Title

A GEOTHERMAL RESOURCE AREAS DATABASE FOR MONITORING THE PROGRESS OF DEVELOPMENT IN THE UNITED STATES

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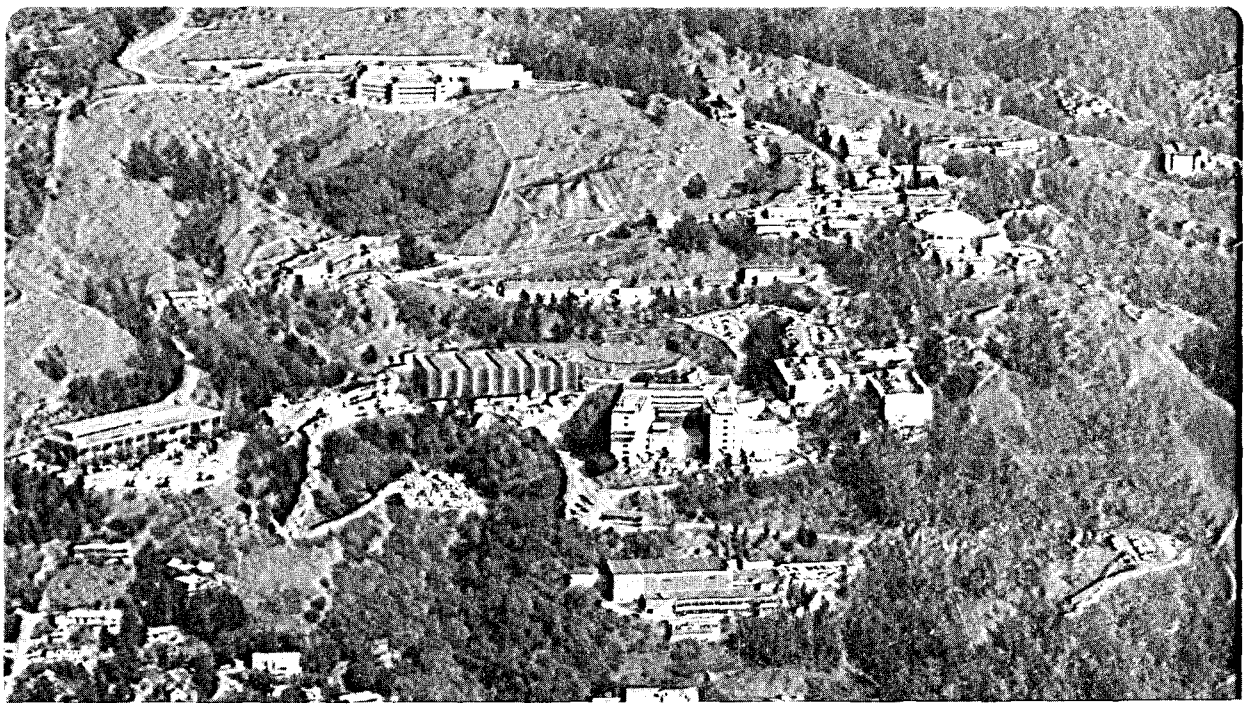

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A GEOTHERMAL RESOURCE AREAS DATABASE for MONITORING THE PROGRESS of DEVELOPMENT IN THE UNITED STATES

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ABSTRACT

The Geothermal Resource Areas Database (GRAD) and associated data system provide broad coverage of information on the development of geothermal resources in the United States. Established for the DOE Division of Geothermal Energy, the system is designed to serve the information requirements of the National Progress Monitoring System. GRAD should also be of interest to other government agencies at the federal, state and local level; to universities; and to private organizations in the geothermal industry.

GRAD covers development from the initial exploratory phase through plant construction and operation. Emphasis is on actual facts or events rather than projections and scenarios. The selection and organization of data are based on a model of geothermal development prepared by the MITRE Corp. Subjects in GRAD include: names and addresses, leases, area descriptions, geothermal wells, power plants, direct use facilities, and environmental and regulatory aspects of development. Data collected in the various subject areas are critically evaluated, and then entered into an on-line interactive computer system. The system is publically available for retrieval and use.

This report describes the background of the project, conceptual development, software development, and data collection. Appendices describe the structure of the database in detail.

TABLE OF CONTENTS

1. INTRODUCTION

How many megawatts of electric power are currently available from geothermal sources in California?

How many federal acres are under lease at the East Mesa geothermal field?

Who drilled well "B-R UNIT 1" at the Geysers?

How much land do different companies have under lease at the various geothermal areas in California?

What recent geothermal drilling activities have taken place in Southern California?

What is the status of geothermal development for electric power production in Utah? Direct use facilities?

Which counties in the United States have the greatest direct heat applications of geothermal energy?

What is the average permit processing time for permits granted by specific federal, state, or local government agencies?

The National Geothermal Information Resource project at the Lawrence Berkeley Laboratory is developing a Geothermal Resource Areas Database, called GRAD, designed to answer these and similar questions. This database contains extensive information on geothermal energy resources for selected areas, covering development from initial exploratory surveys to plant construction and operation. The database is available for on-line interactive query by anyone with access to the computer, a computer terminal with an acoustic coupler, and a telephone.

