

ATTACHMENT D: INJECTION WELL PLUGGING PLAN

40 CFR 146.92(b)

CLEAN ENERGY SYSTEMS MENDOTA

1. Facility Information

Facility name: CLEAN ENERGY SYSTEMS
MENDOTA_INJ_1
Facility contact: Rebecca Hollis
400 Guillan Park Drive, Mendota, CA 93640
Office: 916-638-7967
Well location: MENDOTA, FRESNO COUNTY, CA
T13S R15E S32
LAT/LONG COORDINATES (36.75585015/-120.36440423)

Clean Energy Systems will conduct injection well plugging and abandonment according to the procedures below. Upon completion of the project, or at the end of the life of the Mendota_INJ_1 injection well, the well will be plugged and abandoned to meet the requirements of 40 CFR 146.92. The plugging procedure and materials will be designed to prevent any unwanted fluid movement, to resist the corrosive aspects of carbon dioxide/water mixtures, and to protect any USDWs. Any necessary revisions to the well plugging plan to address new information collected during logging and testing of the well will be made after construction, logging, and testing of the well have been completed. The final plugging plan will be submitted to the UIC Program Director.

This attachment is one of the several documents listed below that was prepared by Schlumberger and delivered to Clean Energy Systems. These documents were prepared to support the Clean Energy Systems preconstruction application to the EPA.

- Attachment A: Summary of Requirements Class VI Operating and Reporting Conditions (Schlumberger, 2021a)
- Attachment B: Area of Review and Corrective Action Plan (Schlumberger, 2021b)
- Attachment C: Testing and Monitoring Plan (Schlumberger, 2021c)
- Attachment D: Injection Well Plugging Plan (Schlumberger, 2021d)
- Attachment E: Post-Injection Site Care and Site Closure Plan (Schlumberger, 2021e)
- Attachment F: Emergency and Remedial Response Plan (Schlumberger, 2021f)
- Attachment G: Construction Details (Schlumberger, 2021g)
- Attachment H: Financial Assurance Demonstration (Schlumberger, 2021h)
- Class VI Permit Application Narrative 40 CFR 146.82(A) Clean Energy Systems Mendota (Schlumberger, 2021i)
- Schlumberger Quality Assurance and Surveillance Plan (Schlumberger, 2021j)

Contents

1. Facility Information	1
1.1 Abbreviations	4
2. Planned Tests or Measures to Determine Bottomhole Reservoir Pressure	5
3. Planned Internal Mechanical Integrity Test.....	5
4. Planned External Mechanical Integrity Test(s)	7
4.1 Ultrasonic Imaging Tool and Cement Bond Log (USIT and CBL).....	7
5. Information on Plugs	7
6. Narrative Description of Plugging Procedures	8
6.1 Notifications, Permits, and Inspections.....	8
6.2 Plugging Procedures: Mendota_INJ_1 Proposed Injection Well.....	8
6.3 Plugging Procedures: Mendota_OBS_1 Well.....	12
6.4 Plugging Procedures: Mendota_ACZ_1 Well	15
6.5 Plugging Procedures: Mendota_USDW_1 Well.....	18
6.6 Plugging Procedures: GW_1-4 Wells	20
7. References	22

List of Figures

Figure 1. Mendota_INJ_1 plug and abandonment well diagram.....	11
Figure 2. Mendota_OBS_1 plug and abandonment well schematic.....	14
Figure 3. Mendota_ACZ_1 plug schematic.....	17
Figure 4. Mendota_USDW_1 plug schematic.....	19
Figure 5. Mendota_GW_1-4 plug schematic.....	21

List of Tables

Table 1. Planned mechanical integrity tests (MITs).....	5
Table 2. Plugging details.....	8

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1.1 Abbreviations

CalGEM: California Geologic Energy Management Division
BOP: blowout preventer
CBL: cement bond log
DAS: distributed acoustic sensing
DTS: distributed temperature survey
GL: ground level
Mendota_ACZ_1: above-confining-zone monitoring well
Mendota_GW1-4: nested shallow groundwater monitoring wells
Mendota_INJ_1: proposed CO₂ injection well
Mendota_OBS_1: injection zone monitoring well
Mendota_USDW_1: USDW monitoring well
MIT: mechanical integrity test
UIC: underground injection control
USDW: underground sources of drinking water
USIT: ultrasonic imaging tool

2. Planned Tests or Measures to Determine Bottomhole Reservoir Pressure

Clean Energy Systems will conduct a downhole pressure test to determine reservoir pressure prior to plugging the injection well as required by 40 CFR 146.92(a). Once downhole pressure has been determined, CES will calculate kill fluid density. The test will be run using slickline or electric-line, based on availability.

The downhole pressure gauge procedure is as follows:

- Move in and rig up slickline unit.
- Assemble slickline pressure control equipment and test for leaks.
- Run in hole with downhole quartz gauge.
- Stop at 100 ft and record pressure for 5 minutes.
- Proceed in hole and determine fluid level. Record fluid level depth. Pull up 50 ft and record pressure for 5 minutes.
- Continue running in hole and take station reading every 2,000 ft until reaching perforation depth.
- Record pressure for 60 minutes or until pressure variance is less than 1 psi in 15 minutes.
- Pull out of hole, download data, and confirm proper tool operation.
- Rig down slickline.

3. Planned Internal Mechanical Integrity Test

Clean Energy Systems will conduct the tests listed in Table 1 to verify internal and external mechanical integrity prior to plugging the injection well as required by 40 CFR 146.92(a).

