-style-type: none"> • Injection pressure. • Injection rate and volume. • Pressure in the annulus between the 	<p>The UIC Program Director may verify that flow rates agree with limits specified in the permit. Options for monitoring down-hole pressure and annular pressure are also presented in the forthcoming <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i>. The UIC Program Director may verify that the cumulative volume is consistent with the proposed</p>

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			<p>tubing and the long-string casing.</p> <ul style="list-style-type: none"> • Annulus fluid volume. <p>The owner or operator must submit semi-annual reports containing monthly average maximum and minimum values for injection pressure, flow rate and volume, and annular pressure. This information is needed to demonstrate that injection is proceeding according to the intended operating conditions, to prevent fracturing of the confining zone, and to inform AoR reevaluations.</p> <p>Flow rate will be measured using one or more of a variety of flow meters, which are described in the <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i>, to be available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p> <p>The owner or operator is required to provide a description of any event that exceeds operating parameters for annulus pressure or injection pressure (refer to Table 3.10 for information on required reporting).</p>	<p>progress of the storage project.</p> <p>An inability to maintain annulus pressure may indicate a mechanical integrity problem; the UIC Program Director may verify that the problem is being satisfactorily addressed through identification of the fluid leak (using additional testing techniques, as discussed in the <i>Draft UIC Class VI Program Well Testing and Monitoring Guidance</i>) and plans for remediation. In evaluating the data, the UIC Program Director may be aware of normal expected variations in the annulus pressure due to temperature changes and other factors. If the annulus requires regular addition of fluid, a mechanical integrity problem is present.</p> <p>The UIC Program Director may request further information on any anomalous values if he or she is not satisfied with the explanation provided. Additionally, the UIC Program Director may request further information if the owner or operator has not provided adequate information on remediation of the well.</p>
4.	Corrosion monitoring of well materials	40 CFR 146.90(c)	Corrosion monitoring is needed to detect deterioration of well components (e.g., casing, tubing and packer) that may cause loss of mechanical integrity. The owner or operator must monitor for corrosion using coupons, corrosion loops, or another method approved by the UIC Program Director (e.g., casing logs) and will submit	If testing using coupons or corrosion loops suggests a problem, the UIC Program Director may request casing logs for further exploration of the issue. Coupons, corrosion loops, and casing logs are all well established corrosion monitoring methods, though it is recommended that the UIC Program Director consider the advantages and disadvantages of the different methods when evaluating plans for their use and the results. Further information regarding the use of coupons, corrosion

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			<p>the results of corrosion monitoring quarterly.</p> <p>Coupons and corrosion loops are able to identify various signs of corrosion (e.g., general, loss of mass or thickness, crevice, pitting, stress cracking, embrittlement, galvanic, metallurgical structure related corrosion). The corrosion rate determined from a coupon, however, may not match that of the actual well equipment. Corrosion loops mimic a well in miniature, but the temperature is generally lower than inside the casing string.</p> <p>Casing log methods include caliper logs, ultrasonic calipers, and electrode pairs. Casing logs provide the advantage of direct measurement of casing thickness.</p>	<p>loops, and casing logs is provided in the <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i>, available on EPA's website.</p> <p>If corrosion is identified, the UIC Program Director may consider the type of corrosion that is occurring. With general corrosion, the rate can be considered in the context of the anticipated lifespan of the GS project. Some degree of generalized corrosion may be acceptable, especially if allowance has been made in the design thickness of the casing. However, if the general corrosion rate is too high, it may ultimately lead to well failure.</p> <p>Localized forms of corrosion, such as pitting or cracking, may pose a more serious threat, and the UIC Program Director may ask for additional information or require remediation of the well to prevent leakage.</p>
5.	Monitoring data of the ground water quality and geochemical changes above the confining zone(s)	40 CFR 146.90(d)	<p>Testing of ground water quality is used to evaluate that carbon dioxide or mobilized fluids are not migrating vertically through the confining layer. The owner or operator must submit ground water quality data for a number of parameters that will likely include, but are not limited to, the following: pH, specific conductivity, temperature, carbon dioxide (%), major cations and anions, TDS, metals, and hydrocarbons.</p> <p>The owner or operator may submit data in the form of an electronic database or tables, and may provide supplemental graphs or diagrams.</p>	<p>Ground water monitoring within the injection zone will be executed similarly to monitoring above the primary confining zone, as discussed above. Detection of carbon dioxide or mobilized fluids in areas not expected to exhibit influences from the injection project at a certain time may indicate that the carbon dioxide plume is not moving as initially predicted. Ground water monitoring data within the injection zone also informs AoR reevaluations.</p> <p>The UIC Program Director may verify that samples were collected in a manner that preserves down-hole conditions (e.g., via U-tube). The UIC Program Director may consider whether the proposed list of analytes is consistent with site-specific concerns, such as impurities in the injectate or prior use of the basin (e.g., hydrocarbon recovery). Results from the initial site characterization will guide the choice of monitoring parameters. If initial site evaluation suggests the possibility of</p>

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				<p>metals release (e.g., arsenic, mercury, lead) due to dissolution of minerals, the ground water quality analyses will need to reflect this.</p> <p>The UIC Program Director may compare ground water quality analyses to those provided as part of the baseline site characterization. A significant change in major anion concentrations, TDS, pH, or concentration of trace constituents may be indicative of a breach of the confining zone.</p> <p>If the list of analytes tested appears incomplete, the UIC Program Director may request additional information.</p>
6.	Demonstration of external mechanical integrity	40 CFR 146.90(e)	External mechanical integrity data are required to demonstrate at least once per year that the well has mechanical integrity (i.e., there is no fluid movement behind the casing). The owner or operator may have selected a tracer survey, temperature log, or noise log; alternative external MITs may be allowed if the owner or operator described these in their Testing and Monitoring Plan and the UIC Program Director approves their use.	Additional information on mechanical integrity can be found in Table 3.8 of this manual and in the <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i> , to be available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm .
7.	Pressure fall-off test	40 CFR 146.90(f)	<p>A pressure fall-off test, including the results and date of the test, must be provided to the UIC Program Director. The test must be performed at least once every 5 years, unless required more frequently by the UIC Program Director. The owner or operator may choose to perform this test in conjunction with well workovers, maintenance, or other testing.</p> <p>The proposed pressure fall-off test must be described in the Testing and Monitoring Plan, including the type of pressure fall-off</p>	The UIC Program Director will want to ensure that the pressure fall-off test is designed to verify that pressure declines agree with modeled projections of reservoir pressure changes.

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			test to be employed, associated quality assurance and surveillance measures, anticipated testing dates, and how data and test results will be recorded and reported.	
8.	Testing and monitoring to track the extent of the carbon dioxide plume and area of elevated pressure	40 CFR 146.90(g)	<p>The owner or operator must submit the results of direct pressure and ground water monitoring within the injection zone. This information is needed to verify the extent of the pressure front associated with the plume and can provide information useful in assessing confinement of the plume within the injection zone. The owner or operator may also perform direct pressure monitoring in the first permeable formation overlying the injection formation. This information can be useful in assessing pressure, carbon dioxide, and/or native brine vertically through the confining zone.</p> <p>Direct pressure monitoring will be performed using one or more of the devices for pressure measurement discussed in the <i>Draft UIC Class VI Program Well Testing and Monitoring Guidance</i>.</p> <p>The owner or operator must also submit the results of indirect monitoring (i.e., geophysical surveys) above the injection zone. This information will image the carbon dioxide plume and confirm that it is not moving laterally or in a manner contradictory to site understanding and the AoR delineation model. Indirect plume</p>	<p>The UIC Program Director may check pressure values against those predicted by modeling of the AoR. The UIC Program Director may anticipate variability in readings for the various devices and understand what constitutes a significant rise in pressure. If pressure is increasing more rapidly than anticipated, this may be indicative of changes in injectivity or other deviations from expected formation characteristics and operating conditions. Pressure data will contribute to reevaluations of the AoR, and the UIC Program Director may bear in mind that this information has implications for the ultimate lifespan and capacity of the GS project. Changes in the reporting frequency for pressure monitoring data may be warranted.</p> <p>In evaluating geophysical data, the UIC Program Director may consider if the results provide an image of the formation at the desired resolution. When using geophysical methods for plume monitoring or other time-lapse purposes, EPA recommends that individual surveys be carefully registered to surface coordinates to facilitate accurate comparison. Any details provided by the owner or operator to the UIC Program Director on the locations of permanent measuring stations, survey markers, or other georeferencing mechanisms will help increase confidence in the time-lapse abilities of the geophysical survey.</p> <p>The UIC Program Director has discretion to determine whether indirect methods are appropriate to monitor for changes in the carbon dioxide plume based on site-specific geology, and in some cases, may deem a site unsuitable for one or more</p>

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			monitoring will be performed using any of a number of geophysical methods, such as seismic, electrical, gravity, or electromagnetic surveys (refer to the <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i> and the <i>Draft UIC Program Class VI Well Site Characterization Guidance</i> , available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm , for more information). These methods will be used to monitor for the presence of supercritical carbon dioxide and will supplement direct monitoring in tracking the fate of the injectate. Seismic profiling data have the added benefit of being used to estimate subsurface pore pressure if the method is planned appropriately.	geophysical techniques. Geophysical methods are difficult to execute in areas that are structurally and topographically complex or where lithologies have limited contrast in density, porosity, permeability, and other physical properties. For example, geologic settings with loose, unconsolidated sediments can attenuate seismic waves and make seismic profiling difficult. Other settings where seismic imaging is difficult, as discussed in the <i>Draft UIC Program Class VI Well Site Characterization Guidance</i> , may also be inappropriate. The owner or operator may provide documentation as to why such methods are infeasible in the Testing and Monitoring Plan.
9.	Surface air monitoring and/or soil gas monitoring, if required by the UIC Program Director	40 CFR 146.90(h)	The UIC Program Director has discretion to determine whether surface air monitoring and/or soil gas monitoring is necessary based on risk of endangerment to USDWs. Surface air monitoring and/or soil gas monitoring can serve as a warning that carbon dioxide has migrated vertically out of the injection formation and may have endangered a USDW.	<p>If the UIC Program Director has reason to believe (i.e., based on site-specific conditions) that additional monitoring is needed to sufficiently assess progress of the GS project or protect against USDW endangerment, it is within his or her authority to request that this additional monitoring be included in the Testing and Monitoring Plan.</p> <p>For soil gas monitoring, analyses of soil gas and vadose zone vapor may be collected using drive point gas probes, vapor monitoring wells, or soil flux chambers. When interpreting the data, it is suggested that the UIC Program Director be aware of the limitations of such methods (i.e., that they are point measurements), understand that there are natural variations in soil gas composition, and verify that background measurements are available.</p>

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				The UIC Program Director may request additional information if he or she believes that the measurement devices were not deployed in locations that may experience leakage (i.e., near the injection well or other potential conduits). If anomalous readings are obtained, the UIC Program Director may consider repeat analyses to determine if the results are persistent.
10.	Any additional monitoring	40 CFR 146.90(i)	If required by the UIC Program Director, the owner or operator must perform additional monitoring that will contribute to AoR or compliance evaluations.	The UIC Program Director has the discretion to require any additional monitoring that is necessary to support, upgrade, and improve the computational modeling of the AoR evaluation or to determine compliance with standards according to 40 CFR 144.12.
11.	Quality assurance and surveillance plan for all testing and monitoring requirements	40 CFR 146.90(k)	<p>A quality assurance and surveillance plan for all testing and monitoring requirements must be included in the Testing and Monitoring Plan. This plan will include procedures to ensure that monitoring data are reliable and of sufficient quality to demonstrate that the GS project is operating as planned or to indicate any problems that may arise. The nature and extent of quality assurance activities required will vary greatly from method to method. Some issues that may be addressed in the quality assurance and surveillance plan include, but are not limited to:</p> <ol style="list-style-type: none"> 1. Proper use of all equipment (e.g., calibration procedures). 2. Obtaining field blanks and duplicates for sampling of fluid or carbon dioxide. 3. Reporting laboratory quality assurance data. 4. Collecting baseline data where 	<p>Quality assurance procedures for geophysical methods may be more detailed as these methods are particularly complex. Quality assurance plans may be requested from contractors retained to perform such surveys or from any other contractors. Planning for quality surveillance may include review of quality assurance information and steps to be taken if quality assurance objectives are not met.</p> <p>The UIC Program Director may request additional information if any of the information is not adequately described.</p>

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			<p>appropriate (e.g., geophysical methods, formation fluid sampling, surface monitoring).</p> <p>5. Specifying detection limits and anticipated precision for analytical methods, pressure measurements, and corrosion measurements.</p>	
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Testing and Monitoring Guidance for Owners and Operators • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Project Plan Development Guidance for Owners and Operators <p><i>All of the above guidance documents are currently available on EPA's website at:</i> http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>				

Table 3.10: Reporting Requirements (40 CFR 146.91)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
EPA expects that the Class VI permit application process will be iterative, during which the owner or operator must submit information to the UIC Program Director to inform permitting decisions and permit issuance. During this process, the UIC Program Director is responsible for reviewing and approving the required information. EPA is requiring that owners or operators submit information in an electronic format to facilitate accessibility and transferability; however, if an owner or operator is unable to submit the required data to the electronic reporting system managed by EPA, EPA expects the UIC Program Director to seek approval from EPA regarding an alternative reporting format. Following EPA approval of a non-electronic reporting format, an alternate procedure may be allowed. UIC Program Directors will have access to information needed to ensure compliance with UIC Class VI permits and that GS projects are operating properly and are sufficiently protective of USDWs. The information collected under 40 CFR 146.91 may be used as evidence of a permit violation.				
1.	Semi-annual reports	40 CFR 146.91(a)	Semi-annual reports must contain, at a minimum, the information on any changes to the physical and chemical characteristics of the carbon dioxide stream from those described in the permit application, based on an analysis of the carbon dioxide stream. The semi-annual report must also include: monthly average, maximum, and minimum values for injection pressure, rate, and annular pressure; monthly injected carbon dioxide volumes; and cumulative injected carbon dioxide volume since initiation of operation. A description of any event that results in divergence or exceedance from permitted operating ranges for annulus pressure or injection pressure specified in the permit, or in the triggering of a shut-off device, must also be included in semi-annual reports.	<p>The UIC Program Director will use this information to confirm that the injection operation is proceeding as planned and continues to not pose any risk to USDWs. The UIC Program Director can use these semi-annual reports in conjunction with other information to verify the absence of significant leaks, determine well integrity, and confirm that injection is proceeding as planned.</p> <p>The GS Rule requires owners or operators of Class VI injection wells to submit the results of required testing, monitoring, reports, submittals, and notifications directly to EPA in an electronic format. All UIC Program Directors will have access to the data required to be submitted through the electronic reporting system managed by EPA. In addition, the UIC Program Director may request that the owner or operator supply any additional necessary reporting information in order to verify protection of USDWs.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
2.	Reports within 30 days	40 CFR 146.91(b)	Reports generated as a result of any periodic MITs, well workovers, or other injection well tests conducted by the owner or operator must be submitted electronically to EPA within 30 days of the activity.	<p>These reports will be accessible to the UIC Program Director for verification that well integrity is intact and that the well does not pose any risk to becoming a conduit for fluid movement into or between the USDWs.</p> <p>The UIC Program Director may request that the owner or operator supply additional reporting information to verify protection of USDWs.</p>
3.	Reports within 24 hours	40 CFR 146.91(c)	<p>Triggers for such reporting may be associated with changes in the quality or volume of the injectate or associated pressure front, noncompliance with a permit condition, or a malfunction of the injection system that may cause fluid migration into or between USDWs. Any triggering of a shut-off device or failure to maintain mechanical integrity must be submitted in a similar report within 24 hours.</p> <p>The UIC Program Director may require surface air monitoring and/or soil gas monitoring to serve as an extra layer of protection to detect carbon dioxide that has reached the surface and may have endangered a USDW. If monitoring is required by the UIC Program Director, any release of gas to the atmosphere or biosphere must be reported within 24 hours to the electronic reporting system managed by EPA [40 CFR 146.91(c)(5)]. The specifics of surface air and soil gas monitoring data to be reported are discussed under the testing and monitoring requirements in Table 3.9 of this manual</p>	<p>The UIC Program Director will have access to all reports submitted within 24 hours indicating any evidence of possible endangerment to USDWs. The shorter timeframe for reporting such events is necessary to ensure an immediate response to any potential endangerment of USDWs.</p> <p>The UIC Program Director may request that the owner or operator supply additional reporting information to verify protection of USDWs.</p>

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			and in the <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i> , available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm .	
4.	Notifications within 30 days	40 CFR 146.91(d)	The UIC Program Director must receive notification in writing 30 days in advance of any planned well workover, well stimulation activities (other than stimulation for formation testing conducted under 40 CFR 146.82), or any other planned test of the injection well conducted by the owner or operator. Note that the UIC Program Director is not required to respond to the notification received.	This notification offers the UIC Program Director an opportunity to evaluate the planned activity in the context of new information received since permit approval and correspond with the owner or operator, if necessary, regarding any suggested modifications to the planned activity or to place additional conditions on the planned activity if necessary. It is recommended that the UIC Program Director oversee tests and inspect completed work as necessary, based on the notifications received.
5.	Electronic reporting system	40 CFR 146.91(e)	The data resulting from monitoring, testing, and operational activities must be submitted by owners or operators. These data must be submitted for each permitted Class VI well, at varying intervals, to a centralized electronic reporting system managed by EPA.	The UIC Program Director will have full access to the owner or operator provided data collected under the centralized electronic reporting system managed by EPA in order to assess compliance and identify potential problems that warrant attention. In addition, the UIC Program Director will be responsible for submitting additional Class VI compliance data to the centralized reporting system. The UIC Program Director will have access to the following reports, which are collected by the centralized electronic reporting system: semi-annual reports; reports within 30 days of specified testing activities; reports within 24 hours of any noncompliance or evidence of endangerment to a USDW; and notifications 30 days in advance of specified activities. EPA anticipates that reports and data provided to the system may be acceptable and available as portable document format (PDF) files and/or tabular data. However, EPA acknowledges that there are other format possibilities under discussion, and decisions may be forthcoming. Required reports and documents may be submitted as PDF files with the date and well identification

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				information in the file properties section as well as in the document itself; this will facilitate retrieval of the report. However, PDF files may pose limitations to achieving usability and exchange between different data formats and to managing the raw data in these reports. Thus, PDF format may not be optimal for actions that require more than simple file retrieval, such as data analysis. As EPA requires data to be in a usable format for implementing EPA's adaptive approach to rulemaking, some reporting data (e.g., injection pressure values, injection rate, monthly or cumulative volume, monthly annulus fluid volume) may be best submitted in tabular raw form. Additional data formats, such as Geographic Information Systems (GIS), are still under discussion and decisions will be forthcoming. UIC Program Directors will want to stay in touch with EPA on this issue.
6.	Recordkeeping	40 CFR 146.91(f)	The UIC Program Director may request records at any time from owners or operators who must retain monitoring data collected pursuant to 40 CFR 146.90(b) through 146.90(i) for 10 years after it is collected. The following data must be retained throughout the life of the GS project and for 10 years following site closure: data collected for Class VI permit applications; data on the nature and composition of the injectate [40 CFR 146.90(a)]; well plugging reports; PISC data, including data and information used to develop the demonstration of the alternative PISC timeframe, if appropriate; and, the site closure report collected pursuant to requirements at 40 CFR 146.93(f) and (h). This recordkeeping timeframe supports EPA's review of project	The UIC Program Director may require that records be transferred from the owner or operator at the conclusion of the retention period and has the authority to require owners or operators to retain any required reports, data, or information for longer than 10 years after site closure.

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			data as part of the adaptive approach to rulemaking (refer to Section 1.4 of this manual for more information).	
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Recordkeeping, Reporting, and Data Management Guidance for Owners and Operators <p><i>This guidance document will be available in the future on EPA's website at:</i> http://water.epa.gov/type/groundwater/uic/regulations.cfm.</p>				

Table 3.11: Injection Well Plugging (40 CFR 146.92)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation
1.	Pre-plugging activities	40 CFR 146.92(a)	Prior to the well plugging, the owner or operator must flush each Class VI injection well with a buffer fluid, determine bottomhole reservoir pressure, and perform a final external mechanical integrity test.	
<i>Injection Well Plugging Plan</i>				
2.	Injection Well Plugging Plan	40 CFR 146.92(b)	To ensure that effective methods are used for well plugging, owners or operators must submit an Injection Well Plugging Plan with the permit application. The approved Injection Well Plugging Plan is enforceable.	<p>The UIC Program Director will evaluate the proposed Injection Well Plugging Plan to verify that all required elements as described in 40 CFR 146.92(b) are present and that they account for all site-specific conditions to ensure that USDWs are protected from endangerment. In particular, the UIC Program Director may consider:</p> <ul style="list-style-type: none"> • Are the plugs and cement the owner or operator proposes to use compatible with the injectate and formation fluid geochemistry? • Is the proposed placement of the plugs and cement appropriate based on the presence and depth of USDWs in the AoR or other geologic features? • Are proposed post-injection tests (e.g., MITs, bottom-hole reservoir pressure tests) sufficient to characterize the well and formation pressures? • If injection depth waivers are allowed, does the proposed Injection Well Plugging Plan protect USDWs both above and below the injection zone? <p>If the UIC Program Director has reason to believe (i.e., based on site-specific conditions) that additional data are needed to sufficiently address risk to USDWs at the site, it is within his or her authority to request that additional site-specific information be collected or additional activities be included in the Injection Well Plugging Plan. In addition, the UIC Program Director has</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation
				the discretion to require any additional information necessary to support the Injection Well Plugging Plan.
3.	Tests to determine bottomhole reservoir pressure	40 CFR 146.92(b)(1)	The owner or operator must submit a description of the test method(s) that will be used to determine bottom-hole reservoir pressure prior to plugging. After injection ceases and the well has been shut in, bottom-hole pressure may be calculated based on measurement of the static fluid level in the borehole, measured directly using a dedicated down-hole pressure measurement gauge, or measured with pressure gauge instrumentation lowered into the borehole.	The UIC Program Director will confirm that the given method is suitable.
4.	Test method(s) for the final mechanical integrity test	40 CFR 146.92(b)(2)	The owner or operator must submit a description of the test method(s) that will be used to assess the external mechanical integrity of the well prior to plugging. This test will determine if remedial actions are needed to address any leakage in the well's casing or cement prior to plugging.	The UIC Program Director will determine whether the final MIT to be conducted will use a suitable method, such as a pressure test with liquid or gas, a radioactive tracer survey, or a noise, temperature, pipe evaluation, or cement bond logs.
5.	Methods and materials for well plugging	40 CFR 146.92(b)(3) – (b)(6)	<p>The owner or operator must submit the following information regarding well plugging methods that will be used:</p> <ul style="list-style-type: none"> • The type and number of plugs. • The placement of each plug including the elevation of the top and bottom. • The type, grade, and quantity of materials to be used in plugging. • The method of placement of the plugs. <p>While maintaining appropriate protection of USDWs, owners or operators are provided</p>	<p>It is recommended that the UIC Program Director verify that all chosen well plugging methods are appropriate to ensure that the well does not serve as a conduit for fluid movement.</p> <p>The UIC Program Director will verify that plugs will be placed:</p> <ol style="list-style-type: none"> 1. Within the primary confining zone, including across the injection zone/confining zone interface. 2. Above, below, and/or through each USDW containing stratum. 3. At the bottom of intermediate and surface casings. 4. Across any casing stubs (pulled casing sections). 5. At the surface.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation
			<p>flexibility in selecting plugging materials and methods, provided the materials are suitable for contact with carbon dioxide.</p> <p>Plugging materials need to: 1) provide sealing against fluid flow; 2) bond well to the existing well bore materials and lithologies; and 3) be durable and non-reactive. Ideally, plugging cements will be non-reactive with carbon dioxide/water mixtures. Non-Portland-based cements, which are less vulnerable to acid attack, may be necessary. It is advised that the density of the cement be great enough to maintain well control, based on the final bottomhole pressure measurement.</p>	<p>For more information on methods used for plug placement, the UIC Program Director can refer to the forthcoming <i>Draft UIC Program Class VI Well Plugging, PISC, and Site Closure Guidance</i>, available in the future on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm, and U.S. EPA (1989).</p>
Notice of intent to plug				
6.	Logistical information regarding the well to be plugged	40 CFR 146.92(c)	<p>At least 60 days prior to plugging of an injection or monitoring well, the owner or operator must provide the UIC Program Director with a notice of their intent to plug. The NOI to plug may consist of a certified letter to the UIC Program Director and provide the time and date of anticipated plugging, the name and location of the well to be plugged, and a list of which parties will be performing the plugging activities. In addition, the letter briefly specifies if any changes have been made to the approved Injection Well Plugging Plan. If any changes are required to the Plan, a revised Injection Well Plugging Plan must be submitted to the UIC Program Director at the same time as the NOI to plug, and the</p>	

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation
			UIC Program Director must approve any changes to the Plan prior to the commencement of plugging.	
<i>Injection well plugging report</i>				
7.	Detailed account of implementation of the Injection Well Plugging Plan	40 CFR 146.92(d)	The plugging report is intended to provide the UIC Program Director with an account of the specific activities that took place during well plugging, highlighting any deviations from the approved Injection Well Plugging Plan. The report must include the location of the well, the date the well was plugged, how the well was prepared for plugging, the materials used for plugging, and methods used for plug placement. The report must be provided to the UIC Program Director within 60 days after plugging and must be certified as accurate by the owner or operator or by the person who performed the well plugging.	The UIC Program Director may request additional information if sufficient detail has not been included to independently assess the quality of the well plugging. Furthermore, the UIC Program Director may require additional plugging activities, if necessary.
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Plugging, Post Injection Site Care (PISC) and Site Closure Guidance for Owners and Operators • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Project Plan Development Guidance for Owners and Operators <p><i>All of the above guidance documents are either currently available or will be available in the future on EPA's website at:</i></p> <p>http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>				

