COLLOCATED RESOURCES

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INTRODUCTION

Low- and moderate-temperature (20°C to 150°C) geothermal resources are widely distributed throughout the western and central United States. Numerous resources occur in the areas indicated in Figure 1, with individual reservoir areas one to ten square miles in extent. In the northern Great Plains, major aquifers with fluid temperatures exceeding 50°C extend in a continuous manner for thousands of square miles. Geothermal resources also occur at certain locations in the east.

The last major effort in assessing the national potential of low-temperature geothermal resources occurred in the early 1980s. Since that time, substantial resource information has been gained through drilling for hydrologic, environmental, petroleum and geothermal projects; but there has been no significant effort to update information on low-temperature geothermal resources.

While there has been a substantial increase (49%) in direct-heat (excluding geothermal heat pumps) utilization during the last decade, the large resource base (266 Quads, the U.S. uses about 80 Quads/yr) is greatly under-utilized. Since the thermal energy extracted from these resources must be used near the reservoir, collocation of the resource and user is required.

PURPOSE

The major goal of the Low-Temperature Geothermal Resources and Technology Transfer program was to update and compile a database of thermal springs and wells with temperatures greater than or equal to 20°C. State geothermal resource teams (State Teams) initiated their resource evaluation and database compilation efforts and have updated their resource inventories. The new digital database reports are in most cases available as Open File Reports from each State Team listed in the reference. A second important goal of the contract was to complete a statewide collocation study of these geothermal resources with communities and other potential users. This article covers the findings for the second goal, which was to complete a collocation study of geothermal resources and communities in the western states in order to identify, and encourage those communities to develop their geothermal resources.

COMPILATION OF DATA OF COLLOCATED RESOURCES

The State Teams databases were searched for all the wells and springs with temperatures greater than or equal to 50°C. From that list a Paradox database was compiled which

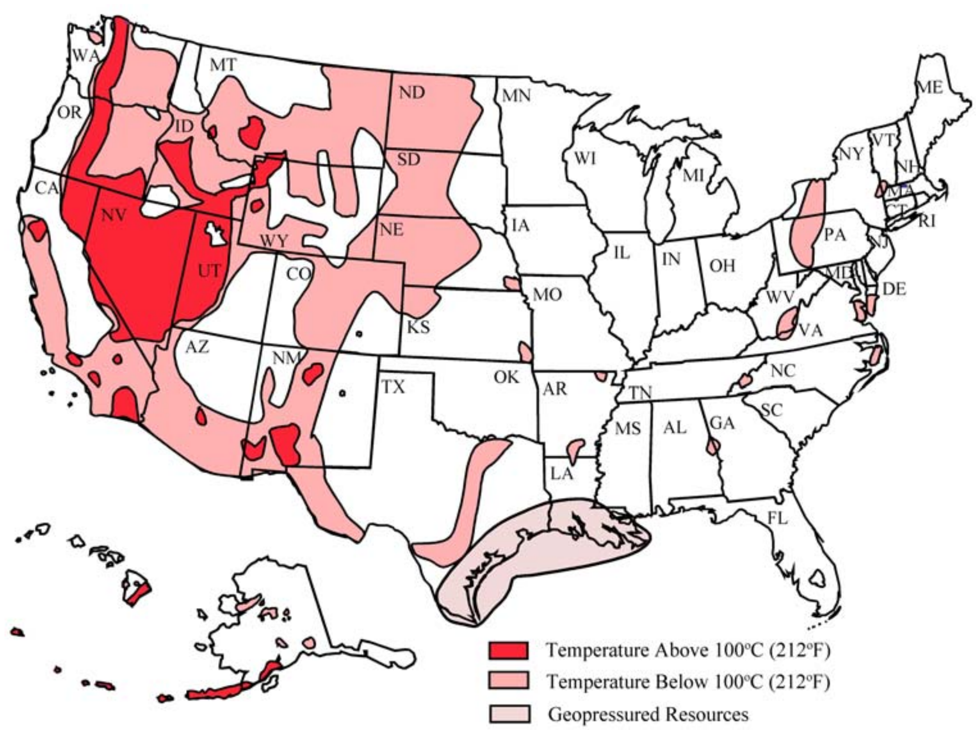

Figure 1. Geothermal resource areas of the United States.

