GL01579

August 31, 1977

Emanuel A. Floor
Salt Lake International Center
Suite 200, Lindbergh Plaza
221 Charles Lindbergh Drive
Salt Lake City, Utah 84116

Dear Mr. Floor:

We were sorry to note the letter from ERDA/Division of Geothermal Energy indicating that the proposed effort for the Salt Lake International Center had not been accepted. I understand that there were 31 responses to the solicitation, and that they are expecting to make only four awards.

From my recent trip to Washington, D.C., I discovered that your proposal not only had been well reviewed, but had drawn considerable attention. The attention was very favorable, and the general atmosphere was one of appreciation for A.K. Utah Properties' interest and willingness to submit a proposal. I detected from two different sources, however, that the proposal was viewed as possibly being more related to a "conservation effort" than to a "geothermal effort", because of the low temperature of the water. We were aware of this when we put the proposal package together, and were concerned at the time that ERDA/Division of Geothermal Energy might view this effort as lower priority because of the low water temperature.

In any case, I was pleased to find that the proposal had drawn favorable attention. I believe that other possibilities exist to resubmit this proposal for possible funding. We enjoyed working with you, the staff, and the other participants.

Best regards,

Sidney Green

Sidney J. Green

SJG:paj

SIDNEY J. GREEN / PRESIDENT
UNIVERSITY RESEARCH PARK / 420 WAKARA WAY / SALT LAKE CITY, UTAH 84108 / (801) 582-2220

August 4, 1977

MEMORANDUM

TO: S. H. Ward

FROM: G. W. Hohmann

SUBJECT: Call from Dick Turley (x6479 or x6441)

He is a professor in Mechanical Engineering Dept. at U of U. He is going to write a letter to Clay Nichols to see if there would be interest in a proposal to look at engineering and economic aspects of one of the Utah warm water sites of Phase II.

Dick called me to be sure there would be no conflict with our program.

Jerry

G. W. Hohmann

GWH:srm

cc PMW

ERDA - USGS - USFS - STATE OF UTAH AGREEMENT

Utah Low Temperature Geothermal Reservoir Assessment and Confirmation Cooperative Program

The purpose of this agreement is to establish a reservoir assessment and confirmation project for the State of Utah and to provide a basis of understanding between the principal contributors to the project; the Division of Geothermal Energy of the U.S. Energy Research and Development Administration (ERDA-DGE), the Geothermal Research Program of the U.S. Geological Survey (USGS), the Department of Agriculture, through the U.S. Forest Service (USFS), and the Utah Geological and Mineral Survey (UGMS). In recognition of the economies to be gained and the benefits that accrue as a result of multidisciplinary integrated technical programs applied to the assessment effort, each principal will contribute funds and manpower to the project as appropriate. It is the intention of the parties involved in this agreement to implement the project through ERDA contracts with the UGMS and letters of agreement among the USGS, USFS, and ERDA. Detailed planning will be accomplished by a working group composed of representatives of the four parties to this agreement.

Objectives

The objectives of this project are: (1) to extend the inventory of geothermal resources in Utah to include the low temperature reservoirs ($35°C<T<90°C$) most suitable for direct heat applications, and (2) to stimulate reservoir confirmation studies at sites with an apparent but unquantified potential for direct heat application development.

The major urban centers of Utah, its agricultural areas, and its important mineral producing regions appear to be near low to moderate temperature geothermal reservoirs. Little utilization of this resource has occurred to date. A major factor in this lack of utilization is the lack of knowledge concerning the location, extent, and quality of the reservoirs. The reservoir confirmation studies being initiated are designed to contribute to the stimulation of public interest in geothermal resource as a viable energy option in the State of Utah.

Research Plan

The program will be implemented in two phases; the first dealing with a statewide survey of available data, and the second concerned with site specific reservoir confirmation studies. Phase one will involve two major activities; the incorporation of low temperature geothermal data into the USGS GEOTHERM data base, and the preparation of a preliminary report which will summarize and synthesize the available low temperature data. The report will emphasize the known geographic distribution and water quality data for the resource which appears suitable for direct heat applications. Phase one studies will also identify candidate sites for reservoir confirmation activities. Preliminary environmental analyses will also be accomplished in phase one. The important decision point in the project will be late in phase one (winter 77-78) when the results of phase one are evaluated by the project's working group and phase two is planned.