Table 1. Planned mechanical integrity tests (MITs).

Test Description	Location
Surface pressure test	Wellhead
Ultrasonic and cement bond log (CBL)	Wireline well log
Temperature using distributed temperature survey (DTS)	Wireline well log
Acoustic (or noise) log/survey coupled with temperature log/survey	Along wellbore using distributed acoustic sensing (DAS); DAS equivalent, or conventional wireline well log

The surface pressure test procedure is as follows:

- Notify by phone California Department of Conservation a minimum of 24 hours prior to moving in rig as blowout preventer (BOP) testing must be witnessed by regulatory agency. CalGEM permit must be posted on site.
- Prepare location by removing all relevant landscaping/lighting fixtures as well as surface piping and electrical components as needed.

- Move in workover rig and rig up.
- Install BOP equipment and test to rated pressure.
- Pick up workstring with bit and scraper and run in hole to bottom. Tag bottom and record depth. Circulate with well with brine appropriately weighted for bottomhole pressure and suitable for CO₂. Pull out of hole.
- Run in hole with retrievable bridge plug and set plug 20 ft above perforations. Release from plug, pull up 20 ft, then lower tubing and tag plug, apply 5,000-lb weight on plug to confirm it is stationary.
- Raise tubing 30 ft, close surface valves, and apply 1000 psi. Hold for 60 min.
- The pressure test is considered passing if total pressure drop for the test interval is less than 1% of start pressure. Results will be provided to the regulatory agency.
- Pull out of hole.

Contingency: In the event this test fails, CES will revert to other investigative methods as listed in Table 1 (e.g., temperature log using (DTS). Detailed procedures for running these surveys can be found in the Testing and Monitoring Plan (Schlumberger, 2021c).

4. Planned External Mechanical Integrity Test(s)

4.1 Ultrasonic Imaging Tool and Cement Bond Log (USIT and CBL)

The ultrasonic imaging tool (USIT) tool will provide both cement information and casing thickness measurements to determine casing mechanical integrity. The cement bond log (CBL) in conjunction with the USIT provides a comprehensive evaluation of cement quality and coverage.

The USIT and CBL logging procedure is as follows:

- Move in and rig up wireline logging unit.
- Assemble the USIT and CBL tool. Assemble wireline pressure control equipment and test for leaks.
- Ensure well is filled to surface with brine.
- Run in hole and record 500 ft of log.
- Lower tool to total depth and record data to surface. Apply 500 psi of pressure and log to surface.
- Interpret log and determine casing integrity and cement coverage.

5. Information on Plugs

Clean Energy Systems will use the materials and methods noted in Table 2 to plug the injection well. The volume and depth of the plug or plugs will depend on the final geology and downhole conditions of the well as assessed during construction. The cement(s) formulated for plugging will be compatible (i.e., CO₂-resistant cement) with the stored carbon dioxide and water mixtures where exposure may occur. The cement formulation and required certification documents will be submitted to the agency with the well plugging plan. Clean Energy Systems will report the wet density and will retain duplicate samples of the cement used for each plug. Cement volumes will be calculated using industry accepted equations for cement volumes, using openhole diameter, casing size, annular areas, and total length of cement plugs, not inclusive.

Table 2. Plugging details.

Plug Information	Plug #1	Plug #2	Plug #3	Plug #4
Diameter of boring in which plug will be placed (in)	5.92	5.92	5.92	5.92
Depth to bottom of tubing or drill pipe (ft)	9637	7782	1900	100
Sacks of cement to be used for each plug (sk)	145	51	51	20
Slurry volume to be pumped (bbl)	28	11	22	4
Slurry weight (lb/gal)	15.8	15.8	15.8	15.8
Calculated top of plug (ft)	8837	7382	1509	0
Bottom of plug (ft)	9637	7532	1900	100
Type of cement or other material	CO ₂ Resistant	Class G	Class G	Class G
Method of emplacement (e.g., balance method, retainer method, or two-plug method)	Balanced	Balanced	Balanced	Balanced

6. Narrative Description of Plugging Procedures

6.1 Notifications, Permits, and Inspections

In compliance with 40 CFR 146.92(c), Clean Energy Systems will notify the regulatory agency at least 60 days before plugging the well and provide an updated version of this document (Schlumberger, 2021d), if applicable. Notification to State regulatory agencies will be provided, and all required State permits will be acquired prior to starting operations.

The procedures described below are subject to modification during execution as necessary to ensure a plugging operation that protects worker safety and is effective to protect USDWs. Any significant modifications due to unforeseen circumstances will be described in the plugging report. The completed plugging report with charts and all laboratory information will be sent to the regulatory agency as required by permit. The plugging report shall be certified as accurate by CES and plugging contractor and shall be submitted within 60 days after plugging is completed.

6.2 Plugging Procedures: Mendota_INJ_1 Proposed Injection Well

- Notify by phone California Department of Conservation and EPA region 9 a minimum of 24 hours prior to moving in rig.
- Prepare location by removing all relevant landscaping/lighting fixtures as well as surface piping and electrical components as needed.