Table 1. Section of the Collocated Resource Database for California.

	Bombay Beach	Boyes Hot springs	Brawley	Bridgeport	Bryon
County	Imperial	Sonoma	Imperial	Mono	Contra Costa
Latitude	33.3500	38.3167	32.9833	38.2500	37.8472
Longitude	115.7167	122.4833	115.5333	119.2333	121.6305
Population	500	5,937	19,450	900	1,100
Resource Temperature °C	88.0	53.1	138.0	82.0	51.0
Number of Wells	11	2	5	3	1
Typical Depth m	201.0	396.0	2,545.0	300.0	75.0
Flow L/min	2,660.0	757.0	500.0	450.0	600.0
TDS	3,800.0	1,287.0	28,000.0	4,320.0	
Current Use	Aquaculture	Baths/pools & Space heating		Power Plant	
HDD	925	3,311	925	6,022	2,806
Design Temperature	38	30	38	10	30
Remarks	11 wells, located with 5 miles of Bombay Beach.	1 spring/1 well, located with 0.5 miles of Boyes Hot Springs, and 2 miles from Sonoma.	5 wells, located within 2 miles of Brawley.	2 springs/1 well, located within 3 miles of Bridgeport.	1 well, located within 1 mile of Byron.

contained 18 data fields. The information included within the data fields are the collocated city, latitude and longitude, resource temperature, number of wells within the area, typical depth, total flow for all the resources within the area, current use, and weather data. Table 1 shows a section of the California database consisting of 5 sites out of a total 70 sites.

A collocated community was identified as being within 8 km (5 miles) of a geothermal resource with a temperature of a least 50°C (120°F). At least 1393 thermal wells and springs were identified by the State Teams of having temperatures greater than or equal to 50°C. Of those 1393 wells and springs, 1173 were located within 8 km of a community. There has been 256 collocated communities identified within the nine western states databases. The breakdown of the collocated communities by states are listed in Table 2. The communities for each state are shown on the state maps in Figures 2 through 10.

Table 2. Number of Collocated Communites within Nine Western States.

State	Number of Collocated Communities
California	70
Colorado	15
Idaho	51
Montana	18
Nevada	30
New Mexico	12
Oregon	32
Utah	23
Washington	6

