



**CALIFORNIA  
ENERGY COMMISSION**



**CALIFORNIA  
NATURAL  
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AGENCY**

California Energy Commission

## **CONSULTANT REPORT**

# **Assessing California's Population of Low- Temperature Geothermal Wells for Plugging and Abandonment**

Research and Analysis on Long-Term Idle Wells

Prepared for: **California Energy Commission**

Prepared by: **California Department of Conservation,  
California Geologic Energy Management Division (CalGEM)**



**Gavin Newsom, Governor**  
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# California Energy Commission

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# PREFACE

The California Energy Commission's (CEC) Geothermal Grant and Loan Program is funded by the Geothermal Resources Development Account and provides funding to local jurisdictions and private entities for a variety of geothermal projects.

*Assessing California's Population of Low-Temperature Geothermal Wells for Plugging and Abandonment: Research and Analysis on Long-Term Idle Wells* is the final report for the Geothermal Grant and Loan Program Contract Number 500-17-004, conducted by the California Department of Conservation, California Geologic Energy Management Division (CalGEM). The information from this project contributes to the Geothermal Grant and Loan Program's overall goals to:

- Promote the use and development of California's vast geothermal energy resources.
- Mitigate any adverse impacts caused by geothermal development.
- Help local jurisdictions offset the costs of providing public services necessitated by geothermal development.

For more information about the [Geothermal Grant and Loan Program](#), please visit the Energy Commission's website at <https://www.energy.ca.gov/programs-and-topics/programs/geothermal-grant-and-loan-program#:~:text=The%20California%20Energy%20Commission's%20Geothermal,other%20resources%20to%20participating%20parties>. Contact the CEC's Reliability, Renewable Energy & Decarbonization Incentives Division at [RREDIANalytics@energy.ca.gov](mailto:RREDIANalytics@energy.ca.gov) or at [geothermal@energy.ca.gov](mailto:geothermal@energy.ca.gov)

# ABSTRACT

California is the number one producer of geothermal energy in the United States, according to the 2021 Energy Information Administration, Power Plant Operations Report. Geothermal energy provides many benefits to Californians, including as a source of reliable baseload electricity generation, supplying hot springs for resorts throughout the state, and providing the heat for district heating projects concentrated in small rural communities.

Low Temperature Geothermal Wells (LTGWs) were drilled and completed in California, mostly during the 1980s, for direct use in applications such as water and space heating. The California Department of Conservation, California Geologic Energy Management Division (CalGEM) regulates the geothermal industry and issues permits for these LTGWs.

Wells that remain unused for years can pose a threat to groundwater and be a safety hazard. These long-term, idle LTGWs should be safely plugged and abandoned in accordance with CalGEM's geothermal regulations.

The California Energy Commission (CEC) contracted with CalGEM to provide technical assistance for the Geothermal Grant and Loan Program. The purpose of this project was to develop plans to plug and abandon identified, unused, and/or deserted LTGWs in California.

CalGEM assessed 30 wells, resulting in 10 wells being targeted as eligible for plugging and abandonment. The corresponding well owners and/or operators may use the information in this report to solicit bids from contractors to plug and abandon the wells.

Additional funding to properly plug and abandon the 10 unused wells would benefit all Californians by providing a safer environment. Six wells were not found, and resources should be allocated to conclusively determine their status and location. Six wells are still in use. Eight wells still exist in viable geothermal resource areas and should be explored to see what means are available to assist in their development.

**Keywords:** long-term, idle, low-temperature, geothermal, wells, abandonment

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# EXECUTIVE SUMMARY

## Introduction

California is the number one producer of geothermal energy in the United States, according to the 2021 Energy Information Administration, Power Plant Operations Report. Geothermal energy provides many benefits to Californians, including as a source of reliable baseload electricity generation, supplying hot springs for resorts throughout the state, and providing the heat for district heating projects concentrated in small rural communities.

The California Department of Conservation, California Geologic Energy Management Division (CalGEM) regulates oil, gas, and geothermal wells. The Department of Conservation is a subset of the California Natural Resources Agency, which is a cabinet-level agency for the Governor of California. The California Energy Commission (CEC) contracted with CalGEM to provide technical assistance for the Geothermal Grant and Loan Program.

## Background

Low Temperature Geothermal Wells (LTGWs) were drilled in California, mostly during the 1980s, by local school districts, rural communities, and municipalities with the intention of using the geothermal fluids for direct use in applications such as heating for schools, swimming pools, and greenhouses. LTGWs are generally shallower than high-temperature geothermal wells and found in geothermal resources scattered across the state. CalGEM issues permits for these LTGWs per Public Resources Code (PRC) sections 3700-3776 and the California Code of Regulations (CCR) title 14 sections 1900-1981.2.