The database presently contains information about past and current events. Speculations about future activities are not part of the effort at this time. Subjects covered include permitting, leasing, exploration, drilling, reservoir characteristics, and plant design, construction and operation. Detailed information is aggregated in various ways to provide summaries at several levels of detail.

GRAD has been designed to serve a diverse community of users who share with the Department of Energy (DOE) an interest in furthering the use of geothermal energy. The Division of Geothermal Energy (the Department of Energy program office that supports the system) requires information on the status and current rate of progress of the development of geothermal energy. A company interested in geothermal development may wish to know who drills wells or holds leases. A geoscientist may need to know average temperatures of particular wells. A financier may require a profile of a geothermal field, before lending money for development. A state or local government agency may desire information on geothermal activities in their area, or to compare activities in an area of interest to them with some other area.

Information for the database is collected from a variety of sources, and is critically evaluated (by ourselves or others) before being entered into the database. We are therefore very interested in specific information about geothermal development, and request readers to cooperate by providing us with important and timely data for use in the database.

The database is an evolving system, and will be modified over time to suit the needs of the users. We welcome suggestions for improvement: what additional subject areas should be covered in the future, and what data should be added to existing areas? Such modifications will be described in future revisions of this report.

2. DEVELOPMENT OF A GEOTHERMAL FIELD

The concept for GRAD was developed in response to the need for the collection of area-specific data to monitor the trends and progress of geothermal resource development. LBL was asked to provide assistance in the organization and acquisition of the data. Because of the large amount of data to be collected, we decided to utilize a database management system to increase the efficiency of retrieval and aggregation of the data.

The areas for data acquisition were organized into three major stages of geothermal resource development: Pre-Lease, Lease and Post-Lease. Within each of these three stages, discrete activities were identified for data collection. Mitre flowcharts [1] were followed for the development process on Federal lands. However, the organization of the database coverage was enlarged to accommodate activities for development on state, private, and Indian lands. The Mitre flowcharts were designed primarily for development of geothermal resources leading to electric power generation; we will extend these to accommodate progress in the development of resources for direct use.

In the remainder of this section, we present the activities that occur in geothermal development, as given by Mitre, in roughly sequential developmental order. The following abbreviations are used:

APD - Application for Permit to Drill
EA - Environmental Analysis
EAR - Environmental Analysis Record
KGRA - Known Geothermal Resource Area
NOI - Notice of Intent
POO - Plan of Operation

Pre-Lease Activities include:
- File NOI for Pre-Lease Exploration
- Process NOI for Pre-Lease Exploration
- Approve NOI for Pre-Lease Exploration
- Conduct Pre-Lease Exploration

Leasing Activities include:
- Designate KGRA
- Receive and Process Lease Applications
- Prepare EAR and Obtain Concurrence on Lease Stipulations

Establish Parcels, Leasing Units, Rents/Royalties
Publish Lease Sale Notice
Conduct Pre-Sale Economic and Resource Evaluation and Recommend Bonus Bids
Conduct Lease Sale
Announce Post-Sale Review of Bids
Clear KGRA Clearlist
Issue Lease

Post-Lease Activities include:
Negotiate Land Position with respect to other Leaseholders; Unitize
File NOI for Post-Lease Exploration
Process, Approve NOI for Post-Lease Exploration
Make Decision for Exploratory Drilling
File First POO for Drilling
File First Deep Well APD
Prepare EA for First Drilling POO
Approve First Drilling POO
Approve First APD and Issue Permit
Conduct Exploratory Drilling and Reservoir Evaluation
File and Approve Additional POO's & APD's; Prepare EA's
Revise and Update Reservoir Evaluation
Conduct Feasibility Study
Conduct Financial Negotiations
Announce Final Decision for Plant Development
File POO's for Development and Injection
Prepare EA's for Development and Injection POO's
Approve Development and Injection POO's
Select Plant Site
Collect Environmental Database
Prepare and File POO for Production
Prepare EA for Production POO
Approve POO for Production
Develop Preliminary Plant Design
Approve Final Plant Design
Apply for Plant Siting License
Conduct Technical Examination and Prepare Environmental Documents for Siting License and Plan of Utilization
Issue Siting License
File Plan of Utilization
Approve Plan of Utilization
Apply for Other Federal and State Permits
Process and Issue Other Federal and State Permits
Develop Field-Wide Drilling and Piping
Construct Plant and Install Transmission Lines
Start up Plant
Shakedown Plant
Operate Plant

3. CONCEPTUALIZATION OF THE DATA SYSTEM

The analysis described in Section 2 led us to believe that many thousands of facts could be collected to assist in assessing and monitoring the progress of geothermal development. Typical facts are: the depth of well THORNE-7 at the Geysers, the date of a particular lease sale, the number of a particular NOI permit for East Mesa, and the name of the company owning lease number CA 956.

Such a large collection of facts requires organization to be manageable. First, we analyze the collection of facts to obtain a collection of data elements, or variables. Next, data elements are aggregated to form a hierarchy of related elements. This aggregation results in a rather abstract description of the data needed to describe the progress of geothermal resource development.