Table 3.12: Post-Injection Site Care and Site Closure (40 CFR 146.93)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
<p>The PISC timeframe is set at 50 years following the cessation of injection. The PISC timeframe may be shortened by the UIC Program Director if the owner or operator can demonstrate that USDWs would not be endangered by the carbon dioxide plume and/or pressure front prior to 50 years. The PISC timeframe may also be extended by the UIC Program Director if, after 50 years, the UIC Program Director determines that USDWs may still become endangered by the carbon dioxide plume and/or pressure front. Records collected during the PISC period must be retained by the owner or operator for 10 years following site closure. After this retention period, the records must be provided to the UIC Program Director, who will designate a location where the records will be retained thereafter. Alternatively, the GS Rule allows the UIC Program Director to approve an alternative PISC timeframe where an owner or operator can demonstrate during the permitting process that an alternative PISC timeframe, other than the 50 year default, is appropriate and ensures non-endangerment of USDWs.</p> <p>Following a determination that the GS project continues to pose no risk to USDWs, based on the owner's or operator's non-endangerment demonstration, the UIC Program Director may approve site closure. Following the UIC Program Director's approval of site closure, the owner or operator must properly close site operations. Activities to occur prior to site closure include, but may not be limited to, plugging all monitoring wells; submitting a site closure report; and recording a notation on the deed to the facility property or other documents that the land has been used to sequester carbon dioxide. Site closure would proceed according to the UIC Program Director-approved PISC and Site Closure Plan.</p>				
Post-Injection Site Care and Site Closure Plan				
1.	Post-Injection Site Care and Site Closure Plan	40 CFR 146.93(a) & 146.93(a)(1)	The UIC Program Director must review and approve the Post-Injection Site Care and Site Closure Plan that describes the anticipated post-injection site care (PISC) monitoring activities and their frequency. The approved PISC and Site Closure Plan is enforceable.	<p>The UIC Program Director will evaluate the proposed PISC and Site Closure Plan to verify that all required elements as described in 40 CFR 146.93(a) are included and that they account for all site-specific conditions to ensure USDWs are protected from endangerment. In particular, the UIC Program Director may consider:</p> <ul style="list-style-type: none"> • Is the proposed monitoring adequate to provide early warning of USDW endangerment? • Are all potential risks identified in the site characterization addressed (e.g., nearby USDWs, faults or fractures)? <p>The UIC Program Director has the discretion to require any additional information necessary to support the PISC and Site Closure Plan.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
2.	Method that will be used to determine risk of endangerment to USDWs	40 CFR 146.93(a)(2)(i) – (a)(2)(ii)	<p>As discussed below, to end the PISC phase, the owner or operator will need to demonstrate to the UIC Program Director that the site no longer poses a risk of endangerment to USDWs. In the PISC and Site Closure Plan, the owner or operator will describe the anticipated methodology that will be used in the non-endangerment demonstration and under what specific conditions site closure may be authorized and PISC may be ended. This demonstration consists of an analysis and interpretation of site monitoring data and may include the results of computational modeling. Key metrics that must be included are:</p> <ul style="list-style-type: none"> • The difference between pre-injection and predicted post-injection pressures in the injection zone. • The predicted position of the carbon dioxide plume and associated pressure front at site closure. 	The description of the non-endangerment demonstration in the PISC and Site Closure Plan is important because it serves as an agreement prior to injection, between the UIC Program Director and the owner or operator, of the conditions that will allow PISC to end. Therefore, the UIC Program Director may ensure that the proposed conditions are sufficient for protection of USDWs and that the proposed methods for demonstration of non-endangerment will provide the necessary data to independently evaluate the risk posed to USDWs.
3.	Description of anticipated post-injection monitoring location, methods, and frequency	40 CFR 146.93(a)(2)(iii)	The owner or operator must submit the location, methods, monitored constituents, and proposed monitoring frequency that will be performed during the PISC period, including the use of wells and any geophysical techniques. This description may detail differences between the anticipated monitoring during PISC and monitoring done during the injection phase and how monitoring activities will change during the progression of the PISC phase. Monitoring activities during the PISC period	The UIC Program Director must ensure that monitoring activities are sufficient to track the evolution of the carbon dioxide plume and associated pressure front and that there is no endangerment to USDWs.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			will be based on the current understanding of the position of the plume and pressure front and the rate of plume movement (if any) or pressure changes.	
4.	Proposed schedule for submitting PISC monitoring results	40 CFR 146.93(a)(2)(iv)	The owner or operator must submit the monitoring locations, methods, and reporting frequency for monitoring data collected during the PISC phase.	<p>The UIC Program Director will either approve of the planned frequency or request an increased frequency of reporting. EPA recommends that increased monitoring frequency be requested if the anticipated rates of plume and pressure front movement, or other events at the site, are great enough that additional reporting is necessary for project understanding.</p> <p>If the UIC Program Director has reason to believe (i.e., based on site-specific conditions) that additional data are needed to sufficiently address risk at the site during the PISC phase, it is within his or her authority to request that additional monitoring be performed.</p>
5.	Demonstration of alternative PISC timeframe	40 CFR 146.93(a)(2)(v)	If the UIC Program Director approves of an alternative PISC timeframe, the owner or operator must provide a demonstration that this timeframe will not result in endangerment of USDWs.	If the UIC Program Director determines that an alternative PISC timeframe is appropriate, he or she must evaluate the information submitted by the owner or operator pursuant to 40 CFR 146.93(c)(1). The UIC Program Director must consider the criteria at 40 CFR 146.93(c)(2) during the evaluation of the alternative PISC timeframe. Refer to row 8 below for more information.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
<i>PISC and Site Closure Plan reevaluation</i>				
6.	<p>Revised PISC and Site Closure Plan and information relevant to the revision, including:</p> <ul style="list-style-type: none"> • New monitoring data • Changes to the site computational 	40 CFR 146.93(a)(3) – (a)(4)	<p>Any changes to the original PISC and Site Closure Plan are subject to UIC Program Director's approval. Changes will be highlighted and may include the locations, methods, chemical constituents, and proposed frequency of monitoring activities that will be performed during the PISC phase. Changes will be based on monitoring and modeling data that provide a new understanding of the position of the plume and pressure front, rate of movement, and risk to USDWs.</p> <p>If any changes to the original PISC and Site Closure Plan are needed at the time of cessation of injection, the owner or operator must submit a revised PISC and Site Closure Plan within 30 days for the UIC Program Director's approval. If the UIC Program Director determines that an amendment is needed during the post-injection phase, the owner or operator and UIC Program Director will agree on a schedule for submittal of the amended PISC and Site Closure Plan. Any amended Plan must be approved by the UIC Program Director and would then be incorporated into the permit.</p> <p>Revisions to the PISC and Site Closure Plan are based in part on new information regarding the position of the carbon dioxide plume and pressure front and other monitoring data collected during injection.</p>	<p>Although the GS Rule does not set a required frequency or a schedule for the review of the PISC and Site Closure Plan during the PISC phase, the UIC Program Director may require a review if any adverse events or significant deviations from predicted performance occur.</p> <p>EPA advises that the UIC Program Director verify that any changes are adequately justified and all necessary changes to the Plan have been made. For instance, if available data indicate a change in the position of the plume or pressure front, the UIC Program Director may confirm that adequate monitoring is planned in that area and denoted in the Plan.</p> <p>It is recommended that the UIC Program Director confirm that data considered for revision of the PISC and Site Closure Plan are accurate and complete, and if not, require that additional data be considered for revision of the plan.</p> <p>The UIC Program Director may check to see that the input data are of good quality and complete, that he or she agrees with any assumptions used in the model, and that any changes to the model are justified, and if not, may require that additional data be considered for revision of the PISC and Site Closure Plan. The UIC Program Director may conduct a detailed critical evaluation of the model assumptions, including the appropriate and complete use of site characterization data. Examples of information the UIC Program Director may want to evaluate include ensuring that sensitivity analyses incorporate the full range of reasonable model input parameters and that model assumptions are reasonable based on PISC site conditions.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>The UIC Program Director will receive all monitoring data that are relevant to planning for PISC and site closure, including direct and indirect data on plume and pressure front position, any leakage of fluids out of the injection zone, and any risks to USDWs.</p> <p>As discussed above, revision of the PISC and Site Closure Plan is based in part on changes to the site AoR delineation, which is in turn based on changes to the site computational model. Any relevant changes to the site computational model must be provided to the UIC Program Director by the owner or operator, including changes to code assumptions, relevant equations, and scientific basis of the model.</p>	
<i>Non-endangerment demonstration and site closure</i>				
7.	PISC monitoring and non-endangerment demonstration	40 CFR 146.93(b)(1) – (b)(4)	<p>The frequency of PISC monitoring and the types of monitoring that must be performed are determined by the risk of endangerment to USDWs. The owner or operator must continue to conduct monitoring as specified in the approved PISC and Site Closure Plan for at least 50 years or for the duration of the approved alternative timeframe. The monitoring must continue until the GS project no longer poses an endangerment to USDWs and a non-endangerment demonstration is submitted and approved by the UIC Program Director.</p>	<p>This demonstration will ideally provide enough information to the UIC Program Director so that he or she is able to make a determination whether a reduction in PISC monitoring frequency, or an end to PISC, is acceptable at that time.</p> <p>The UIC Program Director may independently assess this quantitative analysis, underlying data, and relevant assumptions. For instance, the UIC Program Director may evaluate modeling assumptions, calculation results, and scientific interpretation of monitoring data. The UIC Program Director may request additional data, approve/deny changes to PISC monitoring, or end PISC, based on this evaluation.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>If the owner or operator demonstrates a reduction in risk to USDWs, the frequency of PISC monitoring may decrease. The UIC Program Director has the discretion to end PISC monitoring completely prior to the 50 year default time period or the approve alternative timeframe if the owner or operator can make a strong demonstration that the project will no longer pose any risk of endangerment to USDWs. At that point, authorization can be granted for site closure. Details regarding how the non-endangerment demonstration will be made on a site-specific basis must be included within the PISC and Site Closure Plan. Any change to the PISC timeframe will require that the PISC Site Closure Plan be amended and approved.</p> <p>The owner or operator must submit relevant monitoring data used in the non-endangerment demonstration. Monitoring data are integral to the determination of plume migration rates and risk to USDWs and must include both direct and indirect data on the position and rate of movement of the carbon dioxide plume and pressure front.</p> <p>The owner or operator is required to provide a written quantitative analysis and discussion of any risk of endangerment to USDWs, including how the risks have changed over time and how they may persist in the future. In addition, the owner or operator may also submit modeling</p>	

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			results in support of the non-endangerment demonstration, in order to assess the risk posed to USDWs. Modeling may be used to estimate the phase-state and degree of trapping of carbon dioxide over time and future plume migration. Modeling results, including sensitivity analyses, may be used to demonstrate that plume migration rates are negligible, based on available site characterization, monitoring, and operational data.	
<i>Demonstration of alternative post-injection site care timeframe</i>				
8.	Demonstration of alternative post-injection site care timeframe	40 CFR 146.93(c)	<p>An alternative PISC timeframe other than the 50 year default is allowed if an owner or operator can demonstrate, to the satisfaction of the UIC Program Director during the permitting process, that an alternative PISC timeframe is appropriate and ensures non-endangerment of USDWs. This demonstration and UIC Program Director approval must be based on significant, site-specific data and information, including all data submitted for the permit and site characterization requirements, and must contain substantial evidence that the GS project will no longer pose a risk of endangerment to USDWs at the end of the alternative PISC timeframe.</p> <p>The owner's or operator's demonstration for an alternative PISC timeframe must include consideration and documentation of:</p> <ul style="list-style-type: none"> • The results of computational modeling 	<p>The UIC Program Director has the discretion to allow an alternative PISC timeframe, whether shorter or longer. The UIC Program Director will want to consult with EPA prior to approving an alternative PSIC timeframe.</p> <p>The UIC Program Director must evaluate the demonstration for an alternative PISC timeframe to ensure that the following criteria are met:</p> <ul style="list-style-type: none"> • All analyses and tests performed to support the demonstration must be accurate, reproducible, and performed in accordance with the established quality assurance standards. • Estimation techniques must be appropriate and EPA-certified test protocols must be used where available. • Predictive models must be appropriate and tailored to the site conditions, composition of the carbon dioxide stream and injection and site conditions over the life of the GS project. • Predictive models must be calibrated using existing information (e.g., at Class I, Class II, or Class V experimental technology well sites) where sufficient data are available. • Reasonably conservative values and modeling assumptions must be used and disclosed whenever values are estimated

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>from the AoR delineation.</p> <ul style="list-style-type: none"> • 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; and/or the timeframe for pressure decline to pre-injection pressures. • The predicted rate of carbon dioxide plume migration within the injection zone, and the predicted timeframe for the cessation of migration. • A description of the site-specific processes that will result in carbon dioxide trapping including immobilization by capillary trapping, dissolution, and mineralization at the site. This information must be verified using the results of laboratory analyses, research studies, and/or field or site-specific studies. • The predicted rate of carbon dioxide trapping in the immobile capillary phase, dissolved phase, and/or mineral phase. This information must be verified using the results of laboratory analyses, research studies, and/or field or site-specific studies. • A characterization of the confining zone(s) including a demonstration that it is free of transmissive faults, fractures, and micro-fractures and of appropriate thickness, permeability, and integrity to impede fluid movement. • The presence of potential conduits for fluid movement including planned 	<p>on the basis of known, historical information instead of site-specific measurements.</p> <ul style="list-style-type: none"> • An analysis must be performed to identify and assess aspects of the alternative PISC timeframe demonstration that contribute significantly to uncertainty. The owner or operator must conduct sensitivity analyses to determine the effect that significant uncertainty may contribute to the modeling demonstration. • An approved quality assurance and quality control plan must address all aspects of the demonstration. • Any additional criteria required by the UIC Program Director.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>injection wells and project monitoring wells associated with the proposed GS project or any other projects in proximity to the predicted/modeled, final extent of the carbon dioxide plume and area of elevated pressure.</p> <ul style="list-style-type: none"> • A description of the well construction and an assessment of the quality of plugs of all abandoned wells within the AoR. • The distance between the injection zone and the nearest USDWs above and/or below the injection zone. • Any additional site-specific factors required by the UIC Program Director. 	
Site closure				
9.	Notice of intent for site closure	40 CFR 146.93(d)	The owner or operator must notify the UIC Program Director in writing at least 120 days prior to site closure and after the cessation of PISC activities. Any changes to the PISC and Site Closure Plan must also be submitted at this time and will be evaluated by the UIC Program Director as discussed above.	A shorter notification period may be allowed at the discretion of the UIC Program Director.
10.	Plugging of monitoring wells	40 CFR 146.93(e)	The owner or operator must plug all monitoring wells in a manner which will not allow fluid movement into USDWs.	The UIC Program Director will review plugging reports and procedures to determine that monitoring wells are properly plugged and USDWs are protected from endangerment.
11.	Site closure reporting	40 CFR 146.93(f) – (g)	A site closure report must be submitted within 90 days of the UIC Program Director's authorization of site closure. The purpose of the report is to document appropriate closure procedures, as well as information concerning injection well operation, which may be of interest to	These requirements ensure that the site was properly closed and that proper notifications have been made for future landowners. EPA recommends that the UIC Program Director confirm that submitted information is both accurate and complete.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>future land owners and planners.</p> <p>The report must: 1) document whether proper injection well and monitoring well plugging occurred; 2) include records reflecting the nature, composition, and volume of carbon dioxide stream; and, 3) contain a copy of a survey plat that has been submitted to the local zoning authority designated by the UIC Program Director. The plat indicates the location of the injection well relative to permanently surveyed benchmarks. It is recommended that documentation of appropriate notification and information to state, local, and tribal authorities be included, as well as records reflecting the nature, composition, and volume of the carbon dioxide stream. For more information on public notification and participation procedures, refer to Section 3.3.2 of this manual.</p> <p>Each owner or operator of a Class VI well must record a notation on the deed to the facility property that notes that the land has been used for GS, the name of the agency with which the survey plat was filed, the volume of fluid injected, the time period of injection, and the injection zone(s).</p>	
12.	PISC recordkeeping	40 CFR 146.93(h)	The owner or operator must retain for 10 years following site closure, records collected during the PISC period. The owner or operator must deliver the records to the UIC Program Director at the	The UIC Program Director has the authority to require owners or operators to retain any required reports, data, or information for longer than 10 years after site closure. Refer to Table 3.10 of this manual for more information on recordkeeping.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>conclusion of the retention period, and the records must thereafter be retained at a location designated by the UIC Program Director for that purpose.</p> <p>This recordkeeping timeframe supports EPA's review of project data as part of the adaptive approach to rulemaking (refer to Section 1.4 of this manual for more information).</p>	
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Plugging, Post Injection Site Care (PISC) and Site Closure Guidance for Owners and Operators • Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Project Plan Development Guidance for Owners and Operators <p><i>All of the above manuals and technical guidance documents are either currently available or will be available in the future on EPA's website at:</i></p> <p>http://water.epa.gov/type/groundwater/uic/class6/qsquidedoc.cfm.</p>				

Table 3.13: Emergency and Remedial Response (40 CFR 146.94)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
1.	Emergency and Remedial Response Plan	40 CFR 146.94(a) & (d)	<p>An Emergency and Remedial Response (E&RR) Plan, required in 40 CFR 146.94(a), must be submitted with the permit application for approval by the UIC Program Director. In the Plan, the owner or operator must describe the measures that would be taken in the event of sudden adverse conditions, such as a loss of mechanical integrity or movement of injection or formation fluids resulting in endangerment to a USDW. Situations requiring emergency response may occur during the construction, operation, or PISC periods. The Plan can ensure that, in the event of an emergency, a process is in place to facilitate and expedite the necessary and appropriate response. The approved E&RR Plan is enforceable.</p> <p>The details of the E&RR Plan may be influenced by a variety of site-specific factors including: geology, USDW depth, injection depth, proposed operating conditions, properties of the carbon dioxide stream, and activities in the AoR (e.g., the presence of population centers, land uses, PWSs).</p> <p>Each E&RR Plan will be tailored to the site, giving flexibility to the owner or operator to design a site-specific plan. However, if the UIC Program Director has reason to believe that additional data or planning measures are needed to sufficiently</p>	<p>The E&RR Plan must demonstrate to the satisfaction of the UIC Program Director that appropriate, timely response actions would be performed in the event of an emergency so that USDWs and other resources are protected.</p> <p>The UIC Program Director will evaluate the E&RR Plan for a GS project in the context of all information submitted with the permit application (e.g., site characterization information, AoR evaluation data, and well construction, monitoring, and operational information) to ensure that the Plan is comprehensive and addresses all potential emergencies. In particular, the UIC Program Director may consider:</p> <ul style="list-style-type: none"> • Are all potential adverse events at the facility addressed in the E&RR Plan and are adequate response procedures and equipment identified? • Are all activities within the AoR, including land use and the presence of population centers, addressed? • Are all potentially affected environmental resources (e.g., ground water, surface water bodies, PWSs, the biosphere) or infrastructure (e.g., the well, buildings, other nearby structures) identified? • Does the Plan consider the proximity of wells to schools, hospitals, and other sensitive nearby communities? • Does the Plan consider the level of risk for each potential adverse event at the site? • Are emergency notification procedures and communication plans identified? • Is there a list of entities or people that will be notified in the event of an adverse event (e.g., local water systems, land owners, pipeline operators, Regional Response Teams)? <p>The UIC Program Director can coordinate with the owner or operator and use the results of the AoR reevaluation, along</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>address risk at the site, it is within his or her authority to request that additional information be provided.</p> <p>The E&RR Plan must be reviewed, and if necessary, updated by the owner or operator following each reevaluation of the AoR (which must occur at least once every 5 years), and must continue through the PISC phase. Any amended Plan must be approved by the UIC Program Director and would then be incorporated into the permit.</p>	<p>with monitoring/operational data collected, to determine the need for amending the E&RR Plan. The UIC Program Director has the discretion to require any additional information necessary to support the E&RR Plan.</p>
2.	Activities in the event of endangerment to a USDW	40 CFR 146.94(b) – (c)	<p>In the event of an emergency, the owner or operator must undertake all required actions in 40 CFR 146.94(b), including cessation of injection, characterization of the release, notification to the UIC Program Director within 24 hours, and implementation of the E&RR Plan.</p> <p>Following the emergency response, the UIC Program Director has the discretion to allow injection operation to resume prior to the subsequent remedial response if the owner or operator demonstrates, and the UIC Program Director confirms, that USDWs will not be endangered [40 CFR 146.94(c)].</p>	<p>The UIC Program Director will discuss the emergency event with the owner or operator and work with the owner or operator to ensure that response actions address the event and that USDWs are protected.</p> <p>EPA recommends that the UIC Program Director initiate a dialogue with the owner or operator prior to the occurrence of an emergency event to determine how emergency measures will be implemented and to discuss any other site-specific emergency or remedial response needs.</p>
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Project Plan Development Guidance for Owners and Operators <p><i>The above guidance document is currently available on EPA's website at:</i> http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm.</p>				

Table 3.14: Class VI Injection Depth Waiver Requirements (40 CFR 146.95)

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
<p>During the permit application process, owners or operators may decide to submit an injection depth waiver application to inject carbon dioxide above or between the lowermost USDW. Note that states granted primacy for the Class VI Program are not required to allow injection depth waivers in their UIC regulations and may choose not to make this option available for Class VI wells in their jurisdiction.</p> <p>In those states that allow injection depth waivers, the UIC Program Director must provide all injection depth waiver application materials to the Regional Administrator (RA), who will determine whether to grant the waiver. Injection depth waiver applications require additional information that will inform the RA's determination whether to approve or deny the waiver. Additional requirements for GS projects operating under injection depth waivers are designed to complement existing requirements by:</p> <ul style="list-style-type: none"> • Building upon site characterization data and the area of review (AoR) delineation model developed during the permit application process. • Providing extensive resource information on regional water use and resources. • Expanding monitoring requirements during the operation and PISC phases to address protection of USDWs underlying and overlying the injection zone. • Requiring all additional, necessary permit conditions to ensure protection of USDWs above and below an injection zone. <p>When an injection depth waiver application is submitted with the permit application, the UIC Program Director will need to receive additional information from the owner or operator that will inform a comprehensive assessment of site-suitability for a proposed Class VI well to inject above or between USDWs. The owner or operator must submit a supplemental report with additional information including: more information about the injection zone; identification of confining units above and below the injection zone; tailored AoR modeling that includes the zones above and below the injection zone; a demonstration that well design is appropriate and protective of USDWs in lieu of specific well construction requirements at 40 CFR 146.86; a description of how monitoring will be tailored for injection above/between USDWs; and information about PWSs supplied by water sources located within the AoR.</p> <p>The purpose of the supplemental report is to ensure that the owner or operator collects information demonstrating to the UIC Program Director that: the injection zone is appropriate for GS and is contained by confining units both above and below; well construction, operation, and monitoring are tailored for the site; and USDWs are not endangered.</p>				
<i>Supplemental report submitted with the permit application [40 CFR 146.95(a)]</i>				
1.	Demonstration that the injection zone is laterally continuous, not hydraulically connected to a USDW, and	40 CFR 146.95(a)(1)	The owner or operator must submit geologic or hydrogeologic maps and cross sections of the region and of the site [40 CFR 146.95(a)(1)]. Ideally, there will be at least two cross sections, oriented perpendicular to each other. These may be the same maps and cross sections	The UIC Program Director may verify that the maps, cross sections, and geophysical results cover an area at least as large as the AoR. Maps, cross sections, and geophysical survey results enable the UIC Program Director to verify the lateral continuity of the injection zone and to ascertain whether confining units both above and below form a clear separation between the injection formation and any USDWs; this

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	does not outcrop		submitted for the requirements at 40 CFR 146.82(a)(3) with the permit application. The owner or operator may also submit the results of geophysical surveys to further constrain the dimensions of the injection zone. EPA recommends that information on any factors that would influence or limit the quality of geophysical surveys be provided.	<p>separation is a crucial component of the injection depth waiver application. This information also demonstrates that the injection formation does not outcrop.</p> <p>The information submitted by the owner or operator may be checked for consistency and compared against other available geologic maps or regional geologic information. Cross sections are somewhat subjective because they are constructed by interpolating between available data points. It is recommended that the UIC Program Director be alert to potential alternative interpretations of the cross sections and other similar map information.</p> <p>The UIC Program Director may request additional information if he or she observes inconsistencies among the submitted information or suspects that a cross section may not accurately represent the subsurface. The UIC Program Director may ask for additional information on geophysical surveys if correlation between seismic lines, cross sections, borehole data (cores and logs), and other data sources is ambiguous.</p>
2.	Demonstration that the injection zone has adequate injectivity, volume, and porosity		More samples may be needed for a site with complex geology than at a site where the geology is homogenous. Details on methods for storage volume determination can be found in the <i>Draft UIC Program Class VI Well Site Characterization Guidance</i> , available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm .	<p>The UIC Program Director will be able to gauge the accuracy of the data by ensuring that the methods of analysis are specified and that quality assurance information (e.g., duplicate measurements) is provided where applicable. The UIC Program Director may consider whether he or she believes a reasonable number of data points were submitted.</p> <p>For volume calculations, the UIC Program Director will want to ensure that descriptions of models and the raw data used have been submitted. The UIC Program Director will also want to verify that the volume available for carbon dioxide storage in the injection zone is greater than the anticipated volume of injected carbon dioxide over the lifetime of the project.</p> <p>The UIC Program Director may also verify that the values for porosity are consistent with typical values for the lithology in</p>

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				<p>the injection zone and that the injectivity will allow the proposed injection rate.</p> <p>If any of these data appear problematic (e.g., insufficient storage volume), the UIC Program Director may request clarification.</p>
3.	Demonstration that the injection zone has appropriate geochemistry		<p>The owner or operator must submit chemical analyses of fluids in the injection formation. Typical data that may be submitted include: pH, specific conductivity, TDS, salinity, dissolved oxygen, major cations (Na^+, K^+, Ca^{2+}, Mg^{2+}), major anions (Cl^-, NO_3^-, SO_4^{2-}), alkalinity, and potential drinking water contaminants (e.g., arsenic, lead). Data will be submitted in tables and/or electronic databases, and may also be supplemented by informative diagrams (i.e., Piper and/or Stiff diagrams) (refer to the <i>Draft UIC Program Class VI Well Site Characterization Guidance</i>, available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm, for further information).</p> <p>Information on sample collection methods, analytical methods, and quality assurance information will be submitted (such information may be limited for chemical analyses taken from preexisting data sources).</p>	<p>The UIC Program Director may verify that samples were taken in a manner that preserves down-hole pressure conditions and that samples were analyzed using EPA-approved methods, ASTM methods, or Standard Methods.</p> <p>In evaluating the appropriateness of the geochemistry of the injection zone, the UIC Program Director will consider analyses of the formation solids in conjunction with fluid analyses. The owner or operator may have conducted geochemical modeling to predict dissolution or precipitation of minerals that may affect injectivity or liberate heavy metals. If so, the name and capabilities of the model used, as well as the input data, are needed for the UIC Program Director's evaluation of the model.</p> <p>Any samples taken during preparation of the waiver application will serve as the baseline for monitoring during the injection phase, and the UIC Program Director may request further information if data appear to be of poor quality or were taken from an area not representative of the injection zone.</p>

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4.	Demonstration that the confining units both above and below the injection zone are laterally continuous, impermeable, and free of transmissive faults and fractures	40 CFR 146.95(a)(2)	<p>The confining zones can be delineated with the same maps, cross sections, and geophysical data used to characterize the injection zone. For the waiver application, it is crucial that this information demonstrate the presence of both an upper and lower confining unit. The results of geophysical surveys (e.g., gravity or seismic surveys) may help with imaging the confining units.</p> <p>To demonstrate the permeability of the confining units, the owner or operator may submit laboratory data from an analysis of core samples. Permeability may also be estimated from wireline logging. It is recommended that the owner or operator state the method by which permeability was measured, rectify any differences in estimated values (e.g., between field- and laboratory-based estimates), and provide information on any replicate analyses done.</p> <p>The owner or operator will also submit an evaluation of the sealing properties of any major faults that penetrate the confining zones. Preferably, the method for determining fault sealing will be specified, as well as the data used. Details of these methods are provided in the <i>Draft UIC Program Class VI Well Site Characterization Guidance</i>, available on EPA's website.</p>	<p>The UIC Program Director will want to ensure that there is adequate information on the confining zones above and below the injection zone. For permeability measurements, the UIC Program Director may keep in mind that these are point measurements. The UIC Program Director may be aware that field-based and laboratory-based measurements may differ and may over- or under-estimate permeability. If other data suggest significant facies changes in the injection zone, the permeability may be spatially variable, and the UIC Program Director will want to be sure that he or she agrees with the number and locations of samples taken. It is recommended that the UIC Program Director verify that the confining units are composed of lithologies that typically form good seals and that the permeability of these units is sufficiently low.</p> <p>It is advised that the UIC Program Director ensure that he or she agrees with the method selected for the fault sealing analysis and that the data used for the analysis are sound.</p> <p>At all stages of the evaluation, the UIC Program Director will ensure that data are provided for both the upper and lower confining zones.</p> <p>When characterization of the confining zones and subsurface geology reveals previously unknown faults, fractures, or other features that were unexpected or anomalous for the region or geologic regime, extra data may be needed to verify that other unexpected features have not been overlooked.</p>

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5.	Demonstration using computational modeling that USDWs above and below injection zone will not be endangered as a result of fluid movement	40 CFR 146.95(a)(3)	<p>For a demonstration that USDWs above and below the injection zone will not be endangered as a result of fluid movement, the owner or operator will submit the following information to the UIC Program Director:</p> <ul style="list-style-type: none"> • The name of the computational code used to model fluid movement. • A description of the model, including physical processes, site characterization data, model areal extent, modeled timeframe, and grid spacing. • Any relevant model assumptions, including relative permeability/saturation relationships, intrinsic permeability descriptions, carbon dioxide physico-chemical properties, and equations of state. • Figures detailing model sensitivity analyses. • As required by the UIC Program Director, any model input and output files, including raw code-specific files, output data transformed to site coordinates, and/or interpolated GIS files. <p>Although not required, EPA expects that in most cases the computational model used for this determination will be developed in conjunction with the AoR delineation.</p>	<p>The UIC Program Director may choose to evaluate the model results in the same way as the evaluation of the AoR determination (refer to Table 3.3 of this manual and the <i>Draft UIC Program Class VI Well AoR Evaluation and Corrective Action Guidance</i>, available on EPA's website at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm).</p> <p>For the injection depth waiver application, the required modeling results go beyond those required for AoR delineation in that the modeling demonstrates that USDWs above and below the injection zone will not be impaired by the injection activity via any process, including migration of carbon dioxide or other fluids, mobilization of hazardous constituents, and leakage through any potential conduits. The UIC Program Director may verify that modeling results include this information. Any independent evaluation of the modeling efforts also ensures that the information provided is reliable.</p>

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6.	Demonstration that well design and construction in conjunction with waiver will ensure isolation of the injectate	40 CFR 146.95(a)(4)	<p>Injection wells must be designed to prevent fluid migration to USDWs both above and below the injection zone. The owner or operator will submit plans for injection well design and construction that will likely include: diagrams with well dimensions and well structure; wellhead elevation; total depth of the well; depth to the injection zone; length of the injection zone; and depths of USDWs. Well construction materials information provided includes the type of cement to be used, including any additives used to ensure resistance to corrosion. The construction plans also detail the types of wellhead and down-hole fixtures to be installed.</p> <p>If construction of the injection well entails the conversion of a monitoring well or production well, the owner or operator will explain how they will ensure that the well is of sufficient quality to maintain zonal isolation. If the preexisting construction is not adequate, explanations of how the well can be modified to ensure isolation of the injectate will be needed. If the proposed well will be converted from a stratigraphic well or monitoring well that has penetrated the lower confining unit, the owner or operator will describe their plans to plug the portion of the well/borehole below the injection formation, including selection of cement and the depth that will be plugged.</p>	<p>The UIC Program Director may verify that well design information specifies the well construction materials (e.g., type of steel for the surface casing, long-string casing, injection tubing, wellhead components, down-hole components). The UIC Program Director may verify that the owner or operator has supported their selection of well construction materials and practices with references to existing case studies, standard methods, or best practice documents. Examples of such references are available in the <i>Draft UIC Program Class VI Well Construction Guidance</i>.</p> <p>It is recommended that the UIC Program Director ensure that zonal isolation will be maintained during the drilling and well installation processes, especially if the owner or operator anticipates drilling through over-pressured or under-pressured formations.</p> <p>If it is not clear to the UIC Program Director that the well construction practices and materials will establish and maintain zonal isolation, he or she may request additional information.</p>
7.	Description of how the Testing	40 CFR	The owner or operator must submit a Testing and Monitoring Plan that describes	The UIC Program Director may consult the <i>Draft UIC Program Class VI Well Testing and Monitoring Guidance</i> (available on

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	and Monitoring Plan, and any additional Plans, will be tailored to the GS project	146.95(a)(5)	<p>how monitoring will occur below the lower confining zone as well as above the upper confining zone. Similar concepts apply to the Testing and Monitoring Plans supplied with both the permit application and the waiver application, with the addition of testing and monitoring of wells below the lower confining zone for the waiver application. Such monitoring both above and below the injection formation is a crucial element for a GS project issued an injection depth waiver. The Testing and Monitoring Plan will specify the formations in which monitoring will take place, including their depths and the anticipated depths of the screened intervals. It will describe the number and placement of monitoring wells, accounting for the possibility of additional wells over time as the AoR expands and geophysical imaging is performed.</p> <p>The Plan will explain if the owner or operator will be using preexisting monitoring wells, constructing new wells, or converting stratigraphic wells for site characterization to multilevel monitoring wells. It will present construction plans for new wells and any necessary improvements to preexisting wells to ensure zonal isolation both above and below the injection zone. In particular, if a multilevel well is planned, the construction plans will ensure that the improvements will prevent inter-formational migration of</p>	<p>EPA's website in the future at http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm) for a discussion of the placement and number of monitoring wells.</p> <p>The UIC Program Director may want to ask for additional information if he or she is not sure as to whether monitoring wells will maintain zonal isolation or if he or she believes the Testing and Monitoring Plan does not include adequate sampling both above and below the injection formation.</p>

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			carbon dioxide or other fluids.	
8.	Information on the location of all the public water supplies affected, reasonably likely to be affected, or served by USDWs in the AoR	40 CFR 146.95(a)(6)	<p>Information that the owner or operator will need to submit to the UIC Program Director includes, but is not limited to, the following:</p> <ul style="list-style-type: none"> • Names and contact information for drinking water utilities within the AoR or that draw from aquifers that may be affected by GS activities. • Population served by each drinking water utility. • Number and locations of production wells. • Average gallons per day withdrawn and delivered for each drinking water utility. • Maps showing aquifers being used for water supplies and their relationship to the injection formation. <p>For completeness, the owner or operator may note how they identified all public water supplies (i.e., their strategy for locating all PWSs that may be affected by GS activities in the event of a leak).</p>	<p>In particular, the UIC Program Director will need to verify that the owner or operator has identified any public water supplies served by USDWs below the injection formation.</p> <p>Much, if not all, of this information supplied by the owner or operator will be publicly available or available by request or via the Freedom of Information Act and can be verified by the UIC Program Director.</p> <p>The UIC Program Director may want to ask for additional information if all of the items listed in this row are not provided. The UIC Program Director may also want to request additional information if he or she believes that the owner or operator may not have identified all public water supplies likely to be affected in the event of a leak from the GS operation.</p>
9.	Any other information requested by the UIC Program Director	40 CFR 146.95(a)(7)	The UIC Program Director has the discretion to request any additional information that will inform the RA's determination concerning an injection depth waiver application.	