Wells that remain unused for years can pose a threat to groundwater and be a safety hazard. These long-term, idle LTGWs should be safely plugged and abandoned in accordance with CalGEM's regulations. Some LTGWs remained unused after being drilled due to the respective owners' inability to complete the additional construction or support the operating and maintenance costs necessary for a direct use project. Other wells became unused with no intention of use in the future but have not been plugged and abandoned. If the last well operator loses the financial ability to properly plug and abandon the well, the status of the well may become re-categorized as "deserted." Such wells subsequently deteriorate with time and can be a health and safety hazard to their local communities and the environment because they are not maintained either downhole or on the surface.

Per CCR section 3725, CalGEM required a bond on each well when it was drilled, intended to ensure that funding was available to properly plug and abandon the well should it become deserted. Unfortunately, the bond funds are usually only \$2000, and insufficient to complete this work.

## **Project Purpose and Objectives**

The purpose of this project was to develop plans to plug and abandon identified, unused, and/or deserted LTGWs in California. CalGEM was chosen to perform this work due to its expertise in permitting and witnessing geothermal well drilling, casing and well bore repair, and abandonments throughout the state.

The project objectives were to identify unused and/or deserted LTGWs, identify the responsible parties for plugging and abandonment of those wells, and provide plugging and abandonment plans that meet CalGEM regulations for each eligible LTGW.

The project activities included analyzing individual well records, performing field inspections, assembling details of well bore construction, and writing a plugging and abandonment plan for eligible, targeted wells that satisfies CalGEM's regulations governing the plugging and abandonment of wells.

CalGEM staff prepared a list of wells to be assessed for plugging and abandonment. This work involved confirming the identity of unused wells, contacting (and attempting to contact) well owners/operators to discuss the current use of the well and if they intended to use it if not in operation, proposed plugging and abandonment plans, and inquiring whether the owners/operators had funding available to support the well work plans. In some cases, information was scarce because the PRC Section 3757.2 allows CalGEM through the State Oil and Gas Supervisor to exempt noncommercial LGTWs from reporting requirements, such as monthly production and injection and changes in operator. As a result, CalGEM has limited data on most of these wells covering the time since they have been drilled.

## **Conclusions and Recommendations**

Based on the recommendation of two experienced staff with extensive experience with the population of statewide geothermal wells, CalGEM analyzed existing records for 30 selected LTGWs that could potentially be targeted as eligible for plugging and abandonment. CalGEM staff visited and inspected the wells, where possible, and mapped and photographed the locations.

After further site investigation and communications with well owners/operators, 10 wells were targeted for plugging and abandonment because the well owners/operators had no interest in using these wells in the future. CalGEM prepared plugging and abandonment plans for the 10 wells, which can serve as preliminary bid packages that well owners/operators may use to solicit contractor bids to plug and abandon the wells.

Six wells were unable to be located, due to old or inaccurate location information. Resources should be allocated to conclusively determine their location and status to help ensure they are not a safety hazard. Six wells are still in use. Eight wells still exist in viable geothermal resource areas and should be explored to see what means are available to assist in their development.



Future projects involving the drilling of LTGWs should consider supporting operation and maintenance costs for a period of time, around five years should suffice, to ensure successful operation of the geothermal project. Additionally, costs to plug and abandon the project and decommission its facilities at the project's inception should be set aside to insure the CEC need not perform this type of grant work nor acquire a contract to perform the work on future projects. For those wells that remain unplugged and can avoid abandonment, this report includes opportunities for development by parties not currently aware of the resources these wells may offer.

## **Benefits to California**

It is unfortunate that not all LTGWs have been used by the entities that originally obtained permits and drilled the wells, given the need to reduce the use of fossil fuels to help meet the state's clean energy and burgeoning decarbonization goals. Many of these wells were drilled in rural areas that only have propane to supply heat. This is usually a failure resulting from other factors that hamper the project from moving forward, not necessarily a result of the wells being unable to provide the intended resources. Given the potential safety hazards and threats to groundwater with idle and/or deserted LTGW wells, the practical solution would be to plug and abandon the recommended wells. Additional funding to properly plug and abandon 10 unused wells would benefit Californians by providing a safer environment.

For the LTGWs that still have potential for use, options should be explored to determine which resources are available to assist their development. In previous years, the CEC funded projects with the Modoc Joint Unified School District supporting the development and use of district heating – even extending district heating for use in a newly built neighboring hospital. This project serves as a successful district heating project and a model for future projects worthy of exploration. Not only would these sorts of projects help California achieve its clean energy and decarbonization goals, they would also save money for the communities they serve.