- Move in workover rig and rig up.
- Install BOP equipment and test to rated pressure.
- Pick up tubing and go to bottom.
- Circulate well clean with 9.4-ppg NaCl brine with corrosion inhibitor.
- Rig up wireline unit and go in hole with gauge ring for 7-in, 38-lb casing (casing drift 5.92 in). Make note of where fluid is tagged.
- Pick up wireline-set 13 Cr bridge plug and trip in hole. Set plug at $\pm 9,637$ ft. Rig down wireline.
- Nipple up pack off on top of tubing head dressed for 3 ½-in tubing.
- Pick up existing 3 ½-in tubing and trip in hole to 9,637ft.
- Tag bridge plug and apply 5,000 lb weight on bridge plug to make sure it is stationary. Raise tubing 5 ft.
- Rig cementers to well. Depending upon where fluid level was noted, either go directly to mixing cement or mix 9.4-ppg NaCl brine with corrosion inhibitor to circulate well. Plan to mix brine if fluid level was lower than 115 ft below surface.
- Pump 10-bbl fresh water and then mix and pump 28-bbl CO₂-resistant cement with .5% dispersant. Mix at 15.8 ppg and yield 1.08 ft³/sk. Displace cement to spot as balanced plug. Trip out of the hole 100 ft above the plug and circulate well to clean cement from tubing.
- Wait 8 hours. Trip in and tag top of plug with ~ 10,000 lb to make sure the plug is set.
- Pull back 10 ft and close in annulus and pressure well 1,000 psi above normal surface pressure.
- Close tubing and monitor pressure in tubing and tubular annulus. Record pressures every 5 minutes.
- Pressure should be maintained $\pm 5\%$ for 30 minutes. If not, there may need to be a waiting period before testing the cement again 4 hours later.
- Trip out of hole laying down workstring to ± 7532 ft.
- Pump 10-bbl fresh water and then mix and pump 11-bbl Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 ft³/sk. Displace cement to spot as balanced plug.
- Trip out of the hole 100 ft above the plug and circulate well to clean cement from tubing.
- Wait 8 hours. Trip in and tag top of plug with ~ 10,000 lb to make sure plug is set.
- Pull back 10 ft and close in annulus and pressure well 500 psi above normal surface pressure.
- Close tubing and monitor pressure in tubing and tubular annulus. Record pressures every 5 minutes.
- Pressure should be maintained $\pm 5\%$ for 30 minutes. If not, there may need to be a waiting period before testing the cement again 4 hours later.
- Trip out of hole laying down workstring to $\pm 1,900$ ft. Pump 10-bbl fresh water and then mix and pump 22-bbl Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 ft³/sk. Displace cement to spot as balanced plug.
- Trip out of the hole 100 ft above the plug and circulate well to clean cement from tubing.
- Wait 8 hours. Trip in and tag top of plug with ~ 10,000 lb to make sure plug is set.
- Pull back 10 ft and close in annulus and pressure well 500 psi above normal surface pressure.
- Close tubing and monitor pressure in tubing and tubular annulus. Record pressures every 5 minutes.

- Pressure should be maintained $\pm 5\%$ for 30 minutes. If not, there may need to be a waiting period before testing the cement again 4 hours later.
- Trip out of hole laying down workstring to ± 100 ft.
- Pump 5-bbl fresh water and then mix and pump 4-bbl Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 ft³/sk. Displace cement to spot as balanced plug. Pull 3 ½-in tubing out of hole, laying it down onto a flatbed.
- Cut off casing strings and casing heads and wellhead. Cut flush with current grade. Final grade -1 ft below GL needs to be visible.
- Top off 7-in casing, if necessary, with sacked cement.
- Weld plate over top of well. Plate needs to be visible.
- Rig down workover rig and move out.

Contingency: Should any plug not pass the pressure test or hardness test, a sample of the slurry shall be sent to the cementing company's laboratory for analysis. Further, all pumping and mixing equipment shall be inspected for contamination or malfunction and appropriate corrective actions will be applied. A new batch of cement shall be blended and used on subsequent pumping operations. The previous plug will be drilled out, tubing will be placed accordingly, and a new plug will be pumped using the most recently designed cement chemistry. These remedial actions will be repeated until the plugging operation is completed.

Figure 1 shows the plug and abandonment well diagram for the Mendota_INJ_1 well.