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Documentation submitted to the Regional Administrator by the UIC Program Director				
10.	Integrity of upper and lower confining units	40 CFR 146.95(b)(1)(i)	The UIC Program Director will need to examine maps, cross sections, and geophysical information to verify that there are confining zones both above and below the injection zone.	<p>The UIC Program Director may ensure and must provide documentation to the RA that the confining zones are laterally continuous within the AoR and are sufficiently thick. The UIC Program Director will also need to evaluate data for permeability and injectivity and verify that adequate data have been submitted, including methods used, number of samples, etc. Values for permeability will need to be low enough to provide a good seal and be consistent with the lithology.</p> <p>EPA recommends that the UIC Program Director consider any faults and fractures identified, including whether they penetrate one of the confining zones or if there is a series of faults or fractures that may collectively provide a conduit for carbon dioxide or brine movement to USDWs. The UIC Program Director may also ensure that he or she agrees with the method selected to determine fault sealing and verify that the data are sound and that the analysis was correctly executed.</p>
11.	Potential storage capacity of geologic formations and accounting for the availability of alternative injection sites	40 CFR 146.95(b)(1)(iii)	The UIC Program Director must also consider and provide documentation to the RA on the potential capacity of geologic formations for the storage or carbon dioxide and the availability of alternative injection sites. The proposed geologic formations at the site must also be adequate to maintain confinement of injected carbon dioxide.	<p>The UIC Program Director may consider the submitted site characterization data when evaluating the potential storage capacity of geologic formations.</p> <p>In accounting for the availability of alternative injection sites, the UIC Program Director must verify that alternative injection sites, which do not require injection depth waivers, are not available. Using his or her best professional judgment, the UIC Program Director may use all available site characterization data to determine if other injection sites exist that will be better suited for the proposed Class VI well.</p> <p>If the UIC Program Director suspects that additional, alternative injection sites have not been thoroughly identified by the owner or operator, he or she may request additional information, including complete site characterization data for the alternative sites.</p>

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12.	Additional considerations	40 CFR 146.95(b)(1)(ii), (b)(1)(iv) & (b)(1)(ix)	<p>Additional factors that the UIC Program Director must consider when evaluating an injection depth waiver application and provide to the RA include:</p> <ul style="list-style-type: none"> • Suitability of the injection zone. • All other site characterization data (refer to Table 3.2 of this manual for more information). • Any other information or considerations required by the UIC Program Director. 	
13.	Emergency and Remedial Response Plan and demonstration of financial responsibility	40 CFR 146.95(b)(1)(iv)	<p>The owner or operator must submit a proposed Emergency and Remedial Response (E&RR) Plan and a demonstration of financial responsibility. The Plan and the demonstration submitted with the waiver application will be similar to those submitted with the permit application, but will need to address movement of injectate or brine that may endanger a USDW below the injection formation.</p> <p>The demonstration of financial responsibility for a waiver application will need to include sufficient financial provisions for procuring alternate sources of drinking water in the event that a drinking water supply is contaminated by GS activities.</p>	<p>The UIC Program Director may verify and provide documentation to the RA that the E&RR Plan describes conditions or events that may trigger an emergency response. For example, a trigger may be, monitoring results indicating that carbon dioxide or brine has breached either the upper or lower confining zone and may present a threat to a USDW. This may be represented by: 1) a change in pH, TDS, or salinity in a formation being monitored either above or below the injection formation; 2) geophysical monitoring showing movement of the carbon dioxide plume into unauthorized zones; or, 3) results from well logging or continuous MITs that suggest that fluid migration may be occurring along the well bore.</p> <p>The UIC Program Director may consider whether the E&RR Plan properly outlines steps to be taken to address movement of the injectate or brine. If a drinking water supply has the potential to be affected by GS activities, remedial action may require procuring an alternative water supply.</p> <p>The UIC Program Director may verify that the owner or operator has submitted estimates of the costs of procuring an alternate water supply and has indicated the mechanism for financial responsibility. The UIC Program Director may consider whether he or she agrees with how the cost estimates</p>

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				<p>were formulated and whether they are adequate to cover the cost of remedial action.</p> <p>The UIC Program Director may want to request additional information if the conditions under which the E&RR Plan would be invoked or the steps that would be taken are not spelled out clearly. For more information, refer to Table 3.13 of this manual and the <i>Draft UIC Program Class VI Well Project Plan Development Guidance</i>.</p> <p>The UIC Program Director may request additional information if there is a discrepancy between the estimated costs of procuring an alternate water supply and the provisions in the demonstration of financial responsibility. For more information, refer to Table 3.4 of this manual and the <i>Draft UIC Class VI Program Financial Responsibility Guidance</i>.</p>
14.	Present and future water resource needs	40 CFR 146.95(b)(1)(v) – (b)(1)(vi)	<p>For present and future water resource needs, the owner or operator must submit information to the UIC Program Director on:</p> <ul style="list-style-type: none"> • Community needs and demands. • Supply from drinking water resources. • Planned needs, potential and/or future use of USDWs and non-USDWs in the area. <p>Also for future water resource needs, the owner or operator may submit, but is not limited to submitting, the following information:</p> <ul style="list-style-type: none"> • Anticipated population growth over the next 5, 10, and 20 years. • Anticipated land use changes that may affect water needs (e.g., planned development). 	<p>In evaluating this information, the UIC Program Director may consider whether the owner or operator noted the process by which they obtained the estimates and how they ensured that the captured information represents all areas that may be affected by GS activities. The UIC Program Director can verify the completeness of this information by determining whether all PWSs supplied by water sources located within the AoR have been identified. Some of the information may be available through municipal master plans or through utilities' planning process. If the UIC Program Director has concerns regarding the data submitted, he or she may be able to independently verify the accuracy and completeness.</p> <p>The UIC Program Director may determine whether the projections: 1) include anticipated land use changes; 2) correspond to regional master plans; and, 3) include an indication of the uncertainty involved. Whether future water needs may entail the use of a USDW in the AoR, either above or below the injection formation, warrants particular attention. The UIC Program Director may want to evaluate whether the</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<ul style="list-style-type: none"> • Locations of aquifers that are not currently used but that may be used in the future (shown on a map). • Future projections of water usage over 5, 10, and 20 years, if available, for all PWSs in the AoR or that draw from aquifers that may be affected by GS activities. • Any water use that is permitted but not yet being exploited. <p>The UIC Program Director must provide this information to the RA.</p>	<p>injection formation is close both vertically and laterally to a USDW projected to be a major supply for a PWS during the lifespan of the GS project. If so, the UIC Program Director may take into consideration information submitted on the integrity of the confining zones to gauge the risks involved.</p> <p>The UIC Program Director may ask for additional information if he or she suspects that the projections do not represent the entire area that may be affected by GS activities. The UIC Program Director may also request additional information if the timeframe for projected water needs differs greatly from the anticipated lifetime of the GS project.</p>
15.	Planned or permitted water, hydrocarbon, or mineral resource exploitation potential of proposed injection formation and other formations above and below the injection zone	40 CFR 146.95(b)(1)(vii)	<p>Information about potential hydrocarbon or mineral resource exploitation in the target or nearby formations may include, but is not limited to, the following:</p> <ul style="list-style-type: none"> • A map with the locations of economically viable deposits. • Geologic maps and cross sections of the region (or maps required under 40 CFR 146.82(a)(3) with this information discussed). • The depths and host formations of deposits. • Information on any past or current mining or hydrocarbon recovery activities. • Information on whether future use of minerals and hydrocarbons has been permitted and/or planned. <p>Information about potential drinking water exploitation in the target formation or</p>	<p>The UIC Program Director may verify and provide documentation to the RA that the information includes resources both above and below the injection formation. The information will include activities within a region large enough to encompass areas that may be affected by GS activities. Much of the information submitted may be publicly available, enabling the UIC Program Director to check the accuracy of any uncertain information and determine if the information is up-to-date.</p> <p>The UIC Program Director may want to request more information if he or she suspects that not all planned or permitted activities have been identified, if the area in which the owner or operator performed their search is smaller than the AoR, or if he or she is unable to check the accuracy of the information from publicly available sources.</p>

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			<p>nearby formations may include, but is not limited to, the following information:</p> <ul style="list-style-type: none"> • Geologic maps and cross sections showing all USDWs above and below the injection zone. • Names, thicknesses, and depths of all USDWs above and below the injection zone. • An explanation of how submittals required under 40 CFR 146.82 would be augmented to meet the needs for injection depth waiver applications. • Any available information on projected water use/development of currently unused USDWs or installation of new wells in currently used USDWs. <p>The goal of this information is to identify any resource exploitation activities that may compromise the confining layers of the injection zone or promote migration of injected carbon dioxide or brine.</p>	
16.	Proposed plan for securing alternative resources or treating USDW formation water in the event of contamination related to Class VI injection activity	40 CFR 146.95(b)(1)(viii)	<p>The owner or operator will submit plans for one of a few basic approaches for securing an alternate water source: purchasing water from a nearby system, drilling new wells in an alternative aquifer, or treating the ground water.</p> <p>If the owner or operator is submitting plans for procuring water from a nearby system, they will need to identify the system, the system's source, and its capability for delivering the necessary amount of water, as well as the cost involved and provisions</p>	<p>In all cases, it is recommended that data and calculations supporting the proposal be included. The UIC Program Director may evaluate if estimates of the quantity of water supplied by the alternative source agree with projections of future needs or if the costs have been adequately accounted for and provided for with a demonstration of financial responsibility. Plans for securing alternate water sources contain uncertainties, and the UIC Program Director will want to verify that such uncertainties are clearly discussed.</p> <p>The UIC Program Director may want to ask for additional information if calculations or data sources are unclear. The UIC Program Director will provide all of the information discussed</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>for financial responsibility. Adequate infrastructure (i.e., piping) will be needed to transport water.</p> <p>If submitting plans for drilling new wells, the owner or operator will need to identify the aquifer in which the wells would be installed and show the locations on a map. They will provide evidence (e.g., results from pumping tests, specific storage) that the proposed aquifer is capable of supplying the needed amount of water and will indicate if other systems are already drawing from that aquifer. The owner or operator will supply cost estimates for installing, operating, and maintaining the new wells as well as the provisions for financial responsibility.</p> <p>Installing water treatment facilities may be the costliest option. If submitting plans for treating the ground water, the owner or operator may need to describe the anticipated treatment processes and cost estimates for building and operating the plant, as well as provisions for financial responsibility.</p>	here to the RA.

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<i>Public notification, role of the Regional Administrator, and actions following issuance of a waiver</i>				
17.	Public notice of injection depth waiver application concurrent with Class VI permit notice process	40 CFR 146.95(b)(2) – (b)(3) & (c)	<p>The Regional Administrator's decision to grant a waiver for injection depth is based on documentation submitted by the UIC Program Director. A waiver of injection depth requirements cannot be granted by the RA until the UIC Program Director, the state's Public Water System Supervision (PWSS) Director, and the public have had opportunity to comment on information specific to the site and the anticipated injection activity. The determination to waive injection depth requirements must be made using a clear and transparent public notification process consistent with 40 CFR 124.10. The requirements of 40 CFR 146.95(b) establish considerations that the RA must assess, as provided by the UIC Program Director, when evaluating a waiver application in conjunction with the permit application for a GS project. In addition, the Rule requires the UIC Program Director to provide the public with appropriate, site-specific and waiver-specific information to inform public comment.</p> <p>The UIC Program Director must give public notice that the injection depth waiver application has been submitted. The notice must clearly state:</p> <ul style="list-style-type: none"> • Depth of proposed injection zone. • Location of injection well. • Name and depth of all USDWs within 	The UIC Program Director must submit to the RA documentation of consultations with the PWSS Directors of all states and tribes having jurisdiction over lands within the AoR of a Class VI well for which a waiver is sought, and any written waiver-related information submitted by the PWSS Director(s) to the UIC Program Director. In addition, the UIC Program Director must give public notice that a waiver application has been submitted.

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>AoR.</p> <ul style="list-style-type: none"> • Map of the AoR. • Names of any public water supplies affected, reasonably likely to be affected, or served by USDWs in AoR. • Results of UIC-PWSS Directors consultation pursuant to 40 CFR 146.95(b)(2). <p>For more information on public notification and participation, refer to Section 3.2.2 of this manual.</p>	
18.	Role of the Regional Administrator	40 CFR 146.95(d) – (e)	Within 30 days of waiver issuance, EPA Headquarters will post the following information on the Office of Water's website: the depth of the proposed injection zone; the location of the injection well; the name and depth of all USDWs within the AoR; a map of the AoR; and the names of any public water supplies affected, reasonably likely to be affected, or served by USDWs in the AoR.	Following public notification, pursuant to 40 CFR 124.10, the UIC Program Director must provide information collected during the waiver application and public notice processes to the RA so that he or she can make a determination whether to issue the injection depth waiver. The RA will submit in writing to the UIC Program Director his or her determination regarding the waiver. The purpose of involving the RA in the decision making process is to ensure that multi-state boundary and water resource issues are addressed and to contribute to national consistency in waiver issuance.
19.	Following issuance of a waiver	40 CFR 146.95(f)	Upon receipt of a waiver of the requirement to inject below the lowermost USDW for a GS project, the owner or operator of the Class VI well must comply with all requirements in 40 CFR 146.84 through 146.85, 40 CFR 146.87 through 146.89, 40 CFR 146.91 through 146.92, and 40 CFR 146.94. In addition, the owner or operator must also comply with the requirements in 40 CFR 146.86, 146.90, and 146.93, with the exception of the following modified requirements:	<p>EPA advises that the UIC Program Director be aware that the approval of an injection depth waiver will generate modified requirements for Class VI wells operating under a waiver.</p> <p>The UIC Program Director may require that an owner or operator operating under an injection depth waiver perform additional actions to ensure the protection of USDWs.</p>

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<p>For injection well construction:</p> <ul style="list-style-type: none"> • Class VI wells granted a waiver must be constructed and completed to prevent movement of fluids into any unauthorized zones, including USDWs. • The casing and cementing program must be designed to prevent the movement of fluids into any unauthorized zones including USDWs. • The surface casing must extend through the base of the nearest USDW directly above the injection zone and be cemented to the surface, or, at the UIC Program Director's discretion another formation above the injection zone and below the nearest USDW above the injection zone. <p>For testing and monitoring:</p> <ul style="list-style-type: none"> • The owner or operator must monitor ground water quality, geochemical changes, and pressure in USDWs immediately above and below injection zone. • The owner or operator must track the extent of the carbon dioxide plume and the presence or absence of elevated pressure. <p>For PISC:</p> <ul style="list-style-type: none"> • The owner or operator must monitor ground water quality, geochemical changes, and pressure in USDWs immediately above and below injection zone. 	

	Requirement or Submission	Federal Regulatory Citation	Owner/Operator Submission Details	UIC Program Director Evaluation and Considerations
			<ul style="list-style-type: none"> The owner or operator must perform testing and monitoring to track the extent of the carbon dioxide plume and the presence or absence of elevated pressure. 	
<p><i>For more information on elements of a permit application, please refer to:</i></p> <ul style="list-style-type: none"> Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Injection Depth Waiver Application Guidance for Owners, Operators, and State Directors Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Site Characterization Guidance for Owners and Operators Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Program Class VI Well Area of Review Evaluation and Corrective Action Guidance for Owners and Operators <p><i>All of the above manuals and technical guidance documents are either currently available or will be available in the future on EPA's website at:</i> http://water.epa.gov/type/groundwater/uic/class6/gsquidedoc.cfm.</p>				

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Appendix A

Federal/State Regulation
Comparison Crosswalk for a
UIC Program Revision
Application Adding Class VI

Federal/State Regulation Comparison Crosswalk for a UIC Program Revision Application Adding Class VI

The following Federal/State Regulation Comparison Crosswalk for a UIC Program Revision application to add Class VI to an existing SDWA Section 1422 program can be completed by the state to identify the state statutory or regulatory provisions that correspond to each federal UIC Class VI requirement. A completed comparison crosswalk will help EPA in reviewing the state's UIC Program Revision application for primacy for Class VI if that state is adding Class VI to its existing SDWA Section 1422 program. This crosswalk is one part of a complete UIC Program Revision primacy application. Additional information on other primacy application requirements can be found in Section 2 of this manual.

Federal/State Regulation Comparison Crosswalk for New UIC Programs (all classes or independent Class VI) is under development. Interested UIC Program Directors should send a request for the crosswalk to the primacy e-mail box at ClassVIPrimacy@epa.gov in order to receive the crosswalk when available. It should help identify state statutory or regulatory provisions that correspond to each federal requirement when submitting a New UIC Program Application to EPA, for either all UIC well classes under SDWA Section 1422 or for independent Class VI primacy.

Note that 40 CFR 145.11(b)(1) says that "states need not implement provisions that are identical to the provisions listed in paragraphs (a)(1) through (a)(32) of this Section. Implemented provisions must, however, establish requirements at least as stringent as the corresponding listed provisions. While states may impose more stringent requirements they may not make one requirement more lenient as a tradeoff for making another requirement more stringent." If the state's provisions differ from federal requirements, the state will want to explain in the crosswalk how its requirements are no less stringent, in order to facilitate EPA's evaluation of the differences.

*** Indicates that additional language is provided in the Code of Federal Regulations for the older UIC regulations and amendments prior to the publication of the UIC Class VI Geologic Sequestration Rule. Only language related to the Class VI GS Rule is provided in this crosswalk; therefore, it is intended for use by states submitting UIC Program Revision applications to add Class VI to their existing UIC programs.