# **CHAPTER 1:**

## **Introduction, Background, and Scope**

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### **Introduction**

California is the number one producer of geothermal energy in the United States, according to the 2021 Energy Information Administration, Power Plant Operations Report. Geothermal energy provides many benefits to Californians, including as a source of reliable baseload electricity generation, supplying hot springs for resorts throughout the state, and providing the heat for district heating projects concentrated in small rural communities.

The California Department of Conservation, California Geologic Energy Management Division (CalGEM) regulates oil, gas, and geothermal wells. The Department of Conservation is a subset of the California Natural Resources Agency, which is a cabinet-level agency for the Governor of California. For this project, the California Energy Commission (CEC) entered into an interagency agreement with CalGEM to provide technical assistance for the Geothermal Grant and Loan Program.

### **Background**

Low Temperature Geothermal Wells (LTGWs) were drilled in California, mostly during the 1980s, by local school districts, rural communities and municipalities with the intention of utilizing the geothermal fluids for direct use in applications such as the heating of school districts, swimming pools, and greenhouses. LTGWs are generally shallower than high temperature geothermal wells and are scattered across the state. CalGEM issues permits for these LTGWs per Public Resources Code (PRC) Sections 3700-3776 and the California Code of Regulations (CCR) title 14 Sections 1900-1981.2.

CalGEM maintains official records regarding the permitting, mechanical history, and bonding for each of these wells, with all other geothermal wells. Noncommercial LTGWs, are, however, exempt from the standard production and injection data reporting requirements in PRC Section 3745.

Some wells remained unused after being drilled due to the respective owners' inability to complete additional construction or maintain operations necessary for the specific direct use. Other wells are unused with no intention of use in the future but have not been plugged and abandoned. If the last operator loses the financial ability to properly plug and abandon the well, the status may be re-categorized as "deserted." Such wells subsequently deteriorate with time and can be a safety hazard to the local communities and surrounding environment because they are exposed at the surface and may even be an open well with no well head. Due to the shallow depth of LTGWs, the unused and deserted wells are a potential threat to the State's groundwater resources.

CalGEM required a bond on each commercial well when it was drilled, intended to ensure that funding was available to properly plug and abandon the well should it become deserted. The bonds for LTGWs have been \$2,000, per prior iterations of PRC Section 3745, which is insufficient to complete this work. The estimate to properly plug and abandon wells is \$10,000, but it could vary since it depends on depth, location, and conditions. Additionally, some of the entities, typically economically limited municipalities, are still responsible for the bonded wells and are unable to maintain the interest payments for the bonds, whose thresholds are set by the provisions of PRC Section 3725.5. LTGWs have historically been required to maintain lower-value bonds due to their generally shallower depths, simpler well construction, and therefore lower abandonment costs. Projected abandonment and site restoration costs were used to determine bonding thresholds, but these costs have become out-of-date.

## **Scope**

The project purpose was to develop plugging and abandonment plans for identified, unused and/or deserted LTGWs in California. CalGEM was chosen to perform this work due to its expertise in permitting and witnessing geothermal well drilling, reworking operations, and abandonments throughout the state.

CalGEM does not normally detail the requirements to plug and abandon wells unless they are deserted oil and gas wells, which have separate regulations and distinct funding sources designated for that purpose. However, CalGEM has the technical expertise to complete the activities outlined in this contract that support the public's health and safety.

The project objectives were to identify unused and/or deserted LTGWs, identify the responsible parties for plugging and abandonment of those wells, and provide plugging and abandonment plans that meet CalGEM regulations for those LTGWs targeted as eligible for abandonment.

The project activities included analyzing individual well records, performing field inspections, assembling details of the well bore's construction, and writing a plugging and abandonment plan that meets CalGEM's regulations for each identified, unused well.

