Underground Injection Control
Carbon Sequestration
Class VI Permit Application

POST-INJECTION SITE CARE AND SITE CLOSURE PLAN
40 CFR 146.93(a)
Section 10.0

TALLGRASS HIGH PLAINS CARBON STORAGE, LLC
WESTERN NEBRASKA SEQUESTRATION HUB

January 2025

Prepared by:

Jessica Gregg (Director, Geoscience Compliance)
Tallgrass High Plains Carbon Storage, LLC
370 Van Gordon St
Lakewood, CO 80228

10.0 POST-INJECTION SITE CARE AND SITE CLOSURE PLAN

WESTERN NEBRASKA SEQUESTRATION HUB

FACILITY INFORMATION

Facility name: Western Nebraska Sequestration Hub
Conestoga I-1

Facility contacts:

Craig Spreadbury | Vice President, Carbon Capture & Sequestration
Tallgrass High Plains Carbon Storage, LLC
370 Van Gordon St
Lakewood, CO 80228
craig.spreadbury@tallgrass.com

Jessica Gregg | Director, Geoscience Compliance
Tallgrass High Plains Carbon Storage, LLC
370 Van Gordon St
Lakewood, CO 80228
jessica.gregg@tallgrass.com

Well location: Kimball County, Nebraska
[redacted]

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

%	percent
2D	two dimensional
A	
AoR	area of review
API	American Petroleum Institute
B	
BLM	Bureau of Land Management
BOP	blowout preventer
BTC	buttress thread coupling
C	
$CaCO_2$	calcium carbonate
CFR	Code of Federal Regulations
CO_2	carbon dioxide
D	
DAS	distributed acoustic sensing
DTS	distributed temperature sensing
E	
EOI	end of injection
EPA	United States Environmental Protection Agency
F	
ft	feet/foot
I	
ID	inner diameter
in.	inches
K	
KB	kelly bushing
mg/L	milligrams per liter
N	
NAD	North American Datum
P	
P&A	plugged and abandoned
PISC	post-injection site care
PLSS	Public Land Survey System
PNL	pulsed-neutron log
psi	pounds per square inch
O	
OD	outer diameter
Q	
QASP	quality assurance surveillance plan
S	
SH	shale

SS	sandstone or subsea
SWD	saltwater disposal
T	
TBD	to be determined
TH.	thickness
TVD	total vertical depth
U	
UIC	Underground Injection Control
USDW	underground source of drinking water
W	
WT	weight

10.0 POST-INJECTION SITE CARE AND SITE CLOSURE PLAN [40 CFR 146.93(A)]

Tallgrass High Plains Carbon Storage, LLC (High Plains) proposes drilling and completing a carbon sequestration injection well (Conestoga I-1) and monitoring well (Conestoga M-1) for the safe sequestration of carbon dioxide as part of their Western Nebraska Sequestration Hub (WNS Hub, the "Project") in Kimball County, [redacted] High Plain's Juniper M-1 stratigraphic test well in Laramie County, Wyoming, is utilized as the Project's characterization well. This Post-Injection Site Care (PISC) and Site Closure Plan describes the activities that High Plains will perform to meet the 40 CFR §146.93 requirements. High Plains will monitor groundwater quality and track the position of the carbon dioxide (CO_2) plume and pressure front for 50 years after the end of injection—the plume is anticipated to have stabilized well before then. The monitoring plan will support the demonstration of non-endangerment of underground source(s) of drinking water (USDW). Following site closure approval, High Plains will plug all monitoring wells, restore the site to its original condition, and submit a site closure report and associated documentation.

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

A maximum pressure differential of approximately [redacted] is predicted to occur at the end of the injection phase (2039, model year 12) (see pressure differential map in **Figure 10.1**). Note that this is below the calculated threshold pressure of [redacted] (see *Section 3.3.1*); thus, no threshold pressure front is anticipated to be generated by the Project. As soon as injection ceases, the pressure will drop off, initially rapidly, and then the rate of pressure decline will decrease as time progresses. The formation pressure at the top perforation of the injection interval is expected to decline to less than [redacted] over the initial reservoir pressure [redacted] years after injection ceases (see **Figure 10.2**). Modeling results indicate that the pressure differential decline will be homogeneous within the AoR. At the end of the fifty-year post-injection site care period (2089, model year 62), maximum differential pressure in the injection zone is predicted to have decreased to less than [redacted] psi (**Figure 10.3**). *Section 3.0—AoR and Corrective Action Plan* presents additional information on the projected post-injection pressures and differentials.