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
40 CFR PART 124--PROCEDURES FOR DECISION MAKING			
SUBPART A--GENERAL PROGRAM REQUIREMENTS			
40 CFR 124.10 Public notice of permit actions and public comment period.			
Methods [applicable to State programs, see 40 CFR 123.25 (NPDES), 145.11 (UIC), 233.23 (404), and 271.14 (RCRA)]. Public notice of activities described in paragraph (a)(1) of this section shall be given by the following methods:	40 CFR 124.10(c)		
For Class VI injection well UIC permits, mailing or emailing a notice to State and local oil and gas regulatory agencies and State agencies regulating mineral exploration and recovery, the Director of the Public Water Supply Supervision program in the State, and all agencies that oversee injection wells in the State.	40 CFR 124.10(c)(1)(xi)		
40 CFR PART 144--UNDERGROUND INJECTION CONTROL PROGRAM			
SUBPART A--GENERAL PROVISIONS			
40 CFR 144.1 Purpose and scope of Part 144.			
Subpart H of 40 CFR 146 sets forth requirements for owners or operators of Class VI injection wells.	40 CFR 144.1(f)(1)(viii)		
<i>Scope of the permit or rule requirement.</i> The UIC permit program regulates underground injection by six classes of wells (see definition of “well injection,” 40 CFR 144.3). The six classes of wells are set forth in 40 CFR 144.6. All owners or operators of these injection wells must be authorized either by permit or rule by the Director. In carrying out the mandate of the SDWA, this subpart provides that no injection shall be authorized by permit or rule if it results in the movement of fluid containing any contaminant into underground sources of drinking water (USDWs –see 40 CFR 144.3 for definition), if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR part 141 or may adversely affect the health of persons (40 CFR 144.12). Existing Class IV wells which inject hazardous waste directly into an underground source of drinking water are to be eliminated over a period of six months and new such Class IV wells are to be prohibited (40 CFR 144.13). For Class V wells, if remedial action appears necessary, a permit may	40 CFR 144.1(g)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
<p>be required (40 CFR 144.25) or the Director must require remedial action or closure by order (40 CFR 144.6(c)). During UIC program development, the Director may identify aquifers and portions of aquifers which are actual or potential sources of drinking water. This will provide an aid to the Director in carrying out his or her duty to protect all USDWs. An aquifer is a USDW if it fits the definition under 40 CFR 144.3, even if it has not been “identified.” The Director may also designate “exempted aquifers” using the criteria in 40 CFR 146.4 of this chapter. Such aquifers are those which would otherwise qualify as “underground sources of drinking water” to be protected, but which have no real potential to be used as drinking water sources. Therefore, they are not USDWs. No aquifer is an exempted aquifer until it has been affirmatively designated under the procedures at 40 CFR 144.7. Aquifers which do not fit the definition of “underground source of drinking water” are not “exempted aquifers.” They are simply not subject to the special protection afforded USDWs. During initial Class VI program development, the Director shall not expand the areal extent of an existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption for Class VI injection wells and EPA shall not approve a program that applies for aquifer exemption expansions of Class II-Class VI exemptions as part of the program description. All Class II to Class VI aquifer exemption expansions previously issued by EPA must be incorporated into the Class VI program descriptions pursuant to requirements at 40 CFR 145.23(f)(9).***</p>			
40 CFR 144.3 Definitions.			
<p><i>Geologic sequestration</i> means the long-term containment of a gaseous, liquid, or supercritical carbon dioxide stream in subsurface geologic formations. This term does not apply to carbon dioxide capture or transport.***</p>	40 CFR 144.3		
40 CFR 144.6 Classification of wells.			
<p><i>Class V.</i> Injection wells not included in Class I, II, III, IV, or VI. Specific types of Class V injection wells are described in 40 CFR 144.81.</p>	40 CFR 144.6(e)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
<i>Class VI.</i> Wells that are not experimental in nature that are used for geologic sequestration of carbon dioxide beneath the lowermost formation containing a USDW; or, wells used for geologic sequestration of carbon dioxide that have been granted a waiver of the injection depth requirements pursuant to requirements at 40 CFR 146.95 of this chapter; or, wells used for geologic sequestration of carbon dioxide that have received an expansion to the areal extent of an existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption pursuant to 40 CFR 146.4 and 40 CFR 144.7(d).	40 CFR 144.6(f)		
40 CFR 144.7 Identification of underground sources of drinking water and exempted aquifers.			
The Director may identify (by narrative description, illustrations, maps, or other means) and shall protect as underground sources of drinking water, all aquifers and parts of aquifers which meet the definition of “underground source of drinking water” in 40 CFR 144.3, except to the extent there is an applicable aquifer exemption under paragraph (b) of this section or an expansion to the areal extent of an existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption for the exclusive purpose of Class VI injection for geologic sequestration under paragraph (d) of this section. Other than EPA approved aquifer exemption expansions that meet the criteria set forth in 40 CFR 146.4(d), new aquifer exemptions shall not be issued for Class VI injection wells. Even if an aquifer has not been specifically identified by the Director, it is an underground source of drinking water if it meets the definition in 40 CFR 144.3.	40 CFR 144.7(a)		
The Director may identify (by narrative description, illustrations, maps, or other means) and describe in geographic and/or geometric terms (such as vertical and lateral limits and gradient) which are clear and definite, all aquifers or parts thereof which the Director proposes to designate as exempted aquifers using the criteria in 40 CFR 146.4.	40 CFR 144.7(b)(1)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
No designation of an exempted aquifer submitted as part of a UIC program shall be final until approved by the Administrator as part of a UIC program. No designation of an expansion to the areal extent of a Class II enhanced oil recovery or enhanced gas recovery aquifer exemption for the exclusive purpose of Class VI injection for geologic sequestration shall be final until approved by the Administrator as a revision to the applicable Federal UIC program under part 147 or as a substantial revision of an approved State UIC program in accordance with 40 CFR 145.32 of this chapter. ***	40 CFR 144.7(b)(2)		
<i>Expansion to the Areal Extent of Existing Class II Aquifer Exemptions for Class VI Wells.</i> Owners or operators of Class II enhanced oil recovery or enhanced gas recovery wells may request that the Director approve an expansion to the areal extent of an aquifer exemption already in place for a Class II enhanced oil recovery or enhanced gas recovery well for the exclusive purpose of Class VI injection for geologic sequestration. Such requests must be treated as a revision to the applicable Federal UIC program under part 147 or as a substantial program revision to an approved State UIC program under 40 CFR 145.32 and will not be final until approved by EPA.	40 CFR 144.7(d)		
The owner or operator of a Class II enhanced oil recovery or enhanced gas recovery well that requests an expansion of the areal extent of an existing aquifer exemption for the exclusive purpose of Class VI injection for geologic sequestration must define (by narrative description, illustrations, maps, or other means) and describe in geographic and/or geometric terms (such as vertical and lateral limits and gradient) that are clear and definite, all aquifers or parts thereof that are requested to be designated as exempted using the criteria in 40 CFR 146.4.	40 CFR 144.7(d)(1)		
In evaluating a request to expand the areal extent of an aquifer exemption of a Class II enhanced oil recovery or enhanced gas recovery well for the purpose of Class VI injection, the Director must determine that the request meets the criteria for exemptions in 40 CFR 146.4. In making the determination, the Director shall consider:	40 CFR 144.7(d)(2)		
Current and potential future use of the USDWs to be exempted as drinking water resources;	40 CFR 144.7(d)(2)(i)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
The predicted extent of the injected carbon dioxide plume, and any mobilized fluids that may result in degradation of water quality, over the lifetime of the GS project, as informed by computational modeling performed pursuant to 40 CFR 146.84(c)(1), in order to ensure that the proposed injection operation will not at any time endanger USDWs including non-exempted portions of the injection formation;	40 CFR 144.7(d)(2)(ii)		
Whether the areal extent of the expanded aquifer exemption is of sufficient size to account for any possible revisions to the computational model during reevaluation of the area of review, pursuant to 40 CFR 146.84(e); and	40 CFR 144.7(d)(2)(iii)		
Any information submitted to support a waiver request made by the owner or operator under 40 CFR 146.95, if appropriate.	40 CFR 144.7(d)(2)(iv)		
40 CFR 144.8 Noncompliance and program reporting by the Director.			
All Class VI program reports shall be consistent with reporting requirements set forth in 40 CFR 146.91 of this chapter.	40 CFR 144.8(b)(2)(iii)		
SUBPART B--GENERAL PROGRAM REQUIREMENTS			
40 CFR 144.12 Prohibition of movement of fluid into underground sources of drinking water.			
For Class I, II, III, and VI wells, if any water quality monitoring of an underground source of drinking water indicates the movement of any contaminant into the underground source of drinking water, except as authorized under 40 CFR 146, the Director shall prescribe such additional requirements for construction, corrective action, operation, monitoring, or reporting (including closure of the injection well) as are necessary to prevent such movement.***	40 CFR 144.12(b)		
40 CFR 144.15 Prohibition of non-experimental Class V wells for geologic sequestration.			
The construction, operation or maintenance of any non-experimental Class V geologic sequestration well is prohibited.	40 CFR 144.15		
40 CFR 144.18 Requirements for Class VI wells.			
Owners or operators of Class VI wells must obtain a permit. Class VI wells cannot be authorized by rule to inject carbon dioxide.	40 CFR 144.18		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
40 CFR 144.19 Transitioning from Class II to Class VI.			
Owners or operators that are injecting carbon dioxide for the primary purpose of long- term storage into an oil and gas reservoir must apply for and obtain a Class VI geologic sequestration permit when there is an increased risk to USDWs compared to Class II operations. In determining if there is an increased risk to USDWs, the owner or operator must consider the factors specified in 40 CFR 144.19(b).	40 CFR 144.19(a)		
The Director shall determine when there is an increased risk to USDWs compared to Class II operations and a Class VI permit is required. In order to make this determination the Director must consider the following:	40 CFR 144.19(b)		
Increase in reservoir pressure within the injection zone(s);	40 CFR 144.19(b)(1)		
Increase in carbon dioxide injection rates;	40 CFR 144.19(b)(2)		
Decrease in reservoir production rates;	40 CFR 144.19(b)(3)		
Distance between the injection zone(s) and USDWs;	40 CFR 144.19(b)(4)		
Suitability of the Class II area of review delineation;	40 CFR 144.19(b)(5)		
Quality of abandoned well plugs within the area of review;	40 CFR 144.19(b)(6)		
The owner's or operator's plan for recovery of carbon dioxide at the cessation of injection;	40 CFR 144.19(b)(7)		
The source and properties of injected carbon dioxide; and	40 CFR 144.19(b)(8)		
Any additional site-specific factors as determined by the Director.	40 CFR 144.19(b)(9)		
SUBPART C--AUTHORIZATION OF UNDERGROUND INJECTION BY RULE			
40 CFR 144.22 Existing Class II enhanced recovery and hydrocarbon storage wells.			
Duration of well authorization by rule. Well authorization under this section expires upon the effective date of a permit issued pursuant to 40 CFR 144.19, 144.25, 144.31, 144.33 or 144.34; after plugging and abandonment in accordance with an approved plugging and abandonment plan pursuant to 40 CFR 144.28(c) and 146.10; and upon submission of a plugging and abandonment report pursuant to 40 CFR 144.28(k); or upon conversion in compliance with 40 CFR 144.28(j).	40 CFR 144.22(b)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
SUBPART D--AUTHORIZATION BY PERMIT			
40 CFR 144.31 Application for a permit; authorization by permit.			
Information requirements. All applicants for Class I, II, III, and V permits shall provide the following information to the Director, using the application form provided by the Director. Applicants for Class VI permits shall follow the criteria provided in 40 CFR 146.82 of this chapter.	40 CFR 144.31(e)		
40 CFR 144.33 Area permits.			
Used to inject other than hazardous waste; and	40 CFR 144.33(a)(4)		
Other than Class VI wells.	40 CFR 144.33(a)(5)		
40 CFR 144.36 Duration of permits.			
Permits for Class I and V wells shall be effective for a fixed term not to exceed 10 years. UIC permits for Class II and III wells shall be issued for a period up to the operating life of the facility. UIC permits for Class VI wells shall be issued for the operating life of the facility and the post-injection site care period. The Director shall review each issued Class II, III, and VI well UIC permit at least once every 5 years to determine whether it should be modified, revoked and reissued, terminated or a minor modification made as provided in 40 CFR 144.39, 144.40, or 144.41.	40 CFR 144.36(a)		
40 CFR 144.38 Transfer of permits.			
Automatic transfers. As an alternative to transfers under paragraph (a) of this section, any UIC permit for a well not injecting hazardous waste or injecting carbon dioxide for geologic sequestration may be automatically transferred to a new permittee if:	40 CFR 144.38(b)		
40 CFR 144.39 Modification or revocation and reissuance of permits.			
*** For Class I hazardous waste injection wells, Class II, Class III or Class VI wells the following may be causes for revocation and reissuance as well as modification; and for all other wells the following may be cause for revocation or reissuance as well as modification when the permittee requests or agrees. ***	40 CFR 144.39(a)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
*** Permits other than for Class I hazardous waste injection wells, Class II, Class III or Class VI wells may be modified during their permit terms for this cause only as follows: ***	40 CFR 144.39(a)(3)		
<i>Basis for modification of Class VI permits.</i> Additionally, for Class VI wells, whenever the Director determines that permit changes are necessary based on:	40 CFR 144.39(a)(5)		
Area of review reevaluations under 40 CFR 146.84(e)(1) of this chapter;	40 CFR 144.39(a)(5)(i)		
Any amendments to the testing and monitoring plan under 40 CFR 146.90(j);	40 CFR 144.39(a)(5)(ii)		
Any amendments to the injection well plugging plan under 40 CFR 146.92(c);	40 CFR 144.39(a)(5)(iii)		
Any amendments to the post-injection site care and site closure plan under 40 CFR 146.93(a)(3);	40 CFR 144.39(a)(5)(iv)		
Any amendments to the emergency and remedial response plan under 40 CFR 146.94(d); or	40 CFR 144.39(a)(5)(v)		
A review of monitoring and/or testing results conducted in accordance with permit requirements.	40 CFR 144.39(a)(5)(vi)		
40 CFR 144.41 Minor modifications of permits.			
Amend a Class VI injection well testing and monitoring plan, plugging plan, post-injection site care and site closure plan, or emergency and remedial response plan where the modifications merely clarify or correct the plan, as determined by the Director.	40 CFR 144.41(h)		
SUBPART E--PERMIT CONDITIONS			
40 CFR 144.51 Conditions applicable to all permits.			
Owners or operators of Class VI wells shall retain records as specified in subpart H of part 146, including 40 CFR 146.84(g), 146.91(f), 146.92(d), 146.93(f), and 146.93(h).	40 CFR 144.51(j)(4)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
A Class I, II or III permit shall include and a Class V permit may include conditions which meet the applicable requirements of 40 CFR 146.10 of this chapter to ensure that plugging and abandonment of the well will not allow the movement of fluids into or between USDWs. Where the plan meets the requirements of 40 CFR 146.10 of this chapter, the Director shall incorporate the plan into the permit as a permit condition. Where the Director's review of an application indicates that the permittee's plan is inadequate, the Director may require the applicant to revise the plan, prescribe conditions meeting the requirements of this paragraph, or deny the permit. A Class VI permit shall include conditions which meet the requirements set forth in 40 CFR 146.92 of this chapter. Where the plan meets the requirements of 40 CFR 146.92 of this chapter, the Director shall incorporate it into the permit as a permit condition. For purposes of this paragraph, temporary or intermittent cessation of injection operations is not abandonment.	40 CFR 144.51(o)		
The owner or operator of a Class I, II, III or VI well permitted under this part shall establish mechanical integrity prior to commencing injection or on a schedule determined by the Director. Thereafter the owner or operator of Class I, II, and III wells must maintain mechanical integrity as defined in 40 CFR 146.8 of this chapter and the owner or operator of Class VI wells must maintain mechanical integrity as defined in 40 CFR 146.89. ***	40 CFR 144.51(q)(1)		
When the Director determines that a Class I, II, III or VI well lacks mechanical integrity pursuant to 40 CFR 146.8 or 146.89 for Class VI of this chapter, he/she shall give written notice of his/her determination to the owner or operator. ***	40 CFR 144.51(q)(2)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
40 CFR 144.52 Establishing permit conditions.			
In addition to conditions required in 40 CFR 144.51, the Director shall establish conditions, as required on a case-by-case basis under 40 CFR 144.36 (duration of permits), 40 CFR 144.53(a) (schedules of compliance), 144.54 (monitoring), and for EPA permits only 40 CFR 144.53(b) (alternate schedules of compliance), and 40 CFR 144.4 (considerations under Federal law). Permits for owners or operators of hazardous waste injection wells shall include conditions meeting the requirements of 40 CFR 144.14 (requirements for wells injecting hazardous waste), paragraphs (a)(7) and (a)(9) of this section, and subpart G of part 146. Permits for owners or operators of Class VI injection wells shall include conditions meeting the requirements of subpart H of part 146. Permits for other wells shall contain the following requirements, when applicable.	40 CFR 144.52(a)		
Corrective action as set forth in 40 CFR 144.55, 146.7, and 146.84;.	40 CFR 144.52(a)(2)		
The well has been plugged and abandoned in accordance with an approved plugging and abandonment plan pursuant to 40 CFR 144.51(o), 146.10, and 146.92 of this chapter, and submitted a plugging and abandonment report pursuant to 40 CFR 144.51(p); or	40 CFR 144.52(a)(7)(i)(A)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
The permittee shall show evidence of such financial responsibility to the Director by the submission of a surety bond, or other adequate assurance, such as a financial statement or other materials acceptable to the Director. For EPA administered programs, the Regional Administrator may on a periodic basis require the holder of a lifetime permit to submit an estimate of the resources needed to plug and abandon the well revised to reflect inflation of such costs, and a revised demonstration of financial responsibility, if necessary. The owner or operator of a well injecting hazardous waste must comply with the financial responsibility requirements of subpart F of this part. For Class VI wells, the permittee shall show evidence of such financial responsibility to the Director by the submission of a qualifying instrument (see 40 CFR 146.85(a) of this chapter), such as a financial statement or other materials acceptable to the Director. The owner or operator of a Class VI well must comply with the financial responsibility requirements set forth in 40 CFR 146.85.	40 CFR 144.52(a)(7)(ii)		
<i>Mechanical integrity.</i> A permit for any Class I, II, III or VI well or injection project which lacks mechanical integrity shall include, and for any Class V well may include, a condition prohibiting injection operations until the permittee shows to the satisfaction of the Director under 40 CFR 146.8, or 146.89 for Class VI, that the well has mechanical integrity.	40 CFR 144.52(a)(8)		
SUBPART G--REQUIREMENTS FOR OWNERS AND OPERATORS OF CLASS V INJECTION WELLS			
40 CFR 144.80 What is a Class V injection well?			
<i>Class V.</i> Injection wells not included in Class I, II, III, IV or VI. ***	40 CFR 144.80(e)		
<i>Class VI.</i> Wells used for geologic sequestration of carbon dioxide beneath the lowermost formation containing a USDW, except those wells that are experimental in nature; or, wells used for geologic sequestration of carbon dioxide that have been granted a waiver of the injection depth requirements pursuant to requirements at 146.95 of this chapter; or, wells used for geologic sequestration of carbon dioxide that have received an expansion to the areal extent of a existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption pursuant to 40 CFR 146.4 of this chapter and 144.7(d).	40 CFR 144.80(f)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
40 CFR PART 145--STATE UIC PROGRAM REQUIREMENTS			
SUBPART A--GENERAL PROGRAM REQUIREMENTS			
40 CFR 145.1 Purpose and scope.			
States seeking primary enforcement responsibility for Class VI wells must submit a primacy application in accordance with subpart C of this part and meet all requirements of this part. States may apply for primary enforcement responsibility for Class VI wells independently of other injection well classes.	40 CFR 145.1(i)		
SUBPART C--STATE PROGRAM SUBMISSIONS			
40 CFR 145.21 General requirements for program approvals.			
To establish a Federal UIC Class VI program in States not seeking full UIC primary enforcement responsibility approval, pursuant to the SDWA section 1422(c), States shall, by December 10, 2011, submit to the Administrator a new or revised State UIC program complying with 40 CFR 145.22 or 145.32 of this part. Beginning on September 6, 2011, the requirements of subpart H of part 146 will be applicable and enforceable by EPA in each State that has not received approval of a new Class VI program application under section 1422 of the Safe Drinking Water Act or a revision of its UIC program under section 1422 of the Safe Drinking Water Act to incorporate subpart H of part 146. Following September 6, 2011, EPA will publish a list of the States where subpart H of part 146 has become applicable.	40 CFR 145.21(h)		
40 CFR 145.22 Elements of a program submission.			
Any State that seeks to administer a program under this part shall submit to the Administrator at least three copies of a program submission. For Class VI programs, the entire submission can be sent electronically. The submission shall contain the following:	40 CFR 145.22(a)		
Copies of all applicable State statutes and regulations, including those governing State administrative procedures;	40 CFR 145.22(a)(5)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
40 CFR 145.23 Program description.			
Any State that seeks to administer a program under this part shall submit a description of the program it proposes to administer in lieu of the Federal program under State law or under an interstate compact. For Class VI programs, the entire submission can be sent electronically. The program description shall include:	40 CFR 145.23		
A description of applicable State procedures, including permitting procedures and any State administrative or judicial review procedures.	40 CFR 145.23(c)		
Copies of the permit form(s), application form(s), reporting form(s), and manifest format the State intends to employ in its program. Forms used by States need not be identical to the forms used by EPA but should require the same basic information. The State need not provide copies of uniform national forms it intends to use but should note its intention to use such forms. For Class VI programs, submit copies of the current forms in use by the State, if any.	40 CFR 145.23(d)		
A schedule for issuing permits within five years after program approval to all injection wells within the State which are required to have permits under this part and 40 CFR part 144. For Class VI programs, a schedule for issuing permits within two years after program approval;	40 CFR 145.23(f)(1)		
The priorities (according to criteria set forth in 40 CFR 146.9 of this chapter) for issuing permits, including the number of permits in each class of injection well which will be issued each year during the first five years of program operation. For Class VI programs, include the priorities for issuing permits and the number of permits which will be issued during the first two years of program operation;	40 CFR 145.23(f)(2)		
A description of how the Director will implement the mechanical integrity testing requirements of 40 CFR 146.8, or, for Class VI wells, the mechanical integrity testing requirements of 40 CFR 146.89, including the frequency of testing that will be required and the number of tests that will be reviewed by the Director each year;	40 CFR 145.23(f)(3)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
A description of the procedure whereby the Director will notify owners or operators of injection wells of the requirement that they apply for and obtain a permit. The notification required by this paragraph shall require applications to be filed as soon as possible, but not later than four years after program approval for all injection wells requiring a permit. For Class VI programs approved before December 10, 2011, a description of the procedure whereby the Director will notify owners or operators of any Class I wells previously permitted for the purpose of geologic sequestration or Class V experimental technology wells no longer being used for experimental purposes that will continue injection of carbon dioxide for the purpose of GS that they must apply for a Class VI permit pursuant to requirements at 40 CFR 146.81(c) within one year of December 10, 2011. For Class VI programs approved following December 10, 2011, a description of the procedure whereby the Director will notify owners or operators of any Class I wells previously permitted for the purpose of geologic sequestration or Class V experimental technology wells no longer being used for experimental purposes that will continue injection of carbon dioxide for the purpose of GS or Class VI wells previously permitted by EPA that they must apply for a Class VI permit pursuant to requirements at 40 CFR 146.81(c) within one year of Class VI program approval;	40 CFR 145.23(f)(4)		
A description of aquifers, or parts thereof, which the Director has identified under 40 CFR 144.7(b) as exempted aquifers, and a summary of supporting data. For Class VI programs only, States must incorporate information related to any EPA approved exemptions expanding the areal extent of existing aquifer exemptions for Class II enhanced oil recovery or enhanced gas recovery wells transitioning to Class VI injection for geologic sequestration pursuant to requirements at 40 CFR 146.4(d) and 144.7(d), including a summary of supporting data and the specific location of the aquifer exemption expansions. Other than expansions of the areal extent of Class II enhanced oil recovery or enhanced gas recovery well aquifer exemptions for Class VI injection, new aquifer exemptions shall not be issued for Class VI wells or injection activities;	40 CFR 145.23(f)(9)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
For Class VI programs, a description of the procedure whereby the Director must notify, in writing, any States, Tribes, and Territories of any permit applications for geologic sequestration of carbon dioxide wherein the area of review crosses State, Tribal, or Territory boundaries, resulting in the need for trans-boundary coordination related to an injection operation.	40 CFR 145.23(f)(13)		
40 CFR 145.32 Procedures for revision of State programs.			
*** All requests for expansions to the areal extent of Class II enhanced oil recovery or enhanced gas recovery aquifer exemptions for Class VI wells must be treated as substantial program revisions.	40 CFR 145.32(b)(2)		
40 CFR PART 146--UNDERGROUND INJECTION CONTROL PROGRAM: CRITERIA AND STANDARDS			
SUBPART A--GENERAL PROVISIONS			
40 CFR 146.4 Criteria for exempted aquifers.			
An aquifer or a portion thereof which meets the criteria for an "underground source of drinking water" in 146.3 may be determined under 40 CFR 144.7 of this chapter to be an "exempted aquifer" for Class I-V wells if it meets the criteria in paragraphs (a) through (c) of this section. Class VI wells must meet the criteria under paragraph (d) of this section:	40 CFR 146.4		
The areal extent of an aquifer exemption for a Class II enhanced oil recovery or enhanced gas recovery well may be expanded for the exclusive purpose of Class VI injection for geologic sequestration under 40 CFR 144.7(d) of this chapter if it meets the following criteria:	40 CFR 146.4(d)		
It does not currently serve as a source of drinking water; and	40 CFR 146.4(d)(1)		
The total dissolved solids content of the ground water is more than 3,000 mg/l and less than 10,000 mg/l; and	40 CFR 146.4(d)(2)		
It is not reasonably expected to supply a public water system.	40 CFR 146.4(d)(3)		
40 CFR 146.5 Classification of injection wells.			
Class V. Injection wells not included in Class I, II, III, IV or VI. ***	40 CFR 146.5(e)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
<i>Class VI.</i> Wells that are not experimental in nature that are used for geologic sequestration of carbon dioxide beneath the lowermost formation containing a USDW; or, wells used for geologic sequestration of carbon dioxide that have been granted a waiver of the injection depth requirements pursuant to requirements at 40 CFR 146.95; or, wells used for geologic sequestration of carbon dioxide that have received an expansion to the areal extent of an existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption pursuant to 40 CFR 146.4 of this chapter and 144.7(d).	40 CFR 146.5(f)		
SUBPART H--CRITERIA AND STANDARDS APPLICABLE TO CLASS VI WELLS			
40 CFR 146.81 Applicability.			
This subpart establishes criteria and standards for underground injection control programs to regulate any Class VI carbon dioxide geologic sequestration injection wells.	40 CFR 146.81(a)		
This subpart applies to any wells used to inject carbon dioxide specifically for the purpose of geologic sequestration, i.e., the long-term containment of a gaseous, liquid, or supercritical carbon dioxide stream in subsurface geologic formations.	40 CFR 146.81(b)		
This subpart also applies to owners or operators of permit- or rule-authorized Class I, Class II, or Class V experimental carbon dioxide injection projects who seek to apply for a Class VI geologic sequestration permit for their well or wells. Owners or operators seeking to convert existing Class I, Class II, or Class V experimental wells to Class VI geologic sequestration wells must demonstrate to the Director that the wells were engineered and constructed to meet the requirements at 40 CFR 146.86(a) and ensure protection of USDWs, in lieu of requirements at 40 CFR 146.86(b) and 146.87(a). By December 10, 2011, owners or operators of either Class I wells previously permitted for the purpose of geologic sequestration or Class V experimental technology wells no longer being used for experimental purposes that will continue injection of carbon dioxide for the purpose of GS must apply for a Class VI permit. A converted well must still meet all other requirements under part 146.	40 CFR 146.81(c)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
<i>Definitions.</i> The following definitions apply to this subpart. To the extent that these definitions conflict with those in 40 CFR 144.3 or 146.3, these definitions govern for Class VI wells: <i>area of review, carbon dioxide plume, carbon dioxide stream, confining zone, corrective action, geologic sequestration, geologic sequestration project, injection zone, post-injection site care, pressure front, site closure, transmissive fault or fracture.</i>	40 CFR 146.81(d)		
40 CFR 146.82 Required Class VI permit information.			
This section sets forth the information which must be considered by the Director in authorizing Class VI wells. For converted Class I, Class II, or Class V experimental wells, certain maps, cross-sections, tabulations of wells within the area of review and other data may be included in the application by reference provided they are current, readily available to the Director, and sufficiently identified to be retrieved. In cases where EPA issues the permit, all the information in this section must be submitted to the Regional Administrator.	40 CFR 146.82		
Prior to the issuance of a permit for the construction of a new Class VI well or the conversion of an existing Class I, Class II, or Class V well to a Class VI well, the owner or operator shall submit, pursuant to 40 CFR 146.91(e), and the Director shall consider the following:	40 CFR 146.82(a)		
Information required in 40 CFR 144.31 (e)(1) through (6);	40 CFR 146.82(a)(1)		
A map showing the injection well for which a permit is sought and the applicable area of review consistent with 40 CFR 146.84. Within the area of review, the map must show the number or name, and location of all injection wells, producing wells, abandoned wells, plugged wells or dry holes, deep stratigraphic boreholes, State- or EPA-approved subsurface cleanup sites, surface bodies of water, springs, mines (surface and subsurface), quarries, water wells, other pertinent surface features including structures intended for human occupancy, State, Tribal, and Territory boundaries, and roads. The map should also show faults, if known or suspected. Only information of public record is required to be included on this map;	40 CFR 146.82(a)(2)		
Information on the geologic structure and hydrogeologic properties of the proposed storage site and overlying formations, including:	40 CFR 146.82(a)(3)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Maps and cross sections of the area of review;	40 CFR 146.82(a)(3)(i)		
The location, orientation, and properties of known or suspected faults and fractures that may transect the confining zone(s) in the area of review and a determination that they would not interfere with containment;	40 CFR 146.82(a)(3)(ii)		
Data on the depth, areal extent, thickness, mineralogy, porosity, permeability, and capillary pressure of the injection and confining zone(s); including geology/facies changes based on field data which may include geologic cores, outcrop data, seismic surveys, well logs, and names and lithologic descriptions;	40 CFR 146.82(a)(3)(iii)		
Geomechanical information on fractures, stress, ductility, rock strength, and in situ fluid pressures within the confining zone(s);	40 CFR 146.82(a)(3)(iv)		
Information on the seismic history including the presence and depth of seismic sources and a determination that the seismicity would not interfere with containment; and	40 CFR 146.82(a)(3)(v)		
Geologic and topographic maps and cross sections illustrating regional geology, hydrogeology, and the geologic structure of the local area.	40 CFR 146.82(a)(3)(vi)		
A tabulation of all wells within the area of review which penetrate the injection or confining zone(s). Such data must include a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the Director may require;	40 CFR 146.82(a)(4)		
Maps and stratigraphic cross sections indicating the general vertical and lateral limits of all USDWs, water wells and springs within the area of review, their positions relative to the injection zone(s), and the direction of water movement, where known;	40 CFR 146.82(a)(5)		
Baseline geochemical data on subsurface formations, including all USDWs in the area of review;	40 CFR 146.82(a)(6)		
Proposed operating data for the proposed geologic sequestration site:	40 CFR 146.82(a)(7)		
Average and maximum daily rate and volume and/or mass and total anticipated volume and/or mass of the carbon dioxide stream;	40 CFR 146.82(a)(7)(i)		
Average and maximum injection pressure;	40 CFR 146.82(a)(7)(ii)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
The source(s) of the carbon dioxide stream; and	40 CFR 146.82(a)(7)(iii)		
An analysis of the chemical and physical characteristics of the carbon dioxide stream.	40 CFR 146.82(a)(7)(iv)		
Proposed pre-operational formation testing program to obtain an analysis of the chemical and physical characteristics of the injection zone(s) and confining zone(s) and that meets the requirements at 40 CFR 146.87;	40 CFR 146.82(a)(8)		
Proposed stimulation program, a description of stimulation fluids to be used and a determination that stimulation will not interfere with containment;	40 CFR 146.82(a)(9)		
Proposed procedure to outline steps necessary to conduct injection operation;	40 CFR 146.82(a)(10)		
Schematics or other appropriate drawings of the surface and subsurface construction details of the well;	40 CFR 146.82(a)(11)		
Injection well construction procedures that meet the requirements of 40 CFR 146.86;	40 CFR 146.82(a)(12)		
Proposed area of review and corrective action plan that meets the requirements under 40 CFR 146.84;	40 CFR 146.82(a)(13)		
A demonstration, satisfactory to the Director, that the applicant has met the financial responsibility requirements under 40 CFR 146.85;	40 CFR 146.82(a)(14)		
Proposed testing and monitoring plan required by 40 CFR 146.90;	40 CFR 146.82(a)(15)		
Proposed injection well plugging plan required by 40 CFR 146.92(b);	40 CFR 146.82(a)(16)		
Proposed post-injection site care and site closure plan required by 40 CFR 146.93(a);	40 CFR 146.82(a)(17)		
At the Director's discretion, a demonstration of an alternative post-injection site care timeframe required by 40 CFR 146.93(c);	40 CFR 146.82(a)(18)		
Proposed emergency and remedial response plan required by 40 CFR 146.94(a);	40 CFR 146.82(a)(19)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
A list of contacts, submitted to the Director, for those States, Tribes, and Territories identified to be within the area of review of the Class VI project based on information provided in paragraph (a)(2) of this section; and	40 CFR 146.82(a)(20)		
Any other information requested by the Director.	40 CFR 146.82(a)(21)		
The Director shall notify, in writing, any States, Tribes, or Territories within the area of review of the Class VI project based on information provided in paragraphs (a)(2) and (a)(20) of this section of the permit application and pursuant to the requirements at 40 CFR 145.23(f)(13).	40 CFR 146.82(b)		
Prior to granting approval for the operation of a Class VI well, the Director shall consider the following information:	40 CFR 146.82(c)		
The final area of review based on modeling, using data obtained during logging and testing of the well and the formation as required by paragraphs (c)(2), (3), (4), (6), (7), and (10) of this section;	40 CFR 146.82(c)(1)		
Any relevant updates, based on data obtained during logging and testing of the well and the formation as required by paragraphs (c)(3), (4), (6), (7), and (10) of this section, to the information on the geologic structure and hydrogeologic properties of the proposed storage site and overlying formations, submitted to satisfy the requirements of paragraph (a)(3) of this section;	40 CFR 146.82(c)(2)		
Information on the compatibility of the carbon dioxide stream with fluids in the injection zone(s) and minerals in both the injection and the confining zone(s), based on the results of the formation testing program, and with the materials used to construct the well;	40 CFR 146.82(c)(3)		
The results of the formation testing program required at paragraph (a)(8) of this section;	40 CFR 146.82(c)(4)		
Final injection well construction procedures that meet the requirements of 40 CFR 146.86;	40 CFR 146.82(c)(5)		
The status of corrective action on wells in the area of review;	40 CFR 146.82(c)(6)		
All available logging and testing program data on the well required by 40 CFR 146.87;	40 CFR 146.82(c)(7)		
A demonstration of mechanical integrity pursuant to 40 CFR 146.89;	40 CFR 146.82(c)(8)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Any updates to the proposed area of review and corrective action plan, testing and monitoring plan, injection well plugging plan, post-injection site care and site closure plan, or the emergency and remedial response plan submitted under paragraph (a) of this section, which are necessary to address new information collected during logging and testing of the well and the formation as required by all paragraphs of this section, and any updates to the alternative post-injection site care timeframe demonstration submitted under paragraph (a) of this section, which are necessary to address new information collected during the logging and testing of the well and the formation as required by all paragraphs of this section; and	40 CFR 146.82(c)(9)		
Any other information requested by the Director.	40 CFR 146.82(c)(10)		
Owners or operators seeking a waiver of the requirement to inject below the lowermost USDW must also refer to 40 CFR 146.95 and submit a supplemental report, as required at 40 CFR 146.95(a). The supplemental report is not part of the permit application.	40 CFR 146.82(d)		
40 CFR 146.83 Minimum criteria for siting.			
Owners or operators of Class VI wells must demonstrate to the satisfaction of the Director that the wells will be sited in areas with a suitable geologic system. The owners or operators must demonstrate that the geologic system comprises:	40 CFR 146.83(a)		
An injection zone(s) of sufficient areal extent, thickness, porosity, and permeability to receive the total anticipated volume of the carbon dioxide stream;	40 CFR 146.83(a)(1)		
Confining zone(s) free of transmissive faults or fractures and of sufficient areal extent and integrity to contain the injected carbon dioxide stream and displaced formation fluids and allow injection at proposed maximum pressures and volumes without initiating or propagating fractures in the confining zone(s).	40 CFR 146.83(a)(2)		
The Director may require owners or operators of Class VI wells to identify and characterize additional zones that will impede vertical fluid movement, are free of faults and fractures that may interfere with containment, allow for pressure dissipation, and provide additional opportunities for monitoring, mitigation, and remediation.	40 CFR 146.83(b)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
40 CFR 146.84 Area of review and corrective action.			
The area of review is the region surrounding the geologic sequestration project where USDWs may be endangered by the injection activity. The area of review is delineated using computational modeling that accounts for the physical and chemical properties of all phases of the injected carbon dioxide stream and is based on available site characterization, monitoring, and operational data.	40 CFR 146.84(a)		
The owner or operator of a Class VI well must prepare, maintain, and comply with a plan to delineate the area of review for a proposed geologic sequestration project, periodically reevaluate the delineation, and perform corrective action that meets the requirements of this section and is acceptable to the Director. The requirement to maintain and implement an approved plan is directly enforceable regardless of whether the requirement is a condition of the permit. As a part of the permit application for approval by the Director, the owner or operator must submit an area of review and corrective action plan that includes the following information:	40 CFR 146.84(b)		
The method for delineating the area of review that meets the requirements of paragraph (c) of this section, including the model to be used, assumptions that will be made, and the site characterization data on which the model will be based;	40 CFR 146.84(b)(1)		
A description of:	40 CFR 146.84(b)(2)		
The minimum fixed frequency, not to exceed five years, at which the owner or operator proposes to reevaluate the area of review;	40 CFR 146.84(b)(2)(i)		
The monitoring and operational conditions that would warrant a reevaluation of the area of review prior to the next scheduled reevaluation as determined by the minimum fixed frequency established in paragraph (b)(2)(i) of this section.	40 CFR 146.84(b)(2)(ii)		
How monitoring and operational data (e.g., injection rate and pressure) will be used to inform an area of review reevaluation; and	40 CFR 146.84(b)(2)(iii)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
How corrective action will be conducted to meet the requirements of paragraph (d) of this section, including what corrective action will be performed prior to injection and what, if any, portions of the area of review will have corrective action addressed on a phased basis and how the phasing will be determined; how corrective action will be adjusted if there are changes in the area of review; and how site access will be guaranteed for future corrective action.	40 CFR 146.84(b)(2)(iv)		
Owners or operators of Class VI wells must perform the following actions to delineate the area of review and identify all wells that require corrective action:	40 CFR 146.84(c)		
Predict, using existing site characterization, monitoring and operational data, and computational modeling, the projected lateral and vertical migration of the carbon dioxide plume and formation fluids in the subsurface from the commencement of injection activities until the plume movement ceases, until pressure differentials sufficient to cause the movement of injected fluids or formation fluids into a USDW are no longer present, or until the end of a fixed time period as determined by the Director. The model must:	40 CFR 146.84(c)(1)		
Be based on detailed geologic data collected to characterize the injection zone(s), confining zone(s) and any additional zones; and anticipated operating data, including injection pressures, rates, and total volumes over the proposed life of the geologic sequestration project;	40 CFR 146.84(c)(1)(i)		
Take into account any geologic heterogeneities, other discontinuities, data quality, and their possible impact on model predictions; and	40 CFR 146.84(c)(1)(ii)		
Consider potential migration through faults, fractures, and artificial penetrations.	40 CFR 146.84(c)(1)(iii)		
Using methods approved by the Director, identify all penetrations, including active and abandoned wells and underground mines, in the area of review that may penetrate the confining zone(s). Provide a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the Director may require; and	40 CFR 146.84(c)(2)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Determine which abandoned wells in the area of review have been plugged in a manner that prevents the movement of carbon dioxide or other fluids that may endanger USDWs, including use of materials compatible with the carbon dioxide stream.	40 CFR 146.84(c)(3)		
Owners or operators of Class VI wells must perform corrective action on all wells in the area of review that are determined to need corrective action, using methods designed to prevent the movement of fluid into or between USDWs, including use of materials compatible with the carbon dioxide stream, where appropriate.	40 CFR 146.84(d)		
At the minimum fixed frequency, not to exceed five years, as specified in the area of review and corrective action plan, or when monitoring and operational conditions warrant, owners or operators must:	40 CFR 146.84(e)		
Reevaluate the area of review in the same manner specified in paragraph (c)(1) of this section;	40 CFR 146.84(e)(1)		
Identify all wells in the reevaluated area of review that require corrective action in the same manner specified in paragraph (c) of this section;	40 CFR 146.84(e)(2)		
Perform corrective action on wells requiring corrective action in the reevaluated area of review in the same manner specified in paragraph (d) of this section; and	40 CFR 146.84(e)(3)		
Submit an amended area of review and corrective action plan or demonstrate to the Director through monitoring data and modeling results that no amendment to the area of review and corrective action plan is needed. Any amendments to the area of review and corrective action plan must be approved by the Director, must be incorporated into the permit, and are subject to the permit modification requirements at 40 CFR 144.39 or 144.41, as appropriate.	40 CFR 146.84(e)(4)		
The emergency and remedial response plan (as required by 40 CFR 146.94) and the demonstration of financial responsibility (as described by 40 CFR 146.85) must account for the area of review delineated as specified in paragraph (c)(1) of this section or the most recently evaluated area of review delineated under paragraph (e) of this section, regardless of whether or not corrective action in the area of review is phased.	40 CFR 146.84(f)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
All modeling inputs and data used to support area of review reevaluations under paragraph (e) of this section shall be retained for 10 years.	40 CFR 146.84(g)		
40 CFR 146.85 Financial responsibility.			
The owner or operator must demonstrate and maintain financial responsibility as determined by the Director that meets the following conditions:	40 CFR 146.85(a)		
The financial responsibility instrument(s) used must be from the following list of qualifying instruments:	40 CFR 146.85(a)(1)		
Trust Funds	40 CFR 146.85(a)(1)(i)		
Surety Bonds	40 CFR 146.85(a)(1)(ii)		
Letter of Credit	40 CFR 146.85(a)(1)(iii)		
Insurance	40 CFR 146.85(a)(1)(iv)		
Self Insurance (i.e., Financial Test and Corporate Guarantee)	40 CFR 146.85(a)(1)(v)		
Escrow Account	40 CFR 146.85(a)(1)(vi)		
Any other instrument(s) satisfactory to the Director	40 CFR 146.85(a)(1)(vii)		
The qualifying instrument(s) must be sufficient to cover the cost of:	40 CFR 146.85(a)(2)		
Corrective action (that meets the requirements of 40 CFR 146.84);	40 CFR 146.85(a)(2)(i)		
Injection well plugging (that meets the requirements of 40 CFR 146.92);	40 CFR 146.85(a)(2)(ii)		
Post injection site care and site closure (that meets the requirements of 40 CFR 146.93); and	40 CFR 146.85(a)(2)(iii)		
Emergency and remedial response (that meets the requirements of 40 CFR 146.94).	40 CFR 146.85(a)(2)(iv)		
The financial responsibility instrument(s) must be sufficient to address endangerment of underground sources of drinking water.	40 CFR 146.85(a)(3)		
The qualifying financial responsibility instrument(s) must comprise protective conditions of coverage.	40 CFR 146.85(a)(4)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Protective conditions of coverage must include at a minimum cancellation, renewal, and continuation provisions, specifications on when the provider becomes liable following a notice of cancellation if there is a failure to renew with a new qualifying financial instrument, and requirements for the provider to meet a minimum rating, minimum capitalization, and ability to pass the bond rating when applicable.	40 CFR 146.85(a)(4)(i)		
Cancellation – for purposes of this part, an owner or operator must provide that their financial mechanism may not cancel, terminate or fail to renew except for failure to pay such financial instrument. If there is a failure to pay the financial instrument, the financial institution may elect to cancel, terminate, or fail to renew the instrument by sending notice by certified mail to the owner or operator and the Director. The cancellation must not be final for 120 days after receipt of cancellation notice. The owner or operator must provide an alternate financial responsibility demonstration within 60 days of notice of cancellation, and if an alternate financial responsibility demonstration is not acceptable (or possible), any funds from the instrument being cancelled must be released within 60 days of notification by the Director.	40 CFR 146.85(a)(4)(i)(A)		
Renewal – for purposes of this part, owners or operators must renew all financial instruments, if an instrument expires, for the entire term of the geologic sequestration project. The instrument may be automatically renewed as long as the owner or operator has the option of renewal at the face amount of the expiring instrument. The automatic renewal of the instrument must, at a minimum, provide the holder with the option of renewal at the face amount of the expiring financial instrument.	40 CFR 146.85(a)(4)(i)(B)		
Cancellation, termination, or failure to renew may not occur and the financial instrument will remain in full force and effect in the event that on or before the date of expiration: the Director deems the facility abandoned; or the permit is terminated or revoked or a new permit is denied; or closure is ordered by the Director or a U.S. district court or other court of competent jurisdiction; or the owner or operator is named as debtor in a voluntary or involuntary proceeding under Title 11 (Bankruptcy), U.S. Code; or the amount due is paid.	40 CFR 146.85(a)(4)(i)(C)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
The qualifying financial responsibility instrument(s) must be approved by the Director.	40 CFR 146.85(a)(5)		
The Director shall consider and approve the financial responsibility demonstration for all the phases of the geologic sequestration project prior to issue a Class VI permit (40 CFR 146.82).	40 CFR 146.85(a)(5)(i)		
The owner or operator must provide any updated information related to their financial responsibility instrument(s) on an annual basis and if there are any changes, the Director must evaluate, within a reasonable time, the financial responsibility demonstration to confirm that the instrument(s) used remain adequate for use. The owner or operator must maintain financial responsibility requirements regardless of the status of the Director's review of the financial responsibility demonstration.	40 CFR 146.85(a)(5)(ii)		
The Director may disapprove the use of a financial instrument if he determines that it is not sufficient to meet the requirements of this section.	40 CFR 146.85(a)(5)(iii)		
The owner or operator may demonstrate financial responsibility by using one or multiple qualifying financial instruments for specific phases of the geologic sequestration project.	40 CFR 146.85(a)(6)		
In the event that the owner or operator combines more than one instrument for a specific geologic sequestration phase (e.g., well plugging), such combination must be limited to instruments that are not based on financial strength or performance (i.e., self insurance or performance bond), for example trust funds, surety bonds guaranteeing payment into a trust fund, letters of credit, escrow account, and insurance. In this case, it is the combination of mechanisms, rather than the single mechanism, which must provide financial responsibility for an amount at least equal to the current cost estimate.	40 CFR 146.85(a)(6)(i)		
When using a third-party instrument to demonstrate financial responsibility, the owner or operator must provide a proof that the third-party providers either have passed financial strength requirements based on credit ratings; or has met a minimum rating, minimum capitalization, and ability to pass the bond rating when applicable.	40 CFR 146.85(a)(6)(ii)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
An owner or operator using certain types of third party instruments must establish a standby trust to enable EPA to be party to the financial responsibility agreement without EPA being the beneficiary of any funds. The standby trust fund must be used along with other financial responsibility instruments (e.g., surety bonds, letters of credit, or escrow accounts) to provide a location to place funds if needed.	40 CFR 146.85(a)(6)(iii)		
An owner or operator may deposit money to an escrow account to cover financial responsibility requirements; this account must segregate funds sufficient to cover estimated costs for Class VI (geologic sequestration) financial responsibility from other accounts and uses.	40 CFR 146.85(a)(6)(iv)		
An owner or operator or its guarantor may use self insurance to demonstrate financial responsibility for geologic sequestration projects. In order to satisfy this requirement the owner or operator must meet a Tangible Net Worth of an amount approved by the Director, have a Net working capital and tangible net worth each at least six times the sum of the current well plugging, post injection site care and site closure cost, have assets located in the United States amounting to at least 90 percent of total assets or at least six times the sum of the current well plugging, post injection site care and site closure cost, and must submit a report of its bond rating and financial information annually. In addition the owner or operator must either: have a bond rating test of AAA, AA, A, or BBB as issued by Standard & Poor's or Aaa, Aa, A, or Baa as issued by Moody's; or meet all of the following five financial ratio thresholds: a ratio of total liabilities to net worth less than 2.0; a ratio of current assets to current liabilities greater than 1.5; a ratio of the sum of net income plus depreciation, depletion, and amortization to total liabilities greater than 0.1; a ratio of current assets minus current liabilities to total assets greater than -0.1; and a net profit (revenues minus expenses) greater than 0.	40 CFR 146.85(a)(6)(v)		
An owner or operator who is not able to meet corporate financial test criteria may arrange a corporate guarantee by demonstrating that its corporate parent meets the financial test requirements on its behalf. The parent's demonstration that it meets the financial test requirement is insufficient if it has not also guaranteed to fulfill the obligations for the owner or operator.	40 CFR 146.85(a)(6)(vi)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
An owner or operator may obtain an insurance policy to cover the estimated costs of geologic sequestration activities requiring financial responsibility. This insurance policy must be obtained from a third party provider.	40 CFR 146.85(a)(6)(vii)		
The requirement to maintain adequate financial responsibility and resources is directly enforceable regardless of whether the requirement is a condition of the permit.	40 CFR 146.85(b)		
The owner or operator must maintain financial responsibility and resources until:	40 CFR 146.85(b)(1)		
The Director receives and approves the completed post-injection site care and site closure plan; and	40 CFR 146.85(b)(1)(i)		
The Director approves site closure.	40 CFR 146.85(b)(1)(ii)		
The owner or operator may be released from a financial instrument in the following circumstances:	40 CFR 146.85(b)(2)		