## **CHAPTER 2:**

# **Identification of Unused Wells**

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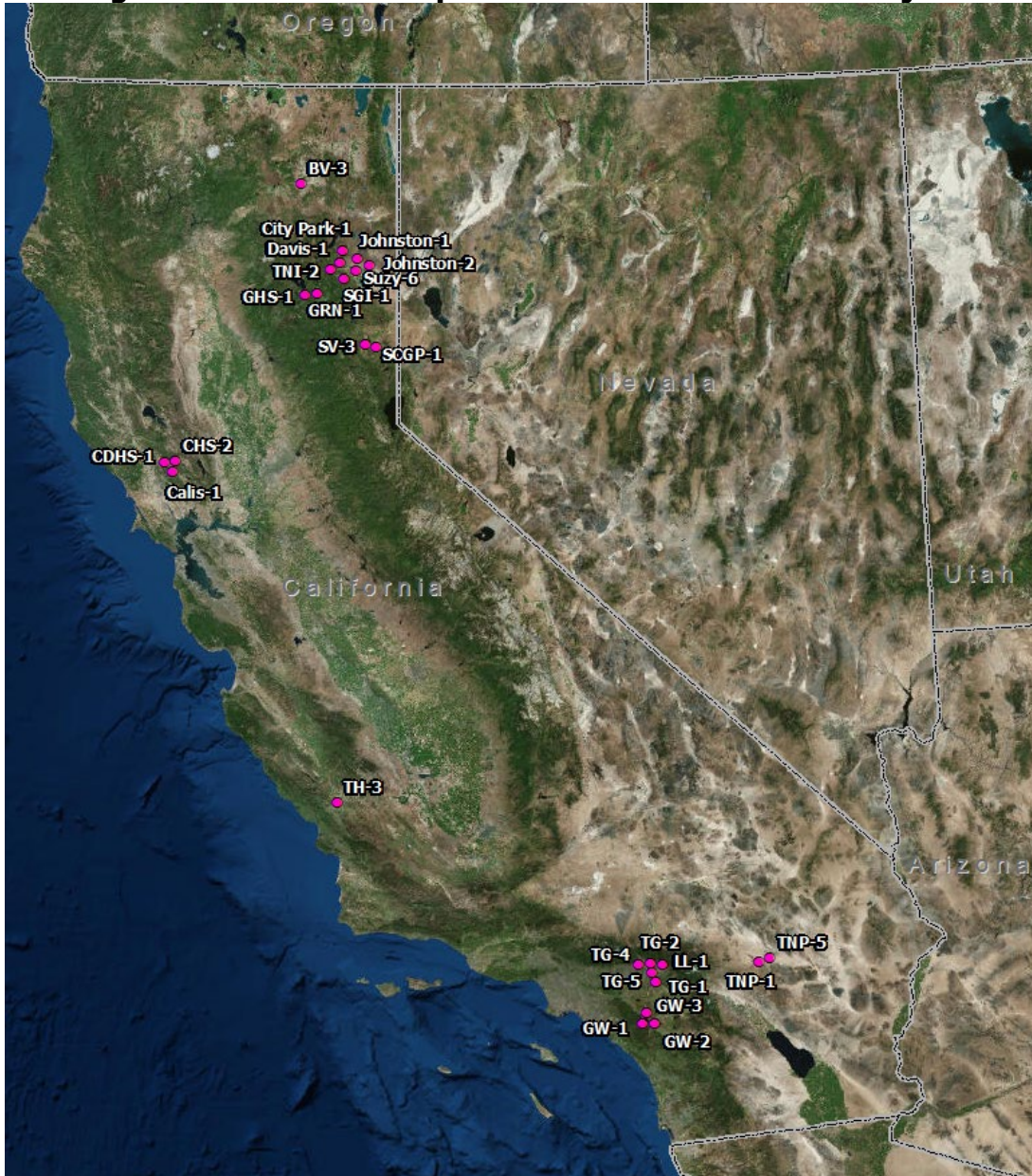
All available well data administered by CalGEM was collated, organized, and presented in well bore diagrams showing the well bore's construction and current known condition of each well. Many of the wells had not been used since they were drilled decades ago and are categorized as long-term idle wells. In some cases, information was scarce because PRC Section 3757.2 allowed CalGEM through the State Oil and Gas Supervisor to exempt noncommercial LGTWs from reporting requirements, such as monthly production and injection, and changes in operator. As a result, CalGEM had limited data for most of these wells since being drilled.

CalGEM staff prepared a list of wells to be assessed for plugging and abandonment. This work involved confirming the identity of unused wells, contacting well owners/operators to discuss current operations or plans for future use, the proposed plugging and abandonment plans, and inquiring whether the owners/operators had funding available to support the well work plans. CalGEM staff reviewed the potential to apply well bonds to the cost of the well work and incorporated all well bond information in the list provided to the CEC. CalGEM staff also submitted a list of responsible parties for each well and their contact information.

A total of 30 wells were selected based on a long history of low or no production over a period of years. CalGEM staff visited and inspected the wells where possible and mapped and photographed the locations. Wells selected for consideration in this project are mapped in Figure 1.

