Geothermal Exploration and Development in Nevada

Larry J. Garside
John H. Schilling
Nevada Bureau of Mines and Geology

Nevada is a state whose geothermal resources appear to have great potential, although only a few of the many areas with prospective value have been examined in any detail. In arid Nevada, water, even if mineralized and hot, has always been an important resource. The hot springs excited the curiosity of Fremont and other early explorers, as well as the Forty-niners who were forced to use the springs as the only source of water along several barren stretches of the California Trail. The mines of the Comstock Lode at Virginia City were famous for the great quantities of hot water encountered; hot water was also encountered at Tonopah and several other mining camps. In the 1800's and early 1900's resorts grew up around and used many of the hot springs. In the Stillwater area of west-central Nevada, steam and hot water were encountered while drilling water wells in an area where there were no hot springs, and have been used to heat dwellings in this farming area. And a number of homes along the Steamboat-Moana fault in the Reno area are heated by simple heat exchange systems that utilize the heat from hot water along the fault. Another interesting use is at Steamboat Hot Springs, south of Reno, where the hot water is used as a safe way to melt explosives.

Only in the last decade have serious attempts been made to exploit Nevada's geothermal resources as a source of power. Drilling began in 1959 and continued through 1965 (see Table 1). Nevada ranks second to California in exploration: twelve geothermal areas in Nevada were tested by drilling during the six years of exploration activity. At three of these (Beowawe, Brady's, and Steamboat) wells encountered water temperatures greater than 350° F and appreciable volumes of water with 5 to 10 percent steam flashover. The deepest well drilled (at The Needles) is 5888 feet deep.

No drilling has been done since 1965, when problems of leasing on Federal land, as well as other problems, combined to completely stifle activity. Yet interest remains high; many new companies have entered the field during the last year. As Federal regulations become clearer, it is anticipated that exploration will increase greatly. However, there is some fear that Federal regulation may turn out to be so restrictive that development will be badly hampered. This is particularly important in Nevada, where almost 90% of the land is Federally owned, and there is essentially no State land. Regulation developments to date are not particularly encouraging.

Magma Energy Company is reportedly considering construction of a pilot plant at Brady's Hot Springs to test the economic feasibility of a 10 megawatt power plant using hot water to flash isobutane in a heat exchanger for propulsion of a turbine. The success of this process (the Magmamax Power Process) could significantly encourage exploration and development of Nevada's low-enthalpy thermal water systems for electric power generation.

Detailed data are unavailable for most geothermal areas (hot springs, wells, etc.) in the State. Many areas have not been studied in any detail. Others have been studied by private groups, but the information is not readily available. The best studied area is Steamboat Hot Springs (White, 1968); Brady's Hot Springs and Beowawe also have received special attention (Oesterling & Anctil, 1960; Oesterling, 1962). To fill the information gap, the Nevada Bureau of Mines and Geology is compiling all available data on the geothermal resources of the State, as well as doing some fieldwork on neglected areas. This information is on file at the Bureau office in Reno and is available for public inspection. The data will later be assembled into a published report. A map showing hot spring locations and names has already been published (Horton, 1964). (We would like to take this opportunity to solicit additional information, to help fill the many gaps in our records).

Hot springs are scattered over the entire State (see Figure 1). Horton (1964) lists 186 hot springs in Nevada, and probably at least 100 more are now known. Twelve areas totalling 344,027 acres have been designated as KGRA (known geothermal resources areas–"areas ... good enough to warrant expenditures of money [for development]" which can be "leased [only] by competitive bidding") by the Federal government (see Table 2; Figure 2; and Godwin & others, 1971); 13,458,000 acres or 19% of the State were listed as "having prospective value" (Godwin & others, 1971). The west-central and north-central areas of the State have higher hot spring temperatures, and are regions of greater than normal heat flow (Sass, et. al., 1971), and thus are considered to have special potential: exploration will probably be concentrated in these areas for the near future. Actually the entire State has considerable potential, especially when one considers "blind" areas (those geothermal areas that are "non-leaky," and thus have no surface expression such as springs).

Geothermal power is of special importance to Nevada. Electric power needs are expanding at a rapid rate, because of the rapidly expanding population and increased per capita consumption, as well as the extension of transmission lines to many remote areas. It is expected that power consumption will more than double in the State by 1980--to 12 million megawatt-hours per year. The relatively-high cost of producing electricity in Nevada by other methods makes geothermal power especially attractive.

State Regulation. At present, no State agency has been given the power to directly regulate geothermal development. However, several agencies indirectly regulate certain phases of geothermal exploration and development:

Division of Water Resources (Roland D. Westergard, State Engineer)
Department of Conservation and Natural Resources
Carson City, Nevada (702-882-7441)

(Present laws give this agency the power to regulate the drilling, use, etc. of water wells. This agency plans to regulate geothermal wells as water wells to the extent that present laws are applicable.)