It is the intention of the parties to this agreement to participate in the second, site-specific phase of the program if promising but unquantified low or moderate temperature sites are identified in phase one. Phase two will involve intermediate depth (300-600 meter) confirmation drilling for reservoir evaluation at two or more sites. These sites will be selected to achieve a maximum impact in terms of contributing to public awareness of the potential for development of the low temperature geothermal resources of the State.

The anticipated term of the program is 2½ years. Phase one will be completed with the publication by the UGMS of a preliminary report within one year from the initiation of the study. Reconnaissance studies will be initiated early in phase one in order to take advantage of the 1977 field season. These reconnaissance studies will provide the site-selection information for detailed site studies of phase two in 1978. Confirmation drilling activities and reservoir testing will be concluded in late calendar year 1978 or early 1979.

Responsibilities

The UGMS Project Manager will serve as the coordinator for the various State and Federal agencies participating in the project. It is anticipated that the State participants will include (but not necessarily be limited to) the Utah Division of Water Rights and the University of Utah. He will also provide liaison and coordination between the project and the ongoing Federally supported geothermal projects in the State.

The UGMS will be responsible for preparation of a preliminary report summarizing the known distribution and quality of geothermal reservoirs in Utah that appear suitable for direct heat applications. This report will be prepared through the synthesis of available geological, geochemical, geophysical and hydrological data. Data obtained through this effort will also be provided to the USGS for incorporation into the GEOTHERM data base. The UGMS will contract for environmental studies during phase one leading to the preparation of environmental reports for the candidate sites. The UGMS will coordinate the site-specific studies of the second phase and shall have responsibility for subcontracting the drilling operations.

The USGS Geothermal Research Program which will serve the planned project has among its objectives the characterization and national inventory of all types of geothermal resources. These include those moderate and low temperature resources most suitable for direct heat applications. The USGS will designate a coordinator for the Utah studies who will provide technical advice to the Project Manager. The USGS coordinator will assist in the transfer of data from the project to the GEOTHERM data file, will coordinate ongoing and planned geoscience studies within the USGS geothermal program with the Utah project and will participate in the selection of specific sites for reservoir studies.

ERDA-DGE participation and support for the project will be primarily through its Direct Heat Applications Reservoir Confirmation Program. The ERDA Program Manager for this project will provide technical management of contracts between the UGMS and DGE, and will maintain liaison with the USGS. He will also coordinate and maintain appropriate interfaces between this project and other DGE programs (i.e. regional planning, exploration technology, direct heat utilization technology, and environmental studies). ERDA-DGE will be responsible for environmental reviews necessitated by Federal participation in projects on non-Federal land.

The coordination of surface activities, environmental assessment and use regulations on land managed by the USFS will be the responsibility of the USFS. ERDA-DGE will also provide support for environmental studies appropriate for each of the sites selected for phase two studies. This agreement and the project may be expanded to include direct participation by the Bureau of Land Management or other parties depending on the location or status of sites selected for phase two studies.

James C. Bresee, Director
Division of Geothermal Energy
U.S. Energy Research and Development Administration

Robert I. Tilling, Chief
Office of Geochemistry and Geophysics
U.S. Geological Survey

Donald T. McMillan, Director
Utah Geological snd Mineral Survey
State of Utah

Gordon E. Harmston, Executive Director
Department of Natural Resources
State of Utah

Vernon O. Hamre
Regional Forester
Intermountain Region
Forest Service
Department of Agriculture

D R A F T D R A F T D R A F T

MEMORANDUM OF UNDERSTANDING

Utah nonelectric Reservoir Assessment and Confirmation Cooperative Program

The purpose of this memorandum is to establish a low to moderate temperature geothemmal reservoir confirmation program for Utah and develop a basis of understanding between the principal contributors to the project. The principals involved, the Division of Geothermal Energy, U.S. Energy Research and Development Administration (ERDA-DGE) the Office of the State Geologist, Utah Geological and Mineral (UGMS) and the U.S. Geological Survey (USGS) share a common interest in furthering the assessment, confirmation, and utimately development of this type of geothermal resource. In recognition of the economies to be gained and the benefits of multidisciplinary, integrated technical programs applied to the assessment and confirmation efforts, each principal will contribute to the extent practical, funds and/or manpower to the project. It is the intention of the Parties involved in this memorandum to implement the project through negotiated contracts (USERDA-UGMS) and letters of agreement (USGS-USERDA). The project will begin formally with the signing of this memorandum.

The primary objective of this project is to stimulate the assessment and confirmation of potential low or moderate temperature geothermal reservoirs in Utah. The project will have two phases, the first of which will be a preliminary phase aimed at statewide data evaluation and synthesis which will review available data, select sites for reservoir studies and initiate any further site work required preparatory to actual reservoir confirmation activities. The second phase will involve the drilling of exploratory holes to confirm the reservoir and allow its testing.

