

GEOTHERMAL ENERGY STRATEGIC PLAN FOR VALLEY COUNTY, IDAHO



Hot Creek Warm Springs (Arling), located between Cascade and Donnelly on the east side of Highway 55.



Gold Fork Hot Springs is located east of Donnelly

Prepared by *the Valley County Geothermal Energy Team*
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Geothermal Energy Strategic Plan For Valley County, Idaho

Strategic Plan

*prepared by the Valley County Geothermal Energy Team comprised of
representatives from:*

Valley County
City of Cascade
Cascade School District
Cascade Medical Center
Valley County Private Citizens

published by the

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Preface

The purpose of the Valley County Geothermal Energy Strategic Plan is to document the ideas and goals that the citizens have for geothermal development in their county. The major portions of this plan cover the geothermal resources of Valley County, the current and potential uses, the needs and barriers, and the projects and action plans. However, this document is not a finished product. The Valley County Geothermal Energy Team developed many plans, but some ideas are still in their formative stages. Consequently, certain sections, such as Identified Projects and Strategic Objectives and Action Plans are considered to be “under construction”. When they are completed by the Valley County Geothermal Energy Team, the plan will be updated and a revised version will be published.

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Mission Statement

The mission of the Valley County Geothermal Energy Team is:

“To develop geothermal resources to their potential in Valley County for the benefit of the greater community, as part of the community’s efforts toward energy independence”.

Community Objectives Related to Geothermal

Why develop the geothermal resources in Valley County?

- Reduce Idaho’s dependence on fossil fuels.
- Establish a renewable energy model community.
- Contribute to national security by developing local renewable energy resources.
- Provide viable economic opportunities.
- Increase the skilled job base.
- Expand existing geothermal operations.
- Add new geothermal operations.
- Reduce energy costs for the community and businesses.
- Create sustainable energy supplies to be used locally and contribute to the regional energy needs.
- Provide a stable socio-economic environment.

Geological and Geothermal Investigations

There are 91 records in the Idaho Office of Energy Resources (IOER) geothermal database for Valley County (Figure 1). Fifty-four have temperatures greater than 85° Fahrenheit (F), but less than 212° F, and thus are classified as “low temperature geothermal”. Vulcan Hot Springs has the highest reported temperature for a spring (191° F). The high reported temperature in a well (150° F) is at an exploration well drilled at Tamarack Resort in 2005 to 1,690 feet. Twenty-nine sites have “warm” temperatures that range from 68° to 85° F. Eight sites are listed in IOER’s geothermal database, but they do not have temperature data. Most of the 91 Valley County sites in IOER’s database are in remote mountainous areas.

The two main rock types in Valley County are: 1) Idaho Batholith, and 2) Alluvium. The Idaho Batholith is a massive igneous intrusion of granite. Alluvium deposits are boulders, cobbles, gravels, sands, clays, and silts that vary in thickness from a few feet to as much as 7,000 feet (the latter occurring in Long Valley about 10 miles north of Cascade (Wilson and others, 1976)). Alluvium deposits are the result of deposition from glaciers, rivers, and streams.

