

A Regulatory Guide to Geothermal Direct Use Development

COLORADO

Introduction

Geothermal resource temperatures range from low temperatures of 50 to 80 degrees F (10 to 27 °C), to temperatures exceeding 650 degrees F (343°C). Although power can be generated economically from resources as low as 218 degrees F (103° C), power generation projects typically favor resource temperatures above 300 degrees F (149° C). High temperature resources (>300 degrees F, 149° C) can also be used for direct-use applications. However, lower temperature resources (< 212° F, 100° C) are often better suited for these projects.

Low temperature, direct-use projects cover a variety of applications. Projects may include traditional space heating applications, as well as greenhouse heating, spas and swimming pools, aquaculture, crop drying, industrial processing and other activities requiring lower temperatures. Because these projects are primarily water use applications, they often fall under a different regulatory process than high temperature, power generation projects. Typically this process is shaped by water and wastewater laws and regulations, and administered by their respective state, and in some cases, federal water and wastewater resource agencies.

The intent of this document is to help guide developers of direct use geothermal projects through the regulatory process of drilling, using and disposing of low temperature geothermal fluids in Colorado. This guide will provide background on the state regulatory process and identify contact information necessary for completing the various applications and permits. This guide; however, cannot substitute for direct communication with the regulatory agencies. These agencies need to be contacted early in the process so that any regulatory hurdles are identified upfront and in time. Projects that are located on federal lands are regulated according to the national Geothermal Steam Act and related federal regulations.

Regulatory Process for Direct Use Applications

Colorado has abundant geothermal resources. In recognition of these resources and their economic potential, the State of Colorado passed the *Colorado Geothermal Resources Act*, which was replaced with [CRS 37-90.5-Geothermal Resources](#). Here “*geothermal resources*” are defined as the natural heat of the earth and include: (1) *the energy that may be extracted from the natural heat*; (2) *the material medium used to extract the energy from a geothermal resource*; and, (3) *geothermal by-products*. “*Geothermal fluids*” means *naturally occurring groundwater, brines, vapor, and steam*. “*Geothermal by-products*” means *dissolved or entrained minerals and gases that may be obtained from the material medium, excluding hydrocarbon substances and carbon dioxide*.

Ownership of geothermal resources is defined under CRS 37-90.5-104. Geothermal fluids are also declared to be a public resource, the rights to which are subject to state appropriation procedures. These procedures are described in detail in the guidance document “Rules and Regulations for Permitting the Development and Appropriation of Geothermal Resources through the Use of Wells”. The rules state that all subsurface geothermal fluids are part of the groundwater resources of the State of Colorado. As a result, low temperature, direct use geothermal projects, including but not limited to greenhouse heating, warm water aquaculture, space heating, irrigation swimming pools and spas, are regulated in accordance with these rules. The Colorado Division of Water Resources (CDWR) is the lead state agency administering geothermal resource rules and regulations. A copy of the rules can be downloaded by clicking [geothermal well rules](#).

Direct use geothermal projects will also need to dispose of the geothermal fluid once it has been used for its design application. Disposal is typically accomplished through direct injection of the geothermal water via an injection well, or through surface disposal to the ground or to surface waters, if injection is not an option.

The Colorado Division of Water Resources (CDWR), is the lead agency in charge of administering and enforcing the various rules and regulations governing geothermal well use in the State of Colorado. CDWR is also responsible for handling water appropriation issues. The permitting of injection wells also falls under the jurisdiction of CDWR , although the U.S. Environmental Protection Agency, Region 8, has primacy and oversees the administration of underground fluid injection wells in Colorado. The Colorado Department of Public Health and Environment’s Water Quality Control Division (WQCD) is responsible for administering surface disposal of wastewater, including geothermal fluids. In addition to state and federal agencies, local and county agencies may also play a role in issuing local zoning and construction permits, and should be contacted early on in the development of a direct use, geothermal project.