Division of Environmental Health
Department of Health, Welfare, and Rehabilitation
201 S. Fall St.
Carson City, Nevada (702-882-7870)

(This agency regulates all forms of pollution. Although no laws deal specifically with pollution caused by geothermal development, the general laws and regulations would definitely apply.)

These agencies can supply copies of pertinent State laws and regulations.

Because there is essentially no State land, there are no State leasing regulations.

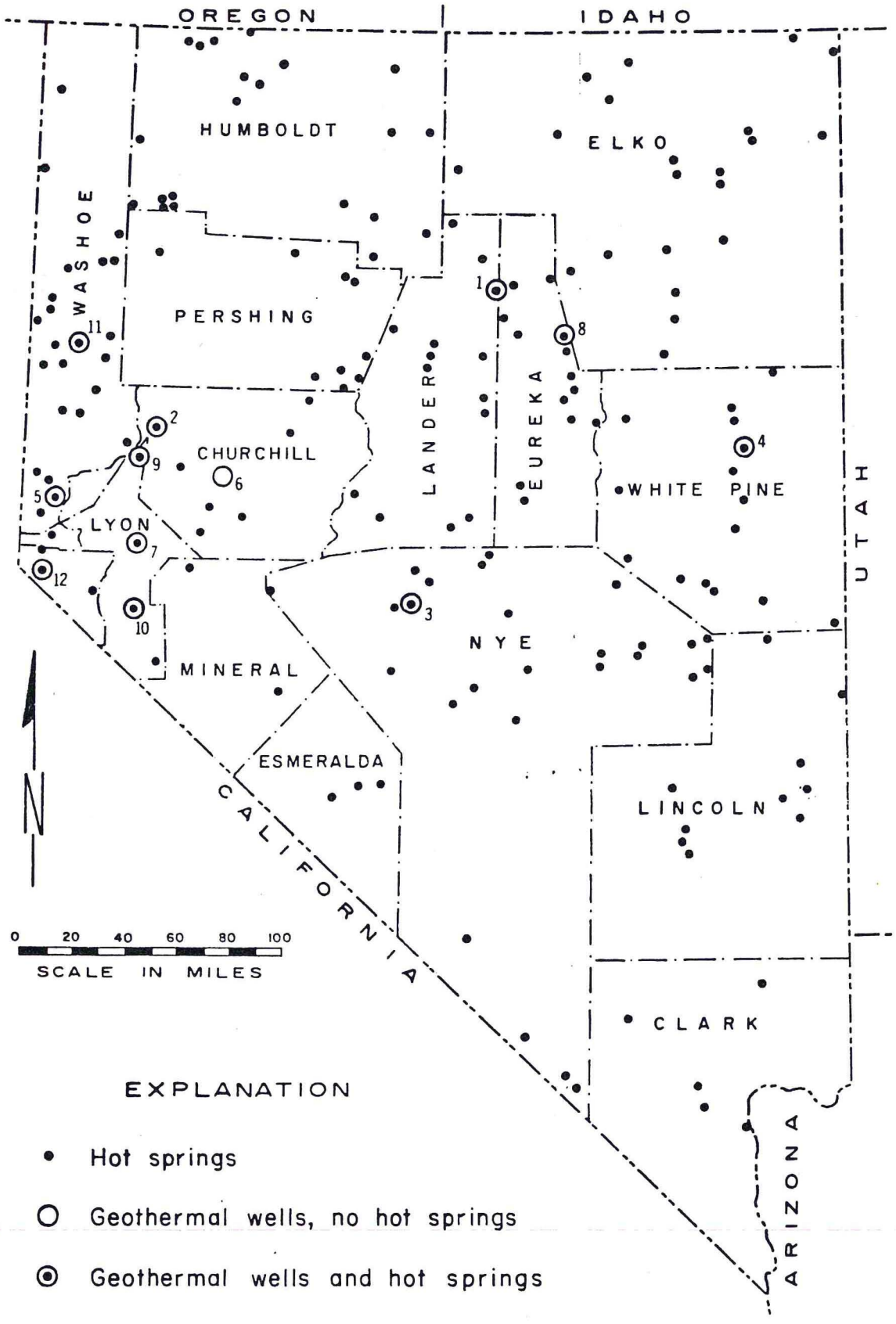

Figure 1. Hot springs and geothermal wells in Nevada (numbers correspond to those of Table 1 which gives drilling details).