While efforts were made to contact all the well owners/operators, in some cases, contact was not possible.

**Figure 1: Statewide Map of Wells Selected for this Project**



**26 of the 30 wells selected for this project are shown on this map. Well Gradient-1's surface location was not accessible due to a change of surface ownership. Well TNP-6 is not shown because it was not visible at the surface location. Latitude and longitude information of Wells TG-6 and TG-7 were not taken so they are also not shown on the map.**

Source: Aerial imagery courtesy of Environmental Science Research Institute (ESRI), DigitalGlobe, GeoEye, EarthStar Geographics, Centre National d'Etudes Spatiales (CNES)/AirBus Defense and Space (DS), U.S. Department of Agriculture (USDA), U.S. Geological Survey (USGS), AeroGRID, Institut Géographique National (IGN), and the Geographic Information System (GIS) User Community.

## **CHAPTER 3:**

# **Well Identification and Assessment**

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CalGEM staff reached out to the operators on file for the 30 wells selected for investigation. The resulting documentation is available in Appendix A under a separate volume, which contains resulting correspondence (Appendix A, Chapter 1), maps of the surface locations (Appendix A, Chapter 2), images of the wells and/or surrounding areas (Appendix A, Chapter 3), technical well data such as well bore diagrams and tables of well characteristics (Appendix A, Chapter 4), and proposed plugging and abandonment plan for those wells that CalGEM staff targeted for plugging and abandonment (Appendix A, Chapter 5).

### **Wells Targeted for Plugging and Abandonment**

CalGEM staff gathered information on wells for which the operator indicated an interest in cooperating with a future plugging and abandonment contract. Ten wells targeted for potential plugging and abandonment are listed in Table 1. The American Petroleum Institute (API) number gives a unique identifier for each well.

**Table 1: List of Wells Targeted for Plugging and Abandonment**

<b>#</b>	<b>County</b>	<b>Operator</b>	<b>Well Name</b>	<b>API Number</b>	<b>Latitude</b>	<b>Longitude</b>
1	Lassen	Big Valley Recreation District	BV-3	03590077	41.1235	-121.13813
2	Lassen	City of Susanville	Davis-1	03590056	40.40451	-120.65784
3	Lassen	City of Susanville	Johnston-1	03590065	40.40197	-121.48055
4	Lassen	City of Susanville	Johnston-2	03590068	40.40227	-120.47703
5	Lassen	City of Susanville	SGI-1	03590080	40.40417	-120.653
6	Lassen	City of Susanville	Suzy-6	03590044	40.40379	-120.65284
7	Lassen	City of Susanville	TNI-2	03590073	40.40477	-120.65655
8	Napa	Calistoga Joint Unified School District	CHS-2	05590084	38.58168	-122.57857
9	Plumas	Plumas Unified School District	GHS-1	06390014	40.13943	-120.94385
10	San Bernardino	City of Twentynine Palms	TNP-1	07190062	34.14526	-116.07158

**Latitude and longitude information for Well TNP-1 was based on a combination of field data and aerial imagery.**

Source: CalGEM Staff



Table 2 summarizes observations from site inspections of the ten wells targeted for plugging and abandonment.

Plugging and abandonment plans were prepared for each well using the prepared diagrams and tables. Each plan includes a description of the plugging operation – e.g., clean-out depth, mudding and cementing requirements; site restoration requirements - for example, cutting the well head off six feet below grade, and backfilling in the area.

**Table 2: Summary of Observations for Wells Targeted for Plugging and Abandonment**

#	Well Name	Date of Inspection	Field Notes and Operator Plans
1	BV-3	11/15/2018	Arrived at 1430 hours. Scrap surrounds well, no well sign. Well is 100-130 feet from parking lot.
1	BV-3	11/15/2018	Per phone call with CalGEM Senior Engineer, operator is generally in favor of plugging well.
2	Davis-1	11/14/2018	Arrived at 1207 hours. Well shed still present. Large quantities of scrap surrounding well head. Well head rusted.
2	Davis-1	11/14/2018	Per phone call with CalGEM Senior Engineer, operator is generally in favor of plugging well.
3	Johnston-1	11/19/2018	Arrived at 1300 hours. Three associated pipes, shed and scrap present. No well sign. Adjacent to dirt road in moderate condition.
3	Johnston-1	11/19/2018	Per phone call with CalGEM Senior Engineer, operator is generally in favor of plugging well.
4	Johnston-2	11/19/2018	Arrived at 1330 hours. Well head relatively intact. Tubing pulled on ground. No well sign. Site adjacent to dirt road in moderate condition.
4	Johnston-2	11/19/2018	Per phone call with CalGEM Senior Engineer, operator is generally in favor of plugging well.
5	SIG-1	11/14/2018	Arrived at 1244 hours. Access via dirt path in field. Beehive in pipe.
5	SIG-1	11/14/2018	Per phone call with CalGEM Senior Engineer, operator is generally in favor of plugging well.
6	Suzy-6	11/14/2018	Arrived at 1236 hours. No road access, approximately 210 feet from the dirt path. Next to shipping container. Scrap all over site. Paint still on well head.
6	Suzy-6	11/14/2018	Per phone call with CalGEM Senior Engineer, operator is generally in favor of plugging well.
7	TNI-2	11/14/2018	Arrived at 1219 hours. Good access from gravel lot. Line still intact. Well head rusted and surrounded by weeds.