The regulatory process for developing a low temperature, direct use geothermal project consists of the following steps:

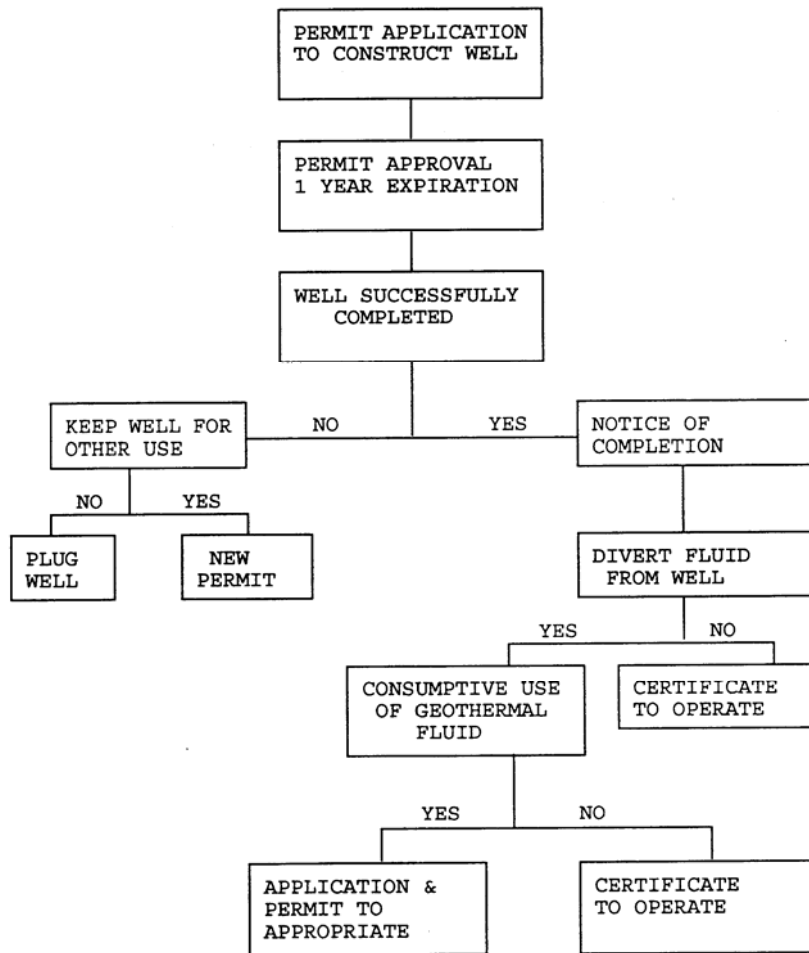
- Gain access to lands either through lease or direct ownership.
- Contact local and/or county agencies to ensure compliance with local land use laws including building permits and zoning restrictions.
- Obtain permit to construct a geothermal well and certificate to operate. **(CDWR)**
- Determine fluid disposal plan and obtain permits for either underground injection or surface disposal. **(CDWR, US EPA, WQCD)**
- Contact the Colorado Department of Agriculture if developing an aquaculture project.

A developer interested in low temperature geothermal resources may want to review data from other wells in the area. The Geo-Heat Center, located in Klamath Falls, Oregon maintains an extensive database covering wells and springs greater than 50 °C (122°F) for 16 western states. Information on the database can be found at <http://geoheat.oit.edu/databse.htm>

Geothermal Well Rules

The regulatory path for direct use geothermal projects in Colorado is laid out in “Geothermal Well Rules”. The following flow chart, developed by CDWR, illustrates the process.

FIGURE 1: GEOTHERMAL WELL PERMIT FLOWCHART



As shown, the first step in permitting a geothermal well is to complete an application for a Permit to Construct a Well. The application is identified as Form GWS-45 and can be downloaded by clicking [here](#). The form must be submitted to CDWR and authorizes well construction. A single copy of the form is submitted for Type A wells, i.e., wells having a total depth not exceeding 2500 feet (762 m) or exceeding 212 degrees F (100 °C). Type B well applications (wells greater than 2500 feet (762 m) and exceeding temperatures of 212 degrees F (100 °C)) need to submit in triplicate. The application filing fee is \$480 and is non-refundable. Information to be submitted in the application includes: ownership, well location, well data, and proposed use.

In reviewing the permit to construct application, CDWR may require additional information. This may include a summary of geophysical, geological, and hydrological information of the area, as well as a list of wells and water rights approximate to the proposed drilling area. Both horizontal and vertical closed-loop ground-source systems are not exempt and must complete Form GWS-45. For Type A wells, CDWR has 45 days from the day of receipt to act on the permit application. For Type B wells, CDWR has 105 days to process the application.