TABLE 1

EXPLORATORY GEOTHERMAL DRILLING IN NEVADA*

Area	Number Wells (when drilled)	Operator	Maximum Depth (ft.)	Maximum Well Temperature (°F)	Maximum Surface Temperature (°F)	Remarks
1. Beowawe	11 (1959-65)	Magma Power Co. & Associates	2,052	414	fumaroles, hot & geyersing springs to 205°	Hot water with 5-10% steam flashover. Problems of scaling and cold water inflow.
2. Brady's Hot Springs	9 (1959-65)	Magma Power Co. & Associates (7) Earth Energy, Inc.(2)	5,060	418	springs to 194°	Hot water with 5% steam flashover. Problem of scaling.
3. Darrough Hot Springs	1 (1962-63)	Magma Power Co. & Associates	812	265	springs to 198°	Very large flow hot water, little steam.
4. Monte Neva	1 (1965)	Magma Power Co. & Associates	402	190	springs to 193°	Hot water
5. Steamboat Hot Springs	about 40 (1920-70)	various (see White, 1968)	3,206	369	fumaroles, springs to 205°	Most wells drilled for purposes other than testing geothermal power potential. Hot water with 5-10% steam flashover.
6. Stillwater	1 (1964)	O'Neill Geothermal, Inc.	3,200	240	no springs or other surface features	Hot water and steam first encountered while drilling water wells; used to heat homes.
7. Wabuska	3 (1959)	Magma Power Co. & Associates	2,223	222	springs to 162°	Hot water
8. Hot Springs Point (Crescent Valley)	1 (1965)	Magma Power Co. & Associates	410	166	springs to 122°	Hot water
9. Fernley (Hazen)	1 (1962)	Magma Power Co. & Associates	750	270	hot springs	
10. Hind's Hot Springs	1 (1962)	U. S. Steel Corp.			springs to 144°	Hot water
11. The Needles (Pyramid Lake)	3 (1964)	Western Geothermal, Inc.	5,888	240	springs to 208°	Large flow hot water
12. Wally's Hot Springs	2 (1962)	U. S. Steel Corp.	1,268	181	springs to 160°	20 additional shallow holes drilled to determine heat flow pattern.

*Data mostly from Koenig (1970); does not include shallow wells drilled mainly to provide water for bathing and drinking, or to heat individual homes.

