TITAN
CARBON SEQUESTRATION

Underground Injection Control – Class VI Permit Application for

Cronos No. 1 and Rhea No. 1

Jefferson County, Texas

SECTION 6 – PLUGGING PLAN

February 2024

LONQUIST
SEQUESTRATION LLC

SECTION 6 – INJECTION WELL PLUGGING PLAN

TABLE OF CONTENTS

Figures

Tables

6.1 Introduction

The plugging plan for the proposed Titan Carbon Sequestration, LLC (Titan) injection wells Cronos No. 1 and Rhea No. 1 has been prepared in accordance with the requirements of Title 16, Texas Administrative Code (16 TAC) **§5.203(k)** and 16 TAC **§3.14** and Title 40, U.S. Code of Federal Regulations (40 CFR) **§146.92**. This section provides a general description of the steps that will be taken to plug and abandon each well in the project. For the injection wells, this plan will include the proposed stages of well development through final abandonment. The plugging and abandonment (P&A) of each monitoring well is also covered in this section. Complete P&A prognoses are included in *Appendix H*.

6.2 Injection Well Zonal Isolation and Final Plugging and Abandonment

The injection wells will be completed in multiple intervals within the gross injection zone. Each injection interval will be used for a discrete period as identified in the plume model. Once that period has been completed, the current injection interval will be isolated to prevent crossflow conditions between the new and old injection intervals. Once an injection stage is isolated, a new injection horizon will be opened. This process will be repeated until the entire gross injection interval is fully developed. After [redacted] injection in both wells, the uppermost plug will be set, and the wells will continue to be used for monitoring purposes until the plume monitoring is no longer required. After that, the wells will be permanently plugged. The P&A procedures for the injection wells are designed to prevent CO_2 or formation fluids in the injection interval from migrating to the Underground Source of Drinking Water (USDW).

The details in this section outline the procedures for both types of plugs—described as follows—to be installed in the injection wells:

- Isolation of the active injection section via recompletion operations
- Final P&A of the wellbore

6.2.1 Zonal Isolation of Injection Zone / Intermediate Plugback Plan

When the current, active injection zone has reached the end of its injection period, that zone will be isolated and abandoned. The general procedure for zonal isolation includes the following.

6.2.1.1 Pre-zonal Isolation Activities

1. Titan will comply with all reporting and notification provisions.
    a. Titan will notify the Underground Injection Control (UIC) Program director (UIC Director) 60 days before planned plugging efforts. If any changes are proposed to the original well plugging plan, a revised well plugging plan will be submitted. (16 TAC ***§*5.203(k)(3)(A)** [40 CFR ***§*146.92(c)**])

b. Notice of Intent to Plug will be communicated to the Texas Railroad Commission (TRRC) by submitting Form W-3A with detailed plans at least 5 days prior to the beginning of plugging operations. (16 TAC **§5.203(k)(3)(B)**)

2. Bottomhole reservoir pressure will be measured [redacted] (16 TAC **§5.203(k)(2)(B)** [40 CFR ***§*146.92(a)**]).
3. External mechanical integrity will be demonstrated through approved monitoring methods described in *Section 5*. (16 TAC **§5.203(k)(2)(C)** [40 CFR ***§*146.92(a)**])

Figures 6-1 and 6-2 show schematics of the first intermediate isolation plans for Cronos No. 1 and Rhea No. 1, respectively.