The owner or operator has completed the phase of the geologic sequestration project for which the financial instrument was required and has fulfilled all its financial obligations as determined by the Director, including obtaining financial responsibility for the next phase of the GS project, if required; or	40 CFR 146.85(b)(2)(i)		
The owner or operator has submitted a replacement financial instrument and received written approval from the Director accepting the new financial instrument and releasing the owner or operator from the previous financial instrument.	40 CFR 146.85(b)(2)(ii)		
The owner or operator must have a detailed written estimate, in current dollars, of the cost of performing corrective action on wells in the area of review, plugging the injection well(s), post-injection site care and site closure, and emergency and remedial response.	40 CFR 146.85(c)		
The cost estimate must be performed for each phase separately and must be based on the costs to the regulatory agency of hiring a third party to perform the required activities. A third party is a party who is not within the corporate structure of the owner or operator.	40 CFR 146.85(c)(1)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
During the active life of the geologic sequestration project, the owner or operator must adjust the cost estimate for inflation within 60 days prior to the anniversary date of the establishment of the financial instrument(s) used to comply with paragraph (a) of this section and provide this adjustment to the Director. The owner or operator must also provide to the Director written updates of adjustments to the cost estimate within 60 days of any amendments to the area of review and corrective action plan (40 CFR 146.84), the injection well plugging plan (146.92), the post-injection site care and site closure plan (40 CFR 146.93), and the emergency and remedial response plan (40 CFR 146.94).	40 CFR 146.85(c)(2)		
The Director must approve any decrease or increase to the initial cost estimate. During the active life of the geologic sequestration project, the owner or operator must revise the cost estimate no later than 60 days after the Director has approved the request to modify the area of review and corrective action plan (40 CFR 146.84), the injection well plugging plan (40 CFR 146.92), the post-injection site care and site closure plan (40 CFR 146.93), and the emergency and response plan (40 CFR 146.94), if the change in the plan increases the cost. If the change to the plans decreases the cost, any withdrawal of funds must be approved by the Director. Any decrease to the value of the financial assurance instrument must first be approved by the Director. The revised cost estimate must be adjusted for inflation as specified at paragraph (c)(2) of this section.	40 CFR 146.85(c)(3)		
Whenever the current cost estimate increases to an amount greater than the face amount of a financial instrument currently in use, the owner or operator, within 60 days after the increase, must either cause the face amount to be increased to an amount at least equal to the current cost estimate and submit evidence of such increase to the Director, or obtain other financial responsibility instruments to cover the increase. Whenever the current cost estimate decreases, the face amount of the financial assurance instrument may be reduced to the amount of the current cost estimate only after the owner or operator has received written approval from the Director.	40 CFR 146.85(c)(4)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
The owner or operator must notify the Director by certified mail of adverse financial conditions such as bankruptcy that may affect the ability to carry out injection well plugging and post-injection site care and site closure.	40 CFR 146.85(d)		
In the event that the owner or operator or the third party provider of a financial responsibility instrument is going through a bankruptcy, the owner or operator must notify the Director by certified mail of the commencement of a voluntary or involuntary proceeding under Title 11 (Bankruptcy), U.S. Code, naming the owner or operator as debtor, within 10 days after commencement of the proceeding.	40 CFR 146.85(d)(1)		
A guarantor of a corporate guarantee must make such a notification to the Director if he/she is named as debtor, as required under the terms of the corporate guarantee.	40 CFR 146.85(d)(2)		
An owner or operator who fulfills the requirements of paragraph (a) of this section by obtaining a trust fund, surety bond, letter of credit, escrow account, or insurance policy will be deemed to be without the required financial assurance in the event of bankruptcy of the trustee or issuing institution, or a suspension or revocation of the authority of the trustee institution to act as trustee of the institution issuing the trust fund, surety bond, letter of credit, escrow account, or insurance policy. The owner or operator must establish other financial assurance within 60 days after such an event.	40 CFR 146.85(d)(3)		
The owner or operator must provide an adjustment of the cost estimate to the Director within 60 days of notification by the Director, if the Director determines during the annual evaluation of the qualifying financial responsibility instrument(s) that the most recent demonstration is no longer adequate to cover the cost of corrective action (as required by 40 CFR 146.84), injection well plugging (as required by 40 CFR 146.92), post-injection site care and site closure (as required by 40 CFR 146.93), and emergency and remedial response (as required by 40 CFR 146.94).	40 CFR 146.85(e)		
The Director must approve the use and length of pay-in-periods for trust funds or escrow accounts.	40 CFR 146.85(f)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
40 CFR 146.86 Injection well construction requirements.			
<i>General.</i> The owner or operator must ensure that all Class VI wells are constructed and completed to:	40 CFR 146.86(a)		
Prevent the movement of fluids into or between USDWs or into any unauthorized zones;	40 CFR 146.86(a)(1)		
Permit the use of appropriate testing devices and workover tools; and	40 CFR 146.86(a)(2)		
Permit continuous monitoring of the annulus space between the injection tubing and long string casing.	40 CFR 146.86(a)(3)		
<i>Casing and Cementing of Class VI Wells.</i>	40 CFR 146.86(b)		
Casing and cement or other materials used in the construction of each Class VI well must have sufficient structural strength and be designed for the life of the geologic sequestration project. All well materials must be compatible with fluids with which the materials may be expected to come into contact and must meet or exceed standards developed for such materials by the American Petroleum Institute, ASTM International, or comparable standards acceptable to the Director. The casing and cementing program must be designed to prevent the movement of fluids into or between USDWs. In order to allow the Director to determine and specify casing and cementing requirements, the owner or operator must provide the following information:	40 CFR 146.86(b)(1)		
Depth to the injection zone(s);	40 CFR 146.86(b)(1)(i)		
Injection pressure, external pressure, internal pressure, and axial loading;	40 CFR 146.86(b)(1)(ii)		
Hole size;	40 CFR 146.86(b)(1)(iii)		
Size and grade of all casing strings (wall thickness, external diameter, nominal weight, length, joint specification, and construction material);	40 CFR 146.86(b)(1)(iv)		
Corrosiveness of the carbon dioxide stream and formation fluids;	40 CFR 146.86(b)(1)(v)		
Down-hole temperatures;	40 CFR 146.86(b)(1)(vi)		
Lithology of injection and confining zone(s);	40 CFR 146.86(b)(1)(vii)		
Type or grade of cement and cement additives; and	40 CFR 146.86(b)(1)(viii)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Quantity, chemical composition, and temperature of the carbon dioxide stream.	40 CFR 146.86(b)(1)(ix)		
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.	40 CFR 146.86(b)(2)		
At least one long string casing, using a sufficient number of centralizers, must extend to the injection zone and must be cemented by circulating cement to the surface in one or more stages.	40 CFR 146.86(b)(3)		
Circulation of cement may be accomplished by staging. The Director may approve an alternative method of cementing in cases where the cement cannot be recirculated to the surface, provided the owner or operator can demonstrate by using logs that the cement does not allow fluid movement behind the well bore.	40 CFR 146.86(b)(4)		
Cement and cement additives must be compatible with the carbon dioxide stream and formation fluids and of sufficient quality and quantity to maintain integrity over the design life of the geologic sequestration project. The integrity and location of the cement shall be verified using technology capable of evaluating cement quality radially and identifying the location of channels to ensure that USDWs are not endangered.	40 CFR 146.86(b)(5)		
<i>Tubing and packer.</i>	40 CFR 146.86(c)		
Tubing and packer materials used in the construction of each Class VI well must be compatible with fluids with which the materials may be expected to come into contact and must meet or exceed standards developed for such materials by the American Petroleum Institute, ASTM International, or comparable standards acceptable to the Director.	40 CFR 146.86(c)(1)		
All owners or operators of Class VI wells must inject fluids through tubing with a packer set at a depth opposite a cemented interval at the location approved by the Director.	40 CFR 146.86(c)(2)		
In order for the Director to determine and specify requirements for tubing and packer, the owner or operator must submit the following information:	40 CFR 146.86(c)(3)		
Depth of setting;	40 CFR 146.86(c)(3)(i)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Characteristics of the carbon dioxide stream (chemical content, corrosiveness, temperature, and density) and formation fluids;	40 CFR 146.86(c)(3)(ii)		
Maximum proposed injection pressure;	40 CFR 146.86(c)(3)(iii)		
Maximum proposed annular pressure;	40 CFR 146.86(c)(3)(iv)		
Proposed injection rate (intermittent or continuous) and volume and/or mass of the carbon dioxide stream;	40 CFR 146.86(c)(3)(v)		
Size of tubing and casing; and	40 CFR 146.86(c)(3)(vi)		
Tubing tensile, burst, and collapse strengths.	40 CFR 146.86(c)(3)(vii)		
40 CFR 146.87 Logging, sampling, and testing prior to injection well operation.			
During the drilling and construction of a Class VI injection well, the owner or operator must run appropriate logs, surveys and tests to determine or verify the depth, thickness, porosity, permeability, and lithology of, and the salinity of any formation fluids in all relevant geologic formations to ensure conformance with the injection well construction requirements under 40 CFR 146.86 and to establish accurate baseline data against which future measurements may be compared. The owner or operator must submit to the Director a descriptive report prepared by a knowledgeable log analyst that includes an interpretation of the results of such logs and tests. At a minimum, such logs and tests must include:	40 CFR 146.87(a)		
Deviation checks during drilling on all holes constructed by drilling a pilot hole which is enlarged by reaming or another method. Such checks must be at sufficiently frequent intervals to determine the location of the borehole and to ensure that vertical avenues for fluid movement in the form of diverging holes are not created during drilling; and	40 CFR 146.87(a)(1)		
Before and upon installation of the surface casing:	40 CFR 146.87(a)(2)		
Resistivity, spontaneous potential, and caliper logs before the casing is installed; and	40 CFR 146.87(a)(2)(i)		
A cement bond and variable density log to evaluate cement quality radially, and a temperature log after the casing is set and cemented.	40 CFR 146.87(a)(2)(ii)		
Before and upon installation of the long string casing:	40 CFR 146.87(a)(3)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Resistivity, spontaneous potential, porosity, caliper, gamma ray, fracture finder logs, and any other logs the Director requires for the given geology before the casing is installed; and	40 CFR 146.87(a)(3)(i)		
A cement bond and variable density log, and a temperature log after the casing is set and cemented.	40 CFR 146.87(a)(3)(ii)		
A series of tests designed to demonstrate the internal and external mechanical integrity of injection wells, which may include:	40 CFR 146.87(a)(4)		
A pressure test with liquid or gas;	40 CFR 146.87(a)(4)(i)		
A tracer survey such as oxygen-activation logging;	40 CFR 146.87(a)(4)(ii)		
A temperature or noise log;	40 CFR 146.87(a)(4)(iii)		
A casing inspection log; and	40 CFR 146.87(a)(4)(iv)		
Any alternative methods that provide equivalent or better information and that are required by and/or approved of by the Director.	40 CFR 146.87(a)(5)		
The owner or operator must take whole cores or sidewall cores of the injection zone and confining system and formation fluid samples from the injection zone(s), and must submit to the Director a detailed report prepared by a log analyst that includes: well log analyses (including well logs), core analyses, and formation fluid sample information. The Director may accept information on cores from nearby wells if the owner or operator can demonstrate that core retrieval is not possible and that such cores are representative of conditions at the well. The Director may require the owner or operator to core other formations in the borehole.	40 CFR 146.87(b)		
The owner or operator must record the fluid temperature, pH, conductivity, reservoir pressure, and static fluid level of the injection zone(s).	40 CFR 146.87(c)		
At a minimum, the owner or operator must determine or calculate the following information concerning the injection and confining zone(s):	40 CFR 146.87(d)		
Fracture pressure;	40 CFR 146.87(d)(1)		
Other physical and chemical characteristics of the injection and confining zone(s); and	40 CFR 146.87(d)(2)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Physical and chemical characteristics of the formation fluids in the injection zone(s).	40 CFR 146.87(d)(3)		
Upon completion, but prior to operation, the owner or operator must conduct the following tests to verify hydrogeologic characteristics of the injection zone(s):	40 CFR 146.87(e)		
A pressure fall-off test; and,	40 CFR 146.87(e)(1)		
A pump test; or	40 CFR 146.87(e)(2)		
Injectivity tests.	40 CFR 146.87(e)(3)		
The owner or operator must provide the Director with the opportunity to witness all logging and testing by this subpart. The owner or operator must submit a schedule of such activities to the Director 30 days prior to conducting the first test and submit any changes to the schedule 30 days prior to the next scheduled test.	40 CFR 146.87(f)		
40 CFR 146.88 Injection well operating requirements.			
Except during stimulation, the owner or operator must ensure that injection pressure does not exceed 90 percent of the fracture pressure of the injection zone(s) so as to ensure that the injection does not initiate new fractures or propagate existing fractures in the injection zone(s). In no case may injection pressure initiate fractures in the confining zone(s) or cause the movement of injection or formation fluids that endangers a USDW. Pursuant to requirements at 40 CFR 146.82(a)(9), all stimulation programs must be approved by the Director as part of the permit application and incorporated into the permit.	40 CFR 146.88(a)		
Injection between the outermost casing protecting USDWs and the well bore is prohibited.	40 CFR 146.88(b)		
The owner or operator must fill the annulus between the tubing and the long string casing with a non-corrosive fluid approved by the Director. The owner or operator must maintain on the annulus a pressure that exceeds the operating injection pressure, unless the Director determines that such requirement might harm the integrity of the well or endanger USDWs.	40 CFR 146.88(c)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Other than during periods of well workover (maintenance) approved by the Director in which the sealed tubing-casing annulus is disassembled for maintenance or corrective procedures, the owner or operator must maintain mechanical integrity of the injection well at all times.	40 CFR 146.88(d)		
The owner or operator must install and use:	40 CFR 146.88(e)		
Continuous recording devices to monitor: the injection pressure; the rate, volume and/or mass, and temperature of the carbon dioxide stream; and the pressure on the annulus between the tubing and the long string casing and annulus fluid volume; and	40 CFR 146.88(e)(1)		
Alarms and automatic surface shut-off systems or, at the discretion of the Director, down-hole shut-off systems (e.g., automatic shut-off, check valves) for onshore wells or, other mechanical devices that provide equivalent protection; and	40 CFR 146.88(e)(2)		
Alarms and automatic down-hole shut-off systems for wells located offshore but within State territorial waters, designed to alert the operator and shut-in the well when operating parameters such as annulus pressure, injection rate, or other parameters diverge beyond permitted ranges and/or gradients specified in the permit.	40 CFR 146.88(e)(3)		
If a shutdown (i.e., down-hole or at the surface) is triggered or a loss of mechanical integrity is discovered, the owner or operator must immediately investigate and identify as expeditiously as possible the cause of the shutoff. If, upon such investigation, the well appears to be lacking mechanical integrity, or if monitoring required under paragraph (e) of this section otherwise indicates that the well may be lacking mechanical integrity, the owner or operator must:	40 CFR 146.88(f)		
Immediately cease injection;	40 CFR 146.88(f)(1)		
Take all steps reasonably necessary to determine whether there may have been a release of the injected carbon dioxide stream or formation fluids into any unauthorized zone;	40 CFR 146.88(f)(2)		
Notify the Director within 24 hours;	40 CFR 146.88(f)(3)		
Restore and demonstrate mechanical integrity to the satisfaction of the Director prior to resuming injection; and	40 CFR 146.88(f)(4)		
Notify the Director when injection can be expected to resume.	40 CFR 146.88(f)(5)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
40 CFR 146.89 Mechanical integrity.			
A Class VI well has mechanical integrity if:	40 CFR 146.89(a)		
There is no significant leak in the casing, tubing, or packer; and	40 CFR 146.89(a)(1)		
There is no significant fluid movement into a USDW through channels adjacent to the injection well bore.	40 CFR 146.89(a)(2)		
To evaluate the absence of significant leaks under paragraph (a)(1) of this section, owners or operators must, following an initial annulus pressure test, continuously monitor injection pressure, rate, injected volumes; pressure on the annulus between tubing and long-string casing; and annulus fluid volume as specified in 40 CFR 146.88 (e);	40 CFR 146.89(b)		
At least once per year, the owner or operator must use one of the following methods to determine the absence of significant fluid movement under paragraph (a)(2) of this section:	40 CFR 146.89(c)		
An approved tracer survey such as an oxygen-activation log; or	40 CFR 146.89(c)(1)		
A temperature or noise log.	40 CFR 146.89(c)(2)		
If required by the Director, at a frequency specified in the testing and monitoring plan required at 40 CFR 146.90, the owner or operator must run a casing inspection log to determine the presence or absence of corrosion in the long-string casing.	40 CFR 146.89(d)		
The Director may require any other test to evaluate mechanical integrity under paragraphs (a)(1) or (a)(2) of this section. Also, the Director may allow the use of a test to demonstrate mechanical integrity other than those listed above with the written approval of the Administrator. To obtain approval for a new mechanical integrity test, the Director must submit a written request to the Administrator setting forth the proposed test and all technical data supporting its use. The Administrator may approve the request if he or she determines that it will reliably demonstrate the mechanical integrity of wells for which its use is proposed. Any alternate method approved by the Administrator will be published in the <i>Federal Register</i> and may be used in all States in accordance with applicable State law unless its use is restricted at the time of approval by the Administrator.	40 CFR 146.89(e)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
In conducting and evaluating the tests enumerated in this section or others to be allowed by the Director, the owner or operator and the Director must apply methods and standards generally accepted in the industry. When the owner or operator reports the results of mechanical integrity tests to the Director, he/she shall include a description of the test(s) and the method(s) used. In making his/her evaluation, the Director must review monitoring and other test data submitted since the previous evaluation.	40 CFR 146.89(f)		
The Director may require additional or alternative tests if the results presented by the owner or operator under paragraphs (a) through (d) of this section are not satisfactory to the Director to demonstrate that there is no significant leak in the casing, tubing, or packer, or to demonstrate that there is no significant movement of fluid into a USDW resulting from the injection activity as stated in paragraphs (a)(1) and (2) of this section.	40 CFR 146.89(g)		
40 CFR 146.90 Testing and monitoring requirements.			
The owner or operator of a Class VI well must prepare, maintain, and comply with a testing and monitoring plan to verify that the geologic sequestration project is operating as permitted and is not endangering USDWs. The requirement to maintain and implement an approved plan is directly enforceable regardless of whether the requirement is a condition of the permit. The testing and monitoring plan must be submitted with the permit application, for Director approval, and must include a description of how the owner or operator will meet the requirements of this section, including accessing sites for all necessary monitoring and testing during the life of the project. Testing and monitoring associated with geologic sequestration projects must, at a minimum, include:	40 CFR 146.90		
Analysis of the carbon dioxide stream with sufficient frequency to yield data representative of its chemical and physical characteristics;	40 CFR 146.90(a)		
Installation and use, except during well workovers as defined in 40 CFR 146.88(d), of continuous recording devices to monitor injection pressure, rate, and volume; the pressure on the annulus between the tubing and the long string casing; and the annulus fluid volume added;	40 CFR 146.90(b)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Corrosion monitoring of the well materials for loss of mass, thickness, cracking, pitting, and other signs of corrosion, which must be performed on a quarterly basis to ensure that the well components meet the minimum standards for material strength and performance set forth in 40 CFR 146.86(b), by:	40 CFR 146.90(c)		
Analyzing coupons of the well construction materials placed in contact with the carbon dioxide stream; or	40 CFR 146.90(c)(1)		
Routing the carbon dioxide stream through a loop constructed with the material used in the well and inspecting the materials in the loop; or	40 CFR 146.90(c)(2)		
Using an alternative method approved by the Director;	40 CFR 146.90(c)(3)		
Periodic monitoring of the ground water quality and geochemical changes above the confining zone(s) that may be a result of carbon dioxide movement through the confining zone(s) or additional identified zones including:	40 CFR 146.90(d)		
The location and number of monitoring wells based on specific information about the geologic sequestration project, including injection rate and volume, geology, the presence of artificial penetrations, and other factors; and	40 CFR 146.90(d)(1)		
The monitoring frequency and spatial distribution of monitoring wells based on baseline geochemical data that has been collected under 40 CFR 146.82(a)(6) and on any modeling results in the area of review evaluation required by 40 CFR 146.84(c).	40 CFR 146.90(d)(2)		
A demonstration of external mechanical integrity pursuant to 40 CFR 146.89(c) at least once per year until the injection well is plugged; and, if required by the Director, a casing inspection log pursuant to requirements at 40 CFR 146.89(d) at a frequency established in the testing and monitoring plan;	40 CFR 146.90(e)		
A pressure fall-off test at least once every five years unless more frequent testing is required by the Director based on site-specific information;	40 CFR 146.90(f)		
Testing and monitoring to track the extent of the carbon dioxide plume and the presence or absence of elevated pressure (e.g., the pressure front) by using:	40 CFR 146.90(g)		
Direct methods in the injection zone(s); and,	40 CFR 146.90(g)(1)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Indirect methods (e.g., seismic, electrical, gravity, or electromagnetic surveys and/or down-hole carbon dioxide detection tools), unless the Director determines, based on site-specific geology, that such methods are not appropriate;	40 CFR 146.90(g)(2)		
The Director may require surface air monitoring and/or soil gas monitoring to detect movement of carbon dioxide that could endanger a USDW.	40 CFR 146.90(h)		
Design of Class VI surface air and/or soil gas monitoring must be based on potential risks to USDWs within the area of review;	40 CFR 146.90(h)(1)		
The monitoring frequency and spatial distribution of surface air monitoring and/or soil gas monitoring must be decided using baseline data, and the monitoring plan must describe how the proposed monitoring will yield useful information on the area of review delineation and/or compliance with standards under 40 CFR 144.12;	40 CFR 146.90(h)(2)		
If an owner or operator demonstrates that monitoring employed under 40 CFR 98.440 to 98.449 of this chapter (Clean Air Act, 42 U.S.C. 7401 et seq.) accomplishes the goals of (h)(1) and (2) of this section, and meets the requirements pursuant to 40 CFR 146.91(c)(5), a Director that requires surface air/soil gas monitoring must approve the use of monitoring employed under 98.440 to 98.449 of this chapter. Compliance with 40 CFR 98.440 to 98.449 of this chapter pursuant to this provision is considered a condition of the Class VI permit;	40 CFR 146.90(h)(3)		
Any additional monitoring, as required by the Director, necessary to support, upgrade, and improve computational modeling of the area of review evaluation required under 40 CFR 146.84(c) and to determine compliance with standards under 40 CFR 144.12;	40 CFR 146.90(i)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
The owner or operator shall periodically review the testing and monitoring plan to incorporate monitoring data collected under this subpart, operational data collected under 40 CFR 146.88, and the most recent area of review reevaluation performed under 40 CFR 146.84(e). In no case shall the owner or operator review the testing and monitoring plan less often than once every five years. Based on this review, the owner or operator shall submit an amended testing and monitoring plan or demonstrate to the Director that no amendment to the testing and monitoring plan is needed. Any amendments to the testing and monitoring plan must be approved by the Director, must be incorporated into the permit, and are subject to the permit modification requirements at 40 CFR 144.39 or 144.41, as appropriate. Amended plans or demonstrations shall be submitted to the Director as follows:	40 CFR 146.90(j)		
Within one year of an area of review reevaluation;	40 CFR 146.90(j)(1)		
Following any significant changes to the facility, such as addition of monitoring wells or newly permitted injection wells within the area of review, on a schedule determined by the Director; or	40 CFR 146.90(j)(2)		
When required by the Director.	40 CFR 146.90(j)(3)		
A quality assurance and surveillance plan for all testing and monitoring requirements.	40 CFR 146.90(k)		
40 CFR 146.91 Reporting requirements.			
The owner or operator must, at a minimum, provide, as specified in paragraph (e) of this section, the following reports to the Director, for each permitted Class VI well:	40 CFR 146.91		
Semi-annual reports containing:	40 CFR 146.91(a)		
Any changes to the physical, chemical, and other relevant characteristics of the carbon dioxide stream from the proposed operating data;	40 CFR 146.91(a)(1)		
Monthly average, maximum, and minimum values for injection pressure, flow rate and volume, and annular pressure;	40 CFR 146.91(a)(2)		
A description of any event that exceeds operating parameters for annulus pressure or injection pressure specified in the permit;	40 CFR 146.91(a)(3)		
A description of any event which triggers a shut-off device required pursuant to 40 CFR 146.88(e) and the response taken;	40 CFR 146.91(a)(4)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
The monthly volume and/or mass of the carbon dioxide stream injected over the reporting period and the volume injected cumulatively over the life of the project;	40 CFR 146.91(a)(5)		
Monthly annulus fluid volume added; and	40 CFR 146.91(a)(6)		
The results of monitoring prescribed under 40 CFR 146.90.	40 CFR 146.91(a)(7)		
Report, within 30 days, the results of:	40 CFR 146.91(b)		
Periodic tests of mechanical integrity;	40 CFR 146.91(b)(1)		
Any well workover; and,	40 CFR 146.91(b)(2)		
Any other test of the injection well conducted by the permittee if required by the Director.	40 CFR 146.91(b)(3)		
Report, within 24 hours:	40 CFR 146.91(c)		
Any evidence that the injected carbon dioxide stream or associated pressure front may cause an endangerment to a USDW;	40 CFR 146.91(c)(1)		
Any noncompliance with a permit condition, or malfunction of the injection system, which may cause fluid migration into or between USDWs;	40 CFR 146.91(c)(2)		
Any triggering of a shut-off system (i.e., down-hole or at the surface);	40 CFR 146.91(c)(3)		
Any failure to maintain mechanical integrity; or.	40 CFR 146.91(c)(4)		
Pursuant to compliance with the requirement at 40 CFR 146.90(h) for surface air/soil gas monitoring or other monitoring technologies, if required by the Director, any release of carbon dioxide to the atmosphere or biosphere.	40 CFR 146.91(c)(5)		
Owners or operators must notify the Director in writing 30 days in advance of:	40 CFR 146.91(d)		
Any planned well workover;	40 CFR 146.91(d)(1)		
Any planned stimulation activities, other than stimulation for formation testing conducted under 40 CFR 146.82; and	40 CFR 146.91(d)(2)		
Any other planned test of the injection well conducted by the permittee.	40 CFR 146.91(d)(3)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Regardless of whether a State has primary enforcement responsibility, owners or operators must submit all required reports, submittals, and notifications under subpart H of this part to EPA in an electronic format approved by EPA.	40 CFR 146.91(e)		
Records shall be retained by the owner or operator as follows:	40 CFR 146.91(f)		
All data collected under 40 CFR 146.82 for Class VI permit applications shall be retained throughout the life of the geologic sequestration project and for 10 years following site closure.	40 CFR 146.91(f)(1)		
Data on the nature and composition of all injected fluids collected pursuant to 40 CFR 146.90(a) shall be retained until 10 years after site closure. The Director may require the owner or operator to deliver the records to the Director at the conclusion of the retention period.	40 CFR 146.91(f)(2)		
Monitoring data collected pursuant to 40 CFR 146.90(b) through (i) shall be retained for 10 years after it is collected.	40 CFR 146.91(f)(3)		
Well plugging reports, post-injection site care data, including, if appropriate, data and information used to develop the demonstration of the alternative post-injection site care timeframe, and the site closure report collected pursuant to requirements at 40 CFR 146.93(f) and (h) shall be retained for 10 years following site closure.	40 CFR 146.91(f)(4)		
The Director has authority to require the owner or operator to retain any records required in this subpart for longer than 10 years after site closure.	40 CFR 146.91(f)(5)		
40 CFR 146.92 Injection well plugging.			
Prior to the well plugging, the owner or operator must flush each Class VI injection well with a buffer fluid, determine bottomhole reservoir pressure, and perform a final external mechanical integrity test.	40 CFR 146.92(a)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
<i>Well Plugging Plan.</i> The owner or operator of a Class VI well must prepare, maintain, and comply with a plan that is acceptable to the Director. The requirement to maintain and implement an approved plan is directly enforceable regardless of whether the requirement is a condition of the permit. The well plugging plan must be submitted as part of the permit application and must include the following information:	40 CFR 146.92(b)		
Appropriate tests or measures for determining bottomhole reservoir pressure;	40 CFR 146.92(b)(1)		
Appropriate testing methods to ensure external mechanical integrity as specified in 40 CFR 146.89;	40 CFR 146.92(b)(2)		
The type and number of plugs to be used;	40 CFR 146.92(b)(3)		
The placement of each plug, including the elevation of the top and bottom of each plug;	40 CFR 146.92(b)(4)		
The type, grade, and quantity of material to be used in plugging. The material must be compatible with the carbon dioxide stream; and	40 CFR 146.92(b)(5)		
The method of placement of the plugs.	40 CFR 146.92(b)(6)		
<i>Notice of intent to plug.</i> The owner or operator must notify the Director in writing pursuant to 40 CFR 146.91(e), at least 60 days before plugging of a well. At this time, if any changes have been made to the original well plugging plan, the owner or operator must also provide the revised well plugging plan. The Director may allow for a shorter notice period. Any amendments to the injection well plugging plan must be approved by the Director, must be incorporated into the permit, and are subject to the permit modification requirements at 40 CFR 144.39 or 144.41, as appropriate.	40 CFR 146.92(c)		
<i>Plugging report.</i> Within 60 days after plugging, the owner or operator must submit, pursuant to 40 CFR 146.91(e), a plugging report to the Director. The report must be certified as accurate by the owner or operator and by the person who performed the plugging operation (if other than the owner or operator.) The owner or operator shall retain the well plugging report for 10 years following site closure.	40 CFR 146.92(d)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
40 CFR 146.93 Post-injection site care and site closure.			
The owner or operator of a Class VI well must prepare, maintain, and comply with a plan for post-injection site care and site closure that meets the requirements of paragraph (a)(2) of this section and is acceptable to the Director. The requirement to maintain and implement an approved plan is directly enforceable regardless of whether the requirement is a condition of the permit.	40 CFR 146.93(a)		
The owner or operator must submit the post-injection site care and site closure plan as a part of the permit application to be approved by the Director.	40 CFR 146.93(a)(1)		
The post-injection site care and site closure plan must include the following information:	40 CFR 146.93(a)(2)		
The pressure differential between pre-injection and predicted post-injection pressures in the injection zone(s);	40 CFR 146.93(a)(2)(i)		
The predicted position of the carbon dioxide plume and associated pressure front at site closure as demonstrated in the area of review evaluation required under 40 CFR 146.84(c)(1);	40 CFR 146.93(a)(2)(ii)		
A description of post-injection monitoring location, methods, and proposed frequency;	40 CFR 146.93(a)(2)(iii)		
A proposed schedule for submitting post-injection site care monitoring results to the Director pursuant to 40 CFR 146.91(e); and,	40 CFR 146.93(a)(2)(iv)		
The duration of the post-injection site care timeframe and, if approved by the Director, the demonstration of the alternative post-injection site care timeframe that ensures non-endangerment of USDWs.	40 CFR 146.93(a)(2)(v)		
Upon cessation of injection, owners or operators of Class VI wells must either submit an amended post-injection site care and site closure plan or demonstrate to the Director through monitoring data and modeling results that no amendment to the plan is needed. Any amendments to the post-injection site care and site closure plan must be approved by the Director, be incorporated into the permit, and are subject to the permit modification requirements at 40 CFR 144.39 or 144.41, as appropriate.	40 CFR 146.93(a)(3)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
At any time during the life of the geologic sequestration project, the owner or operator may modify and resubmit the post-injection site care and site closure plan for the Director's approval within 30 days of such change.	40 CFR 146.93(a)(4)		
The owner or operator shall monitor the site following the cessation of injection to show the position of the carbon dioxide plume and pressure front and demonstrate that USDWs are not being endangered.	40 CFR 146.93(b)		
Following the cessation of injection, the owner or operator shall continue to conduct monitoring as specified in the Director-approved post-injection site care and site closure plan for at least 50 years or for the duration of the alternative timeframe approved by the Director pursuant to requirements in paragraph (c) of this section, unless he/she makes a demonstration under (b)(2) of this section. The monitoring must continue until the geologic sequestration project no longer poses an endangerment to USDWs and the demonstration under (b)(2) of this section is submitted and approved by the Director.	40 CFR 146.93(b)(1)		
If the owner or operator can demonstrate to the satisfaction of the Director before 50 years or prior to the end of the approved alternative timeframe based on monitoring and other site-specific data, that the geologic sequestration project no longer poses an endangerment to USDWs, the Director may approve an amendment to the post-injection site care and site closure plan to reduce the frequency of monitoring or may authorize site closure before the end of the 50-year period or prior to the end of the approved alternative timeframe, where he or she has substantial evidence that the geologic sequestration project no longer poses a risk of endangerment to USDWs.	40 CFR 146.93(b)(2)		
Prior to authorization for site closure, the owner or operator must submit to the Director for review and approval a demonstration, based on monitoring and other site-specific data, that no additional monitoring is needed to ensure that the geologic sequestration project does not pose an endangerment to USDWs.	40 CFR 146.93(b)(3)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
If the demonstration in paragraph (b)(3) of this section cannot be made (i.e., additional monitoring is needed to ensure that the geologic sequestration project does not pose an endangerment to USDWs) at the end of the 50-year period or at the end of the approved alternative timeframe, or if the Director does not approve the demonstration, the owner or operator must submit to the Director a plan to continue post-injection site care until a demonstration can be made and approved by the Director.	40 CFR 146.93(b)(4)		
<i>Demonstration of alternative post-injection site care timeframe.</i> At the Director's discretion, the Director may approve, in consultation with EPA, an alternative post-injection site care timeframe other than the 50 year default, if an owner or operator can demonstrate during the permitting process that an alternative post-injection site care timeframe is appropriate and ensures non-endangerment of USDWs. The demonstration must be based on significant, site-specific data and information including all data and information collected pursuant to 40 CFR 146.82 and 146.83, and must contain substantial evidence that the geologic sequestration project will no longer pose a risk of endangerment to USDWs at the end of the alternative post-injection site care timeframe.	40 CFR 146.93(c)		
A demonstration of an alternative post-injection site care timeframe must include consideration and documentation of:	40 CFR 146.93(c)(1)		
The results of computational modeling performed pursuant to delineation of the area of review under 40 CFR 146.84;	40 CFR 146.93(c)(1)(i)		
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; and/or the timeframe for pressure decline to pre-injection pressures;	40 CFR 146.93(c)(1)(ii)		
The predicted rate of carbon dioxide plume migration within the injection zone, and the predicted timeframe for the cessation of migration;	40 CFR 146.93(c)(1)(iii)		
A description of the site-specific processes that will result in carbon dioxide trapping including immobilization by capillary trapping, dissolution, and mineralization at the site;	40 CFR 146.93(c)(1)(iv)		
The predicted rate of carbon dioxide trapping in the immobile capillary phase, dissolved phase, and/or mineral phase;	40 CFR 146.93(c)(1)(v)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
The results of laboratory analyses, research studies, and/or field or site-specific studies to verify the information required in paragraphs (iv) and (v) of this section;	40 CFR 146.93(c)(1)(vi)		
A characterization of the confining zone(s) including a demonstration that it is free of transmissive faults, fractures, and micro-fractures and of appropriate thickness, permeability, and integrity to impede fluid (e.g., carbon dioxide, formation fluids) movement;	40 CFR 146.93(c)(1)(vii)		
The presence of potential conduits for fluid movement including planned injection wells and project monitoring wells associated with the proposed geologic sequestration project or any other projects in proximity to the predicted/modeled, final extent of the carbon dioxide plume and area of elevated pressure;	40 CFR 146.93(c)(1)(viii)		
A description of the well construction and an assessment of the quality of plugs of all abandoned wells within the area of review;	40 CFR 146.93(c)(1)(ix)		
The distance between the injection zone and the nearest USDWs above and/or below the injection zone; and	40 CFR 146.93(c)(1)(x)		
Any additional site-specific factors required by the Director.	40 CFR 146.93(c)(1)(xi)		
Information submitted to support the demonstration in paragraph (c)(1) of this section must meet the following criteria:	40 CFR 146.93(c)(2)		
All analyses and tests performed to support the demonstration must be accurate, reproducible, and performed in accordance with the established quality assurance standards;	40 CFR 146.93(c)(2)(i)		
Estimation techniques must be appropriate and EPA-certified test protocols must be used where available;	40 CFR 146.93(c)(2)(ii)		
Predictive models must be appropriate and tailored to the site conditions, composition of the carbon dioxide stream and injection and site conditions over the life of the geologic sequestration project;	40 CFR 146.93(c)(2)(iii)		
Predictive models must be calibrated using existing information (e.g., at Class I, Class II, or Class V experimental technology well sites) where sufficient data are available;	40 CFR 146.93(c)(2)(iv)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Reasonably conservative values and modeling assumptions must be used and disclosed to the Director whenever values are estimated on the basis of known, historical information instead of site-specific measurements;	40 CFR 146.93(c)(2)(v)		
An analysis must be performed to identify and assess aspects of the alternative post-injection site care timeframe demonstration that contribute significantly to uncertainty. The owner or operator must conduct sensitivity analyses to determine the effect that significant uncertainty may contribute to the modeling demonstration.	40 CFR 146.93(c)(2)(vi)		
An approved quality assurance and quality control plan must address all aspects of the demonstration; and,	40 CFR 146.93(c)(2)(vii)		
Any additional criteria required by the Director.	40 CFR 146.93(c)(2)(viii)		
<i>Notice of intent for site closure.</i> The owner or operator must notify the Director in writing at least 120 days before site closure. At this time, if any changes have been made to the original post-injection site care and site closure plan, the owner or operator must also provide the revised plan. The Director may allow for a shorter notice period.	40 CFR 146.93(d)		
After the Director has authorized site closure, the owner or operator must plug all monitoring wells in a manner which will not allow movement of injection or formation fluids that endangers a USDW.	40 CFR 146.93(e)		
The owner or operator must submit a site closure report to the Director within 90 days of site closure, which must thereafter be retained at a location designated by the Director for 10 years. The report must include:	40 CFR 146.93(f)		
Documentation of appropriate injection and monitoring well plugging as specified in 40 CFR 146.92 and paragraph (e) of this section. The owner or operator must provide a copy of a survey plat which has been submitted to the local zoning authority designated by the Director. The plat must indicate the location of the injection well relative to permanently surveyed benchmarks. The owner or operator must also submit a copy of the plat to the Regional Administrator of the appropriate EPA Regional Office;	40 CFR 146.93(f)(1)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Documentation of appropriate notification and information to such State, local and Tribal authorities that have authority over drilling activities to enable such State, local, and Tribal authorities to impose appropriate conditions on subsequent drilling activities that may penetrate the injection and confining zone(s); and	40 CFR 146.93(f)(2)		
Records reflecting the nature, composition, and volume of the carbon dioxide stream.	40 CFR 146.93(f)(3)		
Each owner or operator of a Class VI injection well must record a notation on the deed to the facility property or any other document that is normally examined during title search that will in perpetuity provide any potential purchaser of the property the following information:	40 CFR 146.93(g)		
The fact that land has been used to sequester carbon dioxide;	40 CFR 146.93(g)(1)		
The name of the State agency, local authority, and/or Tribe with which the survey plat was filed, as well as the address of the Environmental Protection Agency Regional Office to which it was submitted; and	40 CFR 146.93(g)(2)		
The volume of fluid injected, the injection zone or zones into which it was injected, and the period over which injection occurred.	40 CFR 146.93(g)(3)		
The owner or operator must retain for 10 years following site closure, records collected during the post-injection site care period. The owner or operator must deliver the records to the Director at the conclusion of the retention period, and the records must thereafter be retained at a location designated by the Director for that purpose.	40 CFR 146.93(h)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
40 CFR 146.94 Emergency and remedial response.			
As part of the permit application, the owner or operator must provide the Director with an emergency and remedial response plan that describes actions the owner or operator must take to address movement of the injection or formation fluids that may cause an endangerment to a USDW during construction, operation, and post-injection site care periods. The requirement to maintain and implement an approved plan is directly enforceable regardless of whether the requirement is a condition of the permit.	40 CFR 146.94(a)		
If the owner or operator obtains evidence that the injected carbon dioxide stream and associated pressure front may cause an endangerment to a USDW, the owner or operator must:	40 CFR 146.94(b)		
Immediately cease injection;	40 CFR 146.94(b)(1)		
Take all steps reasonably necessary to identify and characterize any release;	40 CFR 146.94(b)(2)		
Notify the Director within 24 hours; and	40 CFR 146.94(b)(3)		
Implement the emergency and remedial response plan approved by the Director.	40 CFR 146.94(b)(4)		
The Director may allow the operator to resume injection prior to remediation if the owner or operator demonstrates that the injection operation will not endanger USDWs.	40 CFR 146.94(c)		
The owner or operator shall periodically review the emergency and remedial response plan developed under paragraph (a) of this section. In no case shall the owner or operator review the emergency and remedial response plan less often than once every five years. Based on this review, the owner or operator shall submit an amended emergency and remedial response plan or demonstrate to the Director that no amendment to the emergency and remedial response plan is needed. Any amendments to the emergency and remedial response plan must be approved by the Director, must be incorporated into the permit, and are subject to the permit modification requirements at 40 CFR 144.39 or 144.41, as appropriate. Amended plans or demonstrations shall be submitted to the Director as follows:	40 CFR 146.94(d)		
Within one year of an area of review reevaluation;	40 CFR 146.94(d)(1)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Following any significant changes to the facility, such as addition of injection or monitoring wells, on a schedule determined by the Director; or	40 CFR 146.94(d)(2)		
When required by the Director.	40 CFR 146.94(d)(3)		
40 CFR 146.95 Class VI injection depth waiver requirements.			
This section sets forth information which an owner or operator seeking a waiver of the Class VI injection depth requirements must submit to the Director; information the Director must consider in consultation with all affected Public Water System Supervision Directors; the procedure for Director – Regional Administrator communication and waiver issuance; and the additional requirements that apply to owners or operators of Class VI wells granted a waiver of the injection depth requirements.	40 CFR 146.95		
In seeking a waiver of the requirement to inject below the lowermost USDW, the owner or operator must submit a supplemental report concurrent with permit application. The supplemental report must include the following,	40 CFR 146.95(a)		
A demonstration that the injection zone(s) is/are laterally continuous, is not a USDW, and is not hydraulically connected to USDWs; does not outcrop; has adequate injectivity, volume, and sufficient porosity to safely contain the injected carbon dioxide and formation fluids; and has appropriate geochemistry.	40 CFR 146.95(a)(1)		
A demonstration that the injection zone(s) is/are bounded by laterally continuous, impermeable confining units above and below the injection zone(s) adequate to prevent fluid movement and pressure buildup outside of the injection zone(s); and that the confining unit(s) is/are free of transmissive faults and fractures. The report shall further characterize the regional fracture properties and contain a demonstration that such fractures will not interfere with injection, serve as conduits, or endanger USDWs.	40 CFR 146.95(a)(2)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
A demonstration, using computational modeling, that USDWs above and below the injection zone will not be endangered as a result of fluid movement. This modeling should be conducted in conjunction with the area of review determination, as described in 40 CFR 146.84, and is subject to requirements, as described in 40 CFR 146.84(c), and periodic reevaluation, as described in 40 CFR 146.84(e).	40 CFR 146.95(a)(3)		
A demonstration that well design and construction, in conjunction with the waiver, will ensure isolation of the injectate in lieu of requirements at 146.86(a)(1) and will meet well construction requirements in paragraph (f) of this section.	40 CFR 146.95(a)(4)		
A description of how the monitoring and testing and any additional plans will be tailored to the geologic sequestration project to ensure protection of USDWs above and below the injection zone(s), if a waiver is granted.	40 CFR 146.95(a)(5)		
Information on the location of all the public water supplies affected, reasonably likely to be affected, or served by USDWs in the area of review.	40 CFR 146.95(a)(6)		
Any other information requested by the Director to inform the Regional Administrator's decision to issue a waiver.	40 CFR 146.95(a)(7)		
To inform the Regional Administrator's decision on whether to grant a waiver of the injection depth requirements at 40 CFR 144.6, 146.5(f), and 146.86(a)(1), the Director must submit, to the Regional Administrator, documentation of the following:	40 CFR 146.95(b)		
An evaluation of the following information as it relates to siting, construction, and operation of a geologic sequestration project with a waiver:	40 CFR 146.95(b)(1)		
The integrity of the upper and lower confining units;	40 CFR 146.95(b)(1)(i)		
The suitability of the injection zone(s) (e.g., lateral continuity; lack of transmissive faults and fractures; knowledge of current or planned artificial penetrations into the injection zone(s) or formations below the injection zone);	40 CFR 146.95(b)(1)(ii)		
The potential capacity of the geologic formation(s) to sequester carbon dioxide, accounting for the availability of alternative injection sites;	40 CFR 146.95(b)(1)(iii)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
All other site characterization data, the proposed emergency and remedial response plan, and a demonstration of financial responsibility;	40 CFR 146.95(b)(1)(iv)		
Community needs, demands, and supply from drinking water resources;	40 CFR 146.95(b)(1)(v)		
Planned needs, potential and/or future use of USDWs and non-USDWs in the area;	40 CFR 146.95(b)(1)(vi)		
Planned or permitted water, hydrocarbon, or mineral resource exploitation potential of the proposed injection formation(s) and other formations both above and below the injection zone to determine if there are any plans to drill through the formation to access resources in or beneath the proposed injection zone(s)/formation(s);	40 CFR 146.95(b)(1)(vii)		
The proposed plan for securing alternative resources or treating USDW formation waters in the event of contamination related to the Class VI injection activity; and,	40 CFR 146.95(b)(1)(viii)		
Any other applicable considerations or information requested by the Director.	40 CFR 146.95(b)(1)(ix)		
Consultation with the Public Water System Supervision Directors of all States and Tribes having jurisdiction over lands within the area of review of a well for which a waiver is sought.	40 CFR 146.95(b)(2)		
Any written waiver-related information submitted by the Public Water System Supervision Director(s) to the (UIC) Director.	40 CFR 146.95(b)(3)		
Pursuant to requirements at 40 CFR 124.10 of this chapter and concurrent with the Class VI permit application notice process, the Director shall give public notice that a waiver application has been submitted. The notice shall clearly state:	40 CFR 146.95(c)		
The depth of the proposed injection zone(s);	40 CFR 146.95(c)(1)		
The location of the injection well(s);	40 CFR 146.95(c)(2)		
The name and depth of all USDWs within the area of review;	40 CFR 146.95(c)(3)		
A map of the area of review;	40 CFR 146.95(c)(4)		
The names of any public water supplies affected, reasonably likely to be affected, or served by USDWs in the area of review; and,	40 CFR 146.95(c)(5)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
The results of UIC-Public Water System Supervision consultation required under paragraph (b)(2) of this section.	40 CFR 146.95(c)(6)		
Following public notice, the Director shall provide all information received through the waiver application process to the Regional Administrator. Based on the information provided, the Regional Administrator shall provide written concurrence or non-concurrence regarding waiver issuance.	40 CFR 146.95(d)		
If the Regional Administrator determines that additional information is required to support a decision, the Director shall provide the information. At his or her discretion, the Regional Administrator may require that public notice of the new information be initiated.	40 CFR 146.95(d)(1)		
In no case shall a Director of a State-approved program issue a waiver without receipt of written concurrence from the Regional Administrator.	40 CFR 146.95(d)(2)		
If a waiver is issued, within 30 days of waiver issuance, EPA shall post the following information on the Office of Water's Web site:	40 CFR 146.95(e)		
The depth of the proposed injection zone(s);	40 CFR 146.95(e)(1)		
The location of the injection well(s);	40 CFR 146.95(e)(2)		
The name and depth of all USDWs within the area of review;	40 CFR 146.95(e)(3)		
A map of the area of review;	40 CFR 146.95(e)(4)		
The names of any public water supplies affected, reasonably likely to be affected, or served by USDWs in the area of review; and	40 CFR 146.95(e)(5)		
The date of waiver issuance.	40 CFR 146.95(e)(6)		
Upon receipt of a waiver of the requirement to inject below the lowermost USDW for geologic sequestration, the owner or operator of the Class VI well must comply with:	40 CFR 146.95(f)		
All requirements at 40 CFR 146.84, 146.85, 146.87, 146.88, 146.89, 146.91, 146.92, and 146.94;	40 CFR 146.95(f)(1)		
All requirements at 40 CFR 146.86 with the following modified requirements:	40 CFR 146.95(f)(2)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
The owner or operator must ensure that Class VI wells with a waiver are constructed and completed to prevent movement of fluids into any unauthorized zones including USDWs, in lieu of requirements at 40 CFR 146.86(a)(1).	40 CFR 146.95(f)(2)(i)		
The casing and cementing program must be designed to prevent the movement of fluids into any unauthorized zones including USDWs in lieu of requirements at 40 CFR 146.86(b)(1).	40 CFR 146.95(f)(2)(ii)		
The surface casing must extend through the base of the nearest USDW directly above the injection zone and be cemented to the surface; or, at the Director's discretion, another formation above the injection zone and below the nearest USDW above the injection zone.	40 CFR 146.95(f)(2)(iii)		
All requirements at 40 CFR 146.90 with the following modified requirements:	40 CFR 146.95(f)(3)		
The owner or operator shall monitor the groundwater quality, geochemical changes, and pressure in the first USDWs immediately above and below the injection zone(s); and in any other formations at the discretion of the Director.	40 CFR 146.95(f)(3)(i)		
Testing and monitoring to track the extent of the carbon dioxide plume and the presence or absence of elevated pressure (e.g., the pressure front) by using direct methods to monitor for pressure changes in the injection zone(s); and, indirect methods (e.g., seismic, electrical, gravity, or electromagnetic surveys and/or down-hole carbon dioxide detection tools), unless the Director determines, based on site-specific geology, that such methods are not appropriate.	40 CFR 146.95(f)(3)(ii)		
All requirements at 40 CFR 146.93 with the following, modified post-injection site care monitoring requirements:	40 CFR 146.95(f)(4)		
The owner or operator shall monitor the groundwater quality, geochemical changes and pressure in the first USDWs immediately above and below the injection zone; and in any other formations at the discretion of the Director.	40 CFR 146.95(f)(4)(i)		