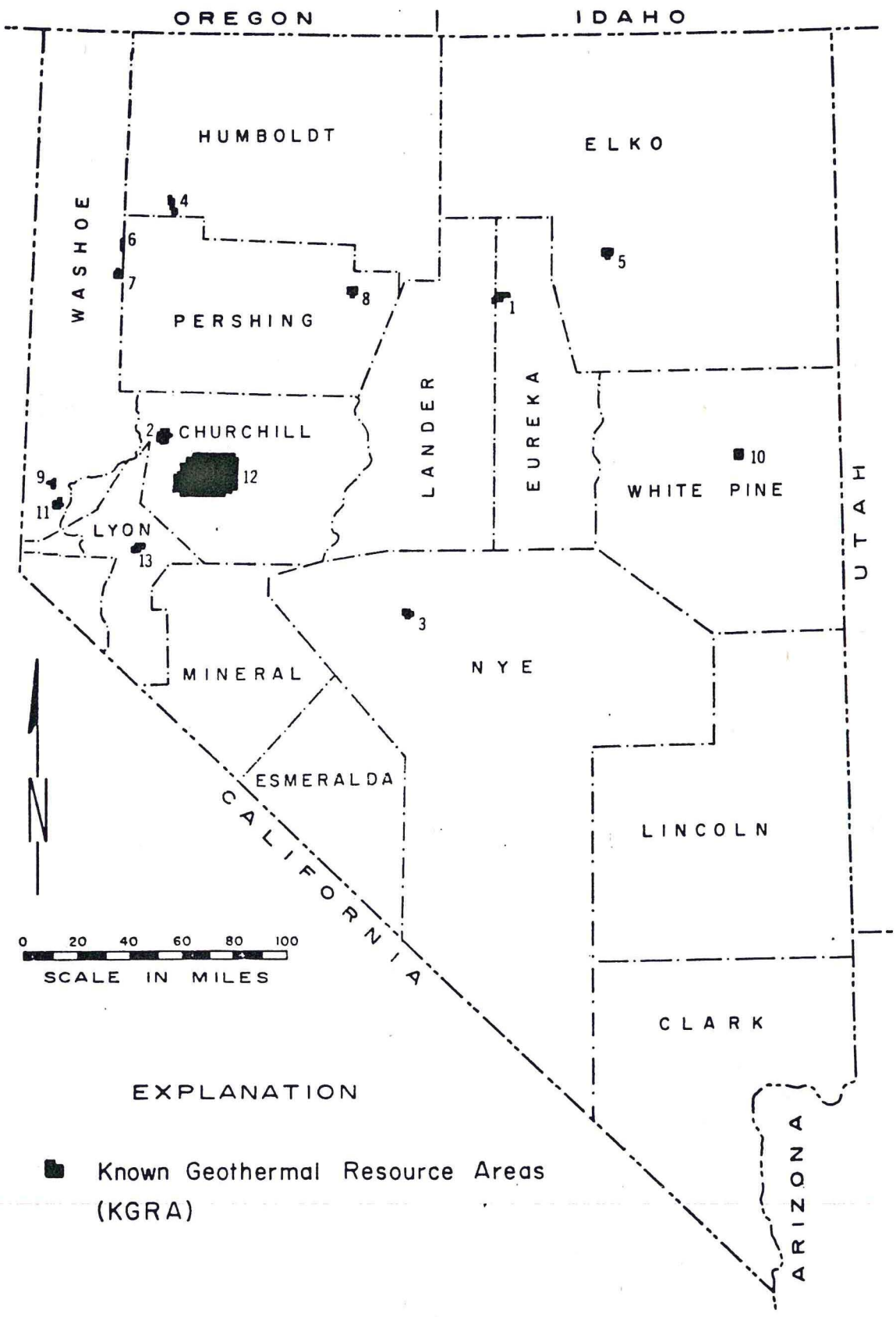

Figure 2. "Known Geothermal Resource Areas" in Nevada. (Numbers correspond to those of Table 2 which gives detailed locations.)

TABLE 2

KNOWN GEOTHERMAL RESOURCES AREAS (KGRA) IN NEVADA*

1. Beowawe (12,712 acres)

   Secs. 13, 24, T. 31 N., R. 47 E.
   Secs. 1-5, 7-12, 15-20, T. 31 N., R. 48 E.
   Sec. 6, T. 31 N., R. 49 E.

2. Brady Hot Springs (19,020 acres)

   Secs. 1-4, 9-16, 21-27, T. 22 N., R. 26 E.
   Secs. 34-36, T. 23 N., R. 26 E.
   Secs. 6-8, 17-19, 30, T. 22 N., R. 27 E.
   Sec. 31, T. 23 N., R. 27 E.

3. Darrough Hot Springs (8,398 acres)

   Secs. 1, 12, 13, T. 11 N., R. 42 E.
   Secs. 5-9, 16-20, T. 11 N., R. 43 E.

4. Double Hot Springs (10,816 acres)

   Secs. 3-5, 8-10, 15, 16, 21-23, 26, 27, 34, T. 36 N., R. 26 E.
   Secs. 32, 33, T. 37 N., R. 26 E.

5. Elko Hot Springs (8,960 acres)

   Secs. 14-17, 20-23, 26-29, 33, 34, T. 34 N., R. 55 E.

6. Fly Ranch (5,125 acres)

   Secs. 1, 2, 11-14, 23, 24, T. 34 N., R. 23 E.

7. Gerlach (8,972 acres)

   Secs. 3, 4, 8-11, 14-17, 20-23, T. 32 N., R. 23 E.

8. Leach Hot Springs (8,920 acres)

   Secs. 1, 2, 12, T. 31 N., R. 38 E.
   Secs. 25, 26, 35, 36, T. 32 N., R. 38 E.
   Secs. 5-7, T. 31 N., R. 39 E.
   Secs. 29-32, T. 32 N., R. 39 E.

9. Moana Springs (5,120 acres)

   Secs. 13, 22-26, 35, 36, T. 19 N., R. 19 E.

10. Monte Neva (10,302 acres)

    Secs. 13-15, 22-27, 34-36, T. 21 N., R. 63 E.
    Secs. 18, 19, 30, 31, T. 21 N., R. 64 E.

11. Steamboat Springs (8,914 acres)

    Secs. 4-6, T. 17 N., R. 20 E.
    Secs. 20, 21, 27-29, 31-34, T. 18 N., R. 20 E.
    Sec. 1, T. 17 N., R. 19 E.
    Sec. 36, T. 18 N., R. 19 E.

12. Stillwater-Soda Lake (225,211 acres)

    Secs. 1-3, 10-15, 22-27, T. 19 N., R. 27 E.
    Secs. 24-26, 34-36, T. 20 N., R. 27 E.
    Secs. 1-30, 32-36, T. 19 N., R. 28 E.
    Secs. 1-5, 7-36, T. 20 N., R. 28 E.
    Secs. 13, 14, 22-28, 33-36, T. 21 N., R. 28 E.
    Secs. 1-36, T. 19 N., R. 29 E.
    Secs. 13-36, T. 21 N., R. 30 E.
    Secs. 3-10, 15-21, 29, 30, T. 19 N., R. 31 E.
    Secs. 3-10, 15-22, 27-34, T. 20 N., R. 31 E.
    Secs. 16-22, 27-34, T. 21 N., R. 31 E.

13. Wabuska (11,520 acres)

    Secs. 9-17, 20-24, 26-29, T. 15 N., R. 25 E.

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*As determined pursuant to Sec. 21(2), Geothermal Steam Act of 1970 (84 Stat. 1566), and published in the Federal Register.

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