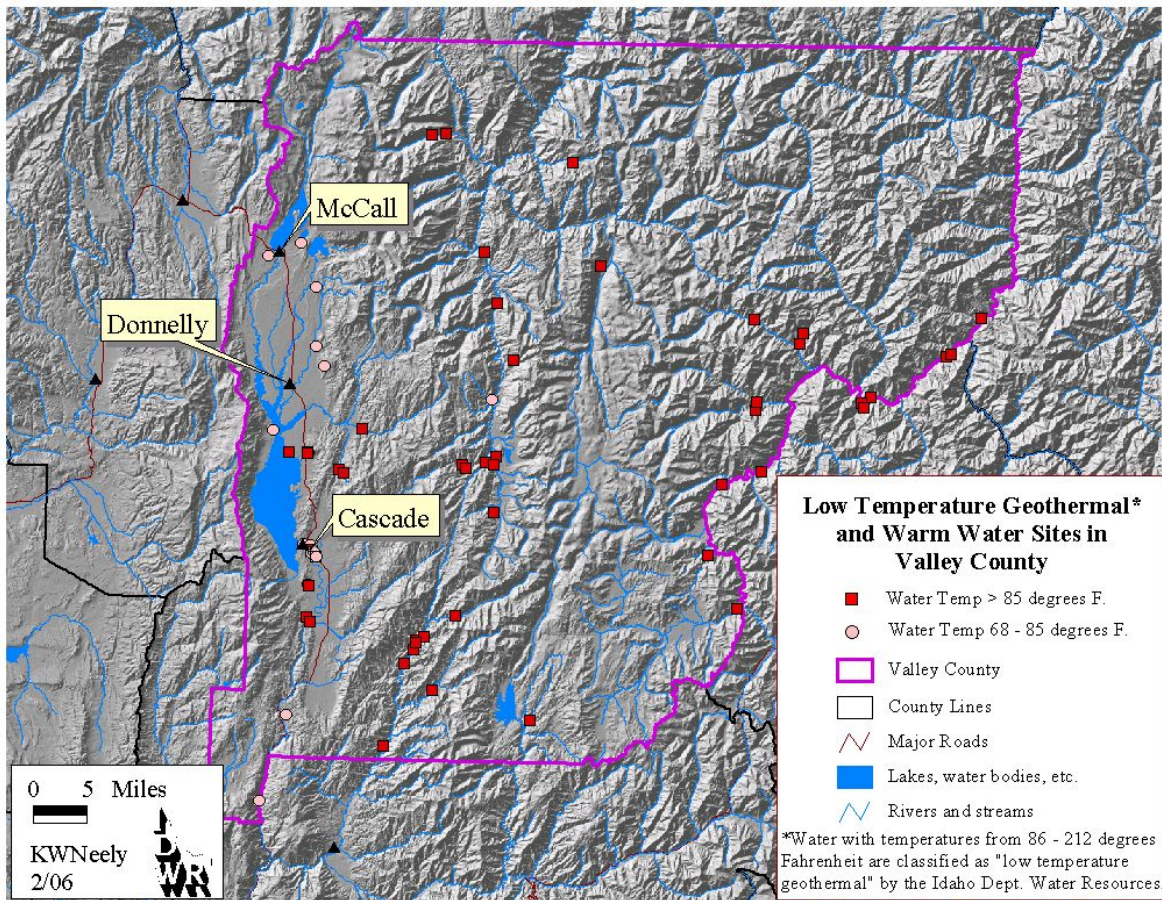


Figure 1. Low temperature geothermal resources in Valley County, Idaho.

Geological and geophysical studies have provided the following evidences that a significant geothermal resource might exist in Valley County:

1. Existence of major north-south trending faults.
2. Existence of east-west trending faults.
3. Macroseismic and microseismic recordings that indicate recent activity (earthquakes) on some of these faults.
4. Intersections of these two types of faults, which could provide permeable transport pathways for geothermal fluids.
5. Geothermometer temperatures that are hot enough for power generation.

In the following paragraphs, these geothermal evidences from studies and reports are described.

Wilson and others (1976) conducted a geothermal investigation of the Cascade area and concluded that there was a geothermal resource that had potential for non-electrical (direct use) applications. The authors noted that the area is highly faulted with displacements as great as 10,000 feet on the north-south trending Long Valley Fault. A comparison of the surface expressions of major faults and the locations of geothermal sites in the county shows that the two are closely correlated (Figure 2). Wilson and others predicted subsurface temperatures of up to 354° F based on the silica geothermometer.

