

A Regulatory Guide to Low Temperature Geothermal Development in Washington

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Contents

Introduction	1
What is Low Temperature Geothermal?	2
Regulatory Process for Geothermal Applications	3
High Temperature Geothermal.....	3
Low Temperature Geothermal	3
Open Loop Geothermal Regulations	5
Water Right Permit.....	5
Well Construction	6
Disposal of Geothermal Fluids for Open Loop Systems	9
Underground Injection Control	9
State Wastewater Discharge Permit.....	10
National Pollution Discharge Elimination System.....	11
Closed Loop Geothermal Regulations	12
Water Right Permit.....	12
Ground Source Heat Pump Boring Construction.....	12

Appendix A. Washington State Contacts

Introduction

Geothermal resources range from low temperatures of 50 to 80 degrees F (10 to 27 °C), to temperatures exceeding 650 degrees F (343°C). Although electricity has been generated from resources as low as 165 degrees F (87° C) using organic rankine cycle power generation technology, power generation projects typically favor resource temperatures above 300 degrees F (149° C).

Low temperature (ambient groundwater temperature up to 100° C) geothermal 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. These types of projects follow a different regulatory process than high temperature, power generation projects. Typically this process is shaped by water and wastewater laws and regulations.

The intent of this document is to guide developers of low temperature geothermal projects through the regulatory process of drilling, using, and disposing of low temperature geothermal fluids in Washington State. This guide provides background on the state regulatory process and identifies 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 up front and in time. Projects that are located on federal lands are regulated according to the U.S. Geothermal Steam Act and related federal regulations.

What is Low Temperature Geothermal?

Low temperature geothermal projects range from direct use applications (where the geothermal water is used directly to provide heat to a spa or an aquaculture project) to projects that use geothermal (ground-source) heat pumps (GHPs) to provide heating, cooling and domestic hot water for homes, schools, commercial and government buildings. Low temperature geothermal applications do not include projects where the geothermal energy is used to generate electricity.

There are two main types of low temperature geothermal projects: open loop (groundwater systems) and closed loop (ground-coupled systems). In a typical open loop system, geothermal water is brought up through a well and the water is circulated through a heat exchanger. The cooled water is then either returned to the underground aquifer by injection, or it is discharged to the ground or into a surface water source.

In a ground-coupled or closed loop system, a closed loop of pipe is placed in the ground either horizontally or vertically. A water-antifreeze solution is then circulated through the pipes to either collect heat from the ground in the winter or reject heat to the ground in the summer.

Typically, horizontal closed loop installations are simpler to install and are generally more cost-effective for smaller projects. A back-hoe or chain trencher digs a series of trenches 3 to 6 feet deep. As many as six pipes, usually in parallel connections, are buried in each trench, with minimum separations of a foot between pipes and 10 to 15 feet between trenches. The length of the trenches is determined by the number of pipes installed. Alternatively, piping can be installed in overlapping loops, like a Slinky. A slinky is a coil of plastic tubing spread out and overlapped in a trench and buried. A slinky will reduce trench length by one to two-thirds.

Vertical closed loop systems are generally used for larger buildings and schools. To install a vertical loop, a contractor will bore holes into the ground. Long, hairpin-shaped loops of pipe are then inserted. The hole is backfilled, plugged or grouted, and the pipes are connected to headers in a trench leading back to the building. A typical borehole depth is 150 to 250 feet, but can run deeper.

Regulatory Process for Geothermal Applications

High Temperature Geothermal

In Washington State a “geothermal resource” is defined under the Geothermal Resources Act, Revised Code of Washington ([RCW 78.60.030](#)) as “...only that natural heat energy of the earth from which it is technologically practical to produce electricity commercially and the medium by which such heat energy is extracted from the earth, including liquids or gases, as well as any minerals contained in any natural or injected fluids, brines and associated gas, but excluding oil, hydrocarbon gas and other hydrocarbon substances” (underlined for emphasis).