The ERDA-DGE participation in this project is thru its Nonelectric Reservoir Confirmation Program. DGE will privide support for the data analysis and site specific phases of the study. The UGMS shall have the lead responsibility for the statewide data synthesis and management of site specific reservoir studies including the additional geologic, geophysical and geochemical site investigation equired. The Water Resources Division (WRD) of the USGS together ith the Utah State Engineers Office and The UGMS shall plan and execute the additionally required hydrologic investigations. The management and coordination of these hydrologic investigations will be the responsibility of the Utah Department of Geology and Mines.

During the first phase of the study a data file will be assembled rom existing State of Utah, USGS, ERDA reports, and other geothermal ata sources. Data relevant to the distribution of moderate and low temperature geothermal resources in the state of Utah will be presented in graphic form accompanied by a narrative report designed for the use of energy planners, energy companies and potential users of nonelectric geothermal energy. It is envisioned that this data presentation will be in the form of maps which show the known geographic extent of the low and moderate temperature geothermal resources. Water quality and temperature data will also be presented to the extent made possible by available analysis. The narative accompanying these maps will be prepared by the Office of the Utah State Geologist in close cooperation with the USGS and ERDA technical personnel involved in various aspects of Utah's geothermal assessment.

Based on a preliminary analysis of the data available for Utah, several sites will be selected for detailed reservoir confirmation studies. These studies, initiated during Phase 1, will be preparatory to the siting of exploration wells during Phase 11 (FY 78) which will be designed to confirm the presence of the reservoirs and begin the quantification of their production characteristics. Sites would be chosen on the basis of both the apparent quality of the resource and the potential for its utilization. Site selection activities will be coordinated with both State and DGE planners and technical program managers involved in the stimulation of non-electric utilization of the geothermal resource.

Site-specific activities planned for the first phase of the program will include heat flow and/or thermal gradient measurements, hydrologic investigations, detailed geologic mapping and DC resistivity surveys, preparatory to the siting of exploration wells. The scale of these activities at a particular site will depend entirely on the state of knowledge concerning the potential reservoir at that site. It is possible that any, all, or none of the above activities might be required in order to site an exploration well.

Although the main emphasis of the project is reservoir assessment, there will be a substantial effort devoted to dealing with environmental, legal and institutional requirements and barriers. Certain of the areas being considered (such as the greater Salt Lake City area) are environmentally sensitive, and every effort must be made to anticipate and mitigate potential environmental concerns such as the seismic risk associated with brine injection along the Wasatch fault zone.

The general responsibilities of the principal contributors are as follows. The overall project management will be the responsibility of the UGMS (principle investigator to be designated). This project management will include the responsibility for compiling the data set and maps, planning site-specific field studies and contracting for drilling operations. ERDA (Clay Nichols, Program Manager) will assist with the initial data compilation and provide financial support for both phases of the investigation.

The USGS (Gene Rush, WRD) will contribute technical expertise to the data aquisition, initial site selection and certain aspects of the site investigations such as the hydrologic investigations.

James C. Bresee, Director
Division of Geothermal Energy
ERDA

Robert E. Tilling, Chief
Office of Geochemistry & Geophysic
USGS

(To Be Provided by UGMS)
State of Utah

30 NOV 77

Utah Geolog. & Mineral Survey

Hank Goode, Wally Gwynn, Pete Murphy, Don McMillan, Dick Fox, Paul Grim, DMW -

Hank → For wells; temp, depth, tds, cl -
need to know what info.
- found great # springs 60-70°F feels some springs around by the sun -
60-70° springs in separate category
also wells that yield 60-70° - believes these are not anomalous -

Brad Taylor - determining uses of direct heat - heat pumps, whats avail, how it can be used, etc.

Hank Goode wants to put temps in °F.
Don Wants °C - feels wants to go metric - its a UGMS policy -

Don doesn't like idea of test on back because of inconvenience in its use.