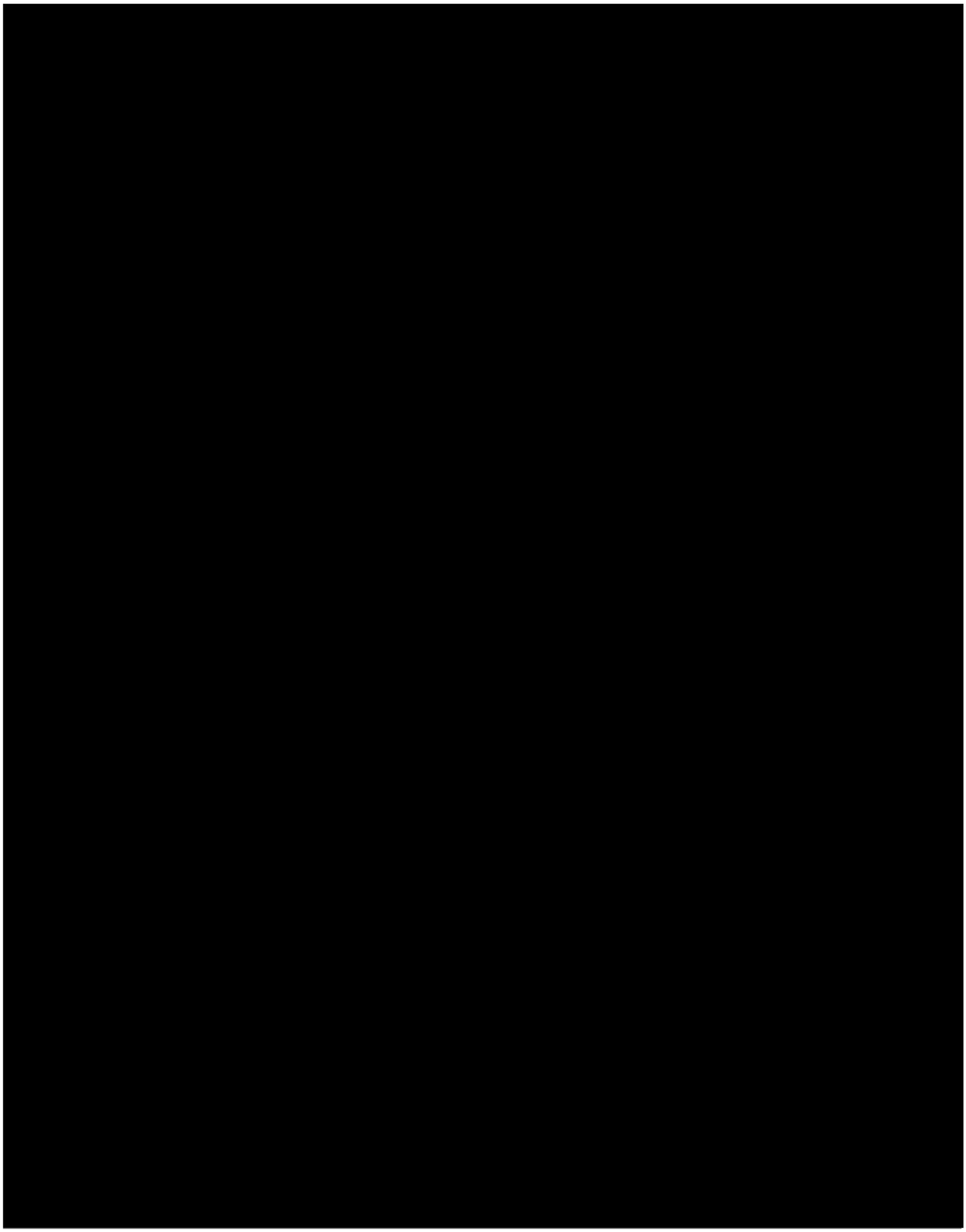

Figure 6-1 – First Plugging Schematic for Cronos No. 1

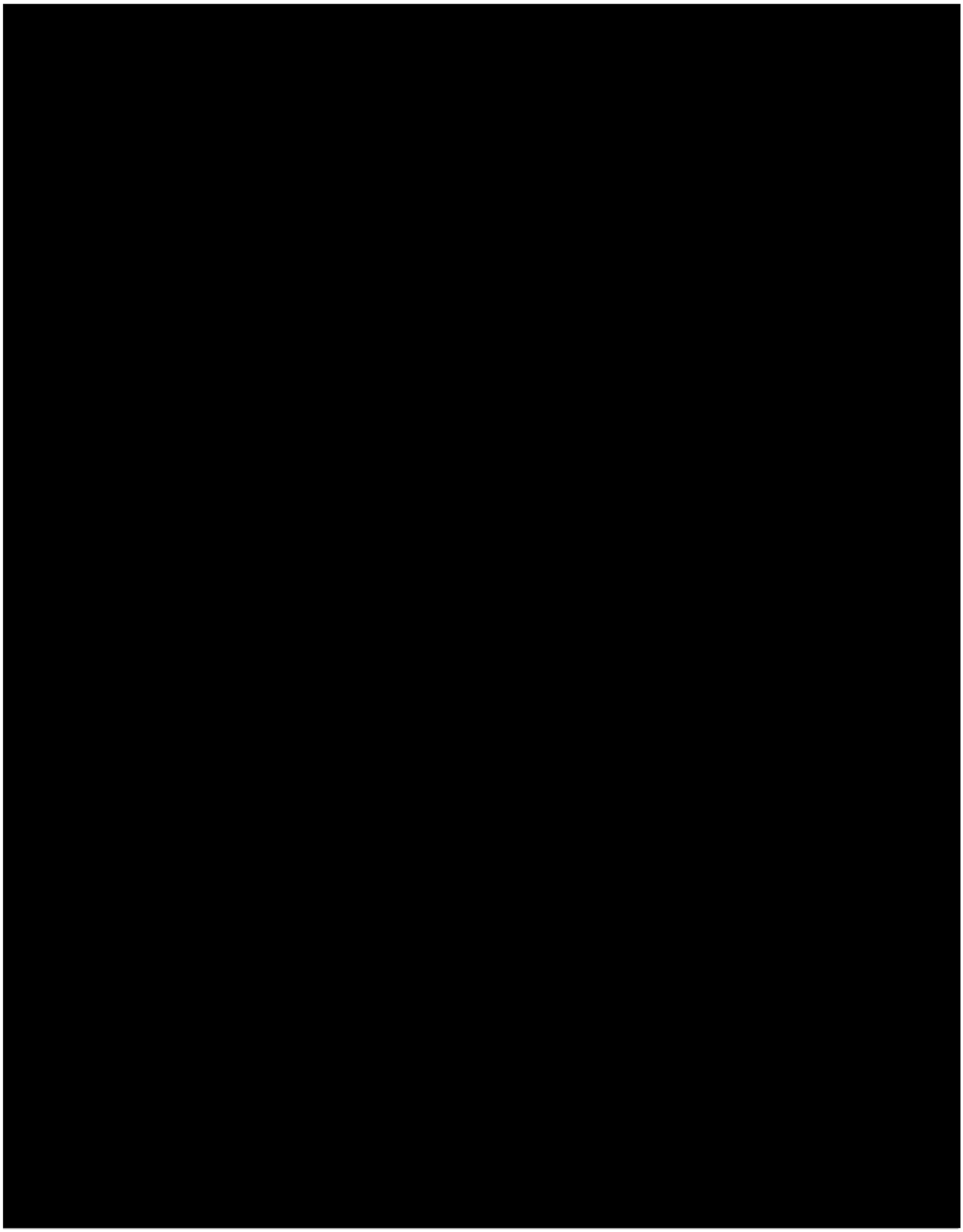

Figure 6-2 – First Plugging Schematic for Rhea No. 1

6.2.1.2 Zonal Isolation Activities

1. A CO_2-compatible barrier will be set above the injection zone to be isolated.
2. The plug will be confirmed by conducting a successful pressure test.
3. The perforations will not be squeezed—to allow for pressure monitoring of the isolated zone during the life of the Titan Project.

6.2.2 Final Zonal Isolation of Injection Zone / Post Injection Monitoring Plugback Plan

When all active injection zones have reached the end of their injection period, the final injection zone will be isolated and abandoned prior to the post injection monitoring phase. The general procedure for final zonal isolation includes the following.

6.2.2.1 Pre-final Zonal Isolation Activities

1. Titan will comply with all reporting and notification provisions.
    a. Titan will notify the Underground Injection Control (UIC) Program director (UIC Director) 60 days before planned plugging efforts. If any changes are proposed to the original well plugging plan, a revised well plugging plan will be submitted. (16 TAC ***§*5.203(k)(3)(A)** [40 CFR ***§*146.92(c)**])
    b. Notice of Intent to Plug will be communicated to the Texas Railroad Commission (TRRC) by submitting Form W-3A with detailed plans at least 5 days prior to the beginning of plugging operations. (16 TAC **§5.203(k)(3)(B)**)
2. Bottomhole reservoir pressure will be measured [redacted] (16 TAC **§5.203(k)(2)(B)** [40 CFR ***§*146.92(a)**]).
3. External mechanical integrity will be demonstrated through approved monitoring methods described in *Section 5*. (16 TAC **§5.203(k)(2)(C)** [40 CFR ***§*146.92(a)**])
4. The injection well will be flushed with a buffer fluid prior to pulling the injection tubing and packer. (16 TAC **§5.203(k)(2)(A)** [40 CFR **§146.92(a)**])
5. All uncemented, nonpermanent components of the well will be removed, as described in Table 6-1.