#	Well Name	Date of Inspection	Field Notes and Operator Plans
7	TNI-2	11/14/2018	Per phone call with CalGEM Senior Engineer, operator is generally in favor of plugging well.
8	CHS-2	11/6/2018	No issues with access to site. Well head is rusted and missing one bolt. Surface rights owner is the same as the operator. Operator requested updates to coordinate with school on site.
9	GHS-1	11/14/2018	Arrived at 1040 hours. Good access from road, approximately 21 feet from road. In small grove of trees next to school parking lot. Covered in gravel and pine needles.
9	GHS-1	11/14/2018	Per phone call with CalGEM Senior Engineer, operator is generally in favor of plugging well.
10	TNP-1	5/9/2019	The well is located within a five-sided enclosure (four sides and top) on the east side of Mesquite Springs Road approximately 800 feet north of El Paseo Drive (Latitude 34.14525, Longitude - 116.07158). The well head is still attached, though mostly buried under sandy deposits. Dug deposits from the casing to a depth of about four inches and struck rigid material which appeared to be hardened cement. The enclosure is kept locked by Public Works Department of Twentynine Palms.
10	TNP-1	5/9/2019	Per conversation with CalGEM staff, operator is amenable to plugging and abandonment if funds come from an external source.

Source: CalGEM Staff

Participating well owners and/or operators may use this information along with the material in Appendix A to prepare bid packages and solicit bids for contractors to plug and abandon the wells.

### **Wells Not Targeted for Plugging and Abandonment**

CalGEM staff gathered information on wells that could not be found or which had an operator uninterested in a future plugging and abandonment contract. Operators who were not interested were still using the wells or generally wanted to keep the wells for future use. Wells not targeted for potential plugging and abandonment are listed in Table 3.

**Table 3: List of Wells Not Targeted for Plugging and Abandonment**

<b>#</b>	<b>County</b>	<b>Operator</b>	<b>Well Name</b>	<b>API Number</b>	<b>Latitude</b>	<b>Longitude</b>
1	Lassen	City of Susanville	City Park-1	03590090	40.418569	-120.655408
2	Napa	City of Calistoga Exploration, Inc.	Calis-1	05590082	38.578754	-122.580437
3	Napa	City of Calistoga Exploration, Inc.	CDHS-1	05590123	38.579567	-122.577476
4	Plumas	Indian Valley Health Care District	GRN-1	06390012	40.140611	-120.140611
5	Riverside	City of Lake Elsinore	GW-1	06590008	39.752959	-120.315639
6	Riverside	City of Lake Elsinore	GW-2	06590009	33.67011	-117.32909
7	Riverside	City of Lake Elsinore	GW-3	06590015	33.680539	-117.330155
8	San Bernardino	San Bernardino Board of Water Commissioners	TG-1	07190033	34.083947	-117.277492
9	San Bernardino	San Bernardino Board of Water Commissioners	TG-2	07190034	34.083636	-117.281845
10	San Bernardino	San Bernardino Board of Water Commissioners	TG-4	07190036	34.076635	-117.277493
11	San Bernardino	San Bernardino Board of Water Commissioners	TG-5	07190037	34.08347	-117.28571
12	San Bernardino	San Bernardino Board of Water Commissioners	TG-6	07190038	(Unknown)	(Unknown)
13	San Bernardino	San Bernardino Board of Water Commissioners	TG-7	07190039	(Unknown)	(Unknown)
14	San Bernardino	City of Loma Linda	LL-1	07190069	34.052885	-117.269879
15	San Bernardino	Patton State Hospital	Gradient-1	07190071	(Unknown)	(Unknown)
16	San Bernardino	City of Twentynine Palms	TNP-5	07190083	34.147825	-116.065664