Depth factor - how to compare temps @ different depth -
Hank is using 60°F @ 200', 67@300', etc. - up to 70°F@1000' depth -

Paul threw out idea of geoth areas, areas of drilling but no resources, untested areas –

Lovering's paper pp on Tintic district
pp 504F

Paul – WATSTOR –
13K wells –
Hank says this would represent about 1/3 of total
Only part of state not studied in detail to date is SE other than that, WATSTOR should contain all avail data. –

George Berry → used to be chief geothermal man for AMOCO – now retired, consultant --
compiled data for Geothermal Resources of Western U.S. –

Hank finish 31 Mar 78 –

Paul could digitize locations of wells and springs –
Hank is plotting all on Basic Data Reports –

USGS – TD – digitizing each state –

THE UNIVERSITY OF UTAH
COLLEGE OF MINES AND MINERAL INDUSTRIES
SALT LAKE CITY 84112

DEPARTMENT OF GEOLOGY
AND GEOPHYSICS

717 MINERAL SCIENCE BUILDING

October 26, 1977

Senator Fred W. Finlinson
State Capitol Building
Salt Lake City, Utah

Dear Senator Finlinson,

Further to my letter of September 6, 1977 I wish to advise that an issue has arisen which well may require legislation in the State of Utah. This has to do with the development of "direct heat" application (non-electric uses) of geothermal fluids.

Pipelines must be constructed from the fluid source to its point of utilization, perhaps a distance of several miles. The "right of eminent domain" then is raised. Who controls the right to direct private, state, and federal interests to permit access for short pipeline construction?

Insofar as Utah may be an early leader in *new* direct heat applications, I urge you to study potential legislation aimed at this potential problem area.

Sincerely,

Stanley H. Ward
Chairman

SHW:mkd

cc: Senator E. T. Beck
Dr. R. J. Snow
Dr. P. M. Wright
Mr. W. M. Dolan

MEMO

To: Dr. Mike Wright
From: Ron Hansen
Subject: Utah Warm Water Project

The following is a brief report concerning the work I accomplished during the weeks 8/8/77 through 9/16/77 while employed for Earth Science Laboratory. My main objective was to collect data for wells in Utah with reported water temperature greater than 16°C (60°F).

Description of Sources for Data

A) Utah State Department of Natural Resources, Div. of Water Rights
Room 442, Utah State Capitol; Telephone 533-6071
I searched through well log files in this office for data. The major problem encountered was the large number of files available. At most 5% of the well logs have a reported temperature greater than 16°C. Also, the accuracy of these repeated temperatures must be questioned, because much of the data contained in these files was approximation rather than measurement.

B) University of Utah Marriott Library

Publications used;

1) Utah State Department of Natural Resources

Technical Publications # 11-14; 17-44; 51; 57 (TA7 U77)

2) UGMS Water Resource Bulletins # 1-13; 19 (TD224 U8)

3) Utah Basic Data Releases # 2-9; 11-16; 21 (Doc I 19.2 : Uty)

4) USGS Professional Papers # 492; 600-D (Doc I 19.16)

5) Univ. of Utah Thesis by Fred Saxon 1972 (TD 7.5 526)

The number of reports which had to be sifted through caused a time problem because well water temperature data was generally supplemental information, not the major concern of the reports.

All of the data collected from both the Division of Water Rights and from publications was compiled in two tables. This information needs to be cross-checked for redundancy and accuracy with existing information already assembled on computer print-outs.

Computer print-outs were obtained from:

A) USGS - Scott Bartholoma, Rm. 8401, Federal Building;
The USGS water quality file WATSTOR was searched and listed as follows:

WATSTOR I - listing well locations and temperature data for wells in the state of Utah.

WATSTOR II- listing wells in the state of Utah that probably have chemical data. Certain ones of these wells can be selected for acquisition of their chemical data.

B) UGMS--A Xerox copy of a listing of the current wells and springs in the USGS file GEOTHERM.

Explanation of tables

The information listed in the data tables is explained below:

I) Well Information

Location and well number

USGS numbering system

USM--Uinta Special Meridian
[U( ) sometimes used instead of USM]
SLBM--Salt Lake Base and Meridian

Owner

Driller

Date Drilled - completion of work done on well; sometimes most recent deepening is listed in state records rather than original drill date.

Diameter of Well (in.)

Casing (in.) and Perforations or Screen Information (ft.)

* Data above line (or appearing by itself) is casing diameter information and depth of casing.
* Data below line is either perforation or screen depth information as noted.
* Example:

Casing dia.	Depth
20	0-250
16	249-600
Perf	350-450 - depth of perforations
Screen	460-470 - depth of screen

Driller's Log

* If nothing appears in this space, there is no log

  "Sed." refers to sedimentary rock bottom hole material

  "Bedrock" refers to bedrock bottom hole material

  "Volc." refers to Volcanic bottom hole material

  Quotation marks surrounding any entry appear in the table when the exact description used by the driller for the bottom hole material is quoted.