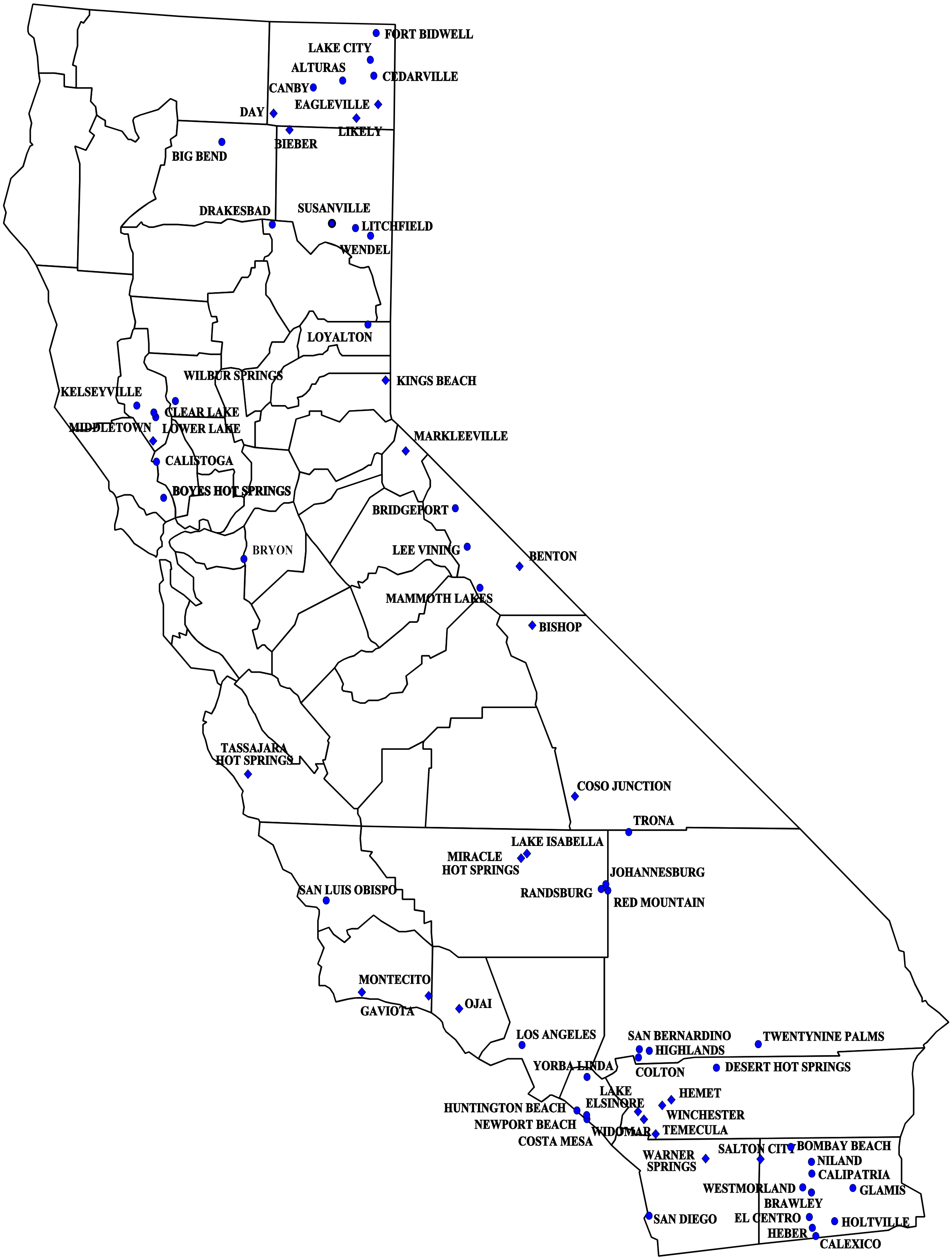

Figure 2. The 70 collocated communities located within California

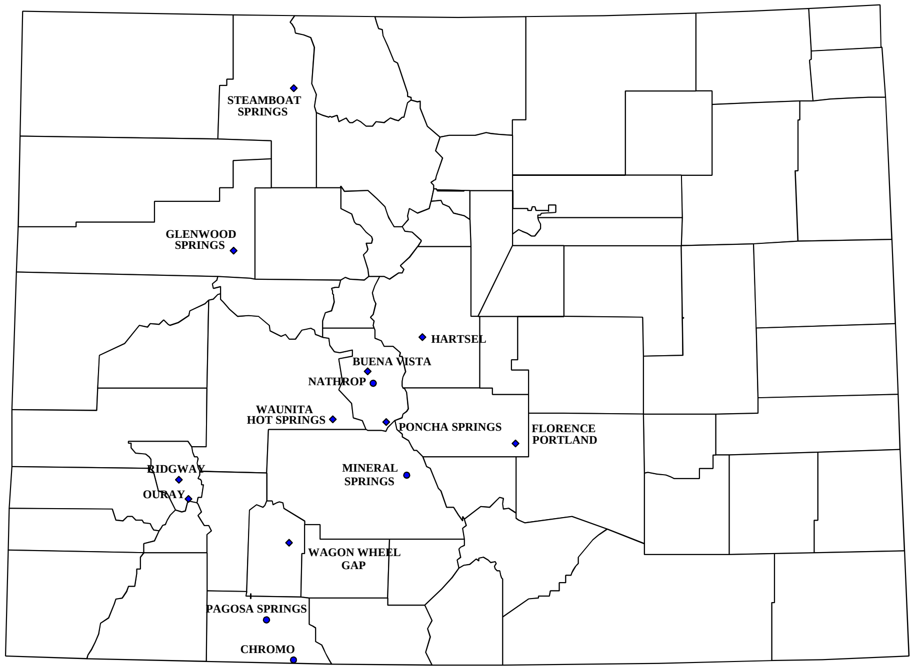