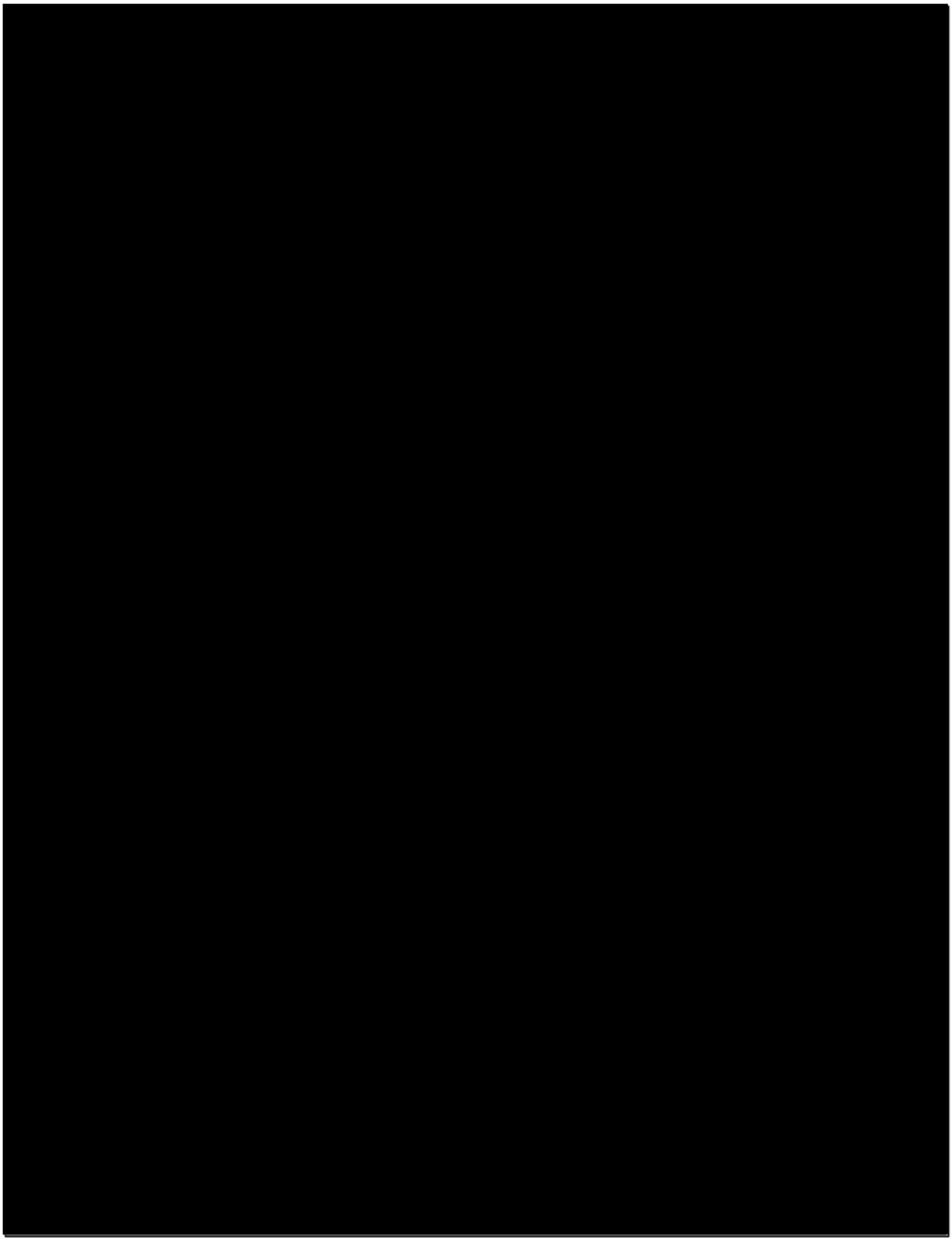

Figure 10.1—Average pressure differential within the Lyons Formation at the end of injection (model year 12). Polygons showing areas with [redacted] injectate concentration or greater after 12 years of injection (purple) and 50 years post injection (the AoR; red dashed).

Figure 10.2—Injection zone pressure at the top of the injection interval during the three phases of the Project: pre-injection, active injection, and post-injection.