If the permit application meets the requirements of Section 37.90.5-106 C.R.S., CDWR will issue a permit subject to terms and conditions. Terms and conditions may include well setback and location limits; reinjection requirements; and in cases involving consumptive use of the geothermal fluids, CDWR may direct the applicant to submit a water augmentation plan or obtain a water right appropriation. CDWR will also notify other agencies which may have an interest in or jurisdiction over a proposed well. These agencies may include the Colorado Oil and Gas Conservation Commission for Type B wells; the Colorado Water Quality Control Division and U.S. EPA for injection wells or surface disposal; and the Colorado Ground Water Commission for construction and appropriations located in designated ground water basins. CDWR notification does not remove the responsibility by the applicant to obtain any necessary permits.

The Permit to Construct is good for one year. All well construction activities for Type A and Type B wells must conform to the "Well Construction and Pump Installation Rules", 2 CCR 402-2 (1988). An applicant should also check with CDWR with respect to specific variances, as some closed loop systems may be exempt from some of the well standards. Type A wells must also be constructed by a contractor or well driller licensed by the Colorado State Board of Examiners of Water Well Construction and Pump Installation Contractors. Type B wells are exempt from this provision; however, Type B wells have additional construction requirements as noted under Rule 8 of the Geothermal Well Rules. Finally, for Type A well permits, all well construction activities must stop if geothermal fluid temperatures greater than 212 degrees F (100 °C) are encountered.

Prior to placing a geothermal well into service, the well operator must submit a Notice of Well Completion to CDWR. In turn, CDWR has up to 45 days to issue a Certificate to Operate. The Certificate will be issued to the well owner if the construction of the well has been completed to state standards, geothermal fluids are not diverted, and that other geothermal users are not injured by the project. If the project involves consumptive use

of geothermal fluids, the well owner must obtain a Permit to Appropriate. The application form is the same used to apply for a well construction permit (GWS-45). If a project developer anticipates that consumptive use may occur, they should note that at the time they submit the original Application to Construct a Well. This notifies CDWR upfront that consumptive use may result as a condition of the project. If done at this time, the applicant does not need to submit an additional GWS-45 form.

For projects involving consumptive use, CDWR will review the project to determine its impact. For most locations in the State, groundwater is over-appropriated. In these cases, CDWR may require the well owner to develop an augmentation plan. An augmentation plan is a court approved plan that is designed to protect existing water rights by replacing water used in a new project. The plan must be made to the State Water Court and is often prepared by an attorney. The plan must explain exactly where the water will be obtained, where it is to be used, how much is to be used, where the augmentation water will come from, as well as when, and how much, water is needed. The plan should be supported by an engineering analysis explaining how the water needs of the project were determined and how the new water use can occur without effecting senior water rights. To help guide consumers, CDWR has published a pamphlet which discusses water appropriation issues in the State. The publication is entitled "*Guide to Colorado Well Permits, Water Rights and Water Administration*" and can be downloaded by clicking [here](#).

Disposal of Geothermal Fluids

The regulations governing the disposal of low temperature geothermal fluids will depend on the type of application. Non contact geothermal projects, where the geothermal fluids are kept in a closed system and do not come in contact with outside contaminants, will typically have an easier compliance path than projects where contact with potential contaminants is made. When contact is made and water quality is potentially degraded, regulatory requirements may become more stringent to ensure that water quality is maintained.

There are basically three disposal options available to a developer of a direct use geothermal project: underground injection; disposal to surface waters; and/or, disposal to the ground or land application. In some cases, the regulatory agency(s) will specify the preferred disposal method. For example, in critical groundwater areas, reinjection may be required to ensure that the aquifer is maintained. However, in most cases, it will be up to the project developer to determine the best disposal method based on regulatory requirements and the cost of compliance. The Colorado Division of Water Resources will assist a geothermal well applicant identify the various resource agencies that regulate the discharge of pollutants in the State of Colorado.

Underground Injection Control

The Underground Injection Control (UIC) Program was established in 1982 when Congress passed the Safe Drinking Water Act. This program regulates, to one degree or the other, every "injection" of "fluid" into the subsurface. An "injection" is the

emplacement of "fluids" regardless of whether the injection requires the application of pressure or not, and a fluid is defined as any liquid, gas or semisolid which can be made to flow. The intent of the program is to preserve and protect underground water from becoming polluted.