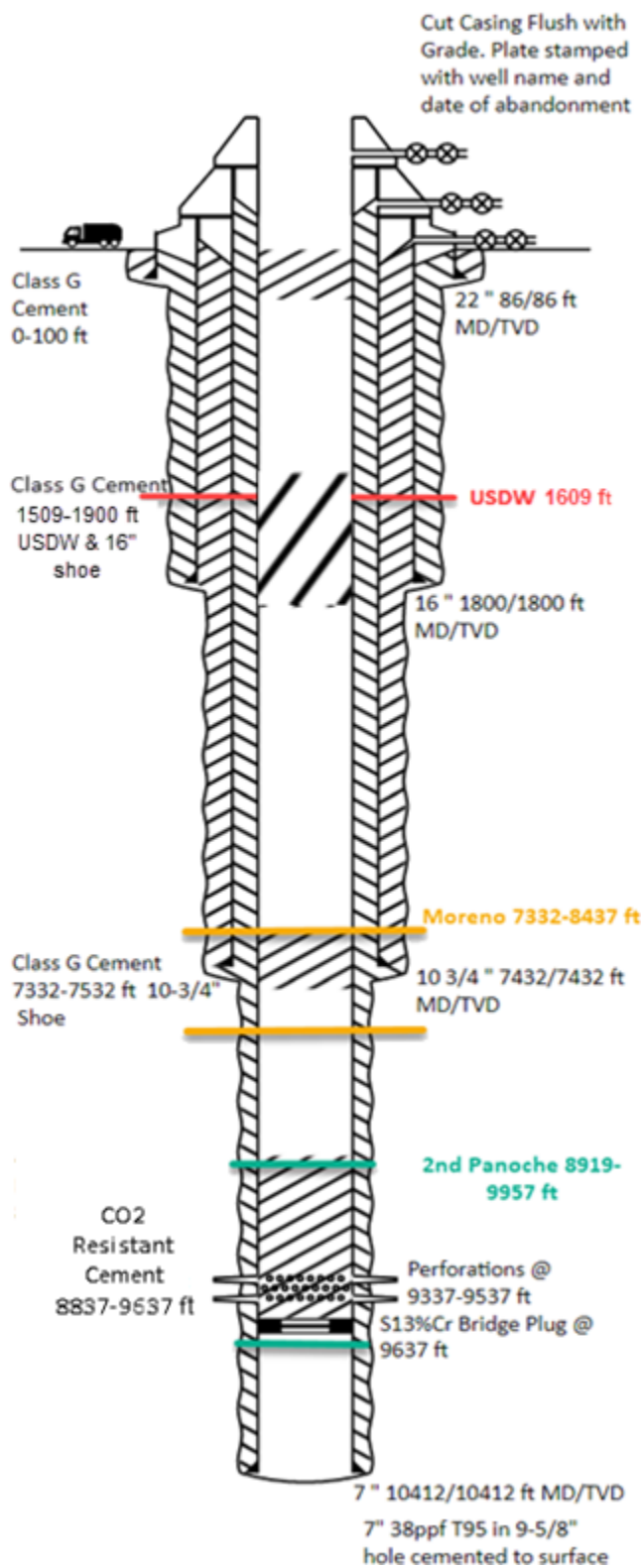


Figure 1. Mendota_INJ_1 plug and abandonment well diagram.

6.3 Plugging Procedures: Mendota_OBS_1 Well

- Notify by phone California Department of Conservation and EPA region 9 a minimum of 24 hours prior to moving in rig.
- Prepare location by removing all relevant landscaping/lighting fixtures as well as surface piping and electrical components as needed.
- Move in workover rig and rig up.
- Install BOP equipment and test to rated pressure.
- Pick up tubing and go to bottom.
- Circulate well clean with 9.4-ppg NaCl brine with corrosion inhibitor.
- Rig up wireline unit and go in hole with gauge ring for 5-1/2-in, 23-lb casing (casing drift 4.670 in). Make note of where fluid is tagged.
- Pick up wireline-set 13 Cr bridge plug and trip in hole. Set plug at ± 9486 ft. Rig down wireline.
- Nipple up pack off on top of tubing head dressed for 2-3/8-in tubing.
- Pick up existing 2 3/8-in tubing and trip in hole to 9,486 ft.
- Tag bridge plug and apply 5,000 lb weight on bridge plug to make sure it is stationary. Raise tubing 5 ft.
- Rig cementers to well. Depending upon where fluid level was noted, either go directly to mixing cement or mix 9.4-ppg NaCl brine with corrosion inhibitor to circulate well. Plan to mix brine if fluid level was lower than 115 ft below surface.
- Pump 10-bbl fresh water and then mix and pump 16-bbl CO₂-resistant cement with .5% dispersant. Mix at 15.8 ppg and yield 1.08 ft³/sk. Displace cement to spot as balanced plug.
- Trip out of the hole 100 ft above the plug and circulate well to clean cement from tubing.
- Wait 8 hours. Trip in and tag top of plug with $\sim 10,000$ lb to make sure plug is set.
- Pull back 10 ft and close in annulus and pressure well 500 psi above normal surface pressure.
- Close tubing and monitor pressure in tubing and tubular annulus. Record pressures every 5 minutes.
- Pressure should be maintained $\pm 5\%$ for 30 minutes. If not, there may need to be a waiting period before testing the cement again 4 hours later.
- Trip out of hole laying down workstring to $\pm 1,800$ ft.
- Pump 10-bbl fresh water and then mix and pump 7-bbl Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 ft³/sk. Displace cement to spot as balanced plug.
- Trip out of the hole 100 ft above the plug and circulate well to clean cement from tubing.
- Wait 8 hours. Trip in and tag top of plug with $\sim 10,000$ lb to make sure plug is set.
- Pull back 10 ft and close in annulus and pressure well 1,000 psi above normal surface pressure.
- Close tubing and monitor pressure in tubing and tubular annulus. Record pressures every 5 minutes.
- Pressure should be maintained $\pm 5\%$ for 30 minutes. If not, there may need to be a waiting period before testing the cement again 4 hours later.
- Trip out of hole laying down workstring to ± 100 ft.

- Pump 5-bbl fresh water and then mix and pump 2-bbl Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 ft³/sk. Displace cement to spot as balanced plug. Pull 2 3/8-in tubing out of hole, laying it down onto a flatbed.
- Cut off casing strings and casing heads and wellhead. Cut flush with current grade. Final grade -1 ft below GL needs to be visible.
- Top off 5-1/2-in casing, if necessary, with sacked cement.
- Weld plate over top of well. Plate needs to be visible.
- Rig down workover rig and move out.

Contingency: Should any plug not pass the pressure test or hardness test, a sample of the slurry shall be sent to the cementing company's laboratory for analysis. Further, all pumping and mixing equipment shall be inspected for contamination or malfunction and appropriate corrective actions will be applied. A new batch of cement shall be blended and used on subsequent pumping operations. The previous plug will be drilled out, tubing will be placed accordingly, and a new plug will be pumped using the most recently designed cement chemistry. These remedial actions will be repeated until the plugging operation is completed

Figure 2 shows the plug and abandonment well diagram for the Mendota_OBS_1 well.