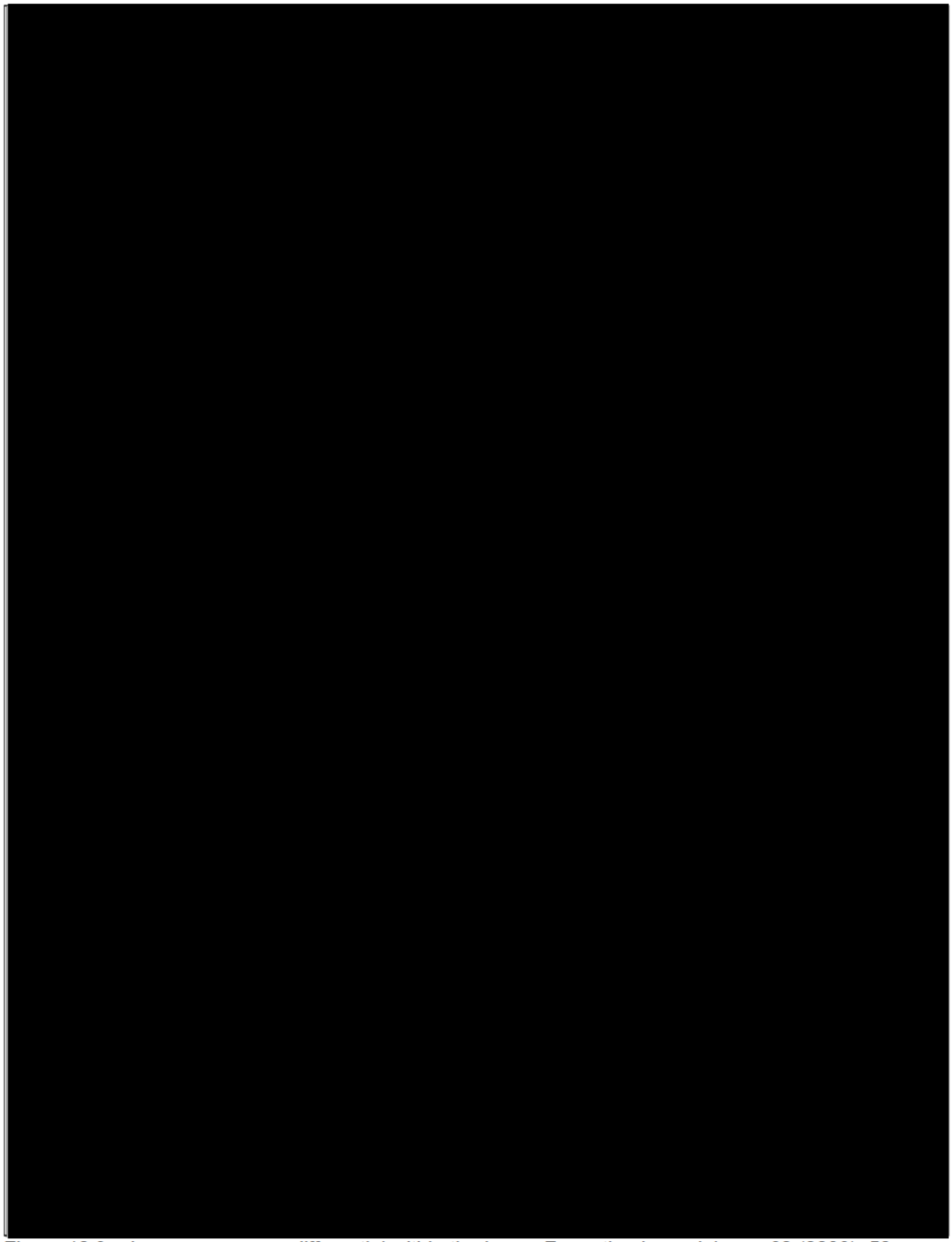

Figure 10.3—Average pressure differential within the Lyons Formation in model year 62 (2089), 50 years after the end of injection, the end of the PISC period. A polygon showing the area with [redacted] gas saturation in model year 62 (the AoR) is shown in red.