From a resource perspective, the preferred method of disposing of geothermal fluids is to return them to the ground by way of injection wells. Injection wells are wells that are used as an entry point for some type of fluid (such as geothermal fluid), which is injected underground for temporary or permanent disposal or storage. The U.S. Environmental Protection Agency Region 8 has regulatory oversight of all underground injection wells in the State of Colorado.

The Underground Injection Control (UIC) Program, created under the authority of the Safe Drinking Water Act (SDWA), is a preventative program aimed at protecting existing and future underground sources of drinking water (USDWs). Shallow wells or disposal systems that direct fluids into the subsurface are known as Class V wells and can be authorized to inject by rule or permit. Class V wells that have the potential for ground water contamination or degradation are usually permitted. Low temperature, direct use injection wells fall under the definition of Class V wells. Those that do not have a potential to contribute to contamination or degradation of ground water are usually rule authorized, once inventory information has been submitted according to the requirements of 40 CFR 144.26. Rule authorized means that a well meets the category definition and does not need to go through individual permitting. In addition to the inventory requirements, EPA may require the owner or operator of any well authorized by rule to submit additional information to determine if a well may be endangering a USDW.

The following information is needed to evaluate the impact a shallow injection well/disposal system will have on the local hydrogeologic system, potential for USDW contamination, and whether a permit for its operation should be required. An applicant should be prepared to submit this information to EPA Region 8 prior to constructing a well. Contacts are presented in Appendix A. In general, injection wells for direct use geothermal projects do not require a permit and are rule authorized as long as they are closed loops. Open loops system may require a permit depending on the operational parameters and exposure of the fluid to potential contaminants.

- Property owner and/or operator of facility, including address and phone number.
- Responsible party for the operation, maintenance, and closure of the injection system, including address and phone number.
- Name, address, phone number of contact at any State Agency associated with the project.
- Site map including extraction and injection well locations and pertinent hydrogeologic features.
- Description and operation of the injection well, including depth, construction information, injection rate and pressure.
- Description of well construction features ensuring that overlying aquifers will be isolated from injected and extracted geothermal brine.

- Analysis or description of the geothermal fluids being extracted/injected.
- Describe any impact to extracted water before re-injection.
- Review of current users of geothermal source and potential impacts on other vested water rights.
- Drinking water wells tapping overlying formations within ¼ mile of injection location.

Once U.S. EPA Region 8 has approved an injection well application, the project developer must still obtain a well construction permit from the State of Colorado. CDWR has well construction authority as described in the previous section “Geothermal Well Rules”. The permit for constructing a geothermal injection well, GWS-45, is the same permit used for constructing a geothermal well, and mirrors this process.

Surface Disposal of Geothermal Fluids

The Colorado Water Quality Act ([C RS 25-8-101 et seq](#)) sets forth the statutes governing water quality in the state of Colorado. Policy 98-2 Colorado Water Quality Management and Drinking Water Protection Handbook identifies the various regulatory agencies involved in water quality management in the state and describes their responsibilities as well as water quality programs and requirements. The handbook can be accessed by clicking [here](#). Discharges to water of the State (surface and groundwater) and discharges to municipal wastewater treatment plants are covered under these laws and regulations which are primarily administered by the Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment. The WQCD maintains an excellent website which describes the various regulatory programs and provides on-line access to forms and guidance documents. This site can be accessed by clicking [here](#).

Typically, surface disposal of geothermal fluids to ground is preferable to discharging into surface waters. Discharging to ground minimizes the chance of degrading existing water quality. Disposal to the ground surface or land application also keeps the water within the same geographic resource area.

Regardless of whether a project is discharging to surface or ground, the State of Colorado requires all wastewater discharge applicants to complete a geographic information system (GIS) form. This form allows WQCD to identify the exact location of a project and its discharge points. The GIS form can be downloaded by clicking [here](#).