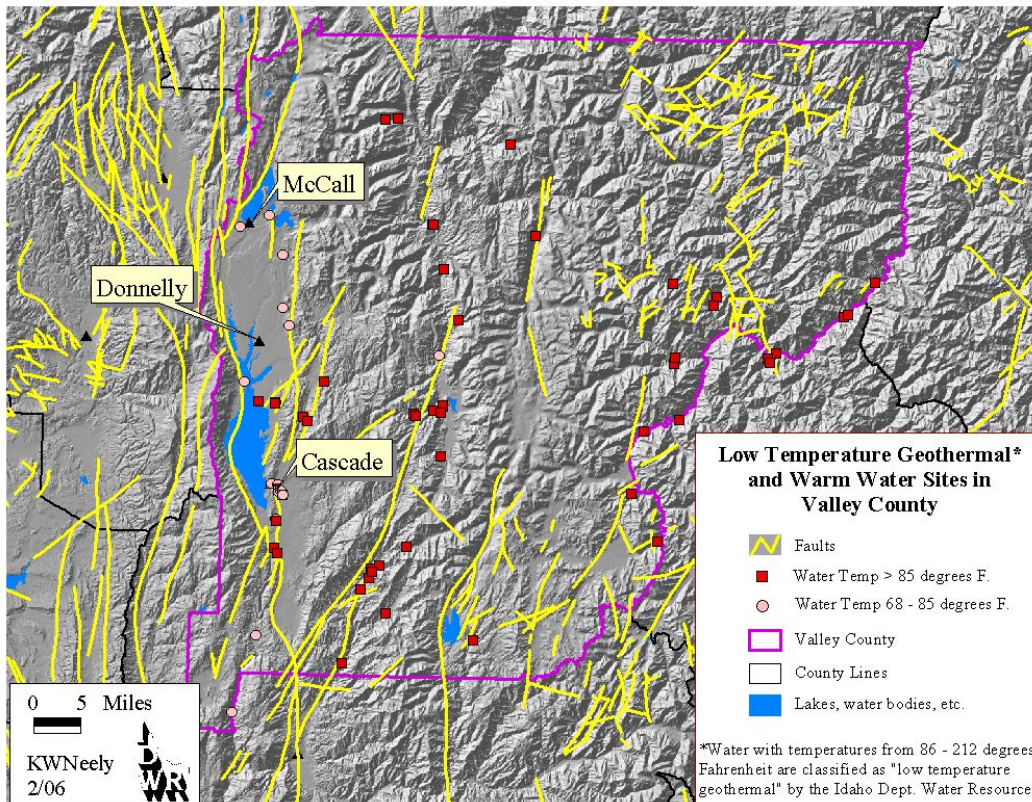


Figure 2. Major faults in Valley County and surrounding areas.

Wilson and others (1976) also conducted a microseismic study in 1975 to determine if the area is tectonically active which, if it is, would increase the potential for the movement of geothermal resources. In their study, the authors detected “swarms” of tectonic activity. Swarms are groups or clusters of low magnitude earthquakes that occur in a specific area over a distinct time period. The authors reported that tectonically-active zones existed and they were aligned in east-west trends. They concluded that the “intersection of two tectonically active zones” (i.e. the major north-south Long Valley Fault system which had previously been known to have experienced seismic activity (earthquakes), and the recently-discovered, seismically-active east-west lineaments) “should provide improved conduits for the circulation of geothermal water” (page 29). They also concluded that “both the granitic rocks and valley fill” (i.e., alluvium) “offer potential as reservoirs for thermal water” and that “a significant untapped thermal aquifer may exist at depth in the valley fill” (page 41).

Mitchell and others (1980) reported that the geothermometer data for Indian Creek Hot Springs and Vulcan Hot Springs indicated that the subsurface reservoirs might be hot enough for power generation. Also in Mitchell and others (1980), it was reported that the digital satellite imagery work conducted by Earth Resources Observation Systems (EROS) indicated that Cascade lies near the intersection of major linear features.

Seismic monitoring by James Zollweg in 2005 has further confirmed the existence of microearthquake activity (Zollweg, personal communication). Significant microearthquake activity was recorded in the Alpha area (9 miles south of Cascade),

which suggested both normal and strike-slip motion on faults oriented northwest to north. These results are consistent with the "Tripod Peak" swarm recorded in 1992; this swarm was located about 10 miles to the southwest of Cascade. According to Zollweg, the normal faults in Valley County dip at 40° to 70° angles, the strike-slip faults dip at 70° to 90° angles, and the seismic activity (earthquakes) occurs at a minimum of about 7,000 feet below the land surface. A written report from Zollweg on his findings is pending.

Dr. Carl Austin, IdaTherm, LLC, completed a reconnaissance study for Valley County and submitted a report to the county commissioners in June, 2006. Although the results are still confidential, a presentation by Dr. Austin in Cascade on June 15, 2006 revealed his opinion that Valley County has good potential for a high temperature geothermal resource that could be used for generating electricity.

Resource Utilization and Potential

• ***Current Use of Geothermal in Valley County***

- Silver Creek Plunge – Recreation, commercial (Figure 3).
- Hot Creek Warm Springs (Arling Warm Springs) – Aquaculture (Tilapia), commercial (Figure 4).
- Gold Fork Hot Springs – Recreation, commercial.
- Leisure Time Swimming Pool – Recreation, commercial
- Vulcan Hot Springs – Research (extremophiles) (Figure 5).
- Undeveloped Hot Springs in mountainous areas – Recreation



Figure 3. Silver Creek Plunge is a commercial recreation facility located in southern Valley County.