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

The CO_2 plume is defined as any region with [redacted] injectate saturation from the start of injection until site closure. The plume is predicted to grow, initially rapidly, through the injection phase, with growth slowing significantly after the end of injection. [redacted] after the end of injection [redacted] the plume is anticipated to have stabilized, exhibiting a modeled annual increase in radius[1] of less than 1% (**Figure 10.4**). By the end of PISC (2089, model year 62), plume radius growth is modeled as less than [redacted]. **Figure 10.5** shows the predicted extent of the plume at the end of the PISC timeframe. **Figure 10.5** is based on the final AoR delineation modeling results submitted pursuant to 40 CFR §146.84. The AoR is based on the predicted extent of the plume in 2089 (thick red line) and was conservatively selected based on the negligible growth rate [redacted] of the plume at that time. The pressure never exceeds the critical pressure threshold; therefore, no pressure front extent is utilized as part of the AoR delineation.

[redacted]

Figure 10.4—Change in plume radius over time. The CO_2 plume radius is considered stable (less than 1% change in plume radius per year) in [redacted] after the end of injection (EOI).

[1] Calculation is based on the modeled plume area and assumes the plume is circular.

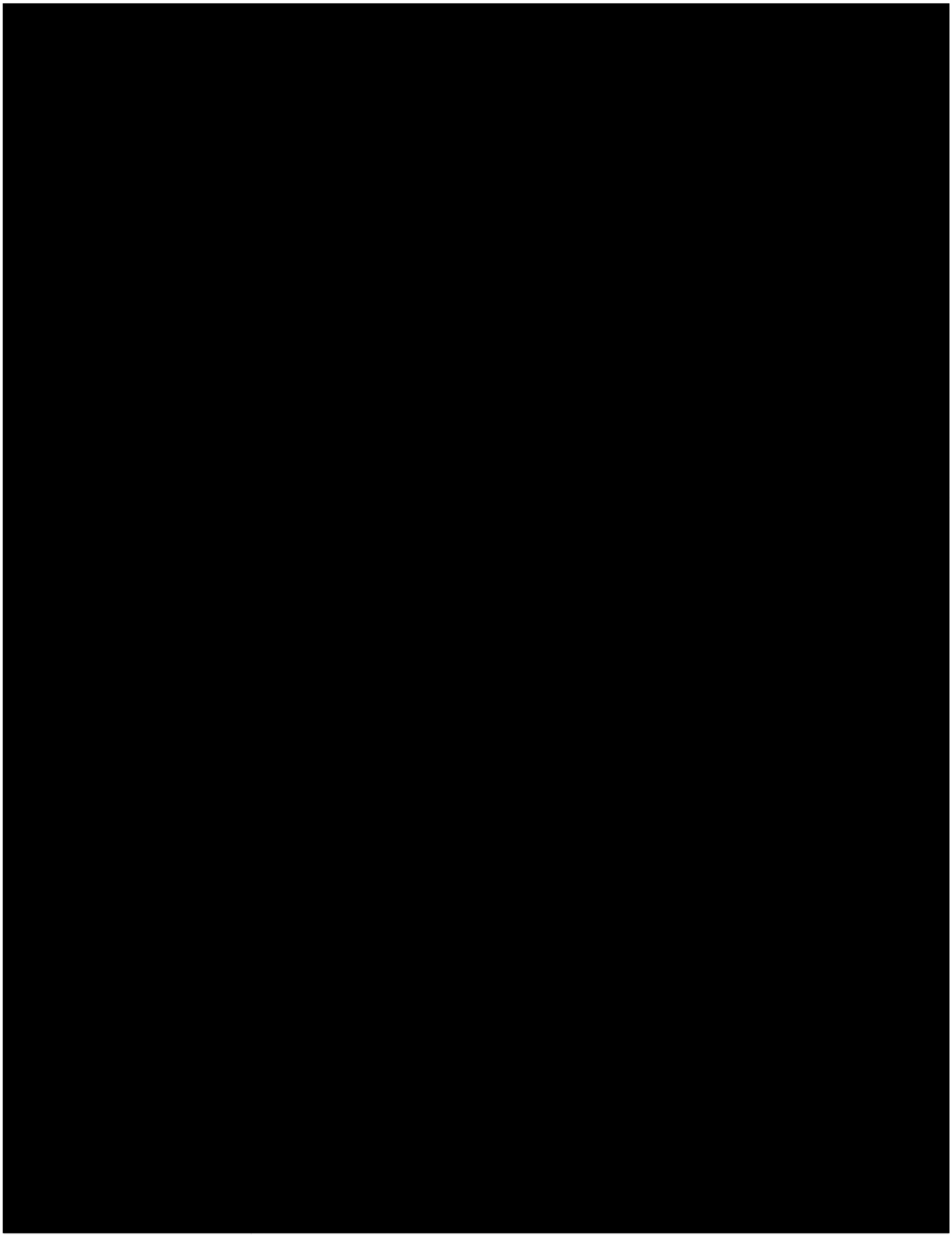

Figure 10.5—Map showing the modeled growth of the CO_2 plume from 2029 through the end of PISC (2089, thick red line).