Table 6-1 – Description of Casing, Tubing, and Other Well-Construction Materials to Be Removed

Well Component	Size	Cronos No. 1 Amount	Rhea No. 1 Amount	Notes / Comments
[redacted]				

Figures 6-3 and 6-4 show schematics of the final zonal isolation plans for Cronos No. 1 and Rhea No. 1, respectively.

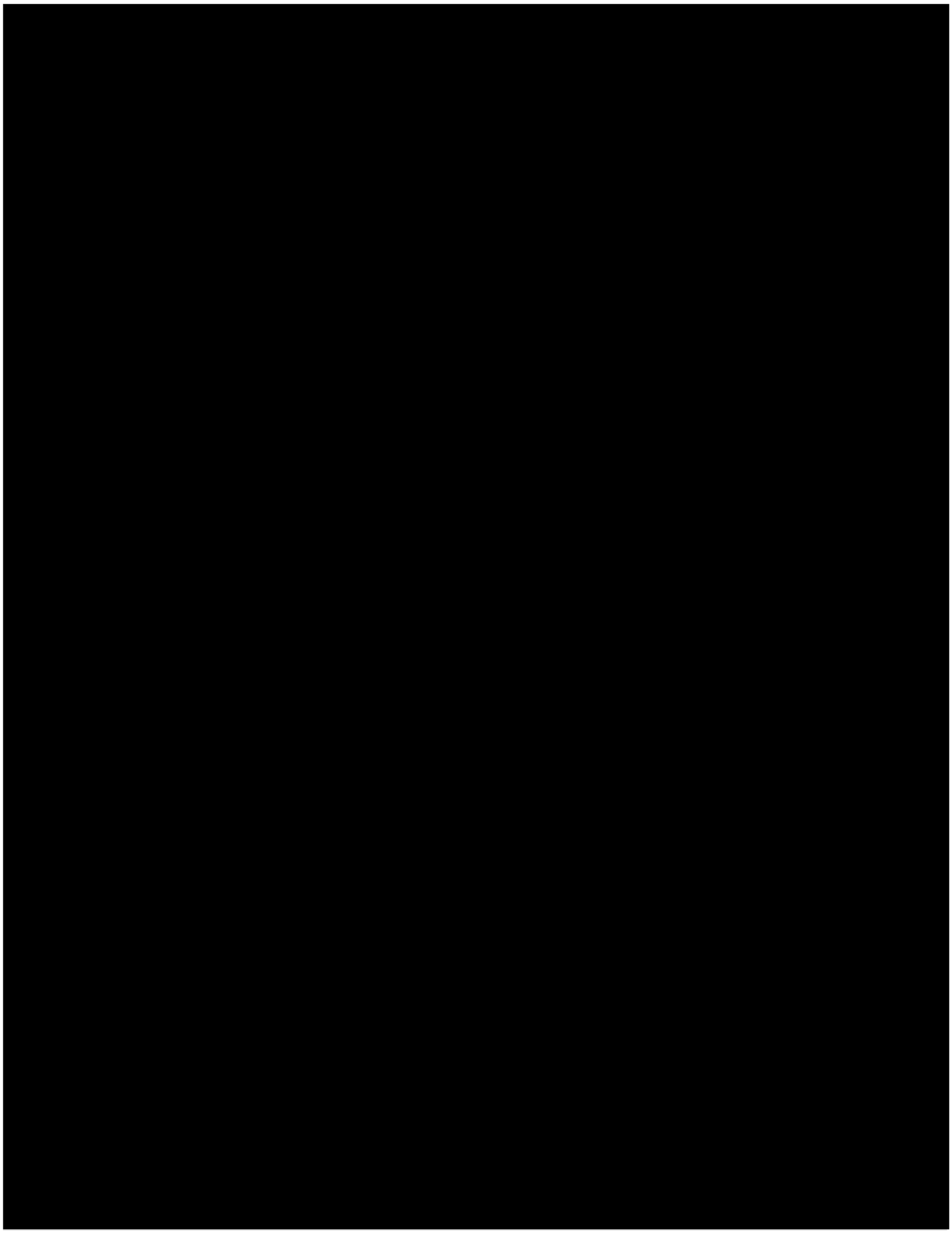

Figure 6-3 – Final Zonal Isolation Plugging Schematic for Cronos No. 1

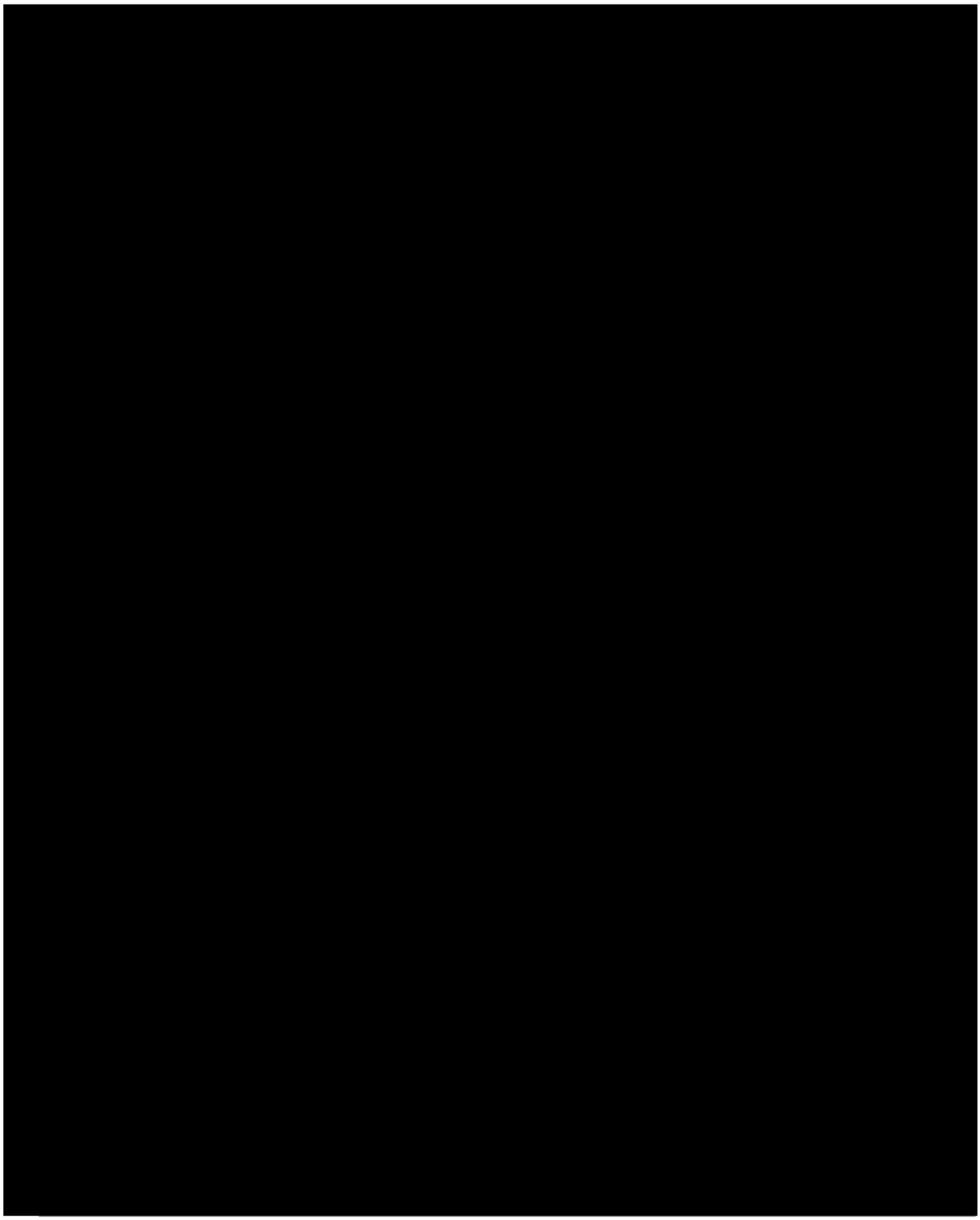

Figure 6-4 – Final Zonal Isolation Plugging Schematic for Rhea No. 1

6.2.2.2 Final Zonal Isolation Activities

1. A CO_2-compatible barrier will be set above the injection zone to be isolated.
2. The plug will be confirmed by conducting a successful pressure test.
3. The perforations will not be squeezed—to allow for pressure monitoring of the isolated zone during the life of the Titan Project.

6.2.3 Final Plugging and Abandonment

After post injection monitoring is complete the injection wells will be prepared for final P&A, the general procedures for which include the following:

6.2.3.1 Pre-plugging Activities

1. Titan will comply with all reporting and notification provisions.
    a. Titan will notify the UIC Director 60 days before planned plugging efforts. If any changes are proposed to the original well plugging plan, a revised well plugging plan will be submitted. (16 TAC ***§*5.203(k)(3)(A)** [40 CFR ***§*146.92(c)**])
    b. Notice of Intent to Plug will be communicated to the TRRC by submitting Form W-3A with detailed plans at least 5 days prior to the beginning of plugging operations. (16 TAC **§5.203(k)(3)(B)**)
2. Bottomhole reservoir pressure will be measured [redacted] (16 TAC **§5.203(k)(2)(B)** [40 CFR ***§*146.92(a)**])
3. External mechanical integrity will be demonstrated through approved monitoring methods described in *Section 5*. (16 TAC **§5.203(k)(2)(C)** [40 CFR ***§*146.92(a)**])