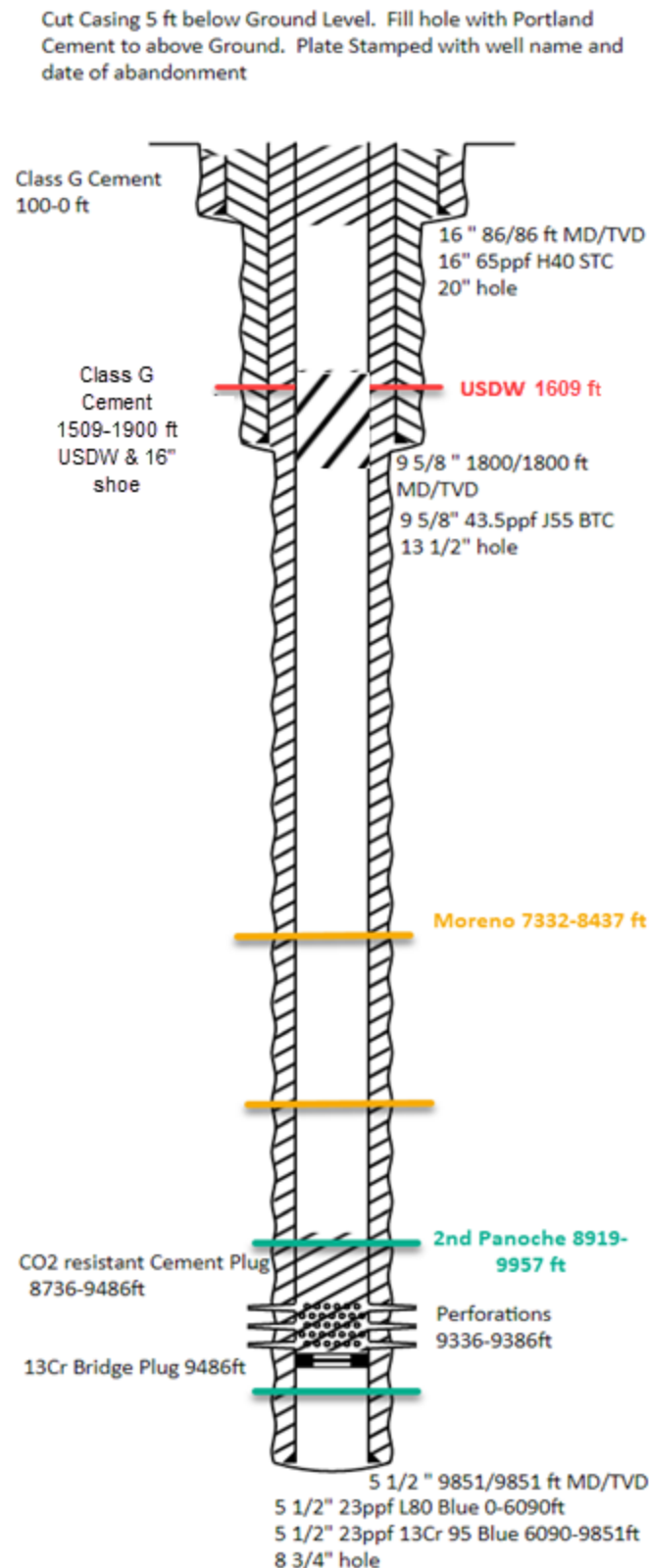


Figure 2. Mendota_OBS_1 plug and abandonment well schematic.

6.4 Plugging Procedures: Mendota_ACZ_1 Well

- Notify by phone California Department of Conservation and EPA Region 9 a minimum of 24 hours prior to moving in rig.
- Prepare location by removing all relevant landscaping/lighting fixtures as well as surface piping and electrical components as needed.
- Move in workover rig and rig up.
- Install BOP equipment and test to rated pressure.
- Pick up tubing and go to bottom.
- Circulate well clean with 9.4-ppg NaCl brine with corrosion inhibitor.
- Rig up wireline unit and go in hole with gauge ring for 5 ½-in, 17-lb casing (casing drift 4.892 in). Make note of where fluid is tagged.
- Nipple up pack off on top of tubing head dressed for 2 3/8-in tubing.
- Pick up existing 2 3/8-in tubing and trip in hole to 7,332 ft.
- Bring cementers to well. Depending upon where fluid level was noted, either go directly to mixing cement or mix 8.6-ppg NaCl brine with corrosion inhibitor to circulate well. Plan to mix brine if fluid level was lower than 115 ft below surface.
- Pump 10-bbl fresh water and then mix and pump 14.5 bbl-Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.08 ft³/sk. Displace cement to spot as balanced plug.
- Trip out of the hole 100 ft above the plug and circulate well to clean cement from tubing.
- Wait 8 hours. Trip in and tag top of plug with ~ 10,000 lb to make sure plug is set.
- Pull back 10 ft and close in annulus and pressure well 1,000 psi above normal surface pressure.
- Close tubing and monitor pressure in tubing and tubular annulus. Record pressures every 5 minutes.
- Pressure should be maintained ±5% for 30 minutes. If not, there may need to be a waiting period before testing the cement again 4 hours later.
- Trip out of hole laying down workstring to ±1,800ft.
- Pump 10-bbl fresh water and then mix and pump 7-bbl Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 ft³/sk. Displace cement to spot as balanced plug.
- Trip out of the hole 100 ft above the plug and circulate well to clean cement from tubing.
- Wait 8 hours. Trip in and tag top of plug with ~ 10,000 lb to make sure plug is set.
- Pull back 10 ft and close in annulus and pressure well 500 psi above normal surface pressure.
- Close tubing and monitor pressure in tubing and tubular annulus. Record pressures every 5 minutes
- Pressure should be maintained ±5% for 30 minutes. If not, there may need to be a waiting period before testing the cement again 4 hours later.
- Trip out of hole laying down workstring to ±100 ft.
- Pump 5-bbl fresh water and then mix and pump 2-bbl Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 ft³/sk. Displace cement to spot as balanced plug. Pull 2 3/8-in tubing out of hole, laying it down onto flatbed.
- Cut off casing strings and casing heads and wellhead. Cut flush with current grade. Final grade -1 ft below GL needs to be visible.
- Top off 5 ½-in casing, if necessary, with sacked cement.

