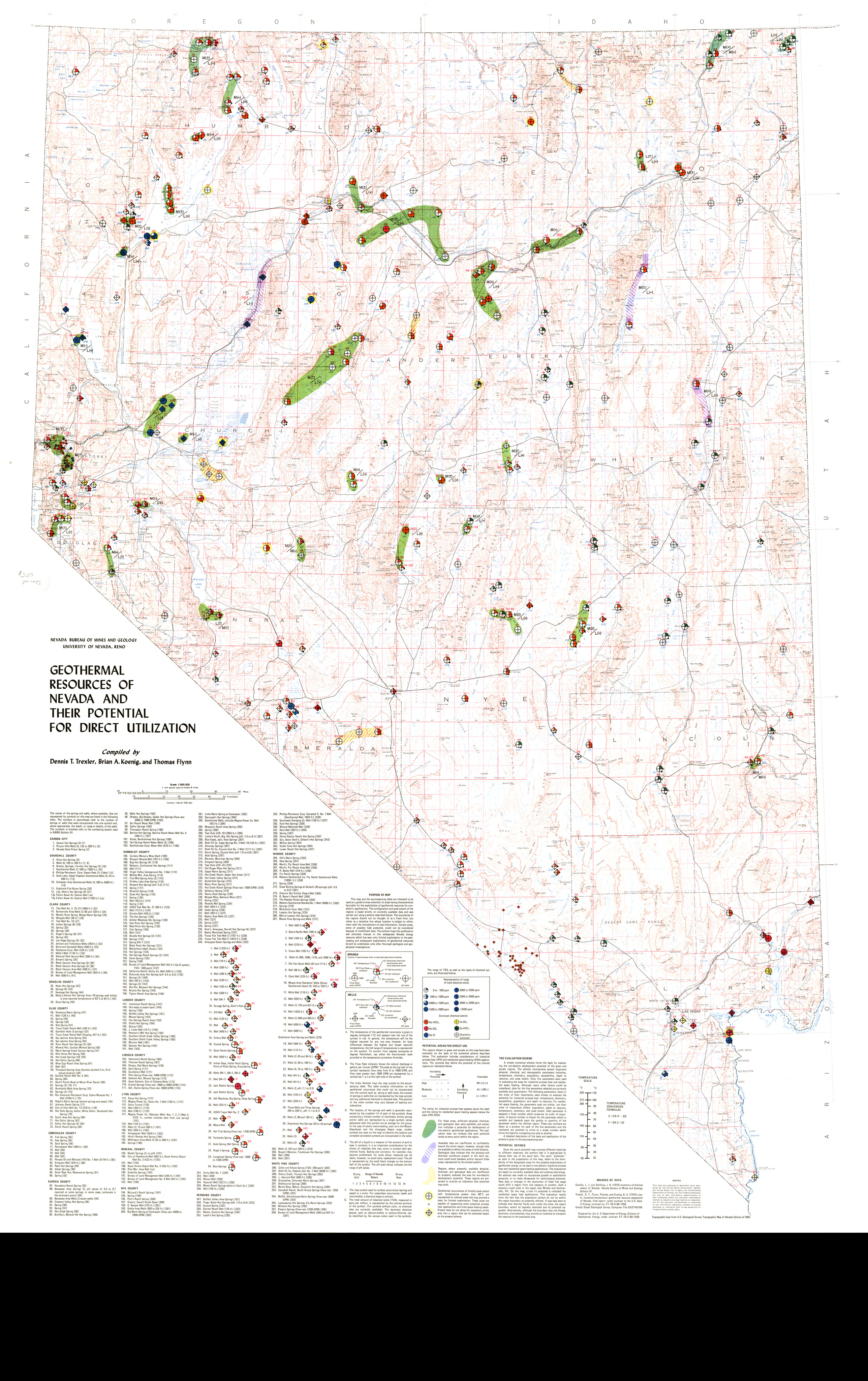

NEVADA BUREAU OF MINES AND GEOLOGY
UNIVERSITY OF NEVADA, RENO

GEOTHERMAL RESOURCES OF NEVADA AND THEIR POTENTIAL FOR DIRECT UTILIZATION

Compiled by

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Scale: 1:500,000
1 inch equals approximately 8 miles
10 0 10 20 30 40 Miles
10 0 10 20 30 40 50 Kilometers
Contour interval 500 feet