4. Casing inspection and cement bond logs will be performed before plugging.

6.2.3.2 Plugging Procedure, Cronos No. 1

1. Check wellhead pressures; determine bottomhole pressure (BHP) with sensor and record. (16 TAC **§5.203(k)(2)(B)** [40 CFR **§146.92(a)**])
2. Treated fluid will be circulated at least once to achieve a state of static equilibrium.
3. Set a [redacted]-ft cement plug from [redacted] ft below the surface casing setting depth to [redacted] ft into the surface casing shoe.
4. Wait on cement. Tag and test to confirm placement.
5. Set a [redacted]-ft cement plug from [redacted] ft below the base of the USDW to surface. (16 TAC **§3.14(d)(8)**)
6. Cut and cap the casing to a minimum of 3 ft below the mud line. (16 TAC **§3.14(d)(8)**)
7. Rig down and move off the location.
8. Perform site closure requirements. (16 TAC **§5.203(m)** [40 CFR **§146.93(a)**])

6.2.3.3 Plug Details, Cronos No. 1

Tables 6-2 and 6-3 provide the plugging details for Cronos No. 1.

Table 6-2 – Plug Details [redacted] Cronos No. 1

Plug Description	[redacted]
Plug Number	
Diameter of Boring in Which Plug Will Be Placed (in.)	
Depth to Bottom of Tubing or Drill Pipe (ft)	
Sacks of Cement to Be Used (each plug)	
Slurry Volume to Be Pumped (ft^3)	
Slurry Weight (lb/gal)	
Top of Plug (ft)	
Bottom of Plug (ft)	
Type of Cement or Other Material	
Method of Emplacement	
New Plug?	

Table 6-3 – Plug Details [redacted] Cronos No. 1

Plug Description	[redacted]
Plug Number	
Diameter of Boring in Which Plug Will Be Placed (in.)	
Depth to Bottom of Tubing or Drill Pipe (ft)	
Sacks of Cement to Be Used (each plug)	
Slurry Volume to Be Pumped (ft^3)	
Slurry Weight (lb/gal)	
Top of Plug (ft)	
Bottom of Plug (ft)	
Type of Cement or Other Material	
Method of Emplacement	
New Plug?	

Figure 6-5 shows the final plugged schematic for Cronos No. 1.