Once organized, various facts are fit into the structure, to become instances of data elements. Related facts are grouped together to become instances of the aggregates, resulting in a database of facts organized so as to facilitate retrieval, manipulation, reporting, and understanding.

The method of analysis is discussed in more detail in the remainder of this section. The results are shown in Appendix A.

3.1. DATA ELEMENTS

Examination of the collection of facts that describe geothermal development reveals that the collection can be divided into classes so that the facts in each class are occurrences of a single concept. For example, all lease numbers are grouped together in one class, all well depths in another, and all plant names in a third. Each such class is given a name (lease number, well depth, plant name) descriptive of the class. These classes are termed data elements, and the process of determining them is fundamental to the structuring of the database.

The process requires judgment at each step. Should one group all plant names together, or should the names of electric power plants form one group, while the names of direct use facilities form another? These decisions must be made consistently across the collection of facts, and the result determines what kinds of aggregations are possible. We have currently identified over 400 such data elements. The exact number can be expected to fluctuate as the system evolves, and experience with the database enables us to improve our decisions.

3.2. RECORDS

Data elements can be aggregated into records which describe the various entities involved in geothermal development. Such entities are: leases, wells, plants, laws, literature references, and so forth. As with the process of identifying data elements, the process of identifying records, and assigning data elements to records, is a matter of judgment. The result determines, to a considerable extent, how the database can be used, and even what questions are meaningful to it.

We have identified seventeen records that describe geothermal development. They are:

NAME AND ADDRESS
PERMIT
LEASE
AREA DESCRIPTION
GEOTHERMAL WELL
EXPLORATORY SURVEY
SHALLOW TEMPERATURE GRADIENT HOLES
RESOURCE EVALUATION
LAND ACQUISITION
UNITIZATION
FEASIBILITY STUDY
FINANCIAL NEGOTIATIONS
PLANT
ENVIRONMENT
LAWS AND REGULATIONS
NEW TECHNOLOGIES
REFERENCE

The Name and Address Records give selected identifying facts about organizations active in geothermal development. An "organization" may be a governmental agency, a private company, or an individual. The record gives addresses and phone numbers, an indication of the organization size, and the roles played by the organization (such as land owner, lease holder, operator, etc.). Space is provided for a bibliographic reference.

The Permit Records describe permits: NOI's, APD's, POO's, Siting Licenses, Building Permits, and any other federal, state, or local permits required for geothermal exploration and development. Data elements include: permit number (if any) and type, names of applicants and approval agencies, associated EA/EAR numbers, relevant dates, a description of the activities permitted, and a reference.

The Lease Records describe leases, be they federal, state, local, Indian, or private. The record gives the lease number, lease holder and land owner, location of the land, land size, relevant dates and costs, and a reference.

The Area Description Records give general descriptive information about the area. Data elements describe the location of the area, size (by type of land owner), classification, geography, physical and legal attributes, and references.

The Geothermal Well Records describe wells, and include the well name and location, associated permit numbers, well owner, relevant dates and costs, summary of well logs, physical and chemical properties of the geothermal fluid, and references.

The Exploratory Survey Records describe initial surveys of the areas, including survey type, operator, dates and permit numbers, a sketch of the results, and a reference.

Shallow Temperature Gradient Hole (STGH) Records describe groups of temperature gradient holes. Data elements include: operator name, associated lease numbers, number of holes drilled, a brief summary of results, and a reference.

The Resource Evaluation Records give the results of formal area evaluations. The record gives evaluator name, date, values for typical parameters, and a reference.

Land Acquisition Records describe leasing events. Both non-competitive and competitive leasing can be described. Data elements include: names, dates, locations, bidding data, and references.

The Unitization Records describe unitization processes, and include: names, associated lease numbers, dates, status of negotiations, and a reference.

The Feasibility Study Records describe these studies. Data elements give names, dates, preliminary plant design details, a preliminary financial analysis, and a reference.

Financial Negotiation Records describe such negotiations, and specify names, dates, financing terms, and a reference.

Plant Records describe electric power and direct use plants. Data elements give plant name, type of use, relevant dates, geothermal fluid characteristics, site selection details, construction and operating costs, some startup and production details, and references.

Environment Records, Laws and Regulations Records, and New Technologies Records have not yet been defined, and are therefore not included in the appendix.

Reference Records describe references to data reported in other records, giving title, authors, and source.

3.3. STRUCTURES

There is a level of aggregation that falls between data elements and records, called structure. Many levels of structure may exist within a record. Their purpose is to allow elements in a record that are related to be grouped together. For example, all of the elements that describe the location of a well (township, range, section, etc.) can be grouped together into a LOCATION structure, and referred to by a single name ("LOCATION"). Indeed, this terminology has already been used in the record descriptions given in the last section.

An important function of structures is to group related instances of multiply occurring elements. Many elements in an instance of a record are restricted to single occurrences - a particular lease has only one lease number, and is of only one type, for example. Other elements may occur more than once. For example, several companies may share the ownership of some lease - each such company is designated by one instance of the lease-holder data element in the lease record.