Washington State further describes geothermal resources as *sui generis* ([RCW 78.60.040](#)), “...being neither a mineral resource nor a water resource and as such are declared to be the private property of the holder of the title to the surface land above the resource.”

Individuals interested in developing a geothermal resource for electrical production are subject to the rules and regulations as described by the Geothermal Resources Act, RCW 78.60. The Department of Natural Resources is the lead state agency responsible for administering and enforcing the provisions of this chapter.

Low Temperature Geothermal

The direct use of low temperature geothermal water resources (including, but not limited to greenhouse heating, warm water aquaculture, space heating, irrigation, swimming pools and hot spring baths) is covered by a separate regulatory process. Washington State characterizes low temperature geothermal water as groundwater and regulates its use accordingly.

Low temperature geothermal projects can be separated into two types: open loop (groundwater) and closed loop (ground-coupled). Open loop geothermal projects follow a similar regulatory process as conventional water wells. This process can involve obtaining water rights and well construction permits. In addition, open loop projects will need to dispose of the geothermal water once it has been used for its design application. Disposal is accomplished either through returning the water back into the ground by way of an injection well, or through surface disposal if injection is not an option.

Closed loop projects follow a slightly different regulatory process. Vertical closed loop projects are regulated as “ground source heat pump borings” and share some of the same regulations as open loop, or water well systems. Conversely, horizontal closed loop projects are not regulated by the State of Washington, as they do not involve the construction or use of wells. Instead, developers of horizontal closed loop systems are only required to meet local building and land-use regulations.

The Department of Ecology (Ecology) is the lead agency in charge of administering the various rules and regulations governing water use and water quality in Washington State. Ecology is responsible for issuing water rights, well construction permits and fluid disposal plans, including underground injection. Developers must also secure ownership or lease rights to the site. In Washington, the Department of Natural Resources Division of Lands covers state land leases. Finally, developers need to contact local and county agencies to ensure compliance with local land use laws including building permits and zoning restrictions.

The steps for developing a low temperature geothermal project are:

- 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.
- Determine project type (no state regulations if horizontal closed loop system is used).
- Obtain water right for open loop system if required.
- File a Notice of Intent (NOI) to construct a water well or a ground source heat pump boring.
- Site and construct well or boring according to state standards.
- Tag wells or borings and submit well logs.
- For open loop systems determine fluid disposal option and obtain permits for either groundwater injection or surface disposal.
- Contact Washington Department of Fish and Wildlife for aquaculture projects.

For regulatory assistance a developer may also contact the Governor's Office of Regulatory Assistance (ORA). ORA has developed a suite of environmental permitting tools, including an on-line permit questionnaire, to assist developers with their projects. The ORA Environmental Permitting website is available at <http://www.ora.wa.gov/resources/permitting.asp>.

Open Loop Geothermal Regulations

State permitting of an open-loop geothermal system may involve obtaining a water right permit, following state water well regulations for well construction and operation, and obtaining the necessary permits for disposal of the geothermal resource water.

Water Right Permit

Unless a ground water withdrawal is exempt from the permit requirements under [RCW 90.44.050](#), an open loop project well cannot be drilled without the well owner first obtaining a water right permit. There are four types of groundwater uses exempt from the state water-right permitting requirements:

- Providing water for livestock (no gallon per day limit or acre restriction).
- Watering a non-commercial lawn or garden one-half acre in size or less (no gallon per day limit).
- Providing water for a single home or groups of homes (limited to 5,000 gallons per day).
- Providing water for industrial purposes, including irrigation (limited to 5,000 gallons per day but no acre limit).