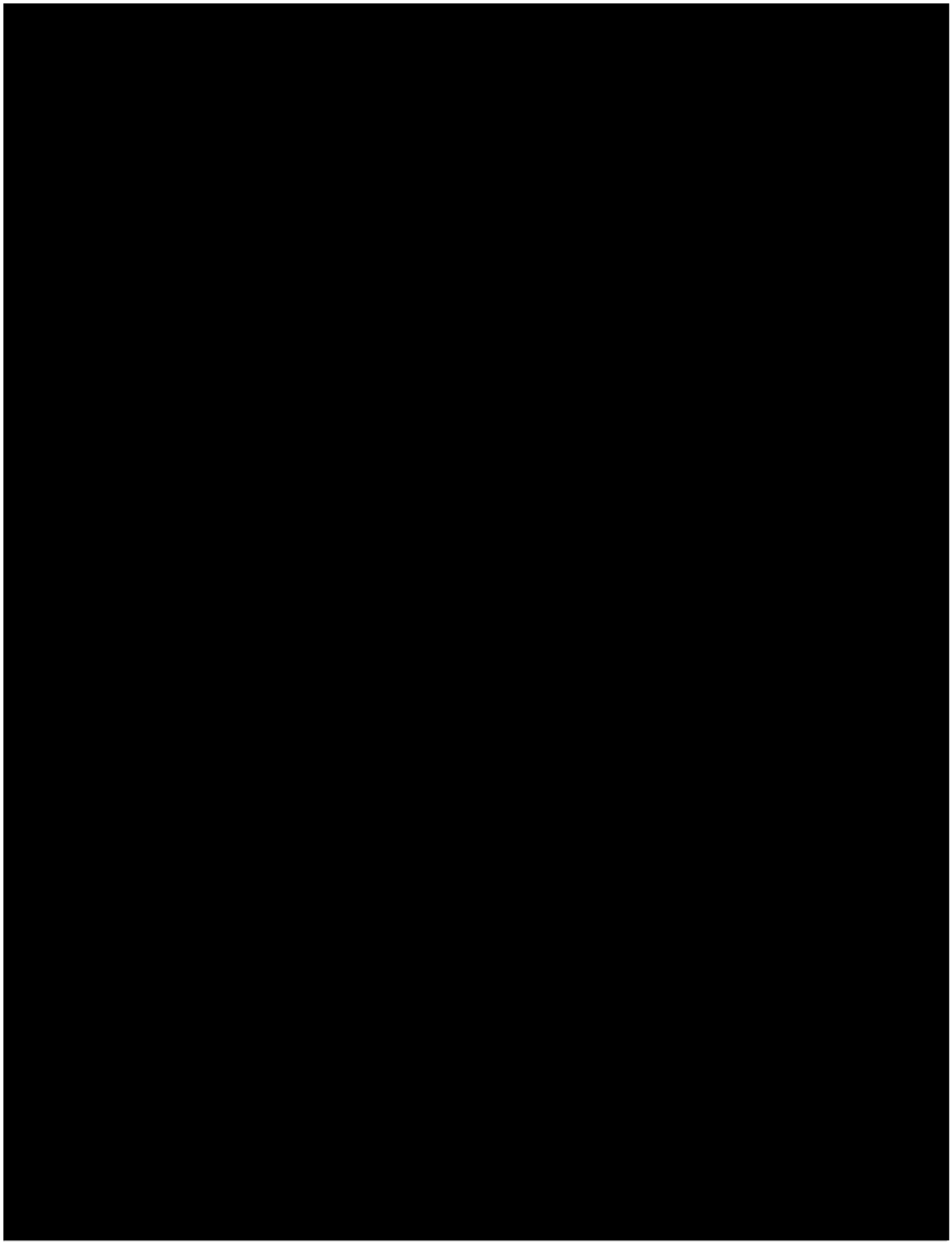

Figure 6-5 – Final Plugging Schematic for Cronos No. 1

6.2.3.4 Plugging Procedure, Rhea No. 1

1. Check wellhead pressures; determine BHP with sensor and record. (16 TAC **§5.203(k)(2)(B)** [40 CFR **§146.92(a)**])
2. Treated fluid will be circulated at least once to achieve a state of static equilibrium.
3. Set a [redacted]-ft cement plug from [redacted] ft below the surface casing setting depth to [redacted] ft into the surface casing shoe.
4. Wait on cement. Tag and test to confirm placement.
5. Set a [redacted]-ft cement plug from [redacted] ft below the base of the USDW to surface. (16 TAC **§3.14(d)(8)**)
6. Cut and cap casing to a minimum of 3 ft below the mud line. (16 TAC **§3.14(d)(8)**)
7. Rig down and move off the location.
8. Perform site closure requirements. (16 TAC **§5.203(m)** [40 CFR **§146.93(a)**])

6.2.3.5 Plug Details, Rhea No. 1

Tables 6-4 and 6-5 provide the plugging details for Rhea No. 1.

Table 6-4 – Plug Details [redacted] Rhea No. 1

Plug Description	[redacted]
Plug Number	
Diameter of Boring in Which Plug Will Be Placed (in.)	
Depth to Bottom of Tubing or Drill Pipe (ft)	
Sacks of Cement to Be Used (each plug)	
Slurry Volume to Be Pumped (ft^3)	
Slurry Weight (lb/gal)	
Top of Plug (ft)	
Bottom of Plug (ft)	
Type of Cement or Other Material	
Method of Emplacement	
New Plug?	

Table 6-5 – Plug Details [redacted] Rhea No. 1

Plug Description	[redacted]
Plug Number	
Diameter of Boring in Which Plug Will Be Placed (in.)	
Depth to Bottom of Tubing or Drill Pipe (ft)	
Sacks of Cement to Be Used (each plug)	
Slurry Volume to Be Pumped (ft^3)	
Slurry Weight (lb/gal)	
Top of Plug (ft)	
Bottom of Plug (ft)	
Type of Cement or Other Material	
Method of Emplacement	
New Plug?	

Figure 6-6 shows the final plugged schematic for Rhea No. 1.