The names of the springs and wells, where available, that are represented by symbols on this map are listed in the following table. The numbers in parentheses refer to the number of springs or wells that were incorporated into one symbol and, where appropriate, the depth, or range in depths, of the wells. The numbers in brackets refer to the numbering system used in NBMG Bulletin 91.

CARSON CITY

1. Carson Hot Springs (2) [1]
2. Pinyon Hills Wells (5; 125 to 200 ft.) [3]
3. Nevada State Prison Spring [2]

CHURCHILL COUNTY

4. Dixie Hot Springs [6]
5. Wells (6; 100 to 200 ft.) [7, 8]
6. Bradys, Springer, Fernley Hot Springs (3) [10]
7. Geothermal Wells (7; 500 to 7300 ft.) [10]
8. Phillips Petroleum Corp. Desert Peak 21-2 Well [12]
9. Soda Lake, Upsal Hogback Geothermal Wells (5; 45 to 500 ft.) [13]
10. Stillwater Area Geothermal Wells (5; 200 to 4000 ft.) [14]
11. Eightmile Flat Borax Spring [20]
12. Lee, Allen's Hot Springs (4) [21]
12a. Fallon Naval Air Station Well [na]
12b. Fallon Naval Air Station Well (1700 ft.) [na]

CLARK COUNTY

13. Test Well No. 3, 75-73 (1800 ft.) [23]
14. Bunkerville Area Wells (2; 60 and 120 ft.) [24]
15. Muddy River Spring, Moapa Warm Springs [25]
16. Whipple Well (80 ft.) [26]
17. Test Well No. 10 [27]
18. Indian Springs (8) [28]
19. Spring [29]
20. Springs [30]
21. Roger's Springs (8) [31]
22. Spring [33]
23. Las Vegas Springs (3) [33]
24. Jenison and Tollackson Wells (250 ft.) [33]
25. Bond and Campbell Wells (400 ft.) [33]
26. Gladstone Corp. Well (325 ft.) [33]
27. Wells's Well (1135 ft.) [33]
28. National Park Service Well (200 ft.) [34]
29. Brown's Spring [35]
30. Black Canyon Area Springs (3) [36]
31. Black Canyon Area Springs (2) [36]
32. Black Canyon Area Well (400 ft.) [37]
33. Bureau of Land Management Well (825 ft.) [40]
34. Well (500 ft.) [41]

DOUGLAS COUNTY

35. Hobo Hot Springs [42]
36. Springs (4) [43]
37. Saratoga Hot Springs [44]
38. Wally's,Genoa Hot Springs Area (10 springs; well drilled in area reported temperature of 83°C at 64 ft.) [45]
39. Doud Spring [46]

ELKO COUNTY

40. Shoshone Warm Spring [47]
41. Well (126 ft.) [48]
42. Spring [49]
43. Springs [50]
44. Nile Spring [51]
45. Trout Creek Ranch Well (246 ft.) [52]
46. Gamble's Hole (2 springs) [52]
47. Trout Creek Ranch Well (flowing, 247 ft.) [52]
48. San Jacinto Area Spring [54]
49. San Jacinto Area Spring [54]
50. Rizzi Ranch Hot Springs (3) [55]
51. Mineral Hot, Contact Mineral Spring [56]
52. Warm Springs Creek Canyon Spring [57]
53. Wild Horse Hot Spring [58]
54. Hot Creek Springs (10) [59]
55. Hot Sulfur Spring [60]
56. Wine Cup Ranch Area Spring [61]
57. Well [62]
58. Thousand Springs Area (Symbol plotted 2 mi. N of actual location) [64]
59. Gamble Ranch Well No. 4 [64]
60. Spring [66]
61. Devil's Punch Bowl at Marys River Ranch [68]
62. Springs (2) [70, 71]
63. Humboldt Wells Area Spring [73]
64. Springs (2) [73]
65. Pan American Petroleum Corp. Cobre Minerals No. 1 Well (5284 ft.) [75]
66. Ralph's Warm Springs (several springs and seeps) [76]
67. Johnson Ranch Spring [77]
68. City of Elko Well No. 12 (570 ft.) [78]
69. Hot Hole Spring, Sulfur, White Sulfur, Humboldt Hot Spring [78]
70. Carlin Area Hot Spring [80]
71. Hot Sulfur Spring [81]
72. Sulfur Hot Springs (3) [83]
73. Smith Ranch Spring [84]