A licensed operator must have a copy of the water right permit or certificate on site at all times. Every well that requires a permit shall be constructed to meet the provisions of that permit. Provisions may include:

- Limitations on zones of completion
- Special sealing requirements
- Special casing and liner requirements
- Other specific construction and testing details

The Department of Ecology will issue water right permits only if the proposed use meets the following requirements: water will be put to beneficial use; no impairment to existing or senior rights; water is available for appropriation; and issuance of the water right will not harm the public's welfare. Water rights are issued by Ecology's regional offices located in Lacey, Bellevue, Yakima and Spokane. A list of contacts is posted at Department of Ecology's water rights website <http://www.ecy.wa.gov/programs/wr/rights/water-right-home.html> and is included in Appendix A.

The water right permit process involves a series of steps that, depending on the complexity of water use and availability within a watershed, may take anywhere from months to years. Early consultation with Ecology should provide the applicant with a better understanding of the time required and any outstanding issues that may complicate the process. Ecology has prepared a list of "[Frequently Asked Questions About Water Rights in Washington](#)" that describes the application process. The following steps outline the permit process:

1. Prepare and submit an “Application for a Water Right” to the Department of Ecology. The applicant is required to provide information on the proposed use, amount, location and ownership of the proposed withdrawal. A copy of the form with instructions is available on-line at <http://www.ecy.wa.gov/programs/wr/forms/forms.html#wrapp>. A minimum filing fee of \$50 is required.
2. Upon review of the application, Ecology will send the applicant a legal notice to be published in a local newspaper for a period of two weeks describing the project and offering an opportunity for public input for up to 30 days. At the end of the publication period the applicant must submit a notarized *Affidavit of Publication* to Ecology.
3. Ecology conducts an investigation of the application and issues a *Report of Examination* that contains a denial or approval of the water right request. A copy of the report is sent to the applicant and other interested parties. The applicant and others have 30 days to appeal the Examiner’s recommendation to the Pollution Control Hearing Board.
4. Provided there are no appeals, the applicant is issued a *Permit to Appropriate Public Waters*. The permit allows for the construction and operation of the water project and contains a schedule and a date by which the applicant should put the water to use. The applicant is required to submit progress reports to Ecology.
5. After construction, the applicant submits a notarized *Proof of Appropriation* affidavit form that includes information on the amount of water used, where it is being used, for what purpose, the type of facility and equipment used, and a statement that all conditions of the permit have been met.
6. Ecology will issue a Certificate of Water Right to the applicant based on the information submitted. The certificate is recorded at the County Auditor’s Office where the project is located and at Ecology. Any filing and recording fees are paid by the applicant at this time.

Well Construction

The Department of Ecology manages well construction activities in the state. RCW 18.104 establishes the regulatory framework for water well construction and identifies the Department of Ecology as the lead agency. The minimum standards for well construction and maintenance, and the regulation and licensing of well contractors and operators are described in Chapters 173-160 and 173-162 of the Washington Administrative Code, respectively. These regulations can be viewed at <http://www.ecy.wa.gov/programs/wr/wells/wellhome.html>.

Before starting well construction, the project developer may want to review data from other wells in the area. Well log data can be obtained from a number of sources including county health offices. The Department of Ecology provides well log information at <http://apps.ecy.wa.gov/welllog/>. The Geo-Heat Center, located in Klamath Falls, Oregon, also maintains an extensive database covering wells and springs greater than 50 degrees C (122 °F) for 16 western states. Information on the database can be found at <http://geoheat.oit.edu/>. County planning and or health departments should also be

contacted at this time to check for any additional county regulations or ordinances covering well placement and construction.

Notice of intent form: To begin well construction, a developer must submit a *Notice of Intent* to the Department of Ecology at least 72 hours prior to well construction. The form requires information on the well owner, well location, construction time, and the proposed use. If the intended withdrawal requires a water right, the permit or certificate must also be attached to the Notice of Intent form. A fee for construction of a new water well is also collected at this time. For a well with a minimum top casing of less than 12 inches, the fee is \$200. For well casings 12 inches or greater the fee is \$300. The forms are available through Ecology’s Regional Offices, county building departments, or on-line at <http://www.ecy.wa.gov/programs/wr/wells/wellhome.html>.