In other cases, instances of multiply-occurring elements are related. Data elements for an address, in the Name and Address Record, include: address line, city, state, zip, country, and phone. If a company has several addresses, say in Phoenix and Seattle, we must be able to associate city Phoenix with state Arizona, and Seattle with Washington. This is done by grouping the elements into an address struc-

ture, and allowing the structure to be multiply occurring. In the example, address line and phone number are each multiply occurring elements within the multiply occurring structure. Here is a more complete example, of a fictitious company:

```
NAME                Pacific Geothermal Conglomerate
ADDRESS
  ADDRESS LINE      77 Maritime Plaza
  CITY              San Francisco
  STATE             California
  ZIP               94111
  PHONE             (415) 956-1234
  PHONE             (415) 956-4312
ADDRESS
  ADDRESS LINE      Field Office
  ADDRESS LINE      Third State Bank Building
  ADDRESS LINE      Suite 4771
  CITY              New York
  STATE             New York
  ZIP               10019
  PHONE             (212) 922-9876
```

Components of structures may be either data elements or other structures. Thus, a rather sophisticated hierarchical organization is possible, as can be seen in Appendix A.

Although all this seems rather detailed, it is intended to simplify the user's task. For example, a complete address may be obtained by the single command TYPE ADDRESS, while searching may restrict a list of addresses to those organizations located in a particular city or state, or the user may order a listing by zip code.

3.4. GEOTHERMAL RESOURCE AREAS

The entire GRAD database is organized around the concept of a Geothermal Resource Area (or Area, for short). This is defined to be an expanse of land associated with a geothermal reservoir that is used, or might be used, for the industrial development of that reservoir.

An area is intended to reflect real developments, and thus will change as development progresses. At any particular time, it is reasonably well defined (albeit with some ambiguity at the edges), but may grow or shrink as knowledge of the reservoir improves, and development proceeds.

How, then, is an area delineated? It's a matter of judgment, based on the available evidence concerning both geology and human activities. We take the following items into account, whenever they apply:

- The extent of the reservoir.
- KGRA boundary lines.
- Current and past leasing activity.
- Well drilling activity.
- Plant construction activity.
- Usage and designation by federal or state agencies.

In some areas (such as The Geysers in California) most of the items in the list apply, and reasonably clear area boundaries can be drawn. In other areas, only vague knowledge of the reservoir exists, and no development has taken place, so the boundaries are known only imprecisely. As development of such a reservoir proceeds, the boundary will become better known.

4. SOFTWARE FOR THE GRAD SYSTEM

Development of the data system includes the adoption and creation of software on a suitable computer. The objectives of the software development are: (1) to provide facilities for storage, indexing, and retrieval of the data, (2) to provide flexible facilities for manipulation and presentation of the data, (3) to provide user interaction that makes it easy to perform the first two tasks, and (4) to provide a system environment that makes it easy to accomplish the initial development and to modify it subsequently as the need arises. The tasks are ideally suited to the use of a database management system (DBMS), which meets the objectives in two ways: it provides many of the basic capabilities - storage, indexing, and retrieval; provision for concurrent access by multiple users; and protection against loss or unintended alteration of the data - and it provides a programming facility (specialized, high-level languages) that minimizes the effort required to create additional software particularized to GRAD.

The success or failure of a system such as GRAD is greatly affected by the computer system chosen. A list of desirable properties was developed and a system that satisfied most of the properties was selected. Based on technical characteristics, accessibility, cost, and performance, we selected the SPIRES data management system [2-5] operating at Stanford University. This system can be accessed by anyone with an account on the Stanford computer, either directly over the telephone or via Telenet (a public network for data communications).

Some of the technical characteristics we considered important are listed here, in no particular order.

On-line interactive retrieval capability.

Rapid response time.

Sophisticated query capability.

Large variety of output formats, including short answers, predefined reports, tables, lists, narratives, bibliographic references, addresses, and graphs.

Variety of data element formats.

Ability to write tailored dialogue systems.

Ability to automatically perform physical units conversion.

Allowance for concurrent users.

Protection of data, and recovery from errors.

Ability to expand and change the application system as user requirements change.

Specialized software for GRAD is required mainly in three areas: file definition, formats, and protocols. File Definition specifies the data elements, records, and associated structures, and provides the system with additional, detailed information about each element (such as how it is to be interpreted and indexed, and whether it can occur multiply or only once per instance of the record). Formats define the content and structure of reports (tables, listings, graphs) to be produced by the system. Protocols define most of the user interaction with the system.

5. DATA COLLECTION

Like all data systems, the usefulness of GRAD is limited by the accuracy and thoroughness of the data collection efforts. Consequently, this activity is an important aspect of the GRAD effort; it is a responsibility of our professional staff to verify each entry based on available information sources.