Figure 3. The 15 collocated communities located within Colorado.

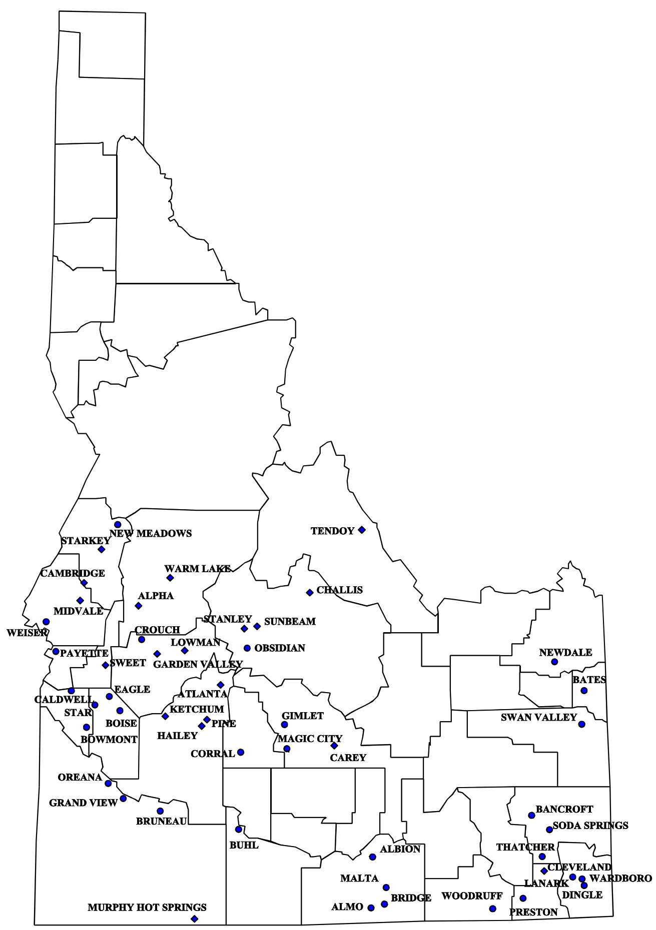

Figure 4. The 51 collocated communities located within Idaho.