The notice of intent form allows Ecology to track well activities and to inspect a well to make sure it is constructed according to state regulations. Of specific concern is the location, sealing and casing of the well to avoid contamination. Requirements for locating a well are addressed in [WAC 173-160-171](#), which includes minimal setbacks from potential sources of contamination. [WAC 173-160-191](#) describes the design and construction requirements for completing a well. Well casing and liner requirements are contained in [WAC 173-160-201](#), while sealing requirements are described in [WAC 173-160-221](#).

Well operator licensing: Only a duly licensed and bonded well contractor is permitted to construct wells in the state of Washington. As described in Chapter 18.104.180 RCW, Washington State licensed engineers, architects and land surveyors are exempt from obtaining a license. The Department of Ecology oversees the licensing of well operators and has posted licensing information at <http://www.ecy.wa.gov/programs/wr/wells/driller.html>.

The regulation governing well contractors is [Chapter 173-162 WAC “Rules and Regulations Governing the Regulation and Licensing of Well Contractors and Operators”](#). Some of the conditions for obtaining a well operator license include:

- Submitting a well operator application form (\$75 application fee)
- 600 hours of drilling experience under direct supervision of a Washington State licensed operator
- Completing six continuing education units
- Passing a written and on-site examination

Well report and tag: After a well is constructed, re-constructed or decommissioned, a well report must be filed within 30 days to the Department of Ecology. A well report must be an accurate summation of data collected in the field as the well was constructed or decommissioned. Field notes must be available at all times during construction or decommissioning for review by state and local inspectors and kept until the well report is submitted. Information contained in the field notes includes:

- Owner name, operator name/license, tax number
- Well location, tag number and construction date

- Intended use
- Well depth, diameter, casing, sealing and drilling method
- Characterization of well stratum and depth to static water level

Well report forms are available at <http://apps.ecy.wa.gov/wellog/forms.asp>. In addition, within thirty days of completion of the well, the well operator is responsible for placing a well identification tag on each well.

Disposal of Geothermal Fluids for Open Loop Systems

Underground injection is the preferred method for disposing of geothermal water from an open loop system. If this method of disposal is unavailable, a developer will need to determine alternative disposal options such as surface water discharge.

Underground Injection Control

The Underground Injection Control (UIC) Program was established in 1982 when Congress passed the Safe Drinking Water Act. This program regulates 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 put underground for temporary or permanent disposal or storage. Underground injection control wells are regulated under [Chapter 173-218 WAC](#) (Underground Injection Control Program), and [Chapter 173-200 WAC](#) (Water Quality Standards for Ground Waters of the State of Washington). The purpose of these regulations is to protect existing and future beneficial uses of underground sources of drinking water (USDW). In Washington State all sources of ground water are considered USDW.

All injection wells come under the jurisdiction of the Department of Ecology.

Geothermal injection wells are classified as Class V injection wells ([WAC 173-218-040](#)) and allowed in Washington as per the following definition:

- Heat pump or cooling water return flow wells used to inject water previously used for heating or cooling
- Injection wells associated with the recovery of geothermal energy for heating, aquaculture and production of electric power

UIC well registration: To operate an existing or new UIC well in Washington, the well must be registered with the UIC program and must either be authorized by rule or receive a state wastewater discharge permit from the Department of Ecology. For new wells, the UIC well needs to be registered before use. In order to receive rule authorization, a well must meet the nonendangerment standard (see [WAC 173-218-080](#) and [173-218-090](#)) and must be registered with the department. If a UIC well is rule authorized, it does not need a state wastewater discharge permit to operate.

Open loop heating and cooling water return flow wells that have not added any chemicals or product to the water should meet the nonendangerment standard and would be rule authorized after the well is registered. Open loop geothermal systems that have been exposed to chemicals or other products will require an associated state wastewater discharge permit.