Colorado Ground-Water Discharge Permit Program

Any discharge or source of pollutants that may discharge to ground water are required to obtain a permit under the Colorado Ground-Water Pollutant Discharge Permit Program and comply with Colorado ground water standards. As a result, direct use geothermal projects discharging to the ground will likely require a ground-water permit. Details of the permit process are contained in the Colorado Discharge Permit Regulations ([Regulations 61 \(5 CCR 1002-61\)](#)). The body of ground-water discharge permit requirements are found in Article 14 of the regulation (61.14). The Water Quality Control

Division (WQCD) has also prepared an informational sheet on the ground-water discharge permit program that can be accessed by clicking [here](#).

A direct use geothermal project would need to apply for a *Process Water, Stormwater and Ground Water Individual Industrial Wastewater* permit. While there are exemptions or waivers to this permit, geothermal projects do not currently qualify. However, an applicant should contact WQCD prior to preparing an application to discuss the project and determine the best approach. The application covers compliance issues with other environmental permits and requires the applicant to submit specific information on the discharge amount, type and characteristics.

The application needs to be submitted at least 180 days prior to the anticipated date of discharge. WQCD reviews the application for completeness and makes a tentative determination on whether to issue or deny a permit. If the decision is to issue a permit, WQCD prepares a draft permit with terms and conditions. At the same time, a public notice is published in a local paper, and other affected resource agencies are notified. Respondents have up to 30 days to ask for a public meeting. If sufficient interest exists, WQCD has to hold a meeting within 60 days from the release date of the public notice and provide public notice of the meeting. Following the close of public comments, WQCD can modify the terms and conditions of the permit and notify EPA of these changes. Following EPA review, WQCD will either issue or deny the permit and will notify the applicant. The permit becomes effective and final 30 days after it is issued.

The ground-water discharge permit is generally issued for a period of 10 years. The permittee must pay an annual permit fee as determined by state statute. WQCD will bill the permittee for this amount once the permit is final. Permits range in price from \$1,533 for facilities processing up to 49,999 gallons per day (2.19 l/sec), to \$14,112 for facilities with daily throughputs of 20,000,000 gallons per day (877 l/sec) or more.

Colorado Surface Water Discharge Permit

A direct use geothermal project proposing to discharge fluids into surface waters of the state will need to obtain a surface water discharge permit from the Colorado Water Quality Control Division (WQCD). Details of the permit process are contained in the Colorado Discharge Permit Regulations ([Regulations 61 \(5 CCR 1002-61\)](#)).

The first step is to submit a geographic information system (GIS) form to WQCD. Following this, most direct use geothermal projects would file an application for a Minimal Discharge Industrial Wastewater (MINDI) permit. This permit was designed to cover facilities discharging wastewater that have either a small volume of flow or has pollutants which are amenable to control through low level technologies. The application can be downloaded by clicking [here](#).

The application requires the project developer to submit information on the project including discharge amount, type and characteristics. Because the permit is a general permit, terms and conditions are generalized and cover a wide variety of projects with

similar low level discharges. In addition, general permit applications do not go through an extended public notice and appeal process.

A project developer must submit an application for a MINDI permit 30 days prior to the anticipated date of discharge. WQCD has 30 days to act on the application. If the applicant does not receive a request for information or a notification of denial within this period of time, the permit is deemed approved and the applicant has authority to discharge under the terms and conditions of the permit. If WQCD determines that the project does not fall under the authority of the general permit, then the information received will be treated as an application for an individual permit. The annual cost of the permit is \$448.

If an individual permit is required, the applicant will need to get a *Process Water, Stormwater and Ground Water Individual Industrial Wastewater* permit. The process (and the permit) is the same as described above in the section dealing with groundwater discharge permitting.

Aquaculture Projects

The Colorado Aquaculture Act was passed by the State of Colorado to support and oversee the development of an aquaculture industry in the state. The statutes governing aquaculture activities in the state are presented in CRS Title 35, [Article 24.5- Aquaculture](#).

The Colorado Department of Agriculture oversees aquaculture activities in the state. Anyone interested in operating an aquaculture facility in Colorado must obtain a permit through DOA. The permit is issued annually and costs \$150 per year. Applicants must submit information on the types of species to be propagated. A copy of the form can be downloaded by clicking [here](#).

The Colorado Water Quality Control Division has also established a separate wastewater permit for aquaculture facilities. The Aquatic Animal Production Facility Discharge permit can be downloaded by clicking [here](#).