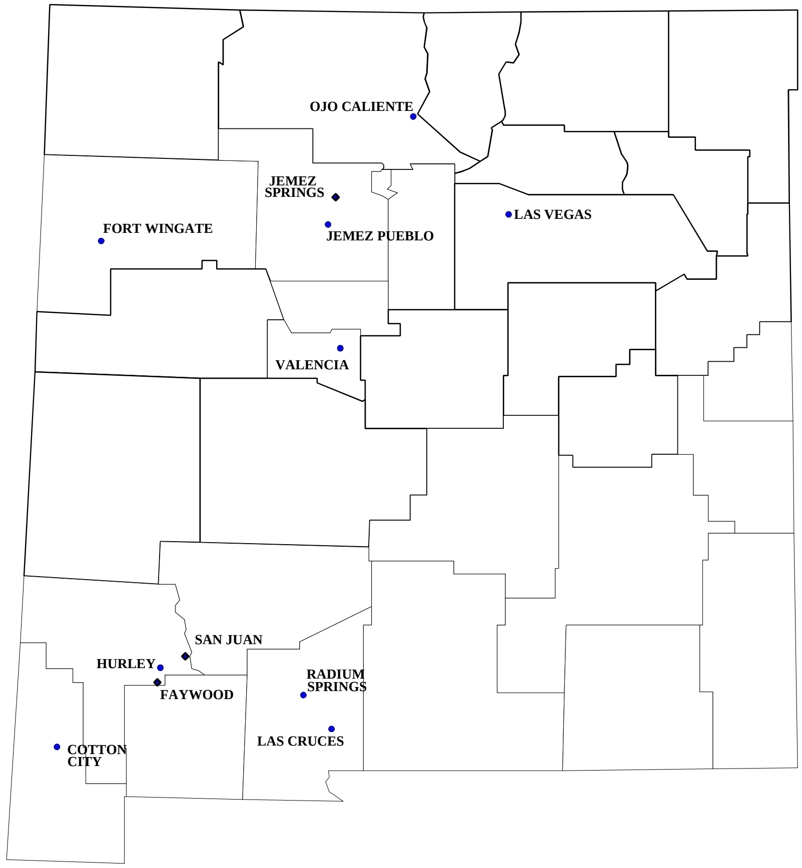

Figure 5. The 12 collocated communities located within New Mexico.

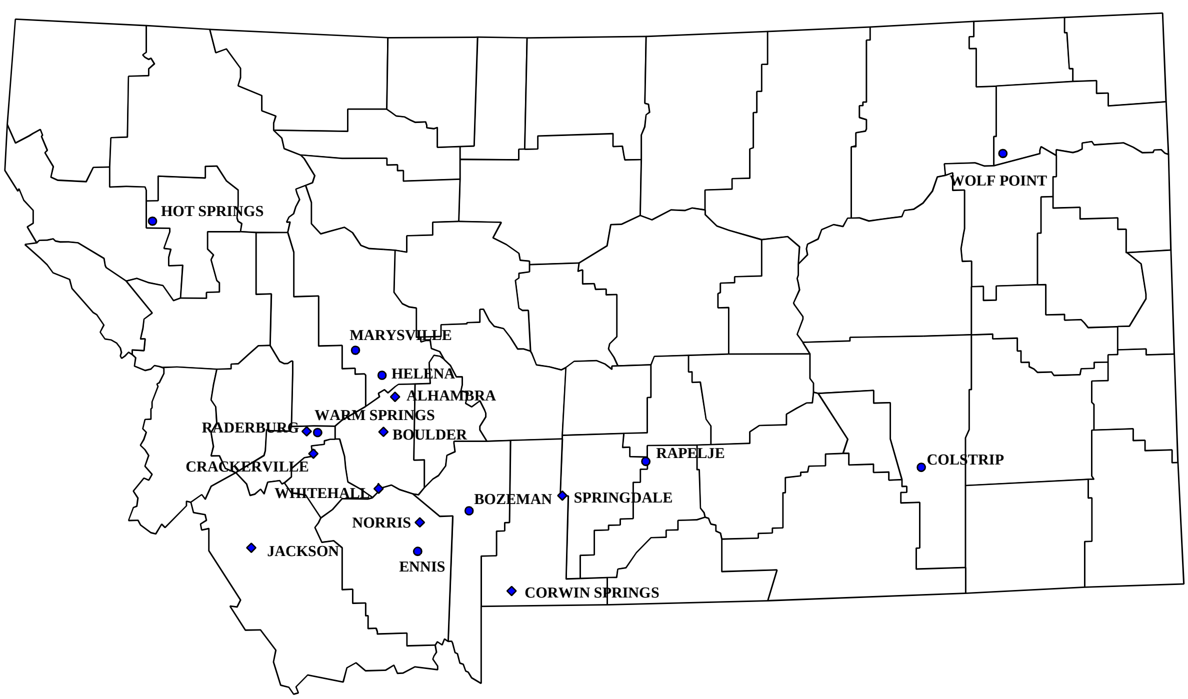

Figure 6. The 18 collocated communities located within Montana.