As discussed in *Section 10.1* and shown in **Figure 10.3**, maximum differential pressure in the injection zone at the end of PISC (site closure) is predicted to be less than [redacted]. No pressure front is anticipated to be generated by the Project, thus no pressure front (areas with reservoir pressure above critical pressure [redacted] will be present at site closure.

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

Post-injection monitoring of the CO_2 plume, associated pressure front,[2] USDWs, and mechanical integrity is planned for 50 years after the end of injection or until measurements confirm plume stabilization, whichever occurs later. **Table 10.1** and the following sections detail the PISC monitoring plans that will meet the requirements of 40 CFR §146.93(b)(1). All post-injection phase testing and monitoring results will be submitted annually, within 60 days of the anniversary of injection ending, as described in the following text under *Section 10.3.3—Schedule for Submitting Post-Injection Monitoring Results [40 CFR 146.93(a)(2)(iv)]*.

Table 10.1—Summary of post-injection surveillance activities.

Type of Monitoring	Frequency	Comments
[redacted]		

[2] No critical pressure front is anticipated to be generated by the Project. Reservoir pressure will still be monitored throughout the PISC period.

10.3.1 Monitoring Above the Confining Zone

Monitoring above the confining zone will continue post-injection in both the Conestoga M-1 and Conestoga I-1 wells in order to detect any potential migration of injection or formation fluids into overlying USDWs. Gauges in both wells will continuously record data in the first permeable zone above the confining layer. Additionally, permanent fiber optic cables will continuously record data across USDWs in the Conestoga M-1. [redacted] in Conestoga I-1 until reservoir pressure declines sufficiently (near pre-injection reservoir pressure) to warrant a reduction in logging frequency. Direct water sampling from the primary groundwater aquifer will continue annually. **Table 10.2** outlines the monitoring methods, locations, and frequencies for monitoring above the confining zone during the PISC period.

Table 10.2—Summary of groundwater quality and geochemical monitoring above the confining zone during the PISC period.

Target Formation	Monitoring Activity	Monitoring Location(s)	Spatial Coverage	Frequency
First permeable interval above the confining layer	[redacted]			
USDWs				
Primary utilized USDW				

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

High Plains will employ direct and indirect methods to track the extent of the CO_2 plume and the presence or absence of elevated pressure during the PISC period to meet the requirements of 40 CFR §146.90(g). [redacted]

Table 10.3 presents the direct and indirect methods High Plains will employ to monitor the CO_2 plume and reservoir pressure during PISC, including the activities, locations, and frequencies High Plains will employ. Pressure gauges installed in the monitoring well, as detailed in **Table 10.4**, will be used to monitor pressure conditions during the post-injection phase of the Project. This data will be compared to dynamic simulation results and used to determine if the dynamic simulation model needs refinement.

Section 8.11, the Quality Assurance Surveillance Plan (QASP), presents quality assurance procedures for seismic monitoring methods.

Table 10.3—Post-injection phase plume monitoring.

Target	Monitoring Activity	Monitoring	Spatial	Frequency
[redacted]				

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

All post-injection site care monitoring data and monitoring results, collected using the methods described above, will be submitted to the U.S. Environmental Protection Agency (EPA) in reports submitted within 60 days of the anniversary of injection cessation. The reports will contain all data collected, their interpretation, and any new findings requiring further review.

10.4 Alternative Post-Injection Site Care Timeframe [40 CFR 146.93(c)]

High Plains is not currently seeking an alternative post-injection site care timeframe.

10.5 Non-Endangerment Demonstration Criteria

Before receiving approval to conclude the post-injection site care phase, High Plains will submit a demonstration of USDW non-endangerment to the UIC Program Director in accordance with 40 CFR 146.93(b)(2) and (3).