UIC well registration forms are available at <http://www.ecy.wa.gov/programs/wq/grndwtr/uic/>. When completing the form, the following information must be included:

- Operator/owner information
- Site location
- Best management practices used to protect ground water quality
- UIC well description
- Other information necessary to meet the nonendangerment standard

UIC well construction: Construction of an injection well can begin once the well is registered and (if needed) a state wastewater discharge permit has been issued. In general, the same standards apply to the construction of a UIC well as for a water well. These steps are outlined in the previous section and include:

- Filing a *Notice of Intent* form and paying a well fee
- Hiring a State of Washington licensed well operator
- Constructing the well in accordance with [Chapter 173-160 WAC](#): Minimum standards for construction and maintenance of wells
- Tagging the well(s) and completing a well log(s)

State Wastewater Discharge Permit

An open loop geothermal project will need to obtain a state wastewater discharge permit if the UIC well does not meet the nonendangerment standard, or if the discharge fluid is disposed of to surface waters. A UIC well could also need a wastewater permit if it is in direct connection with a surface water body. A wastewater discharge permit is a legal document issued by the Department of Ecology to control the discharge of wastewater to surface or ground waters and to publicly-owned sewage systems. Permits place limits on the quantity and concentrations of contaminants that may be discharged and may require treatment of wastewater or impose other operating conditions on dischargers to ensure that permit limits are met. Washington State permits are grouped by geographical areas called Water Quality Management Areas (WQMAs) and are typically issued for five years.

State wastewater discharge permits are required for anyone who discharges waste materials from a commercial or industrial operation to ground or to a publicly-owned treatment plant. A National Pollution Discharge Elimination System (NPDES) permit is required for any projects that discharge wastewater to surface waters. Ecology administers both state wastewater discharge permits and the federal NPDES permits.

Currently, the state of Washington issues two types of wastewater discharge permits:

- General permits that cover a category of similar dischargers
- Individual permits that cover a single, specific facility or activity, like factories

Individual and general permits may be issued either as a state permit or a NPDES permit. When discharges are to both surface waters and to ground or a treatment plant, the discharges are covered by a combined state/NPDES permit. Currently, the state does not have a general permit for open loop air conditioning/heat pump return flow wells. Therefore, any open loop project that requires a state wastewater discharge permit to operate must apply for an individual permit.

To obtain a state wastewater permit, a developer must first contact a Department of Ecology regional wastewater permit coordinator. The coordinator will advise a project developer on the application process and will determine the parameters to be measured in the discharge. Permit applications provide Ecology with information on pollutants in the waste stream, materials which may enter the waste stream, the flow characteristics of the discharge, and the site characteristics at the point of discharge. A list of regional coordinators is presented in Appendix A, or can be viewed at http://www.ecy.wa.gov/programs/wq/permits/permit_coord.html. Additional information on state wastewater permits is available at <http://www.ecy.wa.gov/programs/wq/permits/guidance.html#presentations>.

National Pollution Discharge Elimination System

The Department of Ecology also administers the National Pollution Discharge Elimination System (NPDES) permit program, which is codified under [173-220 WAC](#).

Discharge from an open loop geothermal system to surface waters would require an NPDES permit. To apply for a permit, a project developer must contact the Department of Ecology's regional wastewater permit coordinator for that geographic area. An NPDES applicant will need to provide mapping information, flow data, an estimate of the type and quantities of pollutants discharged and a brief description of any planned treatment. This information will be used to determine the conditions of the permit including appropriate control or treatment strategies, monitoring, and reporting requirements. Program guidance is available at <http://www.ecy.wa.gov/programs/wq/permits/index.html>. In general, the NPDES permit application process can take from two months to one year depending on the conditions of the permit.

Closed Loop Geothermal Regulations

There are two types of closed loop (ground-coupled) systems — horizontal and vertical. In horizontal systems the subsurface heat exchange loop is installed in trenches. Because these horizontal systems do not use any type of well or boring, they are not regulated by the State of Washington. However, developers of horizontal closed loop systems are required to meet local building and land-use regulations.