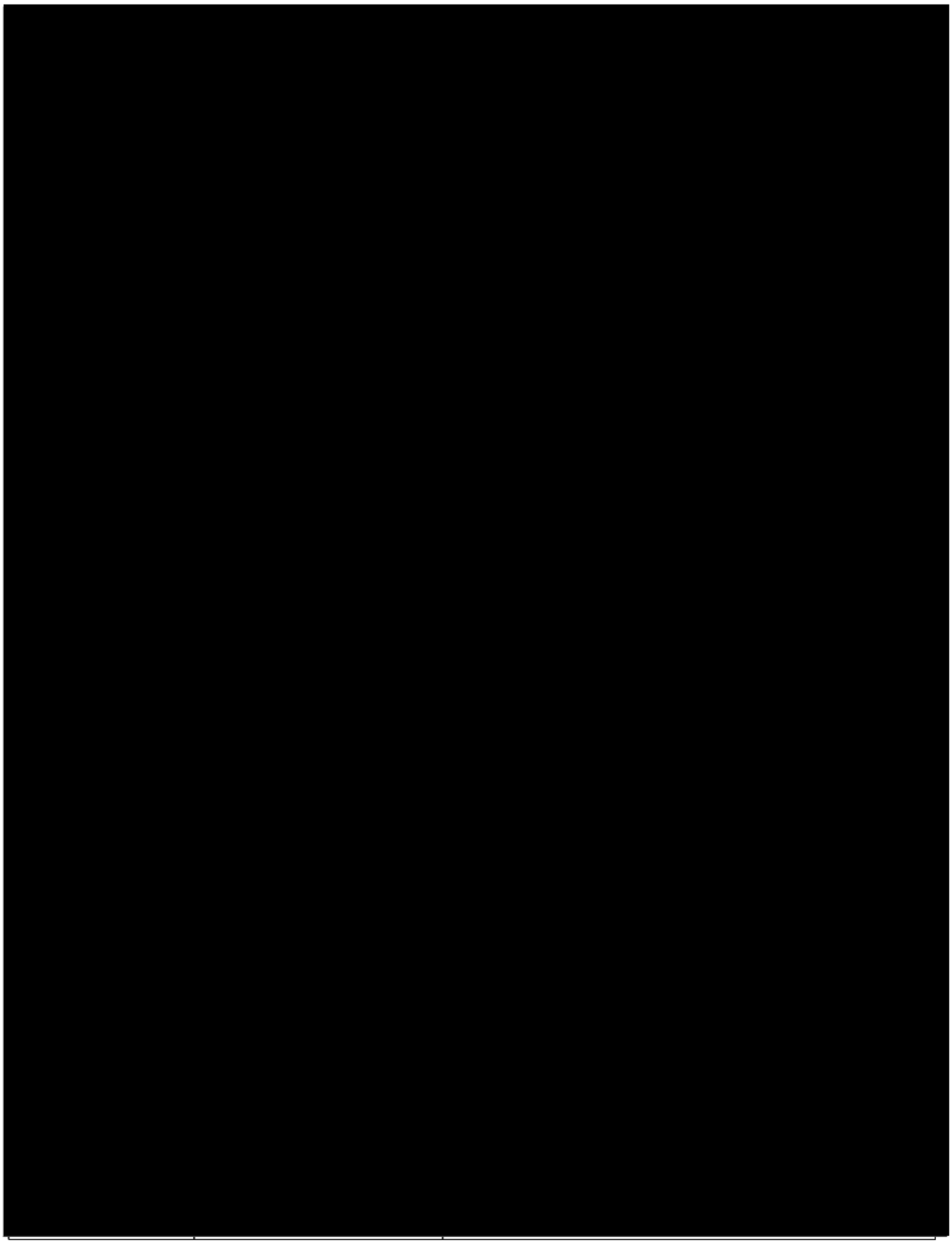

Figure 6-6 – Final Plugging Schematic for Rhea No. 1

6.3 Monitoring Wells Plugging and Abandonment

The following sections outline the plan for the P&A of the monitoring wells associated with the proposed injection wells Cronos No. 1 and Rhea No. 1.

6.3.1 Pre-plugging Activities

Titan will comply with all reporting and notification provisions.

1. Titan will notify the UIC Director 60 days before planned plugging efforts. If any changes are proposed to the original well plugging plan, a revised well plugging plan will be submitted. (16 TAC **§5.203(k)(3)(A)** [40 CFR ***§*146.92(c)**])
2. Notice of Intent to Plug will be communicated to the TRRC by submitting Form W-3A with detailed plans at least 5 days prior to the beginning of plugging operations. (16 TAC **§5.203(k)(3)(B)**)

6.3.2 Plugging Procedure, TCS WM No. 1 and TCS WM No. 2

The two USDW monitoring wells will be plugged by pulling and removing all downhole equipment. Portland cement will then be placed along the entire casing string through a work string. The plugging schematic for TCS WM No. 1 is provided in Figure 6-5, which TCS WM No. 2 will closely follow. The plugging schematics for both wells are provided in *Appendix H-11*.