High Plains will issue a report to the UIC Program Director. This report will demonstrate USDW non-endangerment based on an evaluation of site monitoring data used in conjunction with the Project's computational model. The report will detail how site-specific conditions confirm and support the non-endangerment demonstration. It will include all relevant monitoring data, interpretations, model documentation, supporting data, and any additional information necessary for the UIC Program Director to review the analysis. The report will include the following sections:

10.5.1 Introduction and Overview

A summary of relevant background information will be provided, including the operational history of the injection Project, the date of the non-endangerment demonstration relative to the post-injection period outlined in this PISC and Site Closure Plan, and a general overview of how monitoring and modeling results will be used together to support a demonstration of USDW non-endangerment.

10.5.2 Summary of Existing Monitoring Data

A summary of all previous monitoring data collected at the site, according to the Testing and Monitoring Plan of this permit application (*Section 8*) and this PISC and Site Closure Plan, including data collected during the injection and post-injection phases of the Project, will be submitted to help demonstrate non-endangerment. Data submittals will be in a format acceptable to the UIC Program Director [40 CFR 146.91(e)]. They will include a narrative explanation of monitoring activities, including the dates of all monitoring events, changes to the monitoring program over time, and an explanation of all monitoring infrastructure at the site. Data will be compared with baseline data collected during site characterization [40 CFR 146.82(a)(6) and 146.87(d)(3)].

10.5.3 Summary of Computational Modeling History

The dynamic simulation outlined in *Section 3.3* demonstrates that critical pressure is never anticipated to be exceeded. The maximum increase in reservoir pressure of [redacted] is less than the critical pressure of [redacted].

As additional data becomes available, the geologic model and dynamic reservoir simulation will be updated to include the most relevant information. As outlined in *Section 3.5*, the models will be incrementally adjusted as new information and impacts to the AoR are evaluated.

10.5.4 Evaluation of Reservoir Pressure

Reservoir pressure will be monitored in the Lyons Formation with the pressure gauges installed in the Conestoga I-1. These pressures will be used to update the reservoir model and determine the extent of the pressure front.

10.5.5 Evaluation of Carbon Dioxide Plume

[redacted]

10.5.6 Evaluation of Emergencies or Other Events

Monitoring for mechanical integrity will continue from the injection period into PISC after the Conestoga I-1 injection well is converted into a monitoring well. [redacted] years until the plume stabilizes and the well is plugged and abandoned. These image logs will help identify any potential degradation to the casing.

Table 10.5—Post-injection phase mechanical integrity monitoring.

Monitoring Activity	Monitoring Location(s)	Spatial Coverage	Frequency
[redacted]			

10.6 Site Closure Plan

High Plains will conduct site closure activities to meet the requirements of 40 CFR 146.93(e) as described below. High Plains will notify the permitting agency at least 120 days prior to its intent to close the site. Once the permitting agency has approved site closure, High Plains will develop and submit a site closure report to the EPA. The activities described below represent the planned actions based on information provided to the EPA. The actual site closure plan may employ different methods and procedures. A final Site Closure Plan will be submitted to the UIC Program Director for approval with the notification of the intent to close the site.

10.6.1 Plugging Monitoring Wells

The Conestoga I-1 and Conestoga M-1 wells will be plugged and abandoned as part of the site closure activities. High Plains intends to plug and abandon these wells according to the requirements of the Nebraska Administrative Code, Title 267, Chapter 3, Section 028. In addition to regulatory requirements, normal and customary engineering and operational practices will be applied during this program to prevent fluid migration and contamination of any USDWs. All materials used during this plugging operation will be compatible with CO_2 and CO_2-water mixtures. For a detailed explanation and plugging procedure, see *Section 9.0*.

10.6.1.1 *Conestoga I-1*

Table 10.6 details the planned plugs to be set in the Conestoga I-1 and **Figure 10.6** is the proposed plugging schematic. The well is planned to be used as a monitoring well during the PISC period.

Table 10.6—Summary of cement plugs for the Conestoga I-1 plug and abandonment.

Cement Plug Number	Interval Range (ft)	Thickness (ft)	Volume (ft^3)	Note
[redacted]				