Figure 7. The 6 collocated communities located within Washington.

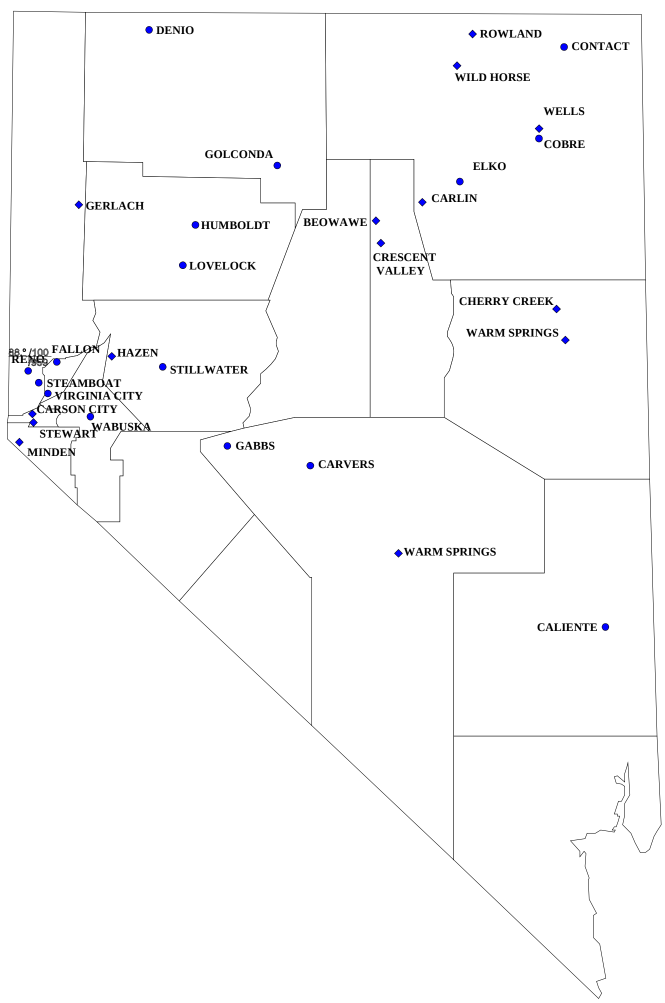

Figure 8. The 30 collocated communities located within Nevada.