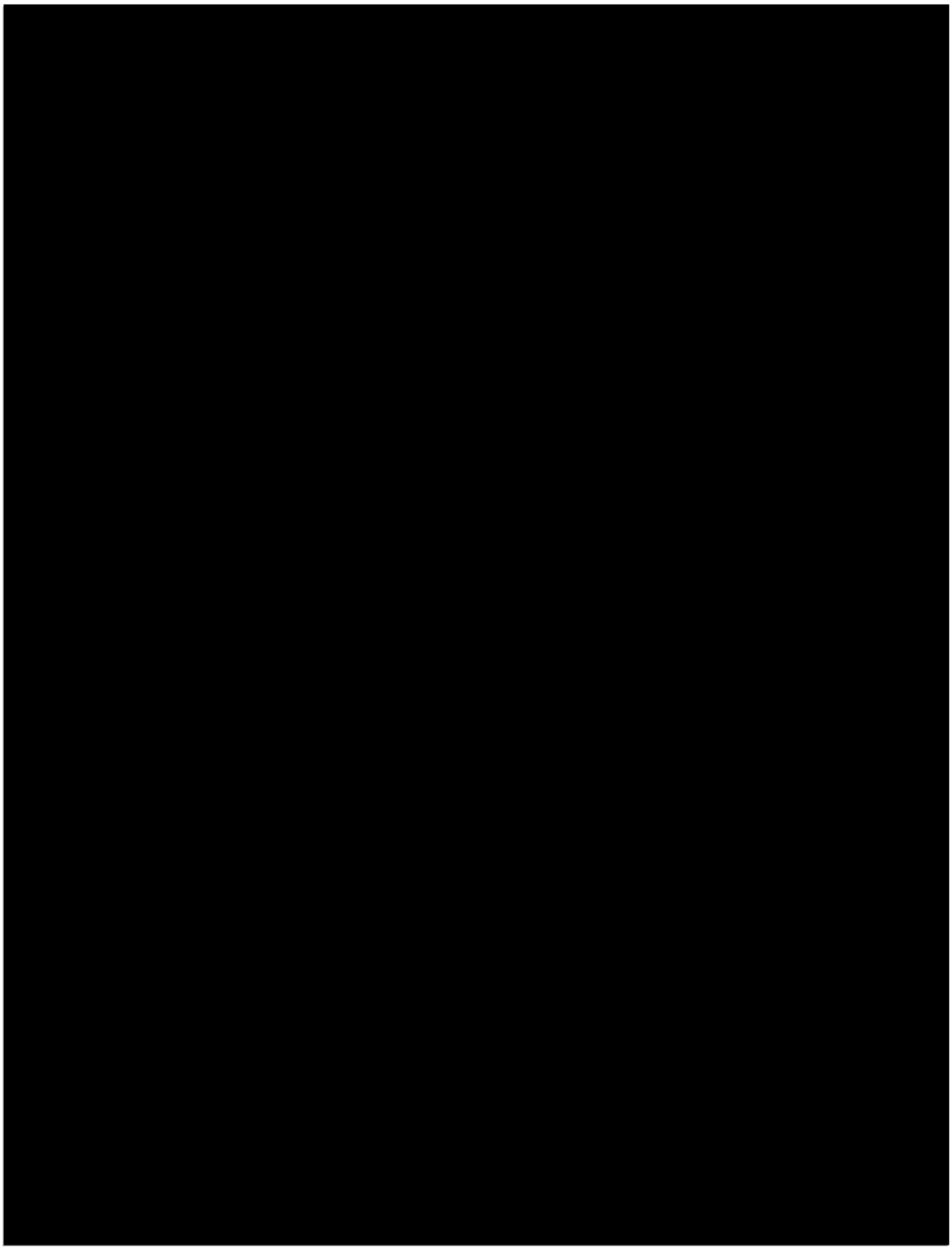

Figure 6-7 – Final Plugging Schematic for TCS WM No. 1

6.3.3 Plugging Procedure, Atlas No. 1

The following is the plugging procedure for above-zone monitoring (AZM) well Atlas No. 1.

1. Move in and rig up workover unit.
2. Check casing and annulus pressures. Record all annuli pressures.
3. Run in hole with work string and circulate the hole clean.
4. Isolate the open monitoring interval.
5. Set a [redacted]-ft cement plug from [redacted] ft below the surface casing setting depth to [redacted] ft into the surface casing shoe.
6. Wait on cement. Tag and test to confirm placement.
7. Set a [redacted]-ft cement plug from [redacted] ft below the base of the USDW to surface. (16 TAC **§3.14(d)(8)**)
8. Cut and cap casing to a minimum of 3 ft below the mud line. (16 TAC **§3.14(d)(8)**)
9. Rig down and move off location.
10. Perform site closure requirements.

Figure 6-8 shows the plugging schematic for Atlas No. 1.