Vertical closed loop projects are regulated by the Department of Ecology as “ground source heat pump borings.” RCW Chapter 18.104.020(9), WAC 173-160-111(31), and WAC 173-160-410(3) define a “ground source heat pump boring” as “a vertical boring constructed for the purpose of installing a closed loop heat exchange system for a ground source heat pump.” A ground source heat pump boring (GSHPB) is considered both a water well and a resource protection well and shares many of the same regulations as water well systems. However, unlike open loop systems, vertical closed loop systems do not require a water right permit, nor do they need to obtain disposal permits as they do not discharge fluids into the environment.

Water Right Permit

Closed loop vertical systems do not require a water right permit or certificate (nor does a horizontal system).

Ground Source Heat Pump Boring Construction

Notice of intent form: Before constructing a ground source heat pump boring, a developer must submit a *Notice of Intent* form to the Department of Ecology *at least 72 hours* prior to well construction. The notice allows Ecology to track well activities and to inspect a well to make sure it is constructed according to state regulations. The notice must be accompanied by a fee of \$40 for construction of up to four ground source heat pump borings per project, plus \$10 for each additional ground source heat pump boring constructed on a project with more than four wells.

Boring construction standards: Ground source heat pump borings cannot be used for any purpose other than heat exchange. Minimum construction standards for a ground source heat pump boring are contained in [WAC 173-160-453](#) and include the following:

- A ground source heat pump boring shall not be located within 100 feet from any water supply well unless local health regulations allow for variances.
- Site specific conditions shall be assessed to determine the best method and materials to be used for sealing the well annulus to protect the ground water.
- If permanent casing is needed in a ground source heat pump boring, it must meet standards set out in WAC 173-160-201 for steel and for plastic.
- The material used to make up the heat exchange loop that is placed into the ground must be able to withstand the typical forces which act upon it during and

- after construction. The material must also be resistant to the corrosive effects of the surrounding formations, earth, water, and heat exchange fluids within the pipe.
- The ground loop will be pressure tested in accordance with manufacturer-recommended specifications. The closed-loop assembly pipe within the bore hole shall not leak or cause contamination to the ground water.
 - All fluids used in the construction and testing of ground source heat pump borings will be handled and utilized in a manner that does not contaminate the ground water or surface water.
 - The hole size for ground source heat pump borings must be of sufficient size to allow placement of the heat exchange loop and tremie tube to the bottom of the hole.
 - No more than one heat exchange loop can be placed in one bore hole.
 - Grouting (sealing) the bore hole of a ground source heat pump boring must be completed immediately after the heat exchange loop is installed. A bentonite grout with a minimum of 20% active solids (bentonite) by weight is required.

Well driller licensing: A ground source heat pump boring is considered both a water well and a resource protection well. A Washington State well operator's license with either a resource protection or water well endorsement is required. The license must be issued by the Department of Ecology. Information on licensing is available at <http://www.ecy.wa.gov/programs/wr/wells/driller.html>. As described under Chapter 18.104.180 RCW, Washington State licensed engineers, architects and land surveyors are exempt from obtaining a license.

Well report and tag: Within 30 days after a ground source heat pump boring is completed or decommissioned, a well report must be filed with the Department of Ecology. Well reports are filled out by the person who constructed the well and are to contain complete and accurate information about construction, soil, location and driller. Well log forms are available at <http://apps.ecy.wa.gov/wellog/forms.asp>. In addition, within 30 days of completion of the well, the well driller is responsible for placing a well identification tag on each ground source heat pump boring constructed.