Flow Data (gallons per minute or cubic feet per second as noted)

* P refers to pumped
* B refers to bailed
* Data by itself refers to artesian flow

* If a date is not given, assume that flow was measured at the same time that the well was completed.

Total depth (ft.)

Water Depth (ft.)

* Static level of water or depth to water bearing strata

Temperature/Depth

* (^{o}F or ^{o}C) as noted or if temperature is below 60^{o} it is recorded in ^{o}C.
* If a slash appears after a given temperature, the subsequent number is the depth at which the temperature was taken in feet.
* "Chem" means that a chemical analysis was made. It appears on a separate table.
* "Chem nw/c" means that a chemical analysis was made, but was not found with the well log.
* Other information recorded in this space:

  "Sp. cond." refers to specific conductance

  Sometimes the driller noted physical characteristics of water such as odor or color.

Number in upper right hand corner refers to page number

II) Chemical Analysis

* Data are reported in parts per million, unless otherwise noted as milligrams per liter.
* Many times throughout the tables specific element entries are substituted in columns marked for other element entries as noted in column heading.

* "St. and Sr." refer to same element, Strontium.
* If no specific value is reported for K, then Na and K were calculated together and the number is circled.
* Sodium is reported in percent rather than ppm.

Prelim. Draft

UTAH VALLEY and GOSHEN VALLEY

INTRODUCTION

Location

Utah Valley and its neighbor to the southwest, Goshen Valley, encompass about 600 square miles between latitudes 39°50' and 40°30' north and between longitudes 111°32' and 112°01' west. Both valleys are wholly within Utah County.

Summary of Uses and Potential Uses

Waters of temperatures from 60° to 115°F are yielded by springs and wells near Saratoga Springs in northern Utah Valley, and waters of temperatures from 60° to 90°F are yielded from wells and springs in southern Utah Valley and in Goshen Valley. In other areas outside Utah, waters in these temperature ranges and of the low salinity of most of the waters of these two valleys are used for space heating, for heating greenhouses, and for extending the growing seasons of certain crops.

At present, the only known use of the thermal properties of the waters of Utah Valley and Goshen Valley is at Saratoga Springs where the moderately saline (1050 to 1600 ppm dissolved solids) warm water from the springs and wells is used to supply swimming pools at the resort.

Some of the wells near Saratoga Springs supply irrigation water, but apparently no attempt is made to use the heat of the water to extend the growing season or to heat greenhouses, a use for which this water would seem to be ideally suited. This water could also be used for space heating, for its fairly low salinity should cause few problems with such use.

With the exception of the springs at Bird Island and at Lincoln Point, whose waters contain 6140 to 6650 ppm total solids, essentially all the warm waters so far reported from wells and springs in southern Utah Valley and in Goshen Valley might be used for space heating, for heating greenhouses, or for extending the growing season.

Neither the chemistry of the warm waters nor the geophysical studies, which provide information to help in the interpretation of the sources of heat, suggest that any heat source in Utah Valley or Goshen Valley is capable of providing water or steam hot enough to generate electricity.

GEOLOGIC ENVIRONMENT

The major structure of Utah Valley is a NNW-trending graben, bounded on the east by the Wasatch fault zone and on the west by the Utah Lake fault zone (Cook and Berg, 1961, plate 13). The northern end of the graben is marked by faults along the southern margin of the Traverse Range, and the southern end by NE-trending splinter faults of the Wasatch fault zone.

Goshen Valley is shaped like an arrowhead that points to the SSW and which is bounded on the southeast by a series of NE-trending faults and on the west side by probable faults that separate the valley from the East Tintic Mountains to the west. Northeastward, Goshen Valley merges into Utah Valley.

Utah Lake occupies about 150 square miles in parts of both valleys, and the other parts of the valleys are underlain at the surface by unconsolidated fluvial and lacustrine deposits of Quaternary age. In most of Utah Valley the Quaternary deposits are about 250 to 600 feet in thickness, but are nearly 900 feet thick just east of Long Ridge, and are about 1300 feet thick at West Mountain; in Goshen Valley the Quaternary deposits are 300 feet to more than 500 feet thick (Cordova, 1970, figs. 4 to 11). Below the Quaternary deposits is an unknown thickness of Tertiary deposits. Cook and Berg (1961, p. 82) believe that the Tertiary and Quaternary rocks in the center of the Utah Valley graben "extend to a depth of at least several thousand feet."