• ***Existing Resources that may be Developed or Expanded***

- Unused warm wells
- Unused hot springs
- Geo Exchange systems (geothermal heat pumps)



Figure 4. Tilapia are raised at Hot Creek Warm Springs (Arling) and served up Fridays at Grandma's Restaurant in Cascade.



Figure 5. Vulcan Hot Springs is used for recreation and for aquaculture research. The spring has also been studied for the possibility of power production

- ***Potential Developments for New Sources or Expansion of Existing Sources***
 - District heating and heating of individual buildings in Cascade
 - Greenhouses
 - Aquaculture
 - Power Production
 - Recreation
 - Snow melt
 - Mushroom culturing
 - Ethanol production
 - Hydrogen production

Needs and Barriers

The Valley County and City of Cascade Geothermal Energy Team identified various needs and barriers facing development and use of geothermal resources. These are:

- Need for better scientific understanding of the resource.
- Coordination of efforts, studies, etc.
- Geothermal council or clearinghouse.
- Geo business plan (BSU Kent Neupert).
- Funding for exploration and development.
- Ensure that planning and zoning will facilitate geothermal development.
- Need to address state legislation allowing municipal ownership of power production facilities which now excludes geothermal power generation.
- Make property tax appealing to financial investors.

Identified Projects

The Valley County and City of Cascade Geothermal Energy Team, and the Idaho Office of Energy Resources developed a list of potential geothermal projects for Valley County (Table 1).

Table 1. Summary of potential geothermal projects in Valley County.

Name of Project	Description	Barriers
Geochemical testing of leakage around Cascade Fracture Ring	Conduct survey to determine leakage sites. Test sites for chemical parameters.	
Determine type of Geo Exchange systems for City, County, High School and Medical Center	What is best – Open Loop, or Closed Loop. Individual systems for each entity or community system?	
Drawdown pump test for Cascade Mill well	Pump the geothermal well at the Cascade Mill, monitoring flow and temperature in it and nearby wells.	
Southern Valley County Rec. District Swimming Pool	Determine location and best method for heating the pool and the facility.	
Economic analyses for Arling	Conduct an economic analyses for an expansion of Tilapia production at Arling.	
Regional Seismic study (BSU – CGISS & Intermountain West Geo. Consortium)	Determine most likely “high temp” areas for potential power prospects, and conduct seismic surveys.	
Drill Deep Test well	After seismic survey, determine the best drill location and drill.	
Determine flow rate at MacGregor’s springs	Devise way to capture all the spring flow and route through a measuring device.	
Evaluate the possibility of transmitting water from MacGregor’s to Cascade	Engineering study	Contingent on flow rate.

Strategic Objectives and Action Plans

The Valley County and City of Cascade Geothermal Energy Team developed a framework of strategic objectives and actions.

- **Strategic Objective 1**

Conduct additional resource investigations.

Actions	Responsible Party(ies)	Target Date
Identify geothermal power exploration well site.	Valley County Commissioners, Chevron Energy Solutions, IdaTherm, LLC, and others	ASAP
Calculate flows of existing springs and wells.		
Reservoir studies.		

- **Strategic Objective 2**

Identify a formal organization structure for steering geothermal exploration and development in Valley County

Actions	Responsible Party(ies)	Target Date
Make recommendations to County Commissioners.	Valley Geothermal Team	ASAP

- **Strategic Objective 3**

Make Valley County 100% sustainable for energy, with geothermal being a component of this achievement.

Actions	Responsible Party(ies)	Target Date
Determine the legal aspects of deep drilling of geothermal.	County Commissioners	
Obtain lease position on primary exploratory drill sites.	County Commissioners	
Remove barriers to geothermal development – create opportunities for geothermal development.	County Commissioners	
Remove county and state law barriers, such as taxation and tax credits.	County Commissioners	
Create incentives for the efficient use of energy – in buildings, municipal structures, homes, lighting, everything. (Energy Star, LEED, Energy Codes).		

- **Strategic Objective 4**

Identify funding mechanisms and develop actions for obtaining funding, such as a) revolving loan fund for exploratory drilling (State, Federal, Venture Capital, Geothermal Investors' Group), b) grants through various sources (Intermountain West Geothermal Consortium, US DOE, Business & Community Development, private foundations), c) local sources (county, city, companies, individuals), and d) facilitate private financing.