Federal Requirement	Federal Citation	State Citation (document title, page number, section/paragraph)	Different From Federal Requirement? (explain on separate sheet)
Testing and monitoring to track the extent of the carbon dioxide plume and the presence or absence of elevated pressure (e.g., the pressure front) by using direct methods in the injection zone(s); and indirect methods (e.g., seismic, electrical, gravity, or electromagnetic surveys and/or down-hole carbon dioxide detection tools), unless the Director determines based on site-specific geology, that such methods are not appropriate;	40 CFR 146.95(f)(4)(ii)		
Any additional requirements requested by the Director designed to ensure protection of USDWs above and below the injection zone(s).	40 CFR 146.95(f)(5)		
40 CFR PART 147--STATE, TRIBAL, AND EPA-ADMINISTERED UNDERGROUND INJECTION CONTROL PROGRAMS			
SUBPART A--GENERAL PROVISIONS			
40 CFR 147.1 Purpose and scope.			
Class VI well owners or operators must comply with 40 CFR 146.91(e) notwithstanding any State program approvals.	40 CFR 147.1(f)		

Appendix B

Class VI Primacy Application Checklist for Both New UIC Programs and UIC Program Revision Applications

Class VI Primacy Application Checklist for Both New UIC Programs and UIC Program Revision Applications

The following Primacy Application Checklist is intended to aid states in ensuring that they have assembled all the necessary documentation for a primacy program application. While it includes the required elements of a primacy program application, it is not a comprehensive list. Therefore, states should refer to 40 CFR 145 Subpart B (“Requirements for State Programs”) and 40 CFR 145 Subpart C (“State Program Submissions”) for additional information. In addition, states submitting a New UIC Program Application should also refer to 40 CFR 124 (“Procedures for Decision-making”) for more information on the primacy and public participation requirements of the UIC Program that have to be met before submitting a New UIC Program Application to EPA. Additional information on primacy application materials and requirements can be found in Section 2 of this manual.

In addition to completing this checklist below, states can also use the Federal/State Regulatory Comparison Crosswalk for a UIC Program Revision Application included in Appendix A, or the Federal/State Regulation Comparison Crosswalk for New UIC Programs (all classes or independent Class VI) to help identify state statutory or regulatory provisions that correspond to each federal requirement. A completed crosswalk will help EPA in reviewing the state application for UIC/Class VI program primacy.

REQUIRED ELEMENTS FOUND IN 40 CFR 145.11 – 145.14 SUBPART B		INCLUDED?
REQUIRED ELEMENTS FOUND IN 40 CFR 145 SUBPART C		INCLUDED?
<i>New SDWA Section 1422 UIC Program Primacy Applications</i>		
A letter from the Governor of the state requesting program approval as required by 40 CFR 145.22(a)(1)		Yes <input type="checkbox"/> No <input type="checkbox"/>
A complete program description as required by 40 CFR 145.23		Yes <input type="checkbox"/> No <input type="checkbox"/>
	A narrative on the scope, structure, coverage, and processes of the state program [40 CFR 145.23(a)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of the organizational structure for the Primacy Agency or agencies [40 CFR 145.23(b)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Description of the responsibilities of each agency and the procedures for coordination if UIC Program is administered by multiple agencies [40 CFR 145.23(b)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Organization charts[40 CFR 145.23(b)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Estimated costs and sources of funding for implementing the program for the first two years [40 CFR 145.23(b)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of permitting, administrative, and judicial review procedures [40 CFR 145.23(c)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Copies of permit, application, reporting, and manifest forms [40 CFR 145.23(d)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of the state’s compliance tracking and enforcement program [40 CFR 145.23(e)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A schedule for issuing permits [40 CFR 145.23(f)(1)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A statement of the state’s priorities for issuing Class VI permits and the number of permits that will be issued [40 CFR 145.23(f)(2)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
A description of how the state will meet the mechanical integrity testing		Yes <input type="checkbox"/> No <input type="checkbox"/>

	requirements [40 CFR 145.23(f)(3)]	
	A description of the state's procedures to notify owners and operators of injection wells of the requirement that they apply for and obtain a permit [40 CFR 145.23(f)(4)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of how the state will establish and maintain a UIC well inventory [40 CFR 145.23(f)(7)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of exempted aquifers, expansions of the areal extent of existing aquifer exemptions for Class II EOR/EGR transitioning to Class VI injection, and a summary of supporting data and the specific locations [40 CFR 145.23(f)(9)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of the state's transboundary notification procedures [40 CFR 145.23(f)(13)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of procedures for documenting interstate consultations [40 CFR 145.23(f)(13)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
An Attorney General's statement as required by 40 CFR 145.24		Yes <input type="checkbox"/> No <input type="checkbox"/>
A Memorandum of Agreement with the EPA Regional Administrator as required by 40 CFR 145.25		Yes <input type="checkbox"/> No <input type="checkbox"/>
Copies of all applicable state statutes and regulations, including those governing State administrative procedures as required by 40 CFR 145.22(a)(5)		Yes <input type="checkbox"/> No <input type="checkbox"/>
The Federal/State Regulation Comparison Crosswalk (request a copy from ClassVIPrimacy@epa.gov)		Yes <input type="checkbox"/> No <input type="checkbox"/>
A demonstration of compliance with public participation requirements as required by 40 CFR 145.22(a)(6) and 145.31(a)-(b)		Yes <input type="checkbox"/> No <input type="checkbox"/>
	State issued public notice of the intent to adopt a UIC Program and seek approval from EPA: circulated statewide by large newspapers, and mailing directly to interested persons	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Notice indicates when and where the State's proposed program submission may be reviewed by the public	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Notice indicates the cost of obtaining a copy of the submission	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Notice provides for a 30-day public comment period	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Notice schedules a public hearing on the state program	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Notice briefly outlines the fundamental aspects of the State UIC Program	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Notice identifies a person that the public can contact for further information	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Copies of all written comments received by the state	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A transcript, recording, or summary of any public hearings	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Responsiveness summary	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Compliance with requirements of 40 CFR 124	Yes <input type="checkbox"/> No <input type="checkbox"/>
<i>SDWA Section 1422 UIC Program Revision Primacy Applications</i>		
A modified program description		Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of the organizational structure for the Primacy Agency [40 CFR 145.23(b)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Description of the responsibilities of each agency and the procedures for coordination if UIC Program is administered by multiple agencies [40 CFR 145.23(b)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Organization charts [40 CFR 145.23(b)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A schedule for issuing permits [40 CFR 145.23(f)(1)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A statement of the state's priorities for issuing Class VI permits and the number of permits that will be issued [40 CFR 145.23(f)(2)]	Yes <input type="checkbox"/> No <input type="checkbox"/>

	A description of how the state will meet the new mechanical integrity testing requirements [40 CFR 145.23(f)(3)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of the state's procedures to notify owners and operators of Class I well previously permitted for geologic sequestration, or any Class V experimental technology wells that are no longer experimental but will continue to inject carbon dioxide for GS, of the requirement that they apply for and obtain a permit [40 CFR 145.23(f)(4)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of exempted aquifers, expansions of the areal extent of existing aquifer exemptions for Class II EOR/EGR transitioning to Class VI injection, and a summary of supporting data and the specific locations. [40 CFR 145.23(f)(9)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of the state's transboundary notification procedures [40 CFR 145.23(f)(13)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A description of procedures for documenting interstate consultations [40 CFR 145.23(f)(13)]	Yes <input type="checkbox"/> No <input type="checkbox"/>
	An updated Attorney General's statement as required by 40 CFR 145.24	Yes <input type="checkbox"/> No <input type="checkbox"/>
	A revised Memorandum of Agreement with the EPA Regional Administrator as required by 40 CFR 145.25	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Copies of all applicable state statutes and regulations, including those governing State administrative procedures as required by 40 CFR 145.25.22(a)(5)	Yes <input type="checkbox"/> No <input type="checkbox"/>
	The Federal/State Regulation Comparison Crosswalk (Appendix A of this Manual)	Yes <input type="checkbox"/> No <input type="checkbox"/>

Appendix C

Example Memorandum of Agreement

MEMORANDUM OF AGREEMENT

Between

Insert Name of State

And

The United States Environmental Protection Agency Region **Insert
Region Number**

I. General

This Memorandum of Agreement (“Agreement”) establishes policies, responsibilities, and procedures pursuant to 40 CFR parts 124, 144, 145, 146, and Section 1421 of the Safe Drinking Water Act (“SDWA” or “the Act”) for **Insert Name of State** Underground Injection Control Program (“state program”) as authorized by Part C of SDWA (P.L. 93-523 as amended; 42 U.S.C. 300f *et seq.*).