ESMERALDA COUNTY

74. Fish Spring [85]
75. Gap Spring [85]
76. Sand Spring [85]
77. Pennebaker Well (300 ft.) [85]
78. Well [85]
79. Well [85]
80. Well [85]
81. Nevada Oil and Minerals VRS No. 1 Well (9178 ft.) [85]
82. Emigrant Well (324 ft.) [86]
83. Pearl Hot Springs [89]
84. Alkali Springs [90]
85. Silver Peak Hot, Waterworks Spring [91]
86. Spring [92]

EUREKA COUNTY

87. Horseshoe Ranch Spring [93]
88. Beowawe Area Springs (3; pH values of 9.3 to 9.7 reported in some springs; in some cases, carbonate is the dominant anion) [94]
89. Beowawe Area Wells (2 steam wells) [94]
90. Crescent Valley Hot Spring [96]
91. Spring [96]
92. Spring [97]
93. Hot Creek Spring [98]
94. Bruffey's, Mineral Hill Hot Spring [100]
95. Walti Hot Springs [102]
96. Shipley, Big Shipley, Sadler Hot Springs (flow rate: 3000 to 7000 GPM) [103]
97. Siri Ranch Water Well [104]
98. Sulfur Springs [105]
99. Thompson Ranch Spring [106]
100. Bartine Hot Springs, Bartine Ranch Water Well No. 4 (485 ft.) [107]
101. Klobe, Bartholomae Hot Springs [108]
102. Hot Springs Ranch Water Wells (2) [108]
103. Bartholomae Corp. Water Well (670 ft.) [108]

HUMBOLDT COUNTY

104. Cordero Mercury Mine Shaft [109]
105. Noque's Nevada Well (701 ft.) [109]
106. Bog Hot Springs (4) [110]
107. Baltazar, Continental Hot Springs [111]
108. Well [111]
109. Virgin Valley Campground No. 1 Well [112]
110. McGee Mtn. Area Spring [113]
111. Five Mile Spring Area (2) [114]
112. Gridley Lake Area Spring [116]
113. Howard Hot Springs (pH: 9.3) [117]
114. Spring [117]
115. Ninemile Spring [118]
116. Dyke Hot Springs [119]
117. Spring [120]
118. Well (352 ft.) [121]
119. Spring [122]
120. USGS Test Well No. 21 (88 ft.) [123]
121. Well (112 ft.) [124]
122. Gondra Well (435 ft.) [125]
123. The Hot Springs [126]
124. Soldier Meadows Hot Springs [128]
125. East Pinto Hot Spring [129]
126. West Pinto Hot Spring [129]
127. Cain Spring [130]
128. Well [131]
129. Double Hot Springs (2) [131]
130. Springs [131]
131. Spring DH-7 [131]
132. Black Rock Hot Springs [131]
133. Macfarlane's Bath House [132]
134. Hot Springs [133]
135. Hot Springs Ranch Springs (2) [134]
136. Caine Spring [135]
137. Spring [136]
138. Bureau of Land Management Well (55 ft.) (Ca-Cl system, TDS = 500 ppm) [137]
139. California Pacific Utility Co. Well (495 ft.) [138]
140. Golconda Area Hot Springs (pH: 6.5 to 8.2) [139]
141. Springs (2) [140]
142. Well (99 ft.) [142]
143. Springs (2) [142]
144. Hot Pot, Blossom Hot Springs [144]
145. Brooks Hot Spring [145]
146. Tipton Ranch Area Spring [146]