The collection effort involves two on-going activities: examination of relevant literature and direct contact with individuals in organizations active in geothermal development. Selected periodical literature is scanned on a regular basis for facts on geothermal development; additional documents (such as technical reports and progress reports) are examined as we become aware of them. The following publications are examined regularly:

Bulletin Geothermal Resources Council
California Division of Oil and Gas Weekly Map Revision Bulletin
California Energy Commission's Announcement on Geothermal Energy
Energy User News
Federal Register
Geothermal Development Updates
Geothermal Energy Magazine
Geothermal Hot Line
Geothermal Progress Monitor Progress Report
Geothermal Report
Munger Oilogram
Newspapers (from San Francisco, Los Angeles and other cities)
OIT Geo-Heat Utilization Center Bulletin
Petroleum Information's National Geothermal Service
The Geysers
USGS Monthly Geothermal Report
Technical reports from: Brookhaven National Laboratory (BNL), the Department of Energy (DOE), the Electric Power Research Institute (EPRI), EG&G Idaho, Gruy Federal, Los Alamos Scientific Laboratory (LASL), Lawrence Berkeley Laboratory (LBL), Lawrence Livermore Laboratory (LLL), Oregon Institute of Technology (OIT), Oak Ridge National Laboratory (ORNL), Sandia Corporation, U. S. Geological Sur-

vey (USGS), University of Utah Research Institute (UURI), state energy offices, and others.

As gaps and inconsistencies are discovered in the database, the organizations involved in the field are contacted by the GRID staff. Data that appears improbable also results in direct contact of the original source for verification. Such organizations include government agencies (BLM, USGS, USFS, California Energy Commission, etc.) as well as private companies.

Some geothermal information is considered proprietary by the company that developed it. As GRAD is intended to be a publically available database, data is not included without permission, even though gaps in coverage result.

As information about a particular aspect of geothermal development (a well, for example) is compiled, it is entered on a form created for the purpose. Data from a number of sources may contribute to a form; space is available on the form for giving the various references.

The forms are then given to a data entry clerk, who enters the data into the database. The results are printed out, and returned to the professional staff for verification against the original sources, to minimize transcription errors.

As new data is discovered about an existing entity (such as a well) the record in the database is brought up to date by a similar process.

By these procedures, the database accurately reflects the current and retrospective status of geothermal energy utilization.

6. SUMMARY

The National Geothermal Information Resource program at the Lawrence Berkeley Laboratory is in the process of designing and implementing a computer system (GRAD) to aid in the understanding of geothermal energy development in the United States. This report has described the design of GRAD, and our plans for implementation. The project consists of three phases: system design, software implementation, and data collection. The design phase has been completed. Software implementation and data collection are well underway, and are proceeding satisfactorily.

A portion of the database system is publically available now [6]. Additional portions will become available as implementation proceeds.

Acknowledgements: We gratefully acknowledge the assistance of Jack Howard, Michael Lederer, Huseyin Ozbek, Mehdi Tavana, and Winifred Yen of LBL; of Dan Entingh of the MITRE Corp.; and of Fred Abel and Robert Oliver of DOE/DGE for helpful discussions during the formulation and design of the database.

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2. SPIRES/270 File Definition. Forsythe Computing Center, Stanford University, Stanford, CA (October 1979).

3. SPIRES Formats Language. Forsythe Computing Center, Stanford University, Stanford, CA (October 1979).

4. SPIRES Protocols. Forsythe Computing Center, Stanford University, Stanford, CA (October 1979).

5. SPIRES Searching and Updating. Forsythe Computing Center, Stanford University, Stanford, CA (October 1979).

6. J. D. Lawrence, K. Leung, and W. Yen. A User's Guide to the Geothermal Resource Areas Database. LBL-11492, Lawrence Berkeley Laboratory, University of California, Berkeley, CA (in prep.).

APPENDIX A. OUTLINE OF RECORDS AND DATA ELEMENTS

Here, we give, in outline form, the data elements that we have defined in each of the records.

A.1. NAME AND ADDRESS RECORD

The Name and Address File contains information about organizations involved in the development of geothermal resources. An "organization" may be a person, company, government agency, etc. Every organization listed anywhere in the Geothermal Resource Areas database will have a descriptive record here; other organizations that are involved in geothermal development may also be listed.

1. Name - name of organization.
2. Address - repeat for each address associated with the organization.
    - 2.1. Address line - repeat for each line of the address.
    - 2.2. City.
    - 2.3. State.
    - 2.4. Zip code.
    - 2.5. Country - defaults to U. S.
    - 2.6. Phone - repeat for each phone number associated with this address.
3. Type of organization - such as: federal, state, county, local, Indian, private.
4. Organization size - such as: 1-9 people, 10-99, 100-999, >=1000.
5. Principal role - such as: drilling company, regulatory agency, power purchaser, lease holder, manufacturer, contractor, land owner, operator, financier.

6. Reference - repeat for each reference.

6.1. Short code - give short code of the reference (key to the bibliographic file).

6.2. Comment - describe how the reference was used to provide information for this address record.

7. Remarks - repeat for each remark.

A.2. AREA DESCRIPTION RECORD

This record gives a general description of a geothermal area. The area is identified and described. Legal aspects are recorded.

1. Area identification.

1.1. Name of area - repeat for each name.

1.2. Location of area.

1.2.1. State.

1.2.2. County - repeat for each county that overlaps the area.

1.2.3. Latitude - give to nearest degree and minute.

1.2.4. Longitude - give to nearest degree and minute.

1.2.5. Meridian.

1.2.6. Township - repeat for each township in the area.

1.2.6.1. Township line.

1.2.6.2. Range line.

1.2.6.3. Section numbers - include each section in this township.

1.3. Size of area.

1.3.1. Amount of land owned by federal government.

1.3.2. Amount of land owned by the state government.

1.3.3. Amount of land owned by county governments.

1.3.4. Amount of land owned by local governments.

1.3.5. Amount of land owned by Indian tribes.

1.3.6. Amount of land owned by private organizations.

1.3.7. Total amount of land in area - may exceed the sum of the preceding amounts, if ownership of some land has not yet been entered into the database.