This Agreement is entered into by **Insert Name of State** and signed by **Insert Name of State Signer** of **Insert Name of State Agency** (*e.g. Department of Environmental Protection*), (hereafter, “the state” or “the Department”) with the United States Environmental Protection Agency, Region **Insert Region Number**, and signed by **Insert Name of Regional Administrator**, Regional Administrator (hereafter, “EPA” or “Regional Administrator”). This Agreement shall become effective when approved by the Regional Administrator.

A. Lead Agency Responsibilities

The lead agency, **Insert Name of State Agency** that receives the annual program grant, as designated by the Governor of the state, is also the lead agency to coordinate the state program. This lead agency shall coordinate the state program to facilitate communication between the EPA and the state agencies having program responsibilities. These responsibilities shall include, but not be limited to, the submission of grant applications, reporting and monitoring results, and annual report requirements. The Department is responsible for and has authority over all Class **Insert All Applicable Well Classes** injection wells.

B. Review and Modifications

This Agreement shall be reviewed annually as part of the annual program grant and State/EPA Agreement (“SEA”) process. The annual program grant and the SEA shall be consistent with this Agreement and may not override this Agreement.

This Agreement may be modified upon the initiative of the state or the EPA. Modifications must be in writing and must be signed by the Department and the Regional Administrator. Modifications become effective when signed by both parties. Modifications may be made by revision prior to the effective date of this Agreement or subsequently by addenda attached to this Agreement and consecutively numbered, signed, and dated.

C. Conformance with Laws and Regulations

The Department shall administer the Underground Injection Control (UIC) program consistent with the state’s submission for program approval, this MOA, SDWA, current federal policies and regulations, promulgated minimum requirements, priorities established as part of the annually approved state UIC grant, state and federal law, and any separate working agreements which shall be entered into with the Regional Administrator as necessary for the full administration of the UIC program.

D. Responsibilities of Parties

Each of the parties has responsibilities to assure that the UIC requirements are met. The parties agree to maintain a high level of cooperation and coordination between state and EPA staffs in a partnership to assure successful and effective administration of the UIC program. In this partnership, the Regional Administrator will provide to the Department necessary technical and policy assistance on program matters.

The Regional Administrator is responsible for keeping the Department apprised, in a timely manner, of the meaning and content of the federal guidelines, technical standards, regulations, policy decisions, directives, and any other factors which affect the UIC program.

The strategies and priorities for issuance, compliance, monitoring and enforcement of permits, and implementation of technical requirements shall be established in the state's program description, the annual SEA, or in subsequent working agreements. If requested by either party, meetings will be scheduled at reasonable intervals between the state and EPA to review specific operating procedures, resolve problems, or discuss mutual concerns involving the administration of the UIC program.

E. Sharing of Information

The Department shall promptly inform EPA of any proposed, pending, or enacted modifications to laws, regulations, or guidelines, and any judicial decisions or administrative actions, which might affect the state program and the state's authority to administer the program. The Department shall promptly inform EPA of any resource allocation changes (for example, personnel budget, equipment, etc.) which might affect the state's ability to administer the program.

Any information obtained or used by the state under its UIC program shall be available to EPA upon request without restriction. If the information has been submitted to the state under a claim of confidentiality, the state must submit that claim to EPA when providing EPA such information. Any information obtained from a state and subject to a claim of confidentiality will be treated in accordance with 40 CFR Part 2. If EPA obtains information from the state that is not claimed to be confidential, EPA may make that information available to the public without further notice.

EPA shall furnish the state the information in its files not submitted under a claim of confidentiality which the states needs to implement its approved program. EPA shall furnish to states information submitted to EPA under a claim of confidentiality which the state needs to implement its approved program subject to conditions in 40 CFR Part 2.

F. Duty to Revise Program

As stated in 40 CFR 145.32(e), within 270 days of any amendment to any regulation promulgated at 40 CFR 124, 144, 145 or 146 revising or adding any requirement respecting state UIC programs, the state shall submit notice to EPA showing that the state program meets the revised or added requirements.

G. Duration of MOA

This Agreement will remain in effect until such time as state primacy enforcement responsibility is returned to EPA by the state, or withdrawn by EPA, according to the provisions of 40 CFR Part 145.31.

H. General Provisions

Nothing in this Agreement is intended to affect any UIC or program requirement, including any standards or prohibitions established by state or local law, as long as the state or local requirements are no less stringent than or are deemed equally protective as: (1) any set forth in the UIC regulations; or (2) other requirements or prohibitions established under SDWA or applicable regulations.

Nothing in this Agreement shall be construed to limit the authority of the EPA to take action pursuant to Sections 1421, 1422, 1424, 1425, 1426, 1431 or other sections of SDWA.

II. Compliance Monitoring

A. General

The state shall operate a timely and effective compliance monitoring system to track compliance with program requirements. For purposes of this Agreement, the terms “compliance monitoring” or “compliance evaluation” shall refer to all efforts associated with determining compliance with UIC program requirements.

B. Compliance Schedule

The state agrees to maintain procedures to receive, evaluate, retain, and investigate all notices and reports that are required by program regulations. These procedures shall also include the necessary elements to investigate the failure of persons required to submit such notices and reports. The state shall initiate appropriate compliance actions when required information is not received or when the reports are not submitted.

C. Review of Compliance Reports

The state shall conduct a timely and substantive review of all such reports to determine compliance status. The state shall operate a tracking system to determine if: (1) the reports required by program regulations are submitted; (2) the submitted reports are complete and accurate; and (3) the program requirements are met. The reports and notices shall be evaluated for compliance status in accordance with the state compliance program and the program requirements.

D. Inspection and Surveillance

The Department agrees to have inspection and surveillance procedures to determine compliance or noncompliance with the applicable requirements of the UIC program. Survey or other methods of surveillance shall be utilized to identify persons who have not complied with program requirements. Any compilations, index, or inventory obtained for such facilities or activities shall be made available to the Regional Administrator upon request.

The Department shall conduct inspections of the facilities and activities subject to regulatory requirements. These compliance monitoring inspections shall be performed to assess compliance with all UIC program requirements and include selecting and evaluating a facility’s monitoring and reporting program. These inspections shall be conducted to determine compliance or noncompliance, verify the accuracy of information submitted in reporting forms and monitoring data, and to verify the adequacy of sampling, monitoring, and other methods to provide the information.

E. Authority to Enter

The Department (and other state designees) engaged in compliance monitoring and evaluation shall have the authority to enter any site or premises subject to regulation or to review and copy the records of relevant program operations where such records are kept.

F. Admissibility

Any investigatory inspections shall be conducted and samples and other information collected in a manner to provide evidence admissible in an enforcement proceeding or in court.

III. Enforcement

A. General

The state is responsible for taking timely and appropriate enforcement action against persons in violation of program requirements, compliance schedules, technical requirements, and other UIC program requirements. This includes violations detected by state or federal inspections.

Failure by the state to initiate appropriate enforcement action against a substantive violation may be the basis for EPA's determination that the state has failed to take timely enforcement action.

B. Enforcement Mechanisms

The state shall have the mechanism to restrain immediately and effectively any person engaging in any unauthorized activity or operation, which is endangering or causing damage to public health or the environment as applicable to the program requirements. The state agency administering the program shall also have the means to sue in courts of competent jurisdiction to prohibit any threatened or continuing violation of any program requirement. Additionally, the state agency administering the program shall have the mechanism to access or sue to recover in court civil penalties and criminal remedies as established in 40 CFR 145.13.

C. EPA Enforcement

Nothing in this Agreement shall affect EPA's authority or responsibility to take enforcement actions under Sections 1423 and 1431 of SDWA.

When the states has a fully approved program, the EPA will not take enforcement actions without providing prior notice to the state and otherwise complying with sections 1423 and 1431 of SDWA.

D. Assessment of Fines

The state shall agree to assess civil penalties in amounts appropriate to the violation as required in Section 145.13(c) of the regulations.

IV. EPA Oversight

A. General

EPA shall oversee the state's administration of the UIC program on a continuing basis to assure that such administration is consistent with this MOA, the state UIC grant application, and all applicable requirements embodied in current regulations, policies, and federal law.

In addition to the specific oversight activities listed in this section, EPA may from time to time request specific information, and the state shall submit and provide access to files necessary for evaluating the Department's administration of the UIC program.

B. Immediate Reporting on Noncompliance

The Department shall immediately notify the Regional Administrator by telephone, or otherwise, of any major, imminent hazard to public health resulting from the endangerment of an underground source of drinking water of the state by well injection.

C. Program Reports

The state shall submit program reports to the Regional Administrator in accordance with Section 144.8. The reports are to be submitted quarterly using the specified 7520 reporting forms and include a narrative.

D. Inspection and Surveillance by EPA

The Regional Administrator may select facilities and activities within the state for EPA inspection.

EPA may conduct such inspections jointly with the state. The Department shall give the Regional Administrator adequate notice to participate in any compliance evaluation inspection scheduled by the state.

The Regional Administrator may also choose to conduct inspections independently of the state's schedule. In such cases, the EPA shall notify the state as least seven (7) days before any inspection that EPA determines to be necessary. However, if an emergency exists, or for some reason it is impossible to give advance notification, the Regional Administrator may waive advance notification to inspect a facility. In keeping with Section 1445(b)(2) of SDWA, the state understands not to inform the person whose property is to be entered of the pending inspection.

E. Annual Performance Evaluation

EPA shall conduct, at least annually, performance evaluations of the state program using program reports and other requested information to determine state program consistency with the program submission, SDWA applicable regulations, and applicable guidance and policies. The review will not only include a review of financial expenditures but reviews on progress towards program implementation, changes in the program description, and efforts towards progress on program elements.

EPA shall submit a summary of the evaluation findings to the state outlining the deficiencies in program performance and recommendations for improving state operations. The report also might provide guidance for the development of an upcoming grant application. The state shall have 15 working days from the date of receipt to concur with or comment on the findings and recommendations.

V. Signatures

Insert Name of State Agency

By _____

Insert Name of State Signer

Insert Title of State Signer

Date _____

U.S. Environmental Protection Agency, Region Insert Region Number

By _____

Insert Name of Regional Administrator

Regional Administrator

Date _____

Appendix D

Example Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING

Between

Insert Name of Agency/Department

And

Insert Name of Agency/Department

I. PURPOSE

This Memorandum of Understanding provides an operating agreement by which **Insert Name of Agency/Department** and **Insert Name of Agency/Department** shall execute their respective responsibilities concerning regulation of Underground Injection Control (UIC) Class VI wells in the **state/Commonwealth** of **Insert Name of State**.

II. BACKGROUND

On December 10, 2010, the United States Environmental Protection Agency published the UIC Geologic Sequestration Class VI Rule (75 FR 77230) under the authority of the Safe Drinking Water Act (SDWA). The Rule defines a new class of injection well, Class VI, used for geologic sequestration of carbon dioxide beneath the lowermost formation containing an underground source of drinking water (USDW).

Currently, **Insert Name of Agency/Department** is the designated regulatory authority in the **state/Commonwealth** of **Insert Name of State** responsible for **Insert Agency/Department's current regulatory responsibility for UIC** (e.g., protection of underground sources of drinking water through the regulation of Class I, II, IV, and V Underground Injection Control Wells). Also currently, **Insert Name of Agency/Department** is the designated regulatory authority in the **state/Commonwealth** **Insert Name of State** responsible for **Insert Agency/Department's current regulatory responsibility for UIC** (e.g., administering the Class II Underground Injection Control program).

Because some of the requirements of the Class VI program may include areas of regulatory overlap (e.g., criteria for siting, area of review, corrective action), **Insert Name of Agency/Department** and **Insert Name of Agency/Department** agree that it is in their mutual interest and benefit to work cooperatively in implementing the Class VI program.

III. AUTHORITIES

This cooperative agreement is entered into with full recognition of the following regulatory mandates/authorities:

The **Insert Name of Agency/Department** has jurisdiction for **Insert Regulated Activity** (e.g. oilfield operations, downhole operations, underground injection control, carbon capture and storage), in accordance with **Insert Specific State Regulation Citations Including all Relevant Definitions** (e.g. Chapter # of State/Territory/Tribe Environmental Code, Section __).

The ***Insert Name of Agency/Department*** has jurisdiction for ***Insert Regulated Activity*** (e.g. *permitting other classes of underground injection control wells*), in accordance with ***Insert Specific State Regulation Citations Including all Relevant Definitions*** (e.g. *Chapter # of State/Territory/Tribe Environmental Code, Section __*).

Insert any specific statutory or regulatory citations, if any, giving the respective Agencies/Departments the authority to enter into this MOU.

IV. SPECIFIC RESPONSIBILITIES

To provide an effective, streamlined, coordinated application and permitting/approval process for Class VI wells, and to reduce or eliminate duplicative administration of regulations and requirements, ***Insert Name of Agency/Department*** and ***Insert Name of Agency/Department*** hereby agree to adhere to the procedures set forth in this MOU for fulfilling the requirements of the UIC Class VI program. The procedures shall be carried out in a cooperative manner, to fulfill the objectives of ***Insert Name of Agency/Department*** and ***Insert Name of Agency/Department***, and reduce regulatory burden.

Insert Name of Agency/Department Responsibility

Insert Class VI Requirement (e.g. *site characterization, reporting, public involvement, etc.*).

Insert Agency Action

Insert Agency Action

Continue as necessary to describe the specific jurisdictions of the Agency/Department for each Class VI requirement.

Insert Name of Agency/Department Responsibility

Insert Class VI Requirement (e.g. *site characterization, reporting, public involvement, etc.*).

Insert Agency Action

Insert Agency Action

Continue as necessary to describe the specific jurisdictions of the Agency/Department for each Class VI requirement.

V. INTERAGENCY ACTIVITIES

Insert and describe any activities that require the two agencies to cooperate and describe any procedures (such as the frequency of meetings), to facilitate these activities.

VI. CLASS VI CONTACTS

<i>Insert Name</i>	<i>Insert Name</i>
<i>Insert Agency</i>	<i>Insert Agency</i>
<i>Insert Address</i>	<i>Insert Address</i>
<i>Insert e-mail</i>	<i>Insert e-mail</i>
<i>Insert Phone Number</i>	<i>Insert Phone Number</i>

VII. TERM OF AGREEMENT

This agreement shall be effective from the date of execution and shall remain in full force and

effect for ***Insert Term of Agreement*** unless terminated earlier by written notice from either party to the other party. This agreement may be modified, extended, or amended upon written request of either party and written concurrence of the other party.

VIII. DISPUTES

Staff from ***Insert Name of Agency/Department*** and ***Insert Name of Agency/Department*** shall meet and attempt to resolve any disputes regarding the interpretation of this MOU or disputes regarding definitions, requirements, or terms of art. Any unresolved disputes shall be elevated to Senior Management level for both Agencies.

IX. APPROVALS

By signature below, the parties to this MOU certify that the individuals listed in this document as representatives of the parties hereto are authorized to act in their respective areas for matters related to this agreement.

Signature of Authorized Representative

Date

Signature of Authorized Representative

Date

Signature of Authorized Representative

Date

Appendix E

Example Attorney General's Statement

Example Attorney General's Statement

I hereby certify, pursuant to my authority as (1) and in accordance with the Safe Drinking Water Act as amended, and 40 CFR 145.24(a), that in my opinion the laws of the [State/Commonwealth of (2)] [or tribal ordinances of (3)] to carry out the program set forth in the State UIC Program Description pursuant to 40 CFR 145.23 submitted by the (4) have been duly adopted and are enforceable. The specific authorities provided are contained in statutes or regulations that are lawfully adopted at the time this Statement is approved and signed and will be fully effective by the time the program is approved.

I. For States with No Audit Privilege and/or Immunity Laws

Furthermore, I certify that [State/Commonwealth of (2)] has not enacted any environmental audit privilege and/or immunity laws.

II. For States with Audit Laws that do Not Apply to the State Agency Administering the Safe Drinking Water Act

Furthermore, I certify that the environmental [audit privilege and/or immunity law] of the [State/Commonwealth of (2)] does not affect the ability of (2) to meet enforcement and information gathering requirements under the Safe Drinking Water Act because the [audit privilege and/or immunity law] does not apply to the program set forth in the State UIC Program Description pursuant to 40 CFR 145.23. The Safe Drinking Water Act program set forth in the State UIC Program Description is administered by (4); the [audit privilege and/or immunity law] does not affect programs implemented by (4), thus the program set forth in the Program Description is unaffected by the provisions of [State/Commonwealth of (2)] [audit privilege and/or immunity law].

III. For States with Audit Privilege and/or Immunity Laws that Worked with EPA to Satisfy Requirements for Federally Authorized, Delegated, or Approved Environmental Programs

Furthermore, I certify that the environmental [audit privilege and/or immunity law] of the [State/Commonwealth of (2)] does not affect the ability of (2) to meet enforcement and information gathering requirements under the Safe Drinking Water Act because [State/Commonwealth of (2)] has enacted statutory revisions and/or issued a clarifying Attorney General's Statement to satisfy requirements for federally authorized, delegated, or approved environmental programs.

Seal of Office

Signature

Name and Title

Date

- (1) State Attorney General or attorney for the primacy agency if it has independent legal counsel.
- (2) Name of state or commonwealth.
- (3) Name of tribe.
- (4) Name of primacy agency.

Appendix F

Example Class VI Permit Application Public Notification Letter

Insert Name of State/Commonwealth
PUBLIC NOTICE OF PERMIT AND HEARING
 Notice Publication Date: ***Insert Notice Date***

PURPOSE OF PUBLIC NOTICE

This notice serves to state the intention of the state/Commonwealth of ***Insert Name of State/Commonwealth*** to issue an Underground Injection Control (UIC) Class VI injection well operating permit, under the authority of the Safe Drinking Water Act (SDWA) and UIC Program regulations [40 CFR Parts 124, 144-146].

PERMIT INFORMATION

The proposed Class VI permit is for a Class VI injection well(s) that will be used to inject carbon dioxide for the purpose of geologic sequestration at ***Insert Specific Well(s) Location(s)*** (e.g., *Section 2 in Township 5, County, State*). The proposed permit, among other things, requires that the permittee monitor the injection and submit periodic reports to ***Insert Name of Permitting Agency***. On-going monitoring requirements are designed to ensure protection of underground sources of drinking water.

Permit Number: ***Insert Permit Number*** issued to:
Insert Name of Permit Holder
Insert Address of Permit Holder

PUBLIC COMMENTS

In accordance with the requirements of 40 CFR 124.10, the public is invited to comment on this draft Class VI permit by sending written comments to:

Insert Contact Name
Insert Contact Agency/Department
Insert Contact Address
Insert Contact E-mail

Or attending a public hearing scheduled to occur from ***Insert Hearing Start Time*** to ***Insert Hearing End Time*** on ***Insert Hearing Date*** at ***Insert Specific Hearing Location***. All comments received prior to the end of the comment period and at the public hearing will be considered in the formulation of any final permit determinations. All comments must be received by ***Insert Last Day of Comment Period***.

If no public comments are received that request a change in the Draft Permit, the ***Insert Name of Permitting Agency*** intends to issue a **Final UIC Class VI injection well operating permit** on ***Insert Permitting Date***.

FURTHER INFORMATION

Additional information may be obtained upon request by calling ***Insert Contact Name*** at ***Insert Contact Phone Number***, or by writing or sending an e-mail to the addresses listed above. The complete permit application, draft permit, and related documents are available for review at ***Insert Where Documents May Be Viewed*** from ***Insert Times for Viewing (if applicable)***. These documents will also be available for public review at the following locations:

Insert Locations, Addresses, and Times (if applicable) of All Viewing Location

Appendix G

Example Interstate Coordination Letter

[Today's Date]

Insert Name of UIC Class VI Program Director

Insert Return Address

To: Insert Name of Agency Director to be Notified

The **Insert Name of UIC Class VI Program Agency** has recently received a Class VI injection well permit application in which the applicant determined that the Area of Review (AoR) for the project as defined by 40 CFR 146.82(b) is predicted to cross jurisdictional boundaries, including **Insert Name of Neighboring State/Tribe/Territory**. While the protective requirements of Subpart H of 40 CFR 146 are designed to prevent endangerment of underground sources of drinking water, **Insert Name of UIC Class VI Program Agency** is informing you of this recently submitted permit application and affording you the opportunity to be involved in activities relevant to potentially permitting this Class VI injection well as required by 40 CFR 146.82(b).

The proposed Class VI well is located at:

Insert Specific Well(s) Location(s)(e.g. Section 2 in Township 5, County, State).

The permit applicant is:

Insert Name of Owner/Operator.

The applicant is located at:

Insert Address of Owner/Operator.

The applicant can be contacted at:

Insert Owner/Operator phone number and/or e-mail.

Additional information can be found by contacting:

Insert state contact name, title, phone number and/or e-mail.

In addition, we will be conducting a public hearing(s) on the permit application. Public hearing(s) will take place:

Insert Date, Time, and place of public hearings.

Insert Name of UIC Class VI Program Agency requests that we undertake a joint effort with **Insert Name of Neighboring State/Tribe/Territory**, along with other interested parties who have been contacted, to address any potential effects of this proposed Class VI injection well within your jurisdiction. These coordinated efforts will ensure the continued protection of underground sources of drinking water.

At this time, we invite you to review the contents of the Class VI injection well permit application, attend any public hearings held in the near future, and engage with us in discussions of the potential effects of this proposed well on the environment and public health of your jurisdiction throughout the permit application review and approval process, and additionally throughout the operation of the injection well.

Sincerely,

Insert Name of UIC Class VI Program Director

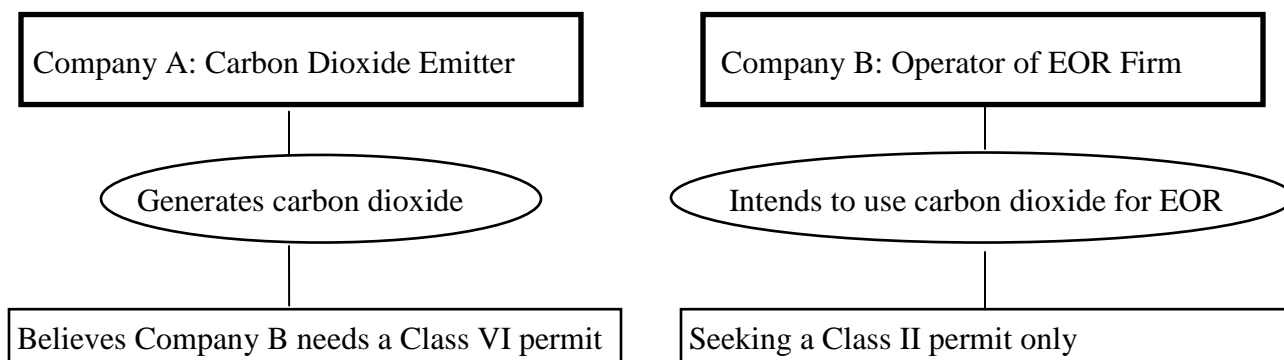
Appendix H

Hypothetical Class VI Primacy and Permitting Scenarios

Scenario 1**Background**

Company A and Company B have a contractual agreement where Company A will produce a high quality carbon dioxide stream to be captured, compressed, and transported via pipeline to Company B's oil field. Ownership is transferred when the carbon dioxide is transported. Company B maintains that their use of carbon dioxide is entirely for enhanced oil recovery (EOR) purposes—no carbon dioxide will be injected into areas that are not bearing commercial quantities of oil and no saline aquifer injection will be employed for long term sequestration. Company A is "confusing" various state agencies, namely the Primacy Agency for Class II Wells with their public statements that they will be "sequestering carbon dioxide."

In preparation for applying for a permit, Company B held meetings with various state agencies including the UIC Primacy Agency for Class II Wells and the EPA Regional Office.

**Question**

The primacy agency, state oil and gas division, and the EPA Region hold discussions to share information provided by Company B and to discuss what type of permit Company B will need in order to inject carbon dioxide. What issues should the agencies consider? What injection well class permit does Company B need?

Solution

The statements made by Company A claiming "carbon dioxide sequestration" are seemingly not relevant, since Company A is not the operator of an injection well, nor the permit applicant proposing to implement carbon dioxide injection activities. The state, or EPA regional office if the state does not have primacy, is responsible for determining at what point EOR activities transition to long-term sequestration of carbon dioxide based on the factors at 40 CFR 144.19. The owner or operator may need to provide additional documentation which supports a request for continued use as a Class II well. For more information on the re-permitting of injection wells from Class II to Class VI, refer to Section 3.3 of this manual.

Scenario 2

Primacy:

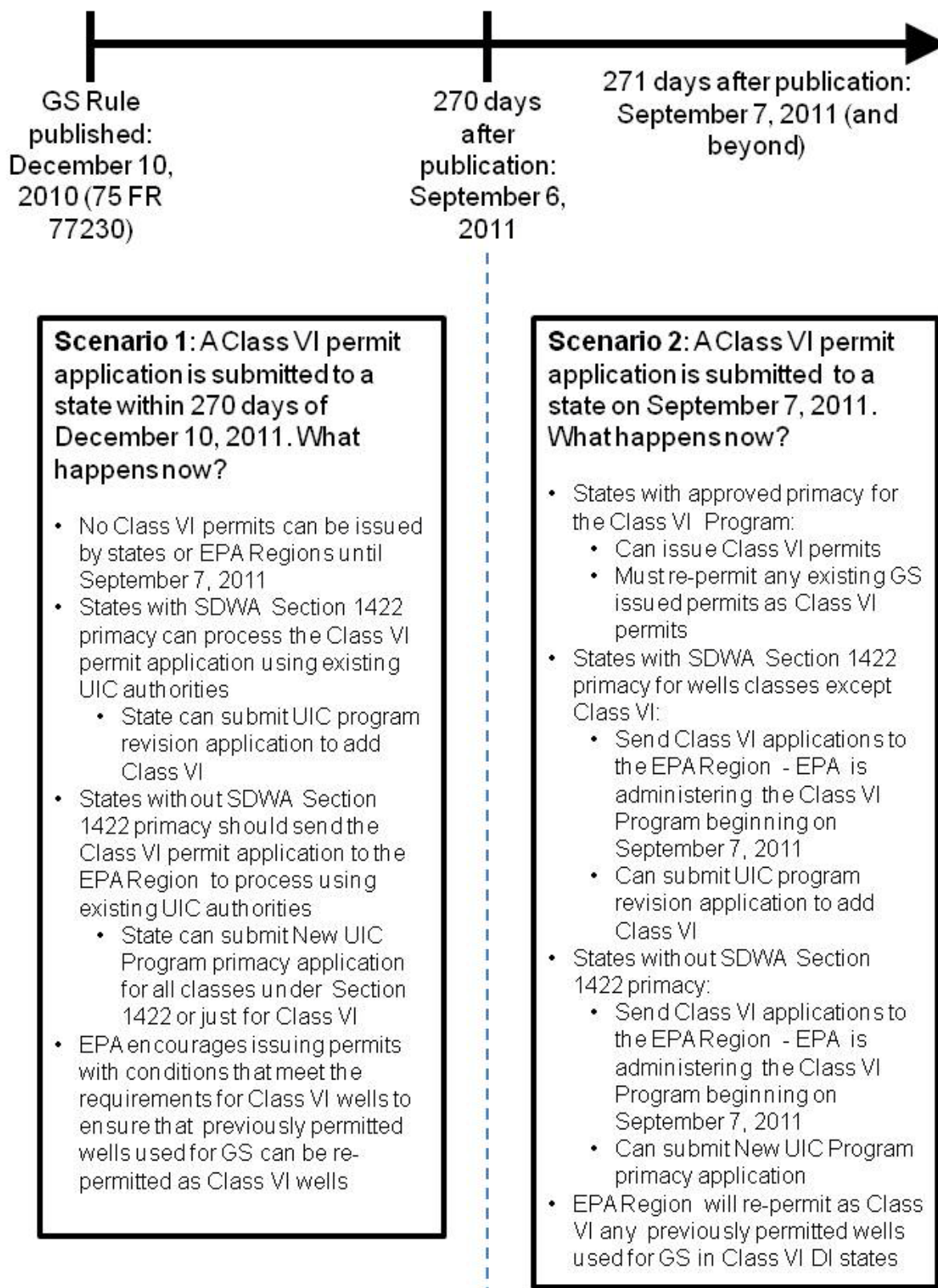
A state has primacy for Class VI wells only. The EPA regional office directly implements the UIC program for all other well classes in the state.

Permit:

An operator in the state would like to re-permit a well from Class II EOR to Class VI for long-term storage of carbon dioxide.