LANDER COUNTY

147. Izzenhood Ranch Spring [147]
148. Hot seeps in steam bank [149]
149. Spring [150]
150. Buffalo Valley Hot Springs [151]
151. Mound Spring [152]
152. Hot Springs Ranch Area [153]
153. Chillis Hot Spring [154]
154. Spring [155]
155. J. Lister Well (15 ft.) [156]
156. Peterson's Mill Hot Spring [159]
157. Southern Smith Creek Valley Springs [160]
158. Southern Smith Creek Valley Springs [160]
159. Monitor Well [161]
160. Spencer Hot Springs [162]
161. Well [163]

LINCOLN COUNTY

162. Hammond Ranch Spring [166]
163. Flatnose Ranch Spring [167]
164. Panaca, Owl Warm Springs [170]
165. Sand Spring [171]
166. Gunderson Well [171]
167. Hiko Spring (flow rate: 4000 GPM) [172]
168. Caliente Hot, Mineral Springs [173]
169. Aqua Caliente, City of Caliente Wells [173]
170. Crystal Springs (flow rate: 2000 to 9000 GPM) [174]
171. Ash, Alamo Spring (flow rate: 9000 GPM) [175]

LYON COUNTY

172. Patsua Hot Spring [177]
173. Magma Power Co. Hazen No. 1 Well (750 ft.) [177]
174. Sutro Tunnel [178]
175. Well (265 ft.) [179]
176. Well (100 ft.) [179]
177. Magma Power Co. Wabuska Wells Nos. 1, 2, 3 (Well 3, 2223 ft.; symbol includes data from one spring) [181]
178. Well (145 ft.) [181]
179. Wells (2; 15 and 200 ft.) [181]
180. Well (364 ft.) [182]
181. Ambassador Well (540 ft.) [183]
182. Hind's Nevada Hot Spring [184]
183. Wellington Area Wells (4; 65 to 200 ft.) [187]
184. Springs [188]

MINERAL COUNTY

185. Wedell Springs (2; no pH) [191]
186. City of Hawthorne Well (602 ft.), Naval Ammo Depot Well No. 2 (423 ft.) [192]
187. Well [192]
188. Naval Ammo Depot Well No. 3 (452 ft.) [192]
189. Pilot Mtn. Area Well [na]
190. Sodaville Springs [193]
191. Bureau of Land Management Well (345 ft.) [194]
192. Bureau of Land Management No. 2 Well (64 ft.) [195]
193. Well [196]

NYE COUNTY

194. McLeod's Ranch Springs [197]
195. Spring [198]
196. Pott's Ranch Spring [200]
197. Diana's, Devel's Punch Bowl [200]
198. G. Sawyer Well (275 ft.) [201]
199. Gabbs Area Wells (200 to 325 ft.) [201]
200. Big Warm Spring at Duckwater (flow rate: 6000 to 7000 GPM) [202]
201. Little Warm Spring at Duckwater [202]
202. Darrough's Hot Springs [204]
203. Geothermal Wells, includes Magma Power Co. Well (812 ft.) [204]
204. Mosquito Ranch Area Spring [205]
205. Spring [206]
206. Test Hole UCE-10 (2963 ft.) [206]
207. Locke's North, Big, Hot Spring (pH: 7.5 to 8.1) [207]
208. Blue Eagle, Jack, Kate Springs [207]
209. Shell Oil Co. Eagle Springs No. 2 Well (10,155 ft.) [207]
210. Chimney Springs [207]
211. Shell Oil Co. Coyote Unit No. 1 Well (1711 ft.) [207]
212. Storm Spring, Coyote Hole (pH: 7.6 to 8.0) [207]
213. Abel Spring [207]
214. Morman, Moorman Spring [208]
215. Emigrant Spring [209]
216. Test Hole UCE-18 [210]
217. Old Dugan Place Hot Spring [211]
218. Upper Warm Spring [211]
219. Hot Creek Ranch, Upper Hot Creek [211]
220. Hot Creek Valley Spring [214]
221. Butterfield Springs [215]
222. Moon River Spring [217]
223. Hot Creek Ranch Springs (flow rate: 7000 GPM) [218]
224. Salisbury Spring [219]
225. Nanny Goat Springs [220]
226. Mizpah Mine, Belmont Mine [221]
227. Spring [223]
228. Reveille Mill Spring [224]
229. Well (465 ft.) [225]
230. Cedar Spring [226]
231. Well (203 ft.) [227]
232. Beatty Area Wells (2) [227]
233. Well [227]
234. Spring [227]
235. Spring [227]
236. Hick's, Amargosa, Burrell Hot Springs (4) [227]
237. Beatty Municipal Spring [227]
238. Yucca Flat Test Well C (1701 ft.) [228]
239. Yucca Flat Test Well E (1875 ft.) [228]
240. Amargosa Desert Springs and Wells [229]
241. Army Well No. 1 [229]
242. Well [230]
243. Wilcox Well [230]
244. Raycraft Well (322 ft.) [230]
245. Manse Ranch Springs (plots in Clark Co.) [230]
246. Well (795 ft.) [230]