Appendix A

Washington State Contacts

Geothermal

Washington State University Extension Energy Program
Renewable Energy Program
905 Plum St SE, Bldg 3
PO Box 43165
Olympia, WA 98504-3165
Phone: 360/956-2000
E-mail: lyonsk@energy.wsu.edu

Department of Natural Resources
Geology and Earth Resources Division
Dave Norman, State Geologist
1111 Washington Street
PO Box 47007
Olympia, WA 98504-7007
Phone: 360/902-1439
E-mail: dave.norman@dnr.wa.gov

Water Resources

Department of Ecology Water Resources Program:

<http://www.ecy.wa.gov/programs/wr/wrhome.html>

Department of Ecology's Regional Offices - Water Rights

Region	Contact	Address	Phone/Website
Northwest	Andy Dunn	3190 160 th Ave SE Bellevue, WA 98008-5452	425-649-7000 http://www.ecy.wa.gov/directory_nw_ro.html
Southwest	Tom Loranger	PO Box 47775 Olympia, WA 98504-7775	360-407-6300 http://www.ecy.wa.gov/directory_sw_ro.html
Central	Mark Schuppe	15 West Yakima Ave -- Suite 200 Yakima, WA 98902-3452	509-575-2490 http://www.ecy.wa.gov/directory_cro.html
Eastern	Keith Stoffel	N. 4601 Monroe Spokane, WA 99205-1295	509-329-3400 http://www.ecy.wa.gov/directory_ero.html

Department of Ecology - Well Construction and Licensing

Headquarters (Lacey) Marian Bruner (360) 407-6650 Well License Testing, Notice of Intent, Continuing Education	Headquarters (Lacey) Bill Lum (360) 407-6648 Well Construction, Technical Advisory Group, Laws, Regulations and Legislative Activities
Northwest Region Jerry Liszak (425) 649-7013 Well Construction Arlene Harris (425) 649-7020 Well Report Tracking	Southwest Region Mike Gallagher (360) 407-6918 Well Construction Mary Lynum (360) 407-6859 Well Report Tracking
Central Region Avery Richardson (509) 575-2639 Well Construction Erin Gutierrez (509) 454-7206 Well Report Tracking	Eastern Region Mark Ader (509) 329-3544 Well Construction Andy Albrecht (509) 329-3541 Well Report Tracking

Water Quality

Department of Ecology Water Quality Program:
<http://www.ecy.wa.gov/programs/wq/wqhome.html>

Underground Injection Control (UIC) Program

Mary Shaleen Hansen
Department of Ecology
Water Quality Program
P.O. Box 47600
Olympia, WA 98504-7600
Phone: (360) 407-6143
E-mail: maha461@ecy.wa.gov
<http://www.ecy.wa.gov/programs/wq/grndwtr/uic/registration/reginfo.html>

Department of Ecology's Regional Offices - Wastewater Discharge Permits

Region	Contact	Address	Phone/ Website
Northwest	Kevin Fitzpatrick	3190 160 th Ave SE Bellevue, WA 98008-5452	425-649-7000 http://www.ecy.wa.gov/directory_nw_ro.html
Southwest	Garin Shrieve	PO Box 47775 Olympia, WA 98504-7775	360-407-6300 http://www.ecy.wa.gov/directory_sw_ro.html
Central	Bob Barwin	15 West Yakima Ave, Suite 200 Yakima, WA 98902-3452	509-575-2490 http://www.ecy.wa.gov/directory_cro.html
Eastern	Jim Bellatty	N. 4601 Monroe Spokane, WA 99205-1295	509-329-3400 http://www.ecy.wa.gov/directory_ero.html

Additional Resources

Geo-Heat Center: <http://geoheat.oit.edu/>

Geothermal Education Office: www.geothermal.marin.org

Geothermal Resources Council: www.geothermal.org

Geothermal Heat Pump Consortium: www.geoexchange.org

International Ground-Source Heat Pump Association: www.igshpa.okstate.edu

U.S. Department of Energy: <http://www.eere.energy.gov/geothermal/>

Washington State University Extension Energy Program:
<http://www.energy.wsu.edu/projects/renewables/geothermal.cfm>