1.4. Classification - repeat for each change in classification.

1.4.1. Class - such as: unclassified, APV, KGRA.

1.4.2. Date of classification.

1.4.3. Remarks - repeat for each remark.

2. Physical description.

2.1. Terrain - repeat for each type of terrain in the area, such as: desert, flat, forest, grassland, hilly, marshland, mountain, plains, scrubland, sloping, underwater, woodland.

2.2. Land use - repeat for each distinct land use, such as: agriculture, grazing, lumbering, military, mining, recreation, state or national forest, state of national park.

2.3. Recognized potential geological hazards - repeat for each hazard, such as: earthquake, landslide, subsidence.

2.4. Climate.

2.4.1. Storm hazards - repeat for each recognized hazard, such as: flood, hurricane, lightning, tornado, wind.

2.4.2. Temperature range.

2.4.2.1. Minimum temperature.

2.4.2.2. Maximum temperature.

2.4.3. Wet bulb temperature range.

2.4.3.1. Wet bulb minimum temperature.

2.4.3.2. Wet bulb maximum temperature.

2.4.4. Precipitation - repeat for each form.

2.4.4.1. Average annual precipitation amount.

2.4.4.2. Form of precipitation - such as: rain, snow.

2.4.4.3. Remarks - repeat for each remark.

2.4.5. Climate remarks.

2.5. Demographic information.

2.5.1. Nearby cities - repeat for each city.

2.5.1.1. City name.

2.5.1.2. Approximate population.

2.5.1.3. Distance of city from area.

2.5.1.4. Remarks - repeat for each remark.

2.5.2. Identified markets - repeat for each market.

2.5.2.1. Market type - such as: agriculture, desalination, electricity, plant drying, space heating, ore drying.

2.5.2.2. Remarks - repeat for each remark.

2.6. Access to area.

2.7. Water supply - repeat for each source of water.

2.7.1. Source.

2.7.2. Flow rate.

2.7.3. Salinity.

2.7.4. Distance between source and area.

2.7.5. Remarks - repeat for each remark.

2.8. Power lines - repeat for each set of lines.

2.8.1. Distance between power lines and area.

2.8.2. Power line capacity - repeat for each voltage in the set of power lines.

2.8.2.1. Number of lines at this voltage.

2.8.2.2. Voltage.

2.8.3. Power line remarks.

2.9. Improvements needed at area for exploitation - repeat for each improvement needed.

3. Legal aspects.

3.1. Ownership - repeat for each right owned.

3.1.1. Right owned - such as: land, geothermal, mineral, water supply, access, surface, power line.

3.1.2. Name of owner - repeat for each owner.

3.2. Control authority - repeat for each jurisdiction.

3.2.1. Jurisdiction - such as: air quality, water quality, noise, solid waste management, liquid waste management, and fish and wildlife management.

3.2.2. Name of authority - repeat for each authority.

4. Reference - repeat for each reference.

4.1. Short code.

4.2. Comment.

5. General remarks - repeat for each remark.

A.3. PERMIT RECORD

Every permit issued for geothermal exploration and development at the areas covered by the Geothermal Resource Areas database will have a descriptive record in the Permit File. This includes permits at all levels of government.

1. Permit number.
2. Permit type - repeat for each type, such as: NOI, APD, POO (various kinds), drilling, siting license, plant construction.
3. Area name.
4. Applicant name - repeat for each applicant.
5. Approving agency - repeat for each agency that must approve the permit.
6. Lease number - repeat for each lease associated with the permit.
7. Associated Environmental Analysis (EA) document - repeat for each EA.
    - 7.1. EA number.
    - 7.2. Date prepared.
8. Associated Environmental Analysis Record (EAR) - repeat for each EAR.
    - 8.1. EAR number.
    - 8.2. Date prepared.
9. Date permit filed.
10. Date permit approved.
11. Date permit expanded - repeat for each expansion.
12. Date activities associated with the permit were started.
13. Date activities were finished.

14. Date records about the activities were filed with the approving agencies.

15. Activity description.

16. Reference - repeat for each reference.

    16.1. Short code.

    16.2. Comment.

17. Remarks - repeat for each remark.

A.4. LEASE RECORD

Every lease issued for geothermal exploration and development at the areas covered by the Resource Areas Database will have a descriptive record in the Lease File. This covers all types of land and leases, private or government.

1. Lease number.

2. Area name.

3. Lease holder - repeat for each organization sharing the lease.

4. Lease type - such as: competitive, noncompetitive, Indian.

5. Land owner - repeat for each owner.

6. Land owner type - such as: federal, state, county, local, Indian, private.

7. Location of land being leased.

    7.1. State.

    7.2. County - repeat for each county that overlaps the lease.

    7.3. Meridian - baseline used to calculate township and range lines.

    7.4. Township - repeat for each township.

7.4.1. Township line.

7.4.2. Range line.

7.4.3. Section numbers - include each section in this township.

8. Size of land leased.

9. Date lease issued.

10. Date lease terminates.

11. Date lease turned back.

12. Bonus.

13. Rent.

14. Royalty.

15. Reference - repeat for each reference.

15.1. Short code.

15.2. Comment.

16. Remarks - repeat for each remark.

A.5. WELL (DEEP DRILLING) RECORD

Every well drilled on areas included in the Resource Areas Database will have a descriptive record in the Wells File.