Questions

1. Does the state or regional UIC Program Director determine if and when the well can be re-permitted? The state may have access to production data to determine whether the oil field was no longer producing, but the EPA region may need to determine the need to plug and abandon injection wells in the area around the proposed well of interest in order to ensure confinement and protection of USDWs.
2. When would the EPA regional office release the operator's financial responsibility, terminate the permit, and transfer total responsibility over to the state?

Scenario 3

Scenario 4

Disclaimer

A hypothetical Class VI geologic sequestration (GS) operation is depicted below to illustrate key points and topics. This example GS situation is for the operation of a Class VI well for the injection and long-term storage of carbon dioxide and is intended to provide a hypothetical scenario similar to what a UIC Program Director may encounter during the permitting, implementation, and program evaluation processes. The hypothetical situations are for illustrative purposes only; they are not meant to provide examples of ideal procedures or preferred technologies endorsed by EPA. Site-specific circumstances will play a large role in determining the appropriate implementation of the GS Rule; therefore, the example provided here is only one of many appropriate and safe strategies that may be used at a GS site.

In this hypothetical situation, GS activities take place at a new coal-fired 500 megawatt (power plant in a Midwestern state. The Midwestern Coal Company, the owner and operator of the power plant and the GS project, will use an integrated gasification combined cycle technique to capture the carbon dioxide and inject it on site. The target formation is a deep saline formation approximately 5,600 feet (ft) below the surface and 1,150 ft thick, one of the lowermost sandstone units in a well-researched, thick, undeformed sedimentary sequence. Previous studies have determined that the total dissolved solids (TDS) level of the target formation is approximately 200,000 milligrams per liter (mg/L), well above the 10,000 mg/L TDS cutoff value for underground sources of drinking water (USDWs). The confining unit is a shale layer approximately 650 ft thick and located directly above the injection zone.

With the Class VI permit application, the operator provided the UIC Program Director with maps, cross sections, and other information specified in the UIC Class VI GS Rule and initiated a discussion regarding the proposed permit application, including whether an injection depth waiver would be necessary. The UIC Program Director confirmed with the operator that an injection depth waiver would not be required. The lowermost identified USDW is located approximately 1,300 ft below the surface. Below the proposed injection zone there is one deep saline unit; the porosity and permeability of this unit suggest it would not be a good candidate for injection. Salinity gradients reviewed by the UIC Program Director suggest that the TDS of this unit is over 200,000 mg/L, and therefore, is not a USDW.

The UIC Program Director verified that the injection zone at the well site has a porosity of 15-20% and a permeability of 25-100 millidarcies. These formation testing data and measurements of injection formation geometry indicate that the area is sufficient to receive the total anticipated volume of the carbon dioxide stream. The main confining unit is generally homogenous and has the low porosity and permeability characteristic of shale. Laterally, it extends well beyond the initial predicted extent of the storage region within the injection zone, and analyses of its thickness and other properties indicate that it will be sufficient to contain the injected carbon dioxide.

Because the injection site is located near several towns that rely on local ground water sources, the UIC Program Director requested that the operator identify and provide data on additional confining zones. The operator provided additional geologic information indicating that

interbedded shale layers in the sedimentary sequence overlying the injection zone would provide additional containment.

Several faults within the area of review (AoR) were identified during previous geologic surveys of the area. Two faults were identified that cross the confining zone. Neither fault has surface expression; both terminate in the subsurface above the confining zone, but below any USDWs and below the additional confining zones identified by the owner or operator. The orientation of the faults is consistent with the basin history and previous stress predictions. It is unlikely that other faults crossing the confining zone went undetected. A calculation of the shale gouge ratio (based on the mineralogy and thickness of the units transected by the faults and the amount of offset along the faults) indicated that the faults were likely to be sealing (non-transmissive). The operator demonstrated during the site characterization process that the risk of leakage from faults or other fractures is very low.

With other Class VI permit application materials, the operator submitted a description of the computational model used to predict vertical and horizontal migration of the supercritical carbon dioxide plume and pressure front. The test model domain's areal extent was sufficiently large, ensuring that model boundaries did not influence results. Model inputs consisted of a combination of previously published information and data collected at the field site. The operational parameters used in the model agreed with the operational conditions predicted for the site. Based on this modeling, the AoR was determined to extend approximately 1.5 miles up-dip from the injection well, 0.5 to 1.0 miles from the injection well in other directions. The UIC Program Director reviewed the model results and determined that they met the requirements of the UIC Class VI GS Rule.

The operator conducted a records search, and an aeromagnetic study identified and cataloged a number of abandoned wells in the AoR. However, the majority of these wells are not deep enough to penetrate the injection or confining zones, and the operator determined that none of the wells would require corrective action to prevent the movement of fluid into USDWs. One well that penetrates the injection zone was used in a previous investigation of subsurface properties; two shallow wells will be reopened and repaired to serve as dedicated monitoring wells for this project. Additionally, two more monitoring wells will be installed within the injection zone.

To meet the financial responsibility requirements of the GS Rule, the owner submitted a cost estimate to the UIC Program Director and secured two financial instruments. First, the owner established a trust fund with its local bank and set aside funds equal to the total estimated costs of corrective action, injection well plugging, and PISC and site closure. Second, to cover emergency and remedial response obligations, the owner took out an insurance policy with a national insurance company. The value of the policy was equal to the estimated costs of emergency and remedial response. The UIC Program Director evaluated and approved the financial responsibility demonstration using these two instruments.

To meet construction requirements, the operator provided details of the casing and cementing program to the UIC Program Director. The well design allowed for the use of down-hole testing devices, workover tools, and permitted continuous monitoring of the annulus space between the injection tubing and long-string casing. The operator provided a description of the materials used

(casing, cement, tubing and packer), along with a determination of the compatibility of the materials with injected fluids and documentation of any standards used to determine compatibility. Information on the composition of the injectate, injection pressure and rate, down-hole temperatures, and other proposed operational data were also provided. In addition, the operator provided other well construction parameters, such as the path of circulated cement; and a determination that fluids would not move into unauthorized zones, that the screened well interval was completely within the injection zone, and that tubing could withstand anticipated injection pressures. The UIC Program Director reviewed this information and determined the proposed construction specifications for the well to be adequate.

During the drilling and construction of the injection well, the operator carried out a series of tests to verify the depth, thickness, porosity, permeability, and other characteristics of the relevant geologic units and fluids. Per the requirements in the GS Rule, tests were carried out during the drilling of the borehole, before and upon installation of the surface casing, and before and upon installation of the long-string casing. In addition, a temperature log was completed to demonstrate the mechanical integrity of the injection well, and cores of the injection and confining zones were retrieved from the injection well borehole as well as from another borehole in the AoR.

The operator notified the UIC Program Director of the logging and testing schedule. The UIC Program Director decided to visit the site to witness a portion of the testing. One day of testing had to be postponed due to scheduling difficulties with the drill rig; the operator was able to notify the UIC Program Director sufficiently in advance to be in compliance with the Rule. The operator hired an experienced log analyst to interpret the results of the logs and tests. The results of the well logs and tests were consistent with work previously done in the area and predictions from site characterization and modeling data.

A number of continuous recording devices were installed in the well to track injection pressure, injection rate, volume and temperature of the carbon dioxide stream, annulus fluid volume, and annulus pressure. The recording devices were installed in conjunction with an alarm system and down-hole shutoff mechanism.

Shortly after injection operations commenced, a low reading from a down-hole pressure gauge triggered an alarm and the automatic shutdown of the well. When the alarm was triggered, the operator immediately stopped all injection operations and notified the UIC Program Director. The operator conducted testing in and around the well, and determined that no leaks had occurred and that the mechanical integrity of the well was not compromised. Instead, the drop in annulus pressure was due to a malfunction in the injection equipment. Adjustments were made to the injection parameters to ensure that the annulus pressure would remain within the permitted range. Additionally, all necessary equipment repairs were performed. After demonstrating mechanical integrity and notifying the UIC Program Director, the operator resumed injection at the well.

Permanent temperature and pressure gauges were installed in the injection well annulus to provide continuous down-hole monitoring. Data from these gauges are used to confirm that there are no leaks in the casing, tubing, or packer and fulfill the monitoring requirements at 40 CFR 146.89(b). The operator opted to use a temperature log one time per year to detect any fluid that

may be moving through channels adjacent to the injection well bore. The UIC Program Director required that the operator run an annual casing evaluation log to check for corrosion in the long-string casing. This will be performed in addition to the quarterly corrosion monitoring described in the approved Testing and Monitoring Plan.

Permanent fiber-optic down-hole distributed temperature and pressure gauges were installed during the construction of the injection well to provide high-quality down-hole monitoring. Data will be available on a continuous basis. Temperature profiles collected along the length of the well will be used to confirm the phase of the injected carbon dioxide.

As discussed above, three monitoring wells were installed within the injection zone, and two at shallower depths. Periodic ground water samples are collected from all wells and analyzed for a suite of analytes, including carbon dioxide (%). Ground water samples from locations throughout the AoR are analyzed on a monthly or bimonthly basis (depending on the sample location). Pressure measurements are also taken periodically from these wells.

The operator decided to use time lapse surface gravity as a monitoring method to track the spread of the carbon dioxide plume. The operator originally considered using time lapse 3D seismic monitoring; however, the simple geology of the subsurface allowed for other lower-cost methods to be used. Pre-monitoring modeling using site-specific data (e.g., depth, porosity, permeability, and lithology) confirmed that gravity would be an appropriate indirect method for plume monitoring. The model indicated that a fluid with 30% carbon dioxide saturation within the reservoir could reliably be imaged using surface gravity methods. The operator arranged with local landowners to set up permanent survey stations for repeat surveys to decrease subsequent survey time and cost as well as to increase repeatability.

To meet the quarterly corrosion monitoring requirement, the operator chose to use corrosion coupons. Casing evaluation logs will also be run once a year, per the requirement of the UIC Program Director.

The operator developed a Post-Injection Site Care (PISC) and Site Closure Plan and submitted it as part of the permit application. Gravity surveys, surface monitoring, and ground water testing will continue after injection has stopped. Monitoring will continue on the same schedule for 2 years; after this time, the frequency will be reduced based on the results of the monitoring. In addition, the mechanical integrity of the abandoned injection wells will be tested prior to well plugging. Following the UIC Program Director's approval and after a successful demonstration of non-endangerment, the monitoring wells will be closed, and the operator will develop a site closure report.

The operator developed an Emergency and Remedial Response Plan and submitted it as part of the initial permit application. After 5 years, the operator and the UIC Program Director reviewed the plan following the required AoR reevaluation. A significant amount of development has taken place in the AoR and surrounding communities, including plans for a new hospital on the edge of the AoR. The owner or operator will submit a revised Emergency and Remedial Response (E&RR) Plan that accounts for the new circumstances.

Appendix I

Class VI Permit Application Materials Checklist

Class VI Permit Application Materials Checklist

MATERIALS REQUIRED WITH CLASS VI PERMIT APPLICATION [40 CFR 146.82(a)]		INCLUDED?
<i>Required Class VI Permit Information [40 CFR 146.82]</i>		
The following information:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	List of the permitted activities	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Facility name, mailing address, and location	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Up to four SIC/NAICS codes	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Operator's name, address, telephone number, ownership status, and status as a federal, state, private, public, or other entity	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Whether the facility is located in Indian country	Yes <input type="checkbox"/> No <input type="checkbox"/>
	List of all permits or construction approvals, including authorization status, permit action type, and permit action date	Yes <input type="checkbox"/> No <input type="checkbox"/>
Map showing the injection wells for which the permit is sought and the applicable area of review (AoR):		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Number, name, and location of all wells	Yes <input type="checkbox"/> No <input type="checkbox"/>
	State or EPA approved subsurface cleanup sites	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Surface bodies of water, springs	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Surface and subsurface mines, quarries	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Water wells	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Other pertinent surface features, including structures intended for human occupancy	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Faults, known or suspected	Yes <input type="checkbox"/> No <input type="checkbox"/>
Information on geologic structure and hydrogeologic properties of storage site and overlying formations including:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Maps and cross-sections of AoR	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Location, orientation, and properties of known or suspected faults and fractures and a determination that they would not interfere with containment	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Data on the depth, areal extent, thickness, mineralogy, porosity, permeability, and capillary pressure of the injection and confining zone(s); including geology/facies changes based on field data which may include geologic cores, outcrop data, seismic surveys, well logs, and names and lithologic descriptions	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Geomechanical information on fractures, stress, ductility, rock strength, and in situ fluid pressures within the confining zone(s)	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Information on the seismic history, including the presence and depth of seismic sources and a determination that the seismicity would not interfere with containment	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Geologic and topographic maps and cross sections illustrating regional geology, hydrogeology, and the geologic structure of the local area	Yes <input type="checkbox"/> No <input type="checkbox"/>
Tabulation of all wells within the AoR which penetrate the injection or confining zone(s), including a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion		Yes <input type="checkbox"/> No <input type="checkbox"/>
Maps and stratigraphic cross sections indicating the general vertical and lateral limits of all USDWs, water wells and springs within the AoR, their positions relative to the injection zone(s), and the direction of water movement, where known		Yes <input type="checkbox"/> No <input type="checkbox"/>
Baseline geochemical data on subsurface formations, including all USDWs in AoR		Yes <input type="checkbox"/> No <input type="checkbox"/>
Proposed operating data:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Average and maximum daily rate and volume mass and total anticipated volume mass of carbon dioxide stream	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Average and maximum injection pressure	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Source of the carbon dioxide stream	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Analysis of chemical and physical characteristics of carbon dioxide stream	Yes <input type="checkbox"/> No <input type="checkbox"/>
Proposed pre-operational formation testing program to obtain analysis of chemical and physical characteristics of injection zone and confining zone		Yes <input type="checkbox"/> No <input type="checkbox"/>

Proposed stimulation program, a description of stimulation fluids to be used and a determination that stimulation will not interfere with containment;		Yes <input type="checkbox"/> No <input type="checkbox"/>
Proposed procedure to outline steps necessary to conduct injection operation		Yes <input type="checkbox"/> No <input type="checkbox"/>
Schematics or other appropriate drawings of surface and subsurface construction details of the well		Yes <input type="checkbox"/> No <input type="checkbox"/>
Injection well construction procedures		Yes <input type="checkbox"/> No <input type="checkbox"/>
Proposed AoR and Corrective Action Plan		Yes <input type="checkbox"/> No <input type="checkbox"/>
Demonstration of financial responsibility		Yes <input type="checkbox"/> No <input type="checkbox"/>
Proposed Testing and Monitoring Plan		Yes <input type="checkbox"/> No <input type="checkbox"/>
Proposed Injection Well Plugging Plan		Yes <input type="checkbox"/> No <input type="checkbox"/>
Proposed Post-Injection Site Care (PISC) and Site Closure Plan		Yes <input type="checkbox"/> No <input type="checkbox"/>
Demonstration of an alternative PISC timeframe, at the UIC Program Director's discretion		Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
Proposed Emergency and Remedial Response Plan		Yes <input type="checkbox"/> No <input type="checkbox"/>
List of contacts for states, tribes, and territories within the AoR		Yes <input type="checkbox"/> No <input type="checkbox"/>
For Class VI injection depth waivers, a supplemental report for a waiver of the requirement to inject below the lowermost USDW		Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
<i>Minimum Criteria for Siting [40 CFR 146.83]</i>		
Demonstration that the wells will be sited in areas with a suitable geologic system and the geologic system is comprised of:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Injection zone of sufficient areal extent, thickness, porosity, and permeability to receive the total anticipated volume	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Confining zones free of transmissive faults or fractures and of sufficient areal extent and integrity to contain the injected carbon dioxide stream and displaced formation fluids and allow injection at proposed maximum pressures and volumes without initiating or propagating fractures in the confining zone(s)	Yes <input type="checkbox"/> No <input type="checkbox"/>
At the UIC Program Director's discretion, identification and characterization of additional zones that will impede vertical fluid movement, demonstration that they are free of faults and fractures, allow for pressure dissipation, and provide additional opportunities for monitoring, mitigation and remediation		Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
<i>Area of Review and Corrective Action [40 CFR 146.84]</i>		
AoR and Corrective Action Plan must include:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Method for delineating the AoR, including the model to be used, assumptions that will be made, and site characterization data on which model will be based	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Description of:	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Minimum fixed frequency to reevaluate the AoR	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Monitoring and operational conditions that would warrant a reevaluation of the AoR	Yes <input type="checkbox"/> No <input type="checkbox"/>
	How monitoring and operational data will be used to inform an AoR reevaluation	Yes <input type="checkbox"/> No <input type="checkbox"/>
	How corrective action will be conducted, including what corrective action will be performed prior to injection and what, if any, portions of the AoR will have corrective action addressed on a phased basis and how the phasing will be determined; how corrective action will be adjusted if there are changes in the AoR; and how site access will be guaranteed for future corrective action	Yes <input type="checkbox"/> No <input type="checkbox"/>
AoR delineation, identification of all wells that require corrective action, and performance of corrective action		Yes <input type="checkbox"/> No <input type="checkbox"/>
Predicted lateral and vertical migration of carbon dioxide plume and formation fluids by using computational modeling. The model must:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Be based on geologic data collected to characterize the injection zone, confining zone and any additional zones; and anticipated operating data including injection pressures, rates, and total volumes	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Take into account any geologic heterogeneities, other discontinuities, data quality, and their possible impact on model predictions	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Consider potential migration through faults, fractures, and artificial penetrations	Yes <input type="checkbox"/> No <input type="checkbox"/>

Identification of all penetrations in the AoR, including a description of each well's type, construction, date drilled, location, depth, and record of plugging and/or completion		Yes <input type="checkbox"/> No <input type="checkbox"/>
Determination that abandoned wells in the AoR that are plugged		Yes <input type="checkbox"/> No <input type="checkbox"/>
Corrective action demonstration		Yes <input type="checkbox"/> No <input type="checkbox"/>
Financial Responsibility [40 CFR 146.85]		
Demonstration of financial responsibility that meets the conditions of:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	One or more of the following qualifying instruments approved by the UIC Program Director: Trust Fund, Surety Bond, Letter of Credit, Insurance, Self Insurance, Escrow Account, or any other instrument(s) satisfactory to the UIC Program Director	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Instrument(s) sufficient to cover the cost of corrective action, injection well plugging, PISC and site closure, and emergency and remedial response	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Instrument(s) sufficient to address endangerment of USDWs	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Instrument(s) comprise protective conditions of coverage	Yes <input type="checkbox"/> No <input type="checkbox"/>
Injection Well Construction [40 CFR 146.86]		
The following information on casing and cementing:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Depth to the injection zone	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Injection pressure, external pressure, internal pressure and axial loading	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Hole size	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Size and grade of all casing strings (wall thickness, external diameter, nominal weight, length, joint specification and construction material)	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Corrosiveness of carbon dioxide stream, and formation fluids	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Down-hole temperatures	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Lithology of injection and confining zones	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Type or grade of cement and cement additives	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Quantity, chemical composition, and temperature of carbon dioxide stream	Yes <input type="checkbox"/> No <input type="checkbox"/>
Demonstration of cement not allowing fluid movement behind well bore by using logs for the use of an alternative method of cementing in cases where the cement cannot be recirculated to the surface		Yes <input type="checkbox"/> No <input type="checkbox"/>
Evaluation of cement quality radially and identification of the location of channels		Yes <input type="checkbox"/> No <input type="checkbox"/>
The following information on tubing and packer:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Depth of setting	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Characteristics of carbon dioxide stream (chemical content, corrosiveness, temperature, and density) and formation fluids	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Maximum proposed injection pressure	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Maximum proposed annular pressure	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Proposed injection rate (intermittent or continuous) and volume of the carbon dioxide stream	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Size of tubing and casing	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Tubing tensile, burst, and collapse strengths	Yes <input type="checkbox"/> No <input type="checkbox"/>
Injection Well Operation [40 CFR 146.88]		
The owner or operator must install and use:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Continuous recording devices to monitor: the injection pressure; the rate, volume and/or mass, and temperature of the carbon dioxide stream; and the pressure on the annulus between the tubing and the long string casing and annulus fluid volume	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Alarms and automatic surface shut-off systems or, at the discretion of the UIC Program Director, down-hole shut-off systems for onshore wells or, other mechanical devices that provide equivalent protection	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Alarms and automatic down-hole shut-off systems for wells located offshore but within state territorial waters	Yes <input type="checkbox"/> No <input type="checkbox"/>
Testing and Monitoring [40 CFR 146.90]		
Testing and Monitoring Plan must include:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Analysis of carbon dioxide stream with sufficient frequency to yield data representative of its chemical and physical characteristics	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Installation and use, except during well workovers, of continuous recording devices	Yes <input type="checkbox"/> No <input type="checkbox"/>

	Corrosion monitoring of the well materials for loss of mass, thickness, cracking, pitting, and other signs of corrosion	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Periodic monitoring of the ground water quality and geochemical changes above the confining zone(s) that may be a result of carbon dioxide movement through the confining zone(s) or additional identified zones	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Demonstration of external mechanical integrity	Yes <input type="checkbox"/> No <input type="checkbox"/>
	If required by the UIC Program Director, a casing inspection log	Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
	Pressure fall-off test	Yes <input type="checkbox"/> No <input type="checkbox"/>
	The UIC Program Director may require surface air monitoring and/or soil gas monitoring to detect movement of carbon dioxide that could endanger a USDW	Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
	Quality assurance and surveillance plan for all testing and monitoring requirements	Yes <input type="checkbox"/> No <input type="checkbox"/>
Injection Well Plugging [40 CFR 146.92]		
	Injection Well Plugging Plan must include:	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Appropriate tests or measures for determining bottomhole reservoir pressure	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Appropriate testing methods to ensure external mechanical integrity	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Type and number of plugs	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Placement of each plug including the elevation of the top and bottom of each plug	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Type and grade and quantity of material to be used in plugging	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Method of placement of the plugs	Yes <input type="checkbox"/> No <input type="checkbox"/>
Post-Injection Site Care and Site Closure [40 CFR 146.93]		
	PISC and Site Closure Plan must include:	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Pressure differential between pre-injection and predicted post-injection pressures in injection zone	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Predicted position of the carbon dioxide plume and associated pressure front at site closure as demonstrated in the AoR evaluation	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Description of post-injection monitoring location, methods, and proposed frequency	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Proposed schedule for submitting PISC monitoring results	Yes <input type="checkbox"/> No <input type="checkbox"/>
Emergency and Remedial Response [40 CFR 146.94]		
	Emergency and Remedial Response Plan that describes actions the owner or operator must take to address movement of the injection or formation fluids that may cause an endangerment to a USDW during construction, operation, and PISC periods	Yes <input type="checkbox"/> No <input type="checkbox"/>
Class VI Injection Depth Waiver Application [40 CFR 146.95]		
	A supplemental report is required for seeking a waiver of the requirement to inject below lowermost USDW, including:	Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
	Demonstration that injection zone is laterally continuous, is not a USDW and is not hydraulically connected to USDW, does not outcrop, and has adequate injectivity, volume, sufficient porosity, and appropriate geochemistry	Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
	Demonstration that injection zone is bounded by laterally continuous, impermeable confining units above and below, and that confining units are free of transmissive faults and fractures	Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
	Demonstration, using computational modeling, that USDWs above and below injection zone will not be endangered as a result of fluid movement, conducted in conjunction with the AoR determination	Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
	Demonstration that well design and construction in conjunction with waiver will ensure isolation of the injectate	Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
	Description of how monitoring and testing and any additional plans will be tailored to GS project	Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
	Information on location of all the public water supplies affected, reasonably likely to be affected, or served by USDWs in the AoR	Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>

MATERIALS REQUIRED PRIOR TO WELL OPERATION [40 CFR 146.82(c)]		INCLUDED?
<i>Required Class VI Permit Information [40 CFR 146.82]</i>		
Final AoR based on modeling, using data obtained during logging and testing of the well and the formations		Yes <input type="checkbox"/> No <input type="checkbox"/>
Any relevant updates, based on data obtained during logging and testing of the well and the formation to the information on the geologic structure and hydrogeologic properties of the proposed storage site and overlying formations		Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
Information on compatibility of carbon dioxide stream with fluids in injection zone(s) and minerals in both injection and confining zone(s), based on the results of formation testing program, and with the materials used to construct the well		Yes <input type="checkbox"/> No <input type="checkbox"/>
Results of the formation testing program		Yes <input type="checkbox"/> No <input type="checkbox"/>
Final injection well construction procedures		Yes <input type="checkbox"/> No <input type="checkbox"/>
Status of corrective action on wells in the AoR		Yes <input type="checkbox"/> No <input type="checkbox"/>
All available logging and testing program data on the well		Yes <input type="checkbox"/> No <input type="checkbox"/>
Demonstration of mechanical integrity		Yes <input type="checkbox"/> No <input type="checkbox"/>
Any updates to the proposed AoR and Corrective Action Plan, Testing and Monitoring Plan, Injection Well Plugging Plan, PISC and Site Closure Plan, or the Emergency and Remedial Response Plan, which are necessary to address new information collected during logging and testing of the well and the formation		Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
Any updates to the alternative PISC timeframe demonstration, which are necessary to address new information collected during the logging and testing of the well and the formation		Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
Any other information requested by the UIC Program Director		Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>
<i>Logging, Sampling, and Testing Prior to Injection Well Operation [40 CFR 146.87]</i>		
Descriptive report prepared by a knowledgeable log analyst that includes an interpretation of the results of appropriate logs, surveys and tests to determine or verify the depth, thickness, porosity, permeability, and lithology of, and the salinity of any formation fluids in all relevant geologic formations to ensure conformance with the injection well construction requirements and to establish accurate baseline data against which future measurements may be compared. At a minimum, such logs and tests must include:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Deviation checks during drilling on all holes constructed by drilling a pilot hole which is enlarged by reaming or another method; such checks must be at sufficiently frequent intervals to determine the location of the borehole and to ensure that vertical avenues for fluid movement in the form of diverging holes are not created during drilling	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Before and upon installation of surface casing:	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Resistivity, spontaneous potential, and caliper logs before casing is installed	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Cement bond and variable density log, and a temperature log after casing is set and cemented	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Before and upon installation of long string casing:	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Resistivity, spontaneous potential, porosity, caliper, gamma ray, fracture finder logs, and any other logs the UIC Program Director requires for the given geology	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Cement bond and variable density log, and temperature log after casing is set and cemented	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Series of tests designed to demonstrate internal and external mechanical integrity of injection wells:	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Pressure test with liquid or gas	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Tracer survey such as oxygen-activation logging	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Temperature or noise log	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Casing inspection log	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Any alternative methods that provide equivalent or better information and that are required by and/or approved of by the UIC Program Director	Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>

Detailed report prepared by a log analyst that includes: well log analyses (including well logs), core analyses, and formation fluid sample information		Yes <input type="checkbox"/> No <input type="checkbox"/>
The owner or operator must record the fluid temperature, pH, conductivity, reservoir pressure, and static fluid level of the injection zone(s)		Yes <input type="checkbox"/> No <input type="checkbox"/>
Information concerning the injection and confining zone(s)		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Fracture pressure	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Other physical and chemical characteristics of the injection and confining zone(s)	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Physical and chemical characteristics of the formation fluids in the injection zone(s)	Yes <input type="checkbox"/> No <input type="checkbox"/>
Upon completion, but prior to operation, hydrogeologic testing of injection zone:		Yes <input type="checkbox"/> No <input type="checkbox"/>
	Pressure fall-off test	Yes <input type="checkbox"/> No <input type="checkbox"/>
	Pump test or injectivity tests	Yes <input type="checkbox"/> No <input type="checkbox"/>
Schedule of testing activities submitted to the UIC Program Director 30 days prior to conducting the first test and submit any changes to the schedule 30 days prior to the next scheduled test		Yes <input type="checkbox"/> No <input type="checkbox"/>

Appendix J

Contact Information

Users of this UIC Class VI Program Interim Final Primacy Application and Implementation Manual that have suggestions or feedback for improving its content are encouraged to provide comments to the EPA Office of Ground Water and Drinking Water. Please send comments to:

E-mail:

GSRuleGuidanceComments@epa.gov

Mail:

U.S. Environmental Protection Agency
Office of Ground Water and Drinking Water (4606M)
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Attn: UIC Class VI Primacy Application and Implementation Manual Comments

Users may direct Class VI Program questions to state and EPA regional contacts. For a list of Regional Underground Injection Control contacts, please visit:
<http://water.epa.gov/type/groundwater/uic/whereyoulive.cfm>.

References

References

Federal Requirements under the Underground Injection Control Program for Carbon Dioxide Geologic Sequestration Wells (75 FR 77230, December 10, 2010). Available on the Internet at: <http://water.epa.gov/type/groundwater/uic/class6/gsregulations.cfm>.

Previous Underground Injection Control Rules. Available on the Internet at: www.gpoaccess.gov/cfr/index.html.

Bureau of Land Management (BLM). 2009. Framework for Geological Carbon Sequestration on Public Land.

Executive Order 12898 (February 11, 1994): Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.

Geologic Sequestration of Carbon Dioxide: Underground Injection Control (UIC) Class VI Well Area of Review Evaluation and Corrective Action Guidance for Owners and Operators. Available on the Internet at: <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm>.

Geologic Sequestration of Carbon Dioxide: Underground Injection Control (UIC) Class VI Well Construction Guidance for Owners and Operators. Available on the Internet at: <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm>.

Underground Injection Control (UIC) Class VI Program: Draft Project Plan Development Guidance for Owners and Operators. Available on the Internet at: <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm>.

Geologic Sequestration of Carbon Dioxide: Draft Underground Injection Control (UIC) Class VI Well Site Characterization Guidance for Owners and Operators. Available on the Internet at: <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm>.

Internal Revenue Service (IRS). 2009. Notice 2009-83: Credit for Carbon Dioxide Sequestration Under Section 45Q. Internal Revenue Bulletin 2009-44. Available on the Internet at: www.irs.gov/irb/2009-44_IRB/ar11.html#d0e1860.

International Association for Public Participation. Available on the Internet at: www.IAP2.org.

Underground Injection Control (UIC) Class VI Program Draft Financial Responsibility Guidance. Available on the Internet at: <http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm>.

United States Geological Survey (USGS). 2009. Development of a Probabilistic Assessment Methodology for Evaluation of Carbon Dioxide Storage. Available on the Internet at: <http://pubs.usgs.gov/of/2009/1035/ofr2009-1035.pdf>.

U.S. EPA, 1989. Technical Assistance Document: Cementing For the Plugging and Abandonment of Injection Wells. Prepared under EPA Contract No. 68-03-3416, by Engineering Enterprises, Inc. Norman Ok.

U.S. EPA, 2010. Environmental Justice. Available on the Internet at:
www.epa.gov/compliance/environmentaljustice/index.html.

U.S. EPA's Action Development Process: Interim Guidance on Considering Environmental Justice During the Development of an Action. Page 12. Available on the Internet at:
www.epa.gov/environmentaljustice/resources/policy/ej-rulemaking.html.

U.S. EPA's Public Involvement web page. 2010. Available on the Internet at:
www.epa.gov/publicinvolvement.