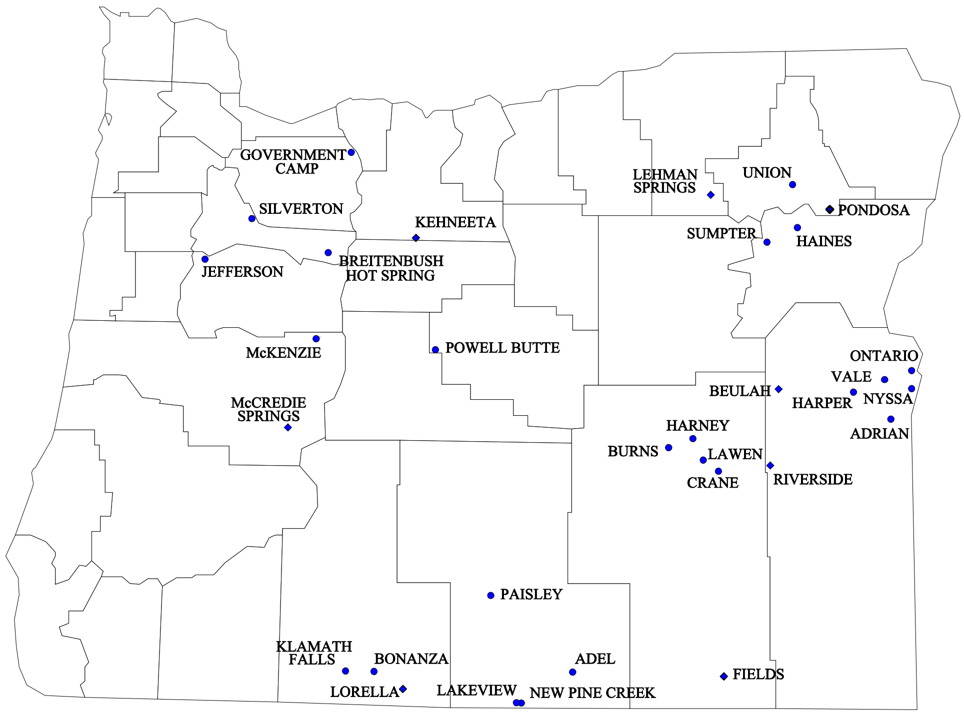

Figure 9. The 32 collocated communities located within Oregon.

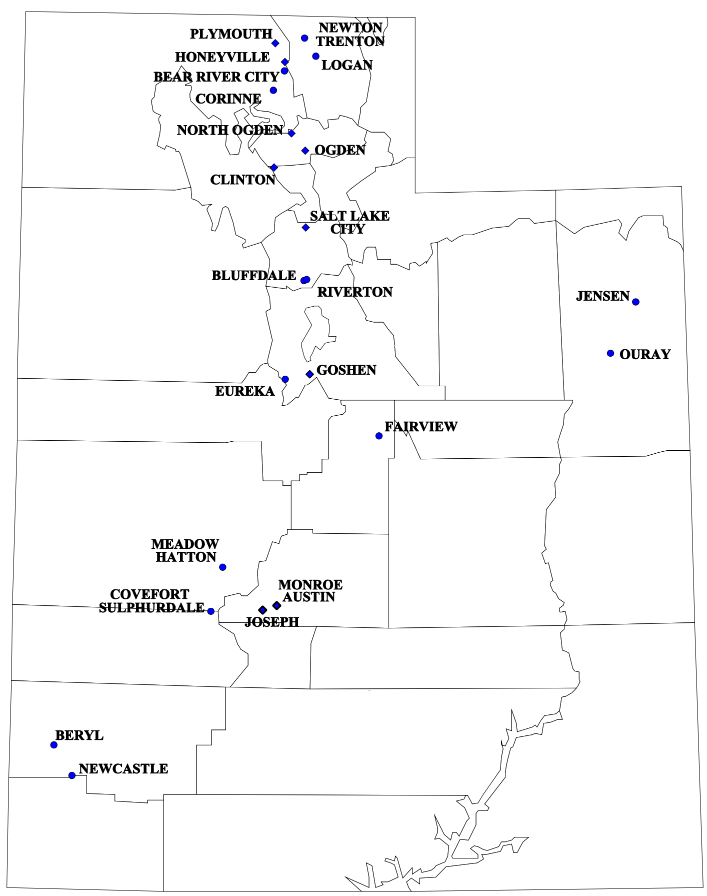

Figure 10. The 23 collocated communities located within Utah.

Historically, most of the communities that were identified have experienced some development of their geothermal resources. However, depending on the characteristics of the resource, the potential exists for increased geothermal development for applications such as space and district heating, resort/spa facilities, aquaculture, industrial and greenhouse operations, and possible electrical generation in some areas. The Geo-Heat Center has sent out information about the resources to the Economic Development Centers for the collocated communities in hopes of promoting geothermal use.

HEATMAP PROGRAM

It is important to characterize energy sources in terms of cost, both capital and unit energy cost. Geothermal energy costs vary with depth and other characteristics of the resource, number of production and injection wells, and many other parameters. Software is currently being evaluated by the Geo-Heat Center for possible use in energy cost evaluation.