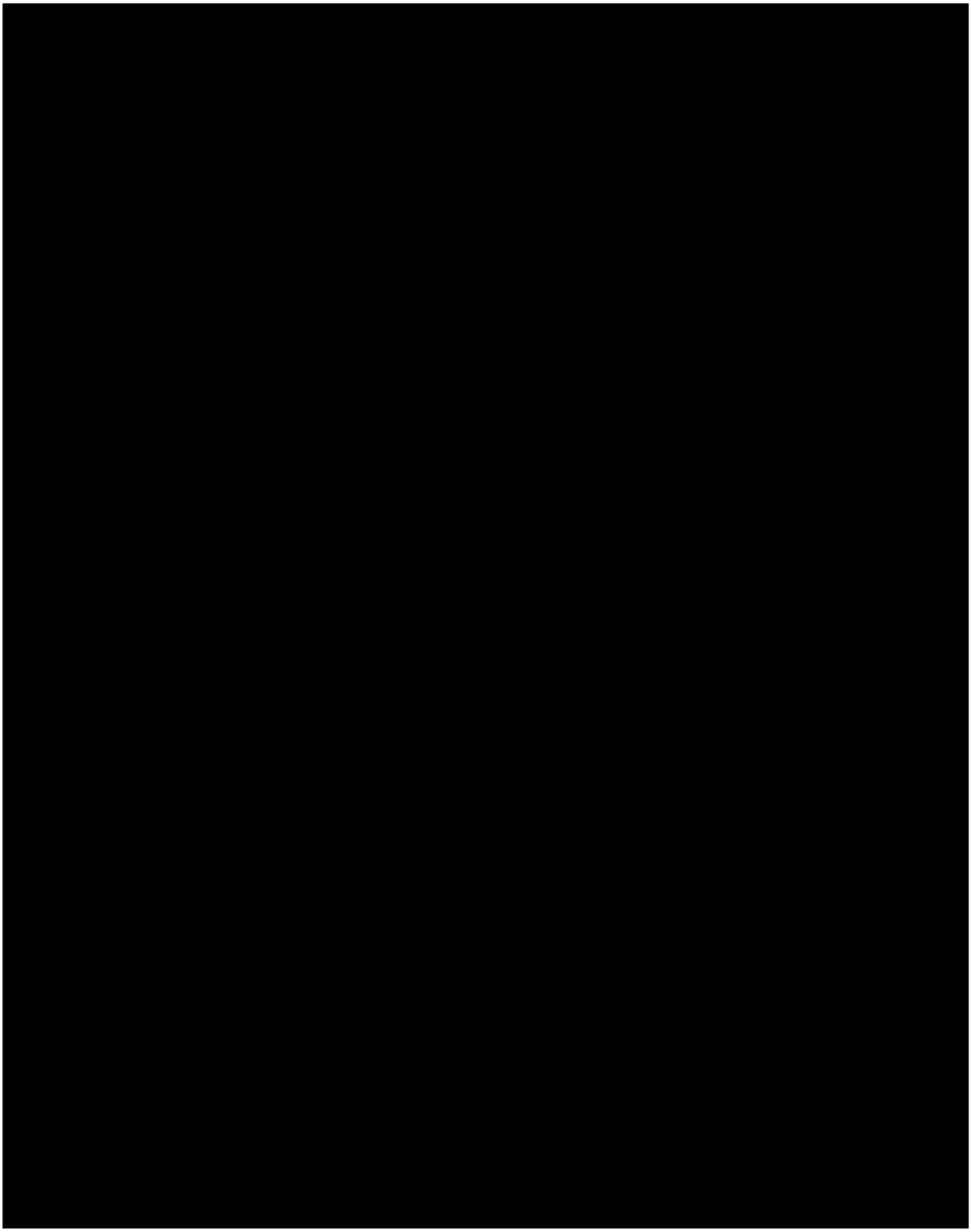

Figure 6-8 – Final Plugging Schematic for Atlas No. 1

6.3.4 Plugging Procedure, Andes No. 1

1. Move in and rig up workover unit.
2. Check casing and annulus pressures. Record all annuli pressures.
3. Run in hole with work string and circulate the hole clean.
4. Isolate the open monitoring interval.
5. Set a -ft cement plug from ft below the surface casing setting depth to ft into the surface casing shoe.
6. Wait on cement. Tag and test to confirm placement.
7. Set a -ft cement plug from ft below the base of the USDW to surface. (16 TAC **§3.14 (d)(8)**)
8. Cut and cap casing to a minimum of 3 ft below the mud line. (16 TAC **§3.14 (d)(8)**)
9. Rig down and move off the location.
10. Perform site closure requirements.

Figure 6-9 shows the plugging schematic for Andes No. 1.

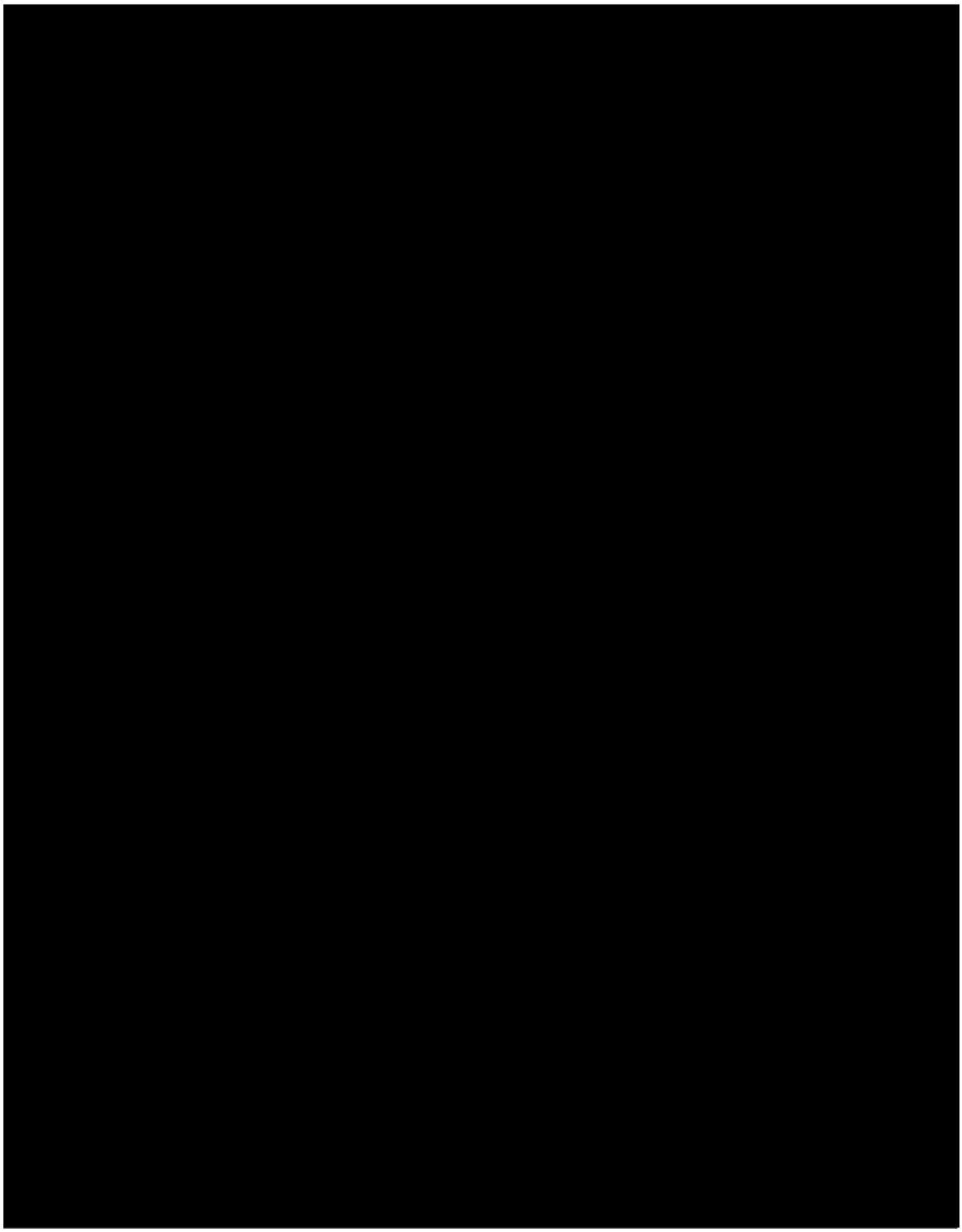

Figure 6-9 – Final Plugging Schematic for Andes No. 1

For each well in the project, final plugging reports—certified by the operator and the person who performed the plugging operation—will be submitted to the UIC Director within 60 days after plugging. Detailed plugging procedures are included in *Appendix H*.

The detailed schematics and procedures in *Appendix H* include the following:

- Appendix H-1 Cronos No. 1 and Rhea No. 1 Zonal Isolation Schematics
- Appendix H-2 Cronos No. 1 and Rhea No. 1 Final Zonal Isolation Schematics
- Appendix H-3 Cronos No. 1 Detailed Plugging Procedure
- Appendix H-4 Rhea No. 1 Detailed Plugging Procedure
- Appendix H-5 Cronos No. 1 and Rhea No. 1 Final P&A Schematics
- Appendix H-6 Atlas No. 1 – Final P&A Procedure
- Appendix H-7 Atlas No. 1 – Final P&A Schematic
- Appendix H-8 Andes No. 1 – Final P&A Procedure
- Appendix H-9 Andes No. 1 – Final P&A Schematic
- Appendix H-10 TCS WM No. 1 and No. 2 – Final P&A Procedures
- Appendix H-11 TCS WM No. 1 and No. 2 – Final P&A Schematics