Actions	Responsible Party(ies)	Target Date
Continue to lobby Idaho congressional delegation to restore geothermal R&D funding to the U.S. Department of Energy's Geopowering the West Program.		
Maintain a dialogue with the Idaho Energy Resource Authority (potential resource for construction).		
The state of Idaho needs to put together a geothermal prospect symposium like the one for the oil and gas industry in Denver.	Idaho Office of Energy Resources	
Participate in poster sessions at the GRC Annual Meeting that shows the geothermal potential in Idaho. Emphasize Idaho's ease of doing business, through its friendly political and regulatory environment.	Idaho Office of Energy Resources	
Establish a local investment group – gives the local community an ability to buy in.	Mike Diem	
Study COSO (California's 275 MW project) as a model for financing, particularly using third-party contracts.		

- **Strategic Objective 5**

Explore power purchase agreements with Idaho Power or with other markets.

Actions	Responsible Party(ies)	Target Date
Reestablish communications with investor-owned utilities (particularly Idaho Power) in Idaho.	Mike Stewart, Idaho Power, and Judy Danielson	
Establish communications with the Bonneville Power Administration.	Mike Stewart, Idaho Power, and Judy Danielson	
Make contact with the Pacific Northwest Power and Conservation Planning Council.	Mike Stewart, Idaho Power, and Judy Danielson	
Investigate having representation in the Integrated Resource Planning process at Idaho Power and others.	Mike Stewart, Idaho Power, and Judy Danielson	
Establish communication with the Idaho Public Utilities Commission.	Mike Stewart, Idaho Power, and Judy Danielson	
Look at participation in the development of the new Idaho Energy Plan at the Legislature's Interim Committee on Energy, Environment and Technology.	Mike Stewart, Idaho Power, and Judy Danielson	

- **Strategic Objective 6**

Promote use of Geo Exchange Systems.

Actions	Responsible Party(ies)	Target Date
Conduct Farm Bill Workshops in 2007 and beyond.	Idaho Office of Energy Resources	
Publicize school and county demonstration projects.		
Use Trinity Pines as another potential candidate for demonstration (26,000 sq ft).		
Invite Renewable Energy Resources and Water Furnace to have booths at the county fair – possibly Thunder Mountain Days also.	Fair Board	
Delineate advantages to county and taxpayers from use of Geo Exchange.		

APPENDIX A – Valley County Geothermal Energy Team Membership

The following Valley County citizens participated in one or more of the Valley County Geothermal Energy Team meetings:

Mike Stewart, Co-Chairman
Scotty Davenport, Co-Chairman
John Austin
Phil Davis
Yvette Davis
Mike Diem
Gary Harris
Amy Fisher
John Gahl
Ardean Grufsrud
Anne Guarino
Elsie Krause
Amy Loomis
David MacGregor
Bob Pair
Mike Smith
Lois VanHoover
Ben Wellington
Bill Wheeler
Gerald Winkle
Robie Winkle

Non-Valley County participants included:

Sarah Bigger, Boise State University and Intermountain West Geothermal Consortium
Brian Dickens, Idaho Department of Commerce and Labor
Gerald Fleischman, Idaho Office of Energy Resources
Gerry Galinato, Idaho Office of Energy Resources
Virginia Gillerman, Idaho Geological Survey
Dan Hand, Chevron-Texaco Energy Solutions
Lane Jolliffe, Representative Otter's office
Ken Neely, Idaho Department of Water Resources
C.J. Northrup, Boise State University, Center for Geophysics of the Shallow Subsurface
Tim O'Leary, Idaho Office of Energy Resources
Rick Tremblay, U.S. Economic Development Administration
Paul Zasada, Chevron-Texaco Energy Solutions

APPENDIX B – Links and Contacts

Information/Education

Geo-Heat Center
Oregon Institute of Technology
3201 Campus Drive
Klamath Falls, OR 97601-8801
541-885-1750 Email: chiasso@oit.edu
<http://geoheat.oit.edu>

Geothermal Education Office
664 Hilary Drive
Tiburon, CA 94920
415-435-4574 or 1-800-866-4436
E-mail: geo@marin.org
www.geothermal.marin.org

Idaho Office of Energy Resources
PO Box 83720
Boise, ID 83720-0098
208-287-4800 or 1-800-344-SAVE (7283)
E-mail: geothermalinfo@idwr.state.id.us
<http://www.idwr.idaho.gov/energy/>
Geothermal Energy Program
www.idahogeothermal.org