PERSHING COUNTY

247. Buffalo Valley Area Springs [151]
248. Trego, Butte Hot Springs (pH: 7.9 to 8.4) [233]
249. Coyote Spring [233]
250. Garrett Ranch Well (125 ft.) [233]
251. Nelson, Guthrie Hot Springs [234]
252. Leach's Hot Spring [235]
253. Phillips Petroleum Corp. Campbell E. No. 1 Well (Geothermal Well, 1853 ft.) [236]
254. Southwest Dredging Co. Well (136 ft.) [237]
255. Kyle Hot Springs [238]
256. Mineral Materials Well [239]
257. Paris Well (382 ft.) [240]
258. Spring [242]
259. Home Station Ranch Hot Spring [242]
260. Sou, Seven Devil's, Gilbert's Hot Springs [243]
261. McCoy Spring [244]
262. Hyder Cone Hot Springs [246]
263. Lower Ranch Hot Springs [247]

WASHOE COUNTY

264. Hill's Warm Spring [253]
265. New Spring [257]
266. Ward's, Fly Ranch Area Well [258]
267. Ward's, Fly Ranch Area Well [258]
268. R. Bailey Well (310 ft.) [258]
269. Fly Ranch Springs [258]
270. Western Geothermal Inc. Fly Ranch Geothermal Wells (1000+ ft.) [258]
271. Spring [258]
272. Great Boiling Springs at Gerlach (20 springs) (pH: 4.5 to 8.3) [261]
273. Chevron San Emidio Desert Well [265]
274. D. Beyer's Ranch Well [266]
275. The Needles Rocks Springs [269]
276. Western Geothermal Needles No. 1 Well (5888 ft.) [269]
277. Springs [270]
278. McCulloch Corp. Well [272]
279. Lawton Hot Springs [275]
280. Well at Lawton Hot Springs [275]
281. Moana Area Springs and Wells [277]
282. Wells (2; 107 and 108 ft.) [279]
283. Bower's Mannion, Franktown Hot Springs [280]
284. Well [280]
285. Well [281]

WHITE PINE COUNTY

286. Collar and Elbow Spring (TDS: 248 ppm) [282]
287. Shell Oil Co. Steptoe Unit No. 1 Well (8406 ft.) [283]
288. Cherry Creek, Young's Hot Springs [285]
289. L. Henroid Well (600 ft.) [286]
290. Giococchea, Simonsen Warm Springs [287]
291. Shellbourne Springs [288]
292. Monte Neva, Melvin, Goodrich Hot Spring [289]
293. Campbell Ranch, North Group Springs (flow rate: 1350 GPM) [291]
294. McGill, Schoolhouse Warm Springs (flow rate: 5000 GPM) [292]
295. Lackawanna Hot Springs, Ely Warm Springs [293]
296. Williams Hot Springs [295]
297. Preston Springs (flow rate: 5700 GPM) [296]
298. Bureau of Land Management Wells (396 and 407 ft.) [297]