1. Well name.

2. Area name.

3. API number.

4. APD number.

5. Well owner - repeat for each owner.

6. Drilling company - repeat for each company.

7. Lease number of lease associated with well.

8. Well location.

    8.1. State - computer system will maintain this element.

    8.2. County well is located in.

    8.3. Meridian.

    8.4. Township line.

    8.5. Range line.

    8.6. Section number.

    8.7. Corner from which exact location is measured - such as: NW, NE, SE, SW, N 1/4, E 1/4, S 1/4, W 1/4, Center.

    8.8. Distance from corner in a north or south direction.

    8.9. Direction (north or south).

    8.10. Distance from corner in an east or west direction.

    8.11. Direction (east or west).

9. Date well spudded.

10. Date well location filed.

11. Date well completed.

12. Well type - such as: abandoned, injection, observation, idle, producible, potential producer, suspended.

13. Well cost data - repeat for each cost estimate.

    13.1. Date of cost report.

    13.2. Cost reported.

    13.3. Reference for this cost estimate.

        13.3.1. Short code.

        13.3.2. Comment.

13.4. Remarks - repeat for each remark.

14. Well depth.

15. Down hole pressure data - repeat for each test.

15.1. Date of test.

15.2. Pressure data - repeat for each measurement.

15.2.1. Depth of measurement.

15.2.2. Pressure measured.

15.3. Reference - repeat for each reference.

15.3.1. Short code.

15.3.2. Comment.

15.4. Remarks - repeat for each remark.

16. Wellhead data - repeat for each test.

16.1. Date of test.

16.2. Flow data - repeat for each measurement.

16.2.1. Pressure measured.

16.2.2. Temperature measured.

16.2.3. Mass flow rate measured.

16.2.4. Volume flow measured.

16.3. Reference - repeat for each reference.

16.3.1. Short code.

16.3.2. Comment

16.4. Remarks - repeat for each remark.

17. Temperature data - repeat for each test.

17.1. Date of test.

17.2. Temperature data - repeat for each measurement.

17.2.1. Depth of measurement.

17.2.2. Temperature measured.

17.3. Reference - repeat for each reference.

17.3.1. Short code.

17.3.2. Comment.

17.4. Remarks - repeat for each remark.

18. Well logging - repeat for each log type.

18.1. Logging company.

18.2. Log type - such as: acoustic, cement bond, caliper, dipmeter, electric resistivity, gamma ray, temperature, self-potential.

18.3. Remarks - repeat for each remark.

19. Drilling information.

19.1. Mud type - repeat for each type used.

19.2. Drilling difficulties - repeat for each difficulty.

19.3. Well casing - repeat for each casing.

19.3.1. Casing diameter.

19.3.2. Casing depth.

19.3.3. Type of casing.

19.4. Slant well - indicate 'yes' or 'no'.

19.5. Stimulation depth - repeat for each stimulation.

19.6. Reference - repeat for each reference.

19.6.1. Short code.

19.6.2. Comment.

19.7. Remarks - repeat for each remark.

20. Well chemistry.

20.1. Noncondensible gas content - repeat for each test.

20.1.1. Date of test.

20.1.2. NCG by volume.

20.1.3. NCG by weight.

20.2. Gas data - repeat for each test.

20.2.1. Date of test.

20.2.2. Test results - repeat for each component of gas.

20.2.2.1. Name of chemical.

20.2.2.2. Amount of chemical, as a percent of NCG.

20.2.3. Reference - repeat for each reference.

20.2.3.1. Short code.

20.2.3.2. Comment.

20.2.4. Remarks - repeat for each remark.

20.3. Fluid data - repeat for each test.

20.3.1. Date of test.

20.3.2. Sample depth.

20.3.3. Instrumentation.

20.3.4. pH.

20.3.5. Total dissolved solids.

20.3.6. Test results - repeat for each component of fluid.

20.3.6.1. Name of chemical.

20.3.6.2. Amount (in ppm).

20.3.6.3. Remarks - repeat for each remark.

20.3.7. Reference - repeat for each reference.

20.3.7.1. Short code.

20.3.7.2. Comment.

20.3.8. Remarks - repeat for each remark.

21. General reference - repeat for each reference.

21.1. Short code.

21.2. Comment.

22. General remarks - repeat for each remark.

A.6. EXPLORATORY SURVEY RECORD

Every exploratory survey performed on areas included in the Resource Areas Database will have a descriptive record in this file.

1. Name of survey.
2. Area name.
3. Type of survey - repeat for each type included in the survey, such as: airborne, active seismic, electromagnetic, geochemical, geophysical, gravity, heat flow, hydrologic, satellite, seismic noise.
4. Operator - repeat for each operator for whom the survey was performed.
5. Subcontractor - repeat for each subcontractor who actually performed the survey.
6. Date survey results were announced.
7. Associated permit numbers - repeat for each permit.
8. Type of result - repeat for each type, such as: maps, cross sections, measurements.
9. Summary of survey results.
10. Reference - repeat for each reference.