#	County	Operator	Well Name	API Number	Latitude	Longitude
17	San Bernardino	City of Twentynine Palms	TNP-6	07190084	(Unknown)	(Unknown)
18	San Luis Obispo	City of El Paso de Robles	Testhole-3	07990002	35.62176	-120.66761
19	Sierra	County of Sierra	SCGP-1	09190008	39.682227	-120.316629
20	Sierra	County of Sierra	SV-3	09190005	39.682903	-120.320271

**Well Testhole-3's coordinates are the official operator-reported values from CalGEM WellFinder. The well's coordinates in Appendix A, Figure 85 were obtained by a CalGEM field engineer.**

Source: CalGEM Staff

Table 4 summarizes observations from site inspections and operator plans for wells not targeted for plugging and abandonment.

**Table 4: Summary of Observations and Operator Plans for Wells Not Targeted for Plugging and Abandonment**

#	Well Name	Date of Inspection	Field Notes and Operator Plans
1	City Park-1	11/19/2018	Well was not visible at its identified surface location. Per conversation with the operator, this well was likely not drilled, but it has coordinates and an API number. Follow up may be warranted to assess if the well was ever drilled.
2	Calis-1	11/6/2018	No issues with access. Parking lot is small, parking was limited due to adjacent museum functioning as polling place. Space next to well is handicap spot. Well head has minor pitting and corrosion paint is worn.
2	Calis-1	11/6/2018	Operator may wish to plug and abandon well in the future, per phone call with CalGEM Senior Engineer. Opportunities should be explored for future use.
3	CDHS-1	11/6/2018	Arrived at 1028 hours. No issues with access. Completely enclosed by fence (no lock on gate). Tree inside fence is growing abutting the well, one branch has grown into the tubing valve handle. Well head is rusted, with no paint and minor pitting. There is no plug in the tubing, spider webs were across the opening.

#	Well Name	Date of Inspection	Field Notes and Operator Plans
3	CDHS-1	11/6/2018	Operator would like to use this well in the future, per phone call with CalGEM Senior Engineer. Opportunities should be explored for future use.
4	GRN-1	11/14/2018	Arrived at 1047 hours. Good access from the road. Approximately 6 feet from parking lot. Insulation partially stripped from riser.
4	GRN-1	11/14/2018	Operator wants to use well for future assisted living facility, per phone call with CalGEM Senior Engineer. Opportunities should be explored for future use.
5, 6, 7	GW-1,-2,-3	(Not applicable)	Operator may use these wells in the future due to urban growth. Wells were not visited. Opportunities should be explored for future use.
8, 9, 10, 11, 12, 13	TG-1, -2, -4, -5, -6, -7	(Not applicable)	Operator currently using six wells to monitor groundwater levels. Coordinates for Wells TG-6 and TG-7 are unknown.
14	LL-1	(Not applicable)	The well was not able to be visited in the field. No response from operator regarding the status of any possible operator-initiated plan for plugging and abandonment. Follow up may be warranted to conclusively assess the status of this well.
15	Gradient-1	(Not applicable)	Operator has not responded to CalGEM communication with status of any possible plugging and abandonment plan. CalGEM staff attempted to access the well's surface location, but could not due to a change in surface ownership; operator has not changed. Follow up may be warranted to identify the new owner and to conclusively assess the status of this well.
16	TNP-5	5/9/2018	Well was not visible at its identified surface location. Follow up may be warranted to conclusively assess the status of this well.
17	TNP-6	5/9/2018	Well was not visible at its identified surface location. Follow up may be warranted to conclusively assess the status of this well.
18	Testhole-3	8/15/2018	Picture taken; no notes recorded. Follow up may be warranted to conclusively assess the status of this well.
18	Testhole-3	8/15/2018	Operator has independent funds to plug and abandon well, per phone call with CalGEM Senior Engineer.

#	Well Name	Date of Inspection	Field Notes and Operator Plans
19	SCGP-1	11/14/2018	Arrived at 0800 hours. Well was approximately 600' from mapped location. No well sign, rusted and attached to nonmetallic tanks that are unlabeled. Access by paved road.
19	SCGP-1	11/14/2018	Operator would like to develop the resource. Opportunities should be explored for future use.
20	SV-3	11/19/2018	Arrived at 1000 hours. Well was approximately 500 feet from mapped location. No well sign, rusted and behind thick dead vegetation. 30 to 60 feet from paved road.
20	SV-3	11/19/2018	Operator would like to develop the resource. Opportunities should be explored for future use.