The rocks of the mountains surrounding Utah and Goshen Valleys are principally Paleozoic marine sediments with early Tertiary volcanics surrounding the tip of the arrowhead of Goshen Valley. Presumably the bedrock underneath the Cenozoic deposits of both valleys is of Paleozoic age.

OCCURRENCE of WARM WATER

Warm water is reported in several areas in the two valleys, grouped here according to their presumed geologic control, which for each is a fault or fault zone.

Utah Lake Fault Zone

The Utah Lake fault zone parallels the northern portion of the west shore of Utah Lake, probably about a quarter mile offshore. Northward, it passes through Saratoga Springs and probably continues northwestward beneath the volcanics of the Traverse Range. (This probable northwestward continuation will be discussed in some detail below.) Southward it goes near Bird Island and then east of Lincoln Point at the north end of West Mountain. From there it goes through Holladay Springs and meets the main Wasatch fault zone about one mile northeast of Santaquin. In the vicinity of Lake Mountain and West Mountain, the west side of the fault is up, and near Santaquin the east side is up, which "suggests either a hinge action or east-west cross faulting" north of Santaquin (Cook and Berg, 1961, p. 82).

Along this fault zone in the vicinity of Saratoga Springs are shallow wells 90 to 198 feet deep that produce water from 70° to 115°F. In the same area are two springs at 110°F. In the lake southeast of Saratoga Springs are springs that have been measured at 107° and 90°F. (During the winter when most of Utah Lake freezes over a band of open water marks the location of these springs in the lake.)

Farther south, a spring on Bird Island yields water of 70°, and springs on the tip of Lincoln Point have been measured at 89°. About ten miles south of Lincoln Point, east of West Mountain are shallow wells, 55 to 125 feet deep, that yield water of 62° to 65°. Finally, about two miles west of Spring Lake are the Holladay Springs, which are described as having "warm waters" by Cook and Berg (1961, p. 83) but are reported to have a temperature of 52° by Cordova (1969, p. 28).

Chemical Quality and Source of the Warm Water

The warm waters that come from springs and wells along the Utah Lake fault zone can be separated into three groups based on the concentration of dissolved solids. Springs and wells in the northern reach of the Utah Lake fault zone near Saratoga Springs range in total dissolved solids from about 1050 to 1600 ppm. The springs on Lincoln Point and the one on Bird Island range from 6140 to 6650 ppm in total solids. The slightly warm (about 60°F) waters in some of the wells that are near the south end of the east face of West Mountain contain less than 500 ppm total solids.

It thus appears that although the Utah Lake fault zone probably is the main conduit by which the water comes to the surface, it is likely that the sources of water, the sources of heat, or both are different in the different parts of the fault zone. Therefore they should be examined separately.

The springs that rise in the lake near Saratoga Springs and the nearby warm springs and warm-water wells are similar chemically and probably therefore are all supplied by a common source. Likely that source is Cedar Valley, west of Lake Mountain, where there are sinks and no surface drainage out of the valley. The principal structure of Lake Mountain is a syncline which, according to cross sections by Bullock (1951, p. 24), would drop the tops of two possible aquifers, the Great Blue Limestone and the Pinyon Peak Limestone, to about 500 feet above sea level and about 3000 feet below sea level, respectively. Either or both of these aquifers could bring water to the fault zone. Probably the normal geothermal gradient is more than sufficient to warm the waters to the 90° to 115° that are reported near Saratoga Springs.

The highly mineralized waters of Bird Island and Lincoln Point must be derived from a different source from the one that supplies the warm water at Saratoga Springs. The salinity of these waters suggests that they are supplied by some deep-seated heat source such as has been postulated for many of the warm and hot springs of Utah that rise along faults or near volcanic areas. No known volcanic rocks are close enough to be the source of heat, and the aeromagnetic map that includes the area of the springs (Mabey and others, 1964) shows no anomaly in the area, so it is likely that water penetrates the fault zone to a great depth and then rises to supply the springs.

In contrast to the saline waters of Bird Island and Lincoln Point the warm waters in the wells east of West Mountain are fresh and therefore they probably derive their heat from the normal geothermal gradient, and at rather shallow depth.

Payson Fault

Cook and Berg (1961, p. 82) recognize a "second concealed northward-striking fault, 2 to 3 miles east of" the Utah Lake fault zone, which "apparently begins near Payson and extends north past the mouth of Spanish Fork." Aligned along and parallel to this fault are many wells, about a dozen of which yield water between 64° and 93°F from depths of 200 to nearly 700 feet. Waters from these warm-water wells contain about 250 to 450 ppm dissolved solids. In fact, the warm-water wells for which there are chemical analyses yield better water than some of the cooler-water wells whose dissolved solids range from 475 to nearly 700 ppm.