10.1. Short code.

10.2. Comment.

11. Remarks - repeat for each remark.

A.7. SHALLOW TEMPERATURE GRADIENT HOLE RECORD

Every STGH drilled on a area included in the Resource Areas Database will have a descriptive record in this file.

1. Area name.
2. Operator - repeat for each operator for whom this set of holes was drilled.
3. Subcontractor - repeat for each subcontractor who actually drilled the holes.
4. Lease number - repeat for each lease associated with the set of holes.
5. Number of holes drilled.
6. Representative temperature gradient - repeat for each value.
7. Representative heat flow - repeat for each value.
8. Reference - repeat for each reference.
   - 8.1. Short code.
   - 8.2. Comment.
9. Remarks - repeat for each remark.

A.8. AREA RESOURCE EVALUATION RECORD

Each formal evaluation of a area included in the Resource Areas Database will have a descriptive record in this file.

1. Area name.
2. Evaluator.

3. Date evaluation was reported.

4. Typical parameter value - repeat for each parameter.

   4.1. Name of parameter - such as: depth to production, subsurface area, temperature, porosity, permeability, fluid chemistry, pressure, resource type, anticipated use, rock types, exploitable energy, reservoir thickness, reservoir volume, thermal conductivity.

   4.2. Value of parameter.

   4.3. Reference (if different from general reference).

      4.3.1. Short code.

      4.3.2. Comment.

   4.4. Remarks - repeat for each remark.

5. General reference - repeat for each reference.

   5.1. Short code.

   5.2. Comment.

6. Remarks - repeat for each remark.

A.9. LAND ACQUISITION (LEASING) RECORD

Every land acquisition event that occurs for a area included in the Resource Areas Database will have a descriptive record in this file.

1. Area name.

2. Noncompetitive lease application - repeat for each application.

   2.1. Application number.

   2.2. Applicant - repeat for each applicant.

   2.3. Agency applied to.

   2.4. Location.

2.4.1. Meridian.

2.4.2. Township - repeat for each township.

2.4.2.1. Township line.

2.4.2.2. Range line.

2.4.2.3. Section numbers - include all sections.

2.5. Owner type - such as: federal, state, county, local, Indian, private.

2.6. Owner name - repeat for each joint owner.

2.7. Size of parcel.

2.8. Date application filed.

2.9. KGRA clear date.

2.10. Reference - repeat for each reference.

2.10.1. Short code.

2.10.2. Comment.

2.11. Remarks - repeat for each remark.

3. Competitive lease process.

3.1. Number of parcels.

3.2. Parcel details - repeat for each parcel.

3.2.1. Parcel number.

3.2.2. Location of parcel - repeat for each township.

3.2.2.1. Township line.

3.2.2.2. Range line.

3.2.2.3. Section numbers - include all sections.

3.2.3. Owner type - such as: federal, state, county, local, Indian, private.

3.2.4. Land owner - repeat for each joint owner.

3.2.5. Parcel size.

3.2.6. Reference - repeat for each reference.

3.2.6.1. Short code.

3.2.6.2. Comment.

3.2.7. Remarks - repeat for each remark.

3.3. Date establishment of parcels started.

3.4. Date establishment finished.

3.5. Parcelling remarks - repeat for each remark.

3.6. Tentative lease sale date - repeat for each date.

3.7. Date lease sale notice published.

3.8. Pre-sale economic/resource evaluation.

3.8.1. Date started.

3.8.2. Date finished.

3.8.3. Remarks - repeat for each remark.

3.9. Date of lease sale.

3.10. Post sale review of bids.

3.10.1. Date started.

3.10.2. Date finished.

3.10.3. Number of parcels offered, no bids.

3.10.4. Number of bids rejected.

3.10.5. Remarks - repeat for each remark.

3.11. Lease data - repeat for each parcel leased.

3.11.1. Parcel number.

3.11.2. Lease number.

3.11.3. Bidding data - repeat for each bid.

3.11.3.1. Bidder.

3.11.3.2. Amount of bid.

3.11.3.3. Remarks - repeat for each remark.

3.11.4. Remarks - repeat for each remark.

4. Reference - repeat for each reference.

4.1. Short code.

4.2. Comment.

5. General remarks - repeat for each remark.

A.10. UNITIZATION RECORD

Each unitization event that occurs for a area included in the Resource Areas Database will have a record in this file.

1. Area name.
2. Date started.
3. Date finished.
4. Lease number - repeat for each lease included.
5. Operator - repeat for each operator involved.
6. Status of negotiations - such as: preliminary conference held, application filed, geologic report filed, application approved, agreement ratified, agreement filed, agreement approved, unitization completed.
7. Status date.
8. Reference - repeat for each reference.

8.1. Short code.

8.2. Comment.

9. Remarks - repeat for each remark.

A.11. FEASIBILITY STUDY RECORD

Every published feasibility study performed on an area included in the Resource Areas Database will have a descriptive record