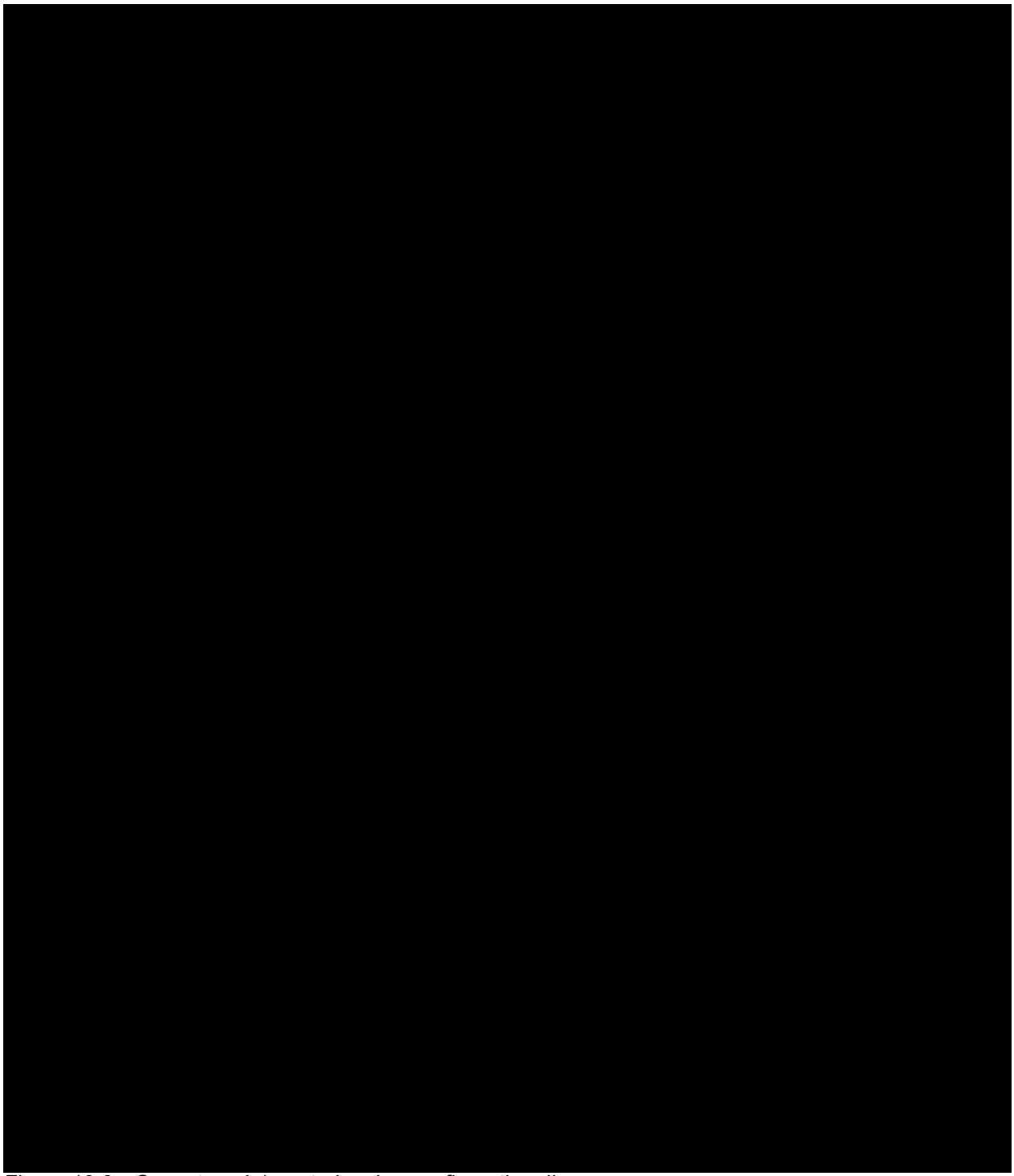

Figure 10.6—Conestoga I-1 post-plugging configuration diagram.

10.6.1.2 *Conestoga M-1*

Table 10.7 details the planned plugs to be set during the abandonment of the Conestoga M-1. **Figure 10.7** is the proposed plugging schematics for the Conestoga M-1 which will be used as a monitoring well during the PISC period.

Table 10.7—Summary of cement plugs, Conestoga M-1 plug and abandonment.

Cement Plug Number	Interval Range (ft)	Thickness (ft)	Volume (ft^3)	Note
[redacted]				