PURPOSE OF MAP

This map and the accompanying table are intended to be used as a guide to drow attention to areas having characteristics favorable for the exploitation of geothermal resources for non-electric applications. The configuration and areal extent of the regions is based strictly on currently available data and was carried out using a scheme described below. The boundaries of the regions should not be thought of as a fixed limit, but rather as a tentative line whose location is subject to refinement with the introduction of new information. Certain areas, some of possibly high potential, could not be considered because of insufficient data. The authors hope this publication will stimulate interest in this widespread Nevada energy resource which has seen only limited exploitation in the past. Leasing and subsequent exploitation of geothermal resources should be undertaken only after thorough geological and geophysical investigations.

SPRINGS
Letters in parentheses refer to detailed descriptions below

WELLS

A. The temperature of the geothermal occurrence is given in degrees centigrade (°C) and appears near the top of the symbol in red. In general, the temperature will be the highest reported for any one area, however, for large differences between the highest and lowest reported temperatures, the full range of temperatures is represented on the symbol. To convert from degrees centigrade to degrees Fahrenheit, use either the thermometer scale provided or the temperature conversion formulas.

B. The Flow Rate indicator shows the natural discharge in gallons per minute (GPM). The scale at the top half of the symbol represents flow rates from 0 to 1000 GPM, and flow rates greater than 1000 GPM are represented by a vertical bar (→) at the right side of the symbol.

C. The Index Number keys the map symbol to the accompanying table. The table contains information on the geothermal occurrence that could not be incorporated into the symbol such as: spring or well name, the number of springs or wells that are represented by the map symbol, and any additional chemical or physical data. The position of the index number may vary because of spacing considerations.

D. The location of the springs and wells is generally represented by the crosshair (+) of each of the symbols. Areas containing a limited number of chemically similar springs and/or wells are represented by a single symbol; values associated with this symbol are an average for the group. In the case of severe overcrowding, such as in the Moana-Steamboat and the Amargosa Desert areas, smaller symbols are used on the map to identify the location and complete annotated symbols are incorporated in the table.

E. The pH of a liquid is a measure of the amount of acid or base it contains; it is an important consideration for the choice of materials that may come in contact with geothermal fluids. Scaling and corrosion, for example, may become problematic for some alloys; measures can be taken, however, to avoid early replacement costs. The pH is represented by the small black triangle on the bottom half of the symbol. The pH scale below indicates the full range of pH values.

Strong Acid	Range of Nevada Waters	Strong Base
1 2 3 4 5	6 7 8 9 10	11 12 13 14

F. The map symbol used for surface occurrences (springs and seeps) is a circle. For subsurface occurrences (wells and mine shafts), a diamond shape is utilized.

G. The total amount of dissolved solids (TDS), measured in parts per million, is represented by the colored portions of the symbol. (For symbols without color, no chemical data are currently available). The dominant chemical species, such as calcium-sulfate or sodium-chloride, can be identified by the various colors used in the symbols.

The range of TDS, as well as the types of chemical systems, are illustrated below.

Representation of range of total dissolved solids
- 0 to 500 ppm
- 500 to 1000 ppm
- 1000 to 1500 ppm
- 1500 to 2000 ppm
- 2000 to 2500 ppm
- 2500 to 3000 ppm
- 3000 to 3500 ppm
- >3500 ppm

Dominant chemical species
- $Na\text{-}HCO_3$
- $Na\text{-}SO_4$
- $Na\text{-}Cl$
- $Ca\text{-}SO_4$
- $Ca\text{-}HCO_3$
- Chemistry unknown

POTENTIAL AREAS FOR DIRECT USE

The regions shown in green and purple on this map have been evaluated on the basis of the numerical scheme described below. The evaluation includes consideration of industrial process heat (IPH) and residential space heating (RSH) applications. The symbols that define the potential of the colored regions are tabulated below.