- Weld plate over top of well. Plate needs to be visible.
- Rig down workover rig and move out.

Contingency: Should any plug not pass the pressure test or hardness test, a sample of the slurry shall be sent to the cementing company's laboratory for analysis. Further, all pumping and mixing equipment shall be inspected for contamination or malfunction and appropriate corrective actions will be applied. A new batch of cement shall be blended and used on subsequent pumping operations. The previous plug will be drilled out, tubing will be placed accordingly, and a new plug will be pumped using the most recently designed cement chemistry. These remedial actions will be repeated until the plugging operation is completed

Figure 3 shows the plug and abandonment diagram for the Mendota_ACZ_1 well.

Cut Casing 5 ft below Ground Level. Fill hole with Portland Cement to above Ground. Plate Stamped with well name and date of abandonment

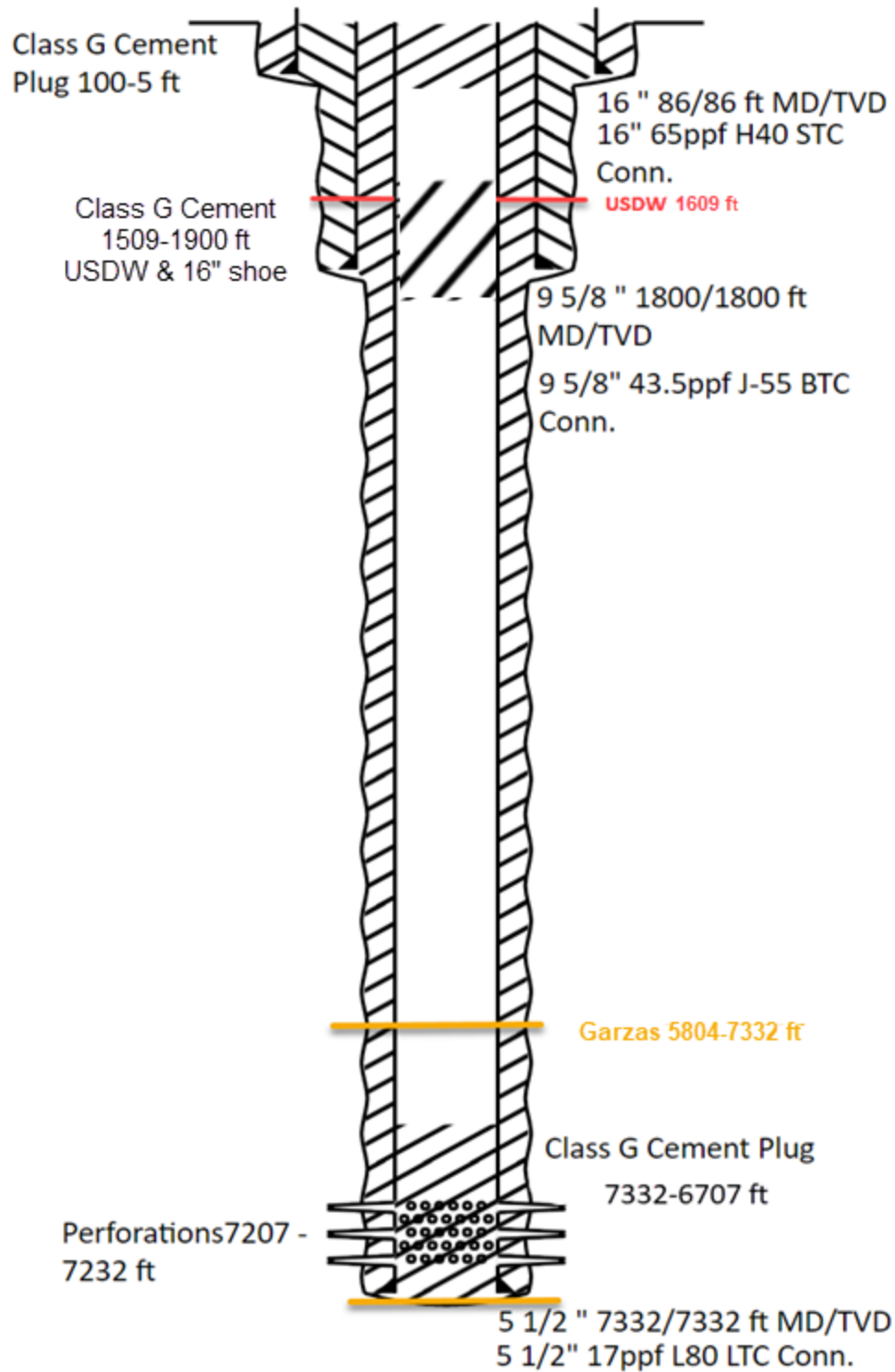


Figure 3. Mendota_ACZ_1 plug schematic.