Probably there is sufficient moderately deep circulation of water at favorable places along the Payson fault to permit water of good quality to become warm without dissolving additional mineral matter.

Other areas in southern Utah Valley

Several wells at scattered places in the southeast portion of Utah Valley yield slightly warm water, apparently of good quality.

Coordinates	Location	Temp	Depth	Total Solids	Cl
(D-7-3)20 bda	Ironton	72	337	259	12
(D-8-2)2cda	NW of Spanish Fork	61	140		
11adb	"	63	204		
12bdc	"	63	199	404	49
26cac	SW of Spanish Fork	65	357		
36dbd	South of Spanish Fork	62	38		
(D-9-3)19ddb	East of Salem	62	112		

Possibly the zone of moderately warm water in southern Utah Valley, even including that along the Payson fault, is related to the geologic cause of a southwestward-trending magnetic nose that is shown on the aeromagnetic map by Mabey and others (1964), but is not further discussed by them. This high could be related to the NE-SW trending fault system that terminates the southern part of the Utah Valley graben.

Castilla Springs in Spanish Fork Canyon two miles below Diamond Fork yields saline water of 6360 ppm total solids at a temperature of 104°. Because the spring area is surrounded by mountains that rise about 5000 feet above the 4900 ft altitude of the spring, Mundorf (1970, p. 49) believes that water descending "from altitudes of 7,000 to 10,000 feet could be heated to the observed temperatures at the altitude of the springs."

Southern Goshen Valley

The springs and principal wells that produce warm water of 65° to 72° in southern Goshen Valley line up as a band that trends about N95°E along the southeast flank of the valley. The wells range in depth from 335 feet to 862 feet and yield waters that contain 491 to 1780 ppm total solids. Warm Springs yield 70 - 72° water with 1320 ppm total solids, and the spring in the canyon of Currant Creek yields 66° water with 1017 ppm total solids.

The volcanic rocks in the vicinity are of Eocene age and therefore probably too old to be the source of heat. It appears more likely that the heat for these moderately warm waters is related to the feature, presumably a NW-SE-trending fault system, that is the cause of the magnetic nose depicted by Mabey and others (1964) and mentioned above to account for some of the warm water in southern Utah Valley.

Springs south of Pelican Point

Two springs on the west shore of Utah Lake about two miles south of Pelican Point yield water of 75° to 77°F. The water contains 1430 to 1570 ppm total solids of which about 500 ppm is chloride. These springs appear to be on line with a northwest-trending thrust fault mapped by Bullock (1951, p. 12) in the Great Blue Limestone on the east side of Lake Mountain. Possibly meteoric water sinks deep enough along the fault to be heated to the observed temperatures.

Northern Goshen Valley

In northern Goshen Valley, in township 8 south, range 1 west, warm water, up to 69°F, is reported from four wells 205 to 392 feet deep, but in three of those wells temperatures of 57° and 58° have also been reported. There are also inconsistencies in chemical analyses of water collected at different times from two of the wells, (C-8-1) 32bcb-1 and (C-8-1) 35dcb-1 (B-D 16, p. 25), so it is difficult to speculate on the origin of the water or the source of the heat in these waters.

OUTLINE
for
REPORT on GEOTHERMAL AREAS in UTAH
(Revised)

11/14/77

INTRODUCTION

Purpose and scope

Methods of investigation

Previous work

SUMMARY of SIGNIFICANT GEOTHERMAL AREAS

POTENTIAL for DEVELOPMENT

Principal uses of thermal water

RECOMMENDATIONS for FURTHER STUDY or EXPLORATION

GENERAL REFERENCES

The main body of the report will consist of discussions of the individual areas, each to follow this outline:

LOCATION — The Blue Devil area encompasses 150 square miles in --

SUMMARY of POTENTIAL USES

GEOLOGIC ENVIRONMENT — The Blue Devil area is in a graben bounded by two N-S faults.

Kind and thickness of valley fill

General geology of bedrock

OCCURRENCE of THERMAL WATER — The Blue Devil area has 42 warm springs whose temperatures range from 63° to 187° F. In addition, warm water has been reported in four wells that are less than 300 feet deep.

Relation of springs and wells to faults, intrusives, extrusives —

Quality and quantity of water yielded by springs and wells — Table

Maps of specific areas (?)