Potential	IPH	RSH	Examples
High	– ± +		M(±)/L(+)
Moderate	– ± +	Increasing Potential ↑	H(–)/M(±)
Low	– ± +		L(–)/H(±)

The rating for industrial process heat appears above the slash and the rating for residential space heating appears below the slash (IPH/RSH).

For these areas, sufficient physical, chemical, and geological data were available, and evaluation indicates a potential for development of non-electric geothermal applications. The evaluation does not indicate that such potential exists at every point within the region.

Available data are insufficient to confidently bound the entire region, however, enough data are available to define the areas of solid shading. Geological data indicate that the physical and chemical conditions present in the solid sections could exist between and/or beyond these areas, represented by the striped pattern.

Regions where presently available physical, chemical, and geological data are insufficient to properly evaluate the area for non-electric development potential. These regions are presented to provide an indication that potential may exist.

Geothermal occurrences of limited areal extent with temperatures greater than 60°C are represented to indicate areas that may provide a basis for limited exploitation. These areas are capable of supporting some industrial process heat applications and most space heating needs. Present data do not allow for expansion of the area into a region that can be evaluated based on the present scheme.

or

THE EVALUATION SCHEME

A simple numerical scheme forms the basis for evaluating the non-electric development potential of the green and purple regions. The scheme incorporates several important physical, chemical, and demographic parameters including: temperature, chemistry, population, accessibility, depth to resource, and areal extent. Only five parameters were used in evaluating the areas for industrial process heat and residential space heating. Although many other factors could be considered, data for the five parameters selected are currently available and quantitative. The following parameters, listed in the order of their importance, were chosen to evaluate the potential for industrial process heat: temperature, chemistry, accessibility, population, and depth to resource. For residential space heating, the parameters used are similar, but their order of importance differs: population, depth to resource, temperature, chemistry, and areal extent. Each parameter is assigned a fixed number which preserves its order of importance. A second number is chosen for the parameter which is variable and depends upon the quality or quantity of the parameter within the defined region. These two numbers are taken as a product for each of the five parameters and the resultants are summed to arrive at a single number which forms the basis for comparing one area to another.

A detailed description of the basis and application of the scheme is given in the accompanying text.

POTENTIAL DEFINED

Since the word potential may connote different meanings to different observers, the authors feel it is appropriate to discuss their use of the word here. The word "potential," as used in the preparation of this map, refers to the *favorability* of the designated areas for the possible exploitation of geothermal energy to be used in non-electric industrial process heat and residential space heating applications. The evaluations are based on currently available data and existing technology. No attempt was made to incorporate growth or exploitation scenarios, or to make allowances for technological advances. New data or changes in the economics of fossil fuel usage could shift a region from one category to another. Such a situation could arise in the region near Minden and Gardnerville, NV. On the map, a low (+) potential is indicated for residential space heat applications. This evaluation results from the fact that the population centers do not lie within the region boundary as presently defined. If new data were to indicate that thermal fluids exist under the cities, the region boundary would be logically extended and its potential upgraded. Alternatively, although the boundary may not change, economic circumstances may provide an incentive to transport the resource to the populated area.

TEMPERATURE SCALE

°F	°C
230	110
212	100
200	90
	80
170	70
	60
140	50
	40
110	30
	20
80	10
50	

TEMPERATURE CONVERSION FORMULAS

C = 5/9 (F – 32)

F = 9/5 C + 32

SOURCES OF DATA

Garside, L. J. and Schilling, J. H. (1979) Inventory of thermal waters of Nevada: Nevada Bureau of Mines and Geology Bulletin 91.

Trexler, D. T., Flynn, Thomas, and Koenig, B. A. (1979) Low- to moderate-temperature geothermal resource assessment of Nevada, final report: under contract to the U.S. Dept. of Energy; contract no. ET-78-S-08-1556.

United States Geological Survey Computer File GEOTHERM.

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Topographic base from U.S. Geological Survey Topographic Map of Nevada Edition of 1965.