The HEATMAP software has been developed by Washington State Energy Office (WSEO). HEATMAP is a computerized system that provides a fast and reliable means of modeling a district heating and cooling (DHC) system. It can be used to identify the cost of geothermal supplied heat in a similar fashion to that used for conventional-fuel heat sources.

HEATMAP requires at the least a digitized map of the area and general building information for each proposed building on the system: building size (sq. ft.), number of stories, and buildings end use to assist in assessing the economic feasibility. The program will: 1) size the central plant heating and cooling equipment, and distribution pipe sizes, 2) finds the most economic operating strategy for selected equipment, 3) calculates annual energy use for each fuel type using the economic operating strategy, 4) calculates annual energy costs to operate central plant equipment, and 5) calculates annual central plant emissions. The HEATMAP economics analysis determines the minimum average price for DHC service that can be charged to a customer while meeting the DHC systems operating parameters and financing assumptions.

CONCLUSIONS

Low- and moderate-temperature geothermal resources are widely distributed throughout the western and central United States. Since the last major effort in assessing the national potential of these resources in the early 1980s, there has been a substantial increase in direct-heat utilization. However, the large resource base is greatly under-utilized. To help expand utilization of the direct-heat resource base, a current inventory of these resources has been developed.

A further breakdown of the current inventory, identifies 256 collocated communities. These communities could benefit by utilizing the geothermal resource. The Geo-Heat Center has sent out information about the resources to the Economic Development Centers for the collocated communities in hopes of promoting geothermal use.

HEATMAP is a computerized system that provides a fast and reliable means of modeling a district heating and cooling system. It can be used to identify the cost of geothermal supplied heat in a similar fashion to that used for conventional-fuel heat sources. The HEATMAP program is currently being evaluated by the Geo-Heat Center as a possible energy cost evaluation tool.

ACKNOWLEDGMENT

This work was supported by the U.S. Department of Energy under INEL Subcontract No. C92-120253 to Oregon Institute of Technology-Geo-Heat Center (OIT-GHC). Such support does not constitute an endorsement by the Department of Energy of the views expressed herein.

REFERENCES

Black, G., 1994. “Digital Data and Selected Texts from Low-Temperature Database for Oregon”, Open File 0-94-9, Oregon Department of Geology and Mineral Industries, Portland, OR, 165 p.

Blackett, R. E., 1994. “Low-Temperature Geothermal Water in Utah: A Compilation of Data for Thermal Wells and Springs Through 1993", Open File Report 331, Geological Survey, Salt Lake City, UT, 74 p.

Cappa, J. A., 1995. “Low-Temperature Geothermal Assessment Program, Colorado”, Open File Report 95-1, Colorado Geological Survey, Denver, CO, 34 p.

Dansart, W. J.; J. D. Kauffman and L. L. Mink, 1994. “Overview of Geothermal Investigations in Idaho, 1980 to 1993", Idaho Water Resources Research Institute, University of Idaho, Moscow, ID, 79 p.

Garside, L. L., 1994. “Nevada Low-Temperature Geothermal Resource Assessment: 1994", Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada, Reno, NV, 58 p.

Hart, B., 1994. “HEATMAP 1.5G”, Washington State Energy Office, Olympia, WA.

Metesh, J., 1994. “Geothermal Resources of Montana”, Montana Bureau of Mines and Geology, Butte, MT, 47 p.

Schuster, J. E. and R. G. Bloomquist, 1994. “Low-Temperature Geothermal Resources of Washington”, Open File Report 94-11, Washington Division of Geology and Earth Resources, Washington State Department of Natural Resources, Olympia, WA, 53 p.

Witcher, J. C., 1995. “A Geothermal Resource Data Base - New Mexico”, Southwest Technology Development Institute, New Mexico State University, Las Cruces, NM, 32 p.

Youngs, L. G., 1994. “California Low-Temperature Geothermal Resources Update - 1993", Division of Mines and Geology, Sacramento, CA, 155 p.