Appendix A

Resource Agency Contacts

Geothermal Well Rules

Colorado Division of Water Resources
Dick Wolfe, PE
Chief of Water Supply
1313 Sherman Street, Room 818
Denver, CO 80203
Phone: 303/866-3581 ext. 8241
Email: Dick.Wolfe@dwr.state.co.us

Underground Injection Control Program

U.S Environmental Protection Agency Region 8 Contacts:

Valois Shea
EPA Region 8
8P-W-GW-UIC
Denver, Colorado 80202-2466
Phone: (303)-312-6276 , 1(800)-227-8917 x6276
shea.valois@epa.gov

Colorado Surface and Ground Discharge Permit System

Department of Public Health and Environment
Water Quality Control Division
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530
Located in Glendale, Colorado
Phone: 303/692-3500 (General permits)

MINDI Permit
John Nieland
Phone: 303/692-3553
Email: john.nieland@state.co.us

Industrial Permit

Mike Liuzzi

Phone: 303/692-3588

Email: michael.liuzzi@state.co.us

Aquaculture Permit

Colorado Department of Agriculture

Markets Division

700 Kipling St, Suite 4000

Lakewood, CO 80215-5894

Phone: 303/239-4114

Appendix B

Geothermal References and Contacts

References

Bloomquist, R.G., Black, G. L., Parker, D. S., Sifford, A., Simpson, S. J., Street, L.V., 1985, Evaluation and Ranking of Geothermal Resources for Electrical Generation or Electrical Offset in Idaho, Montana, Oregon and Washington: Bonneville Power Administration, US Department of Energy, pp. 1-504

Bloomquist, R. Gordon., Nimmons, John. T., Rafferty, Kevin, 1988, District Heating Development Guide, Legal, Institutional and Marketing Issues, Volume 1: for the Washington State Energy Office, funded by the US Department of Energy, pp. 1-268.

Bloomquist, R. Gordon, 1991, Geothermal, A Regulatory Guide to Leasing, Permitting, and Licensing in Idaho, Montana, Oregon and Washington: Bonneville Power Administration, 1-277.

Lund, John W., Lienau, Paul J., Lunis, Ben C., 1998, Geothermal Direct-Use Engineering and Design Guidebook: Geo-Heat Center Oregon Institute of Technology, sponsored by the US Department of Energy Idaho Operations Office, pp. 1-454.

Rafferty, Kevin, 2000, Geothermal Power Generation, A Primer on Low-Temperature, Small-Scale Applications: Oregon Institute of Technology, pp. 1-11.

Lund, John W., **date**, Pavement Snow Melting, Geo-Heat Center Oregon Institute of Technology, pp1-13.

Rafferty, Kevin, 2001, An Information Survival Kit for the Prospective Geothermal Heat Pump Owner: Geo-Heat Center, Oregon Institute of Technology, Grant No. DE-FG07-90ID 13040, pp. 1-23.

Rafferty, Kevin, 2001, Small Geothermal Systems: A Guide For The Do-It Yourselfer: Geo-Heat Center, Oregon Institute of Technology, Contract No. FG01-99-EE35098, pp. 1-30.

Lund, John W., **date**, Balneological Use of Thermal Waters: Geo-Heat Center, Oregon Institute of Technology, pp. 1-10.

Boyd, Tanya, Rafferty, Kevin, **date**, Aquaculture Information Package: Geo-Heat Center, Oregon Institute of Technology, Contract No. DE-FG07-90ID 13040, pp. 1-60.

Rafferty, Kevin, Boyd, Tonya, **date**, Geothermal Greenhouse Information Package: Geo-Heat Center, Oregon Institute of Technology, Contract No. DE-FG07-90ID 13040, pp.1-80.

Contacts

Geo-Heat Center

Website: www.oit.edu/-geoheat

Geothermal Education Office

Website: www.geothermal.marin.org

Geothermal Resources Council

Website: www.geothermal.org

Geothermal Heat Pump Consortium

Website: www.geoexchange.org

International Ground-Source Heat Pump Association

Website: www.igshpa.okstate.edu

U.S. Department of Energy

Website: www.eren.doe.gov/geothermal

Washington State University Energy Program

Website: <http://www.energy.wsu.edu/projects/renewables/geothermal.cfm>