6.5 Plugging Procedures: Mendota_USDW_1 Well

- Notify by phone California Department of Conservation and EPA Region 9 a minimum of 24 hours prior to moving in rig.
- Prepare location by removing all relevant landscaping/lighting fixtures as well as surface piping and electrical components as needed.
- Move in workover rig and rig up.
- Install BOP equipment and test to rated pressure.
- Prehydrate bentonite.
- Pick up tubing and go to bottom.
- Circulate well clean with fresh water.
- Rig up wireline unit and go in hole with gauge ring for 5 ½-in, 17-lb casing (casing drift 4.892 in). Make note of where fluid is tagged.
- Nipple up pack off on top of tubing head dressed for 2 3/8-in tubing.
- Pick up existing 2 3/8-in tubing and trip in hole to 1,709 ft.
- Bring cementers to well. Depending upon where fluid level was noted, either go directly to mixing cement or mix fresh water to circulate well.
- Pump 5-bbl fresh water and then mix and pump 40-bbl bentonite/cement. Mix at 15.8 ppg and yield 1.14 ft³/sk. Displace cement to spot as balanced plug.
- Wait 8 hours. Tag top of plug to make sure plug is set.

Contingency: Should any plug not pass the pressure test or hardness test, a sample of the slurry shall be sent to the cementing company's laboratory for analysis. Further, all pumping and mixing equipment shall be inspected for contamination or malfunction and appropriate corrective actions will be applied. A new batch of cement shall be blended and used on subsequent pumping operations. The previous plug will be drilled out, tubing will be placed accordingly, and a new plug will be pumped using the most recently designed cement chemistry. These remedial actions will be repeated until the plugging operation is completed

Figure 4 shows the plug schematic for the Mendota_USDW_1 well.

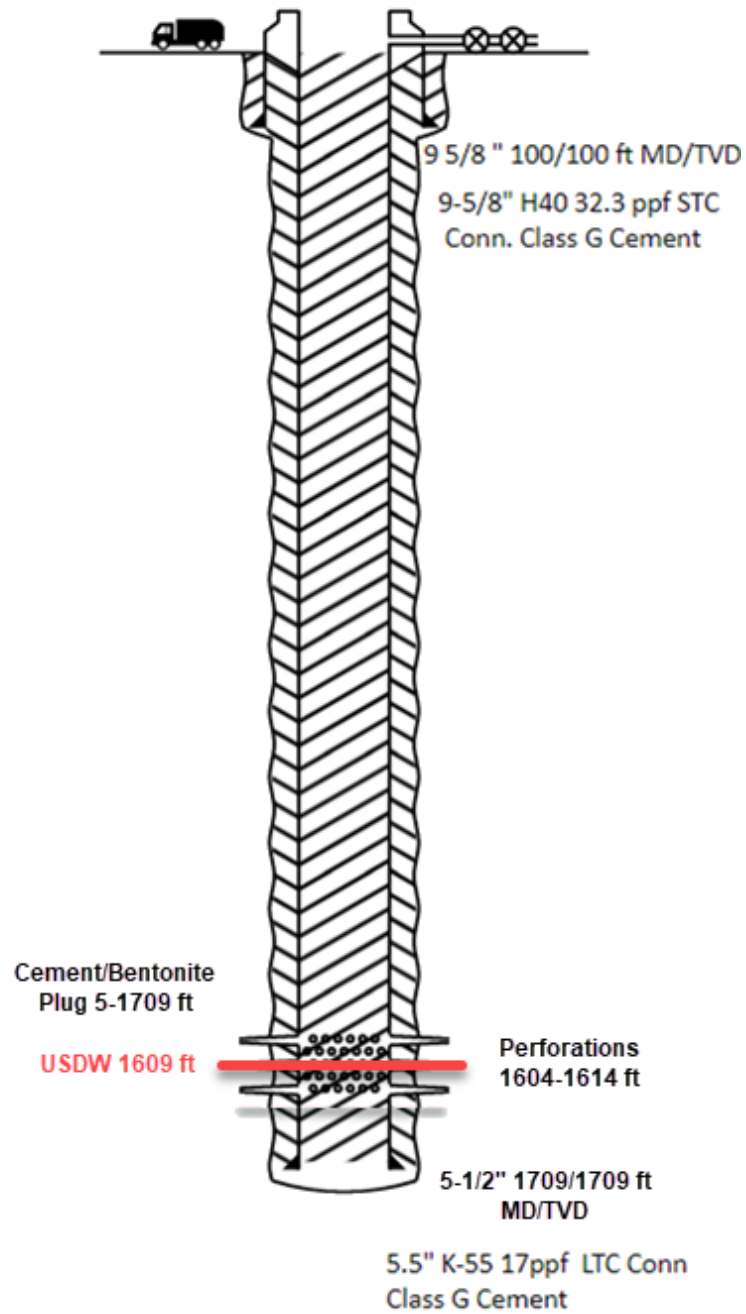


Figure 4. Mendota_USDW_1 plug schematic.