Source: CalGEM Staff

# **CHAPTER 4:**

## **Results and Recommendations**

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### **Results**

CalGEM staff initially analyzed existing records and determined that 30 LTGWs could potentially be plugged and abandoned. After further site investigation and communication with well owners and or operators, 10 wells were targeted as eligible for plugging and abandonment. Appendix A of this report contains material that may assist responsible parties in procuring bids from drilling contractors for plugging and abandoning the 10 wells identified in Table 1. Final abandonment of the 10 identified wells will positively contribute to the life, health, and safety of all Californians, but particularly those in the nearby communities. Data arising from this report, such as GPS coordinates for well surface locations, may be used to update CalGEM records that were previously based on operator-reported information.

PRC Section 3757.2 exempts noncommercial LTGWs, such as those covered within this report, from the agent representation, sale notification, and blanket bonding of other PRC sections, which could decrease the amount of data available to CalGEM on any pre-abandonment actions taken by the respective operators.

The remaining 20 wells did not have a bid package prepared for plugging and abandonment primarily due to interest in future use. For example, some wells are used for groundwater monitoring and others have ideas for district heating uses. CalGEM, through the course of normal regulatory routines, monitors use of these wells. Given California's clean energy and building decarbonization goals, the possibility of these LTGWs being used where they otherwise might not have been, may be an unintended positive outcome of this project. CalGEM does not collect data on the economic or resource potential of wells; however, operator decisions about applications of their resources will determine new or continued usage.

### **Recommendations**

LTGWs are typically in a poor state of repair when it comes to both surface and downhole condition, making plugging and abandonment of these wells potentially challenging. Selecting a competent contractor for this work is critical to success and, having sufficient funds to cover the cost, are perhaps the largest challenges in successfully getting these wells plugged and abandoned.

Further analysis may be merited as to the lifetime benefit of LTGWs, both to their community and the state, and the associated risks if the wells become unused or long-term idle. Future projects involving the drilling of LTGWs should consider supporting operation and maintenance costs for an estimated five years to ensure successful operation of the geothermal project. Additionally, costs to plug and abandon the project

and decommission its facilities at the project's inception should be set aside to insure against the need for this type of grant work on future projects.

It is in the best interest of the state to provide technical and financial support to plug and abandon these 10 long-term, unused LTGWs that are an environmental burden on local governments and small public agencies, and pose a potential threat to the environment, public health, and safety.

For the LTGWs that still have the potential for use, options should be explored to see what resources are available to assist in their development. In recent years, the CEC funded projects with the Modoc Joint Unified School District, supporting the development and use of district heating – including extending the use to a nearby hospital. The school district has estimated annual savings to be approximately \$37,000 as a result of decreased heating costs. This savings means more money is available to the school district for other important expenses. Examples of successful district heating projects can serve as a model for future LTGW projects. Such projects can help California achieve its clean energy and building decarbonization goals, save money, and benefit the communities they serve.



## GLOSSARY

<b>Acronym, Abbreviation, or Term</b>	<b>Definition</b>
'	feet, typically used for depth, whether for casing or other tool located in the well bore, or total depth of the well.
"	inches, typically a casing size.
API	American Petroleum Institute
BOPE	blowout prevention equipment
CCR	California Code of Regulations
CEC	The California Energy Commission.
Debris	Material byproducts of well drilling, reworking, plugging, or abandoning.
ESRI	Environmental Systems Research Institute
FSL	From south line
FWL	From west line
GIS	Geographic Information System
Junk	Downhole equipment lost in the well during well operations.
KB	Kelly Bushing, an adapter that serves to connect a rotary table to a Kelly.
MDB&M	Mount Diablo Base & Meridian. The Base and Meridian system is a standard survey reference used in cadastral survey throughout the United States.
SBB&M	Santa Barbara Base and Meridian. The Base and Meridian system is a standard survey reference used in cadastral survey throughout the United States.
Scrap	Drilling equipment remaining on a well site.
TD	Total depth, usually referring to a drilled well's depth to bottom hole.
reworking operations	Actual working of a well previously completed as a producer or injector, in an attempt to recomplete or repair the well and, respectively, return it to, or enhance its, injection or production.

<b>Acronym, Abbreviation, or Term</b>	<b>Definition</b>
Waste	Fluid byproducts of drilling, reworking, plugging, or abandoning a well that must be properly disposed of.
well bore	A hole that is drilled to aid in the exploration and recovery of natural resources including oil, gas, or water (cold or hot).
well head	The unit at the surface of a well which controls pressure and connects to drilling and production equipment.

# APPENDIX

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Appendix A is available as a separate volume, Publication Number [CEC-xxx-xxxx-xxx-APA](#)