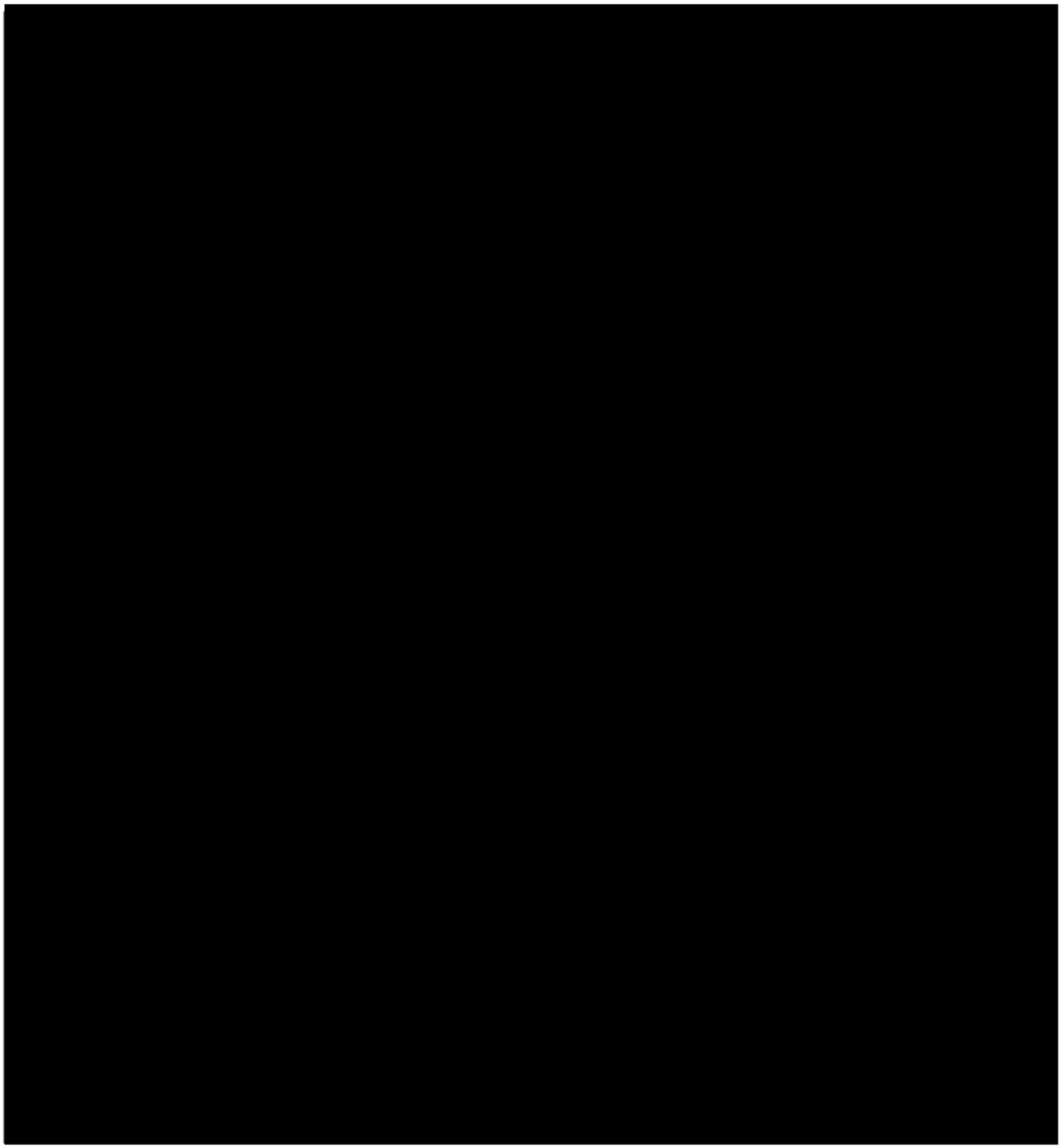

Figure 10.7—Conestoga M-1 post-plugging configuration diagram.

10.6.2 Site Closure Report

A site closure report will be prepared and submitted within 90 days following site closure, documenting the following:

- Plugging of the monitoring wells (and the injection well if not previously plugged).
- The location of the sealed injection well on a plat survey submitted to the local zoning authority.
- Notifications to state and local authorities as required at 40 CFR 146.93(f)(2).
- Records regarding the nature, composition, and volume of the injected CO_2.
    - Post-injection monitoring records. High Plains will record a notation to the property's deed on which the injection well was located, indicating that the property was used for carbon dioxide sequestration.
    - The name of the local agency to which a plat of survey with injection well location was submitted.
    - The volume of fluid injected.
    - The formation into which the fluid was injected.
    - The period over which the injection occurred.

The site closure report will be submitted to the permitting agency and maintained by the owner or operator for ten years following site closure. Additionally, the owner or operator will maintain the records collected during the post-injection period for ten years, after which these records will be delivered to the UIC Program Director.