6.6 Plugging Procedures: GW_1-4 Wells

- Prepare location by removing all relevant landscaping/lighting fixtures as well as surface piping and electrical components as needed.
- Move in equipment and rig up.
- Notify by phone California Department of Conservation and EPA Region 9 a minimum of 24 hours prior to moving in equipment.
- Prehydrate bentonite.
- Circulate well clean with fresh water.
- Run tubing/hose
- Inject 2.25-bbl bentonite/cement mix at 15.8 ppg and yield 1.14 ft³/sk.
- Wait 8 hours. Tag top of plug to make sure plug is set.

Contingency: Should any plug not pass the pressure test or hardness test, a sample of the slurry shall be sent to the cementing company's laboratory for analysis. Further, all pumping and mixing equipment shall be inspected for contamination or malfunction and appropriate corrective actions will be applied. A new batch of cement shall be blended and used on subsequent pumping operations. The previous plug will be drilled out, tubing will be placed accordingly, and a new plug will be pumped using the most recently designed cement chemistry. These remedial actions will be repeated until the plugging operation is completed

Figure 5 shows the plug schematic for the Mendota_GW_1-4 wells.

Cut Casing 5 ft below Ground level. Fill hole with Portland Cement to above Ground. Plate Stamped with well name and date of abandonment

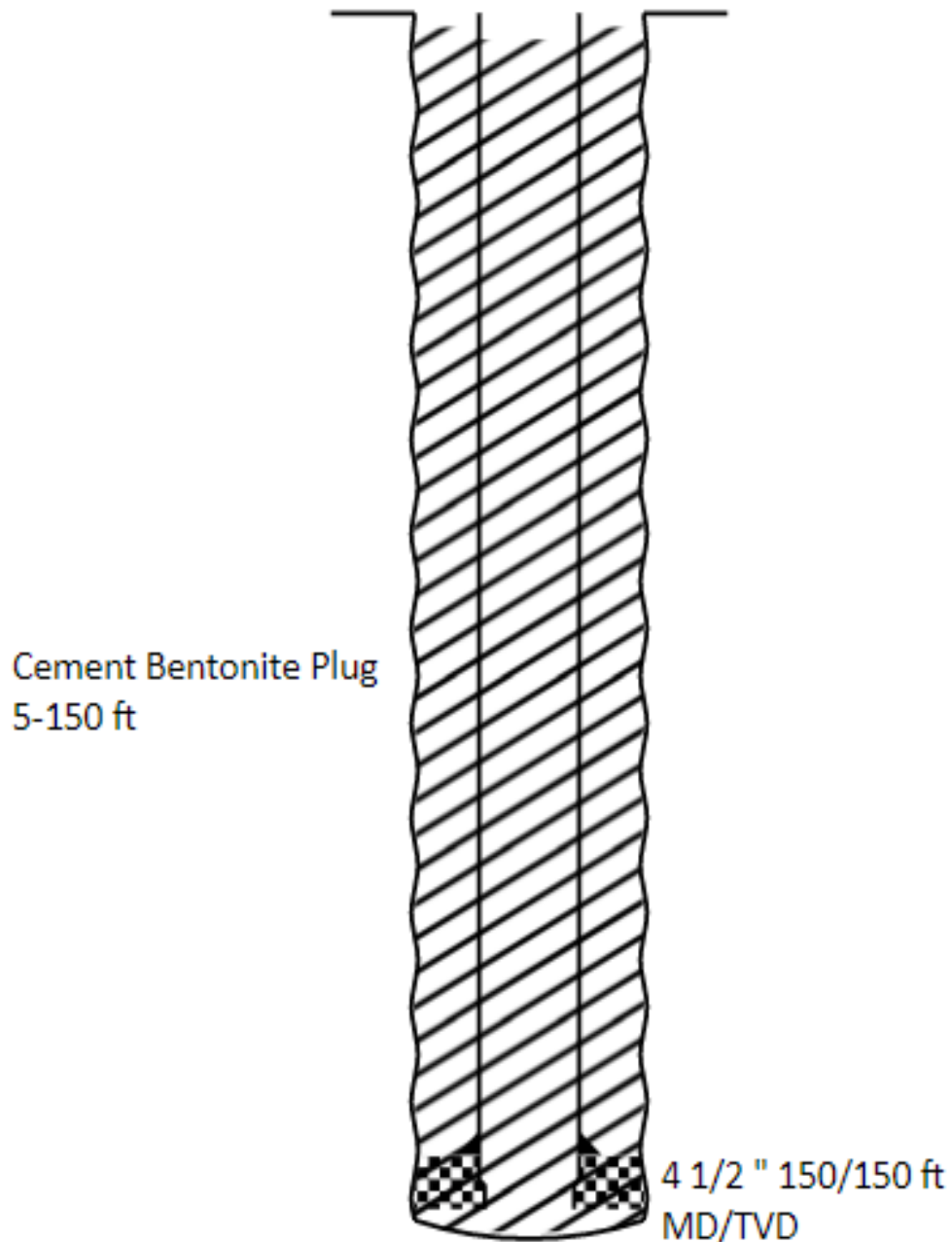


Figure 5. Mendota_GW_1-4 plug schematic.

7. References

- Schlumberger. (2021a). *Attachment A: Summary of Requirements Class VI Operating and Reporting Conditions.*
- Schlumberger. (2021b). *Attachment B: Area of Review and Corrective Action Plan 40 CFR 146.84(b) Clean Energy Systems Mendota.*
- Schlumberger. (2021c). *Attachment C: Testing and Monitoring Plan 40 CFR 146.90 Clean Energy Systems Mendota.*
- Schlumberger. (2021d). *Attachment D: Injection Well Plugging Plan 40 CFR 146.92(B) Clean Energy Systems Mendota.*
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