POTENTIAL for USE

Estimate of uses based on quantity and quality

SELECTED REFERENCES

MAPS — 1:500,000 scale

Springs and wells by temperature range:
60-90°, 91-120°, 121-150, 151-180, 181 ↑
Earthquake epicenters (overlay) and faults
Recent flows and volcanoes — Pleistocene too

For Ron Hansen

UTAH WARM WATER DATA COMPILATION 9 Aug 77

1. Buy base maps for project: From USGS
   [a) ≈14 maps @ 1:250,000 AMS quadrangles no green
   [b) state map @ 1:500,000 - topo - no green
⇒ 2. Assemble all data on water well locations and temperatures
3. Assemble literature that goes with data
4. Post data on maps -
   a) well location, depth
   b) max, min recorded temperature (°F)

Sources of data

1. Call Utah State Water Resources Div. 533-5401
   " " " Rights " 533-6071
   Jack Feight
   oil & gas well maps " " Oil, Gas & Mining Div 533-5771
   " " Agriculture Dept 533-5421
   - ask about their compilations
   - visit their offices
   - obtain publications, etc. -
2. USGS reports WRD
   a) water Supply Papers & publications } open f[ile]
   → b) heat flow reports } and p[ublished]
   → c) Research Reports
3. Particular authors, etc.
   * a) Mundorff - wrote report on water wells - UG[MS]
   water Resources Bull, 1971 -- other Reports as well
   → b) Marine, I.W., temperature data for wells [...]
   Great Salt Lake?
   c) Wright, P.M., 1966, Geothermal gradient a[nd]
   heat flow in Utah, PhD Thesis, Univ[...]
   d.) Roy, Robert, PhD Thesis, Harvard an[d]
   publications list temp data for some
   wells

②

e) Blackwell, David - Several papers on heat flow in western U.S. -- gives Utah data

f) Lachenbruch, Art -- USGS type has published on heat flow

g) Sass, Jan - do

h) Diment, - do

i) Decker, Ed, Univ Wyoming heat flow type - possible that some of his data include Utah

* j) Gene Rush - USGS Open File Report 72-132

4. U of U Dept of Geology & Geophys
   - heat flow reports by Sill & Bodell
   - go to dept -- ask Mary deWitte for help, tell her what you are doing -- need all published data

from

Ron Hansen — Utah

9 Aug. 77

He has been to Water Resources Division

1) can't get copies
2) won't let him take them out or put them back
3) Few temp. data --
4) He talked to one of bosses -
   boss knew of no compilations of water temperature

I told him to let it rest for now, that we could possibly go back later, have a person trained by them to peruse their files, and then we could prob get data -

Ron mentioned a few +60°F temps for some wells. Interesting!

J / 30	(40) / (55)	J / 85

Crystal Hot Spring

1. Call Parry re geochem faps.
2. call Clay & Davy re expanded UGMS budget
3. Get Cook's gravity map on Jordan Valley
4. Get state-wide mag maps

Areas

Little Mtn areas - west of Ogden - E of Great Salt Lake Minerals
Becks - Wasatch H.S.
Crystal (Prison)
Midway - 6 holes committed to Kohler -

wally wants us to go to bat for him re more budget

5. check w/ Chapman on H.F.
6. Check w/ Stur re sensitivity -
7. Earthquake epicenters -

get updated Geotherm for UT

Department of Energy
Idaho Operations Office
550 Second Street
Idaho Falls, Idaho 83401

February 14, 1978

Dr. Clayton Nichols
Department of Energy, DGE
20 Massachusetts Avenue
Washington, D. C.

RE: EG-77-S-07-1979 - UTAH GEOLOGICAL SURVEY

Dear Clay:

Please find enclosed the environmental analysis report for those shallow temperature holes that will be drilled at Midway, Utah, and at the Crystal Warm Lake Area, south of Salt Lake City by the Utah Geological Survey.

David H. Crockett
Program Geologist

cc: J.L. Griffith
P.M. Wright, U of U, ESL

Enclosures:
As stated

MAR 15 1978

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division
345 Middlefield Road
Menlo Park, California 94025

March 13, 1978

Mr. Mike Wright
University of Utah Research Institute
Earth Science Laboratory
391 Chipeta Way, Suite A
Salt Lake City, UT 84108

Dear Mike:

This is to add the name of Joseph Gates, WRD District Office, Salt Lake City, to the list of WRD people who will serve as contacts for the DOE/DGE Low-Temperature Coop Program. The telephone number is FTS 588-5663.

Gates has been working with Hank Goode on the Utah data, and should be regarded as the principal liaison person for the State.

Sincerely,

E. A. Sammel

cc: Frank Olmsted