US Department of Energy
Energy Efficiency and Renewable Energy Network
Geothermal Energy Program
www.eere.energy.gov/geothermal
GeoPowering the West
<http://www1.eere.energy.gov/geothermal/gpw/>

Technical/Science Support

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Geo-Heat Center

Oregon Institute of Technology
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<http://geoheat.oit.edu>

Idaho National Engineering and Environmental Laboratory
Energy Efficiency and Renewable Energy Network
Robert Neilson, Jr.
PO Box 1625 MS 3830
Idaho Falls, ID 83415
208-526-8274
E-mail: rmn@inel.gov
<http://geothermal.id.doe.gov>

Intermountain West Geothermal Consortium
Boise State University
Dr. Walter Snyder
1910 University Drive
Boise, ID 83725-1525
208-426-5905
Email: wsnyder@boisestate.edu
<http://www.geothermalresearch.org/>

Financial Assistance

Idaho Office of Energy Resources
Low Interest Energy Loan Program
PO Box 83720
Boise, Idaho 83720-0098
208 287-4800 or
Idaho Energy Hotline 1-800-334-SAVE (7283)
www.energy.idaho.gov/loans

US Department of Energy
Energy Efficiency and Renewable Energy Network
Geothermal Energy Program
www.eere.energy.gov/geothermal
GeoPowering the West
<http://www1.eere.energy.gov/geothermal/gpw/>

US Department of Agriculture
Rural Business-Cooperative Service (RBS)
Brian Buch, Rural Energy Coordinator
725 Jensen Grove Drive, Suite 1
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Other Contacts

Idaho Office of Energy Resources

- Gerry Galinato, Principal Energy Specialist
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- Ken Neely, Technical Hydrogeologist
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- Western Regional Office (water rights)
208-334-2190

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University of Idaho
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208-885-5730
stevenp@uidaho.edu

APPENDIX C – Selected References

1. Geo-Heat Center, Oregon Institute of Technology, 2005, Preliminary feasibility study for HVAC retrofit with a geothermal heat pump system at the Cascade Medical Center, Cascade Idaho. Geo-Heat Center Technical Paper, 11 p. http://www.idwr.idaho.gov/energy/alternative_fuels/geothermal/technical_reports.htm
2. Liberty, L., and Squires, E., 2003, Seismic reflection imaging across the Johnson Ranch, Valley County, Idaho. Boise State University Center for Geophysical Investigation of the Shallow Subsurface Technical Report 03-04, 9 p. Contact Ken Neely for a copy of the report (208-287-4852 or ken.neely@idwr.idaho.gov).
3. Mitchell, J.C., Johnson, L.L., and Anderson, J.E., 1980, Geothermal investigations in Idaho, Part 9: Potential for direct heat application of geothermal resources. Idaho Department of Water Resources Water Information Bulletin No. 30, Part 9, 396 p. Contact Ken Neely for a copy of the report (208-287-4852 or ken.neely@idwr.idaho.gov).
4. Peterson, S., Widner, L., and Nelson, J.R., 2004, Estimated impacts of proposed Idaho geothermal energy projects. Idaho Department of Water Resources, 86 p. http://www.idwr.idaho.gov/energy/alternative_fuels/geothermal/technical_reports.htm
5. St. Marie, J., Mink, L.L., and Neely, K.W. 2002, Examination and evaluation of geothermal sites in the state of Idaho with emphasis given to potential for electric generation or direct use. Idaho Department of Water Resources, 37 p. http://www.idwr.idaho.gov/energy/alternative_fuels/geothermal/technical_reports.htm
6. Widner, L., Rafferty, K., Peterson, S., and Nelson, J.R., 2003, Economic analysis of plans to further utilize local geothermal resources in Lava Hot Springs, Idaho. University of Idaho, College of Agriculture and Life Sciences, 15 p. http://www.idwr.idaho.gov/energy/alternative_fuels/geothermal/technical_reports.htm
7. Wilson, M.D., Applegate, J.K., Chapman, S.L., and Donaldson, P.R., 1976, Geothermal investigation of the Cascade, Idaho area. Boise State University, Department of Geology and Geophysics, 44 p. Contact Ken Neely for a copy of the report (208-287-4852 or ken.neely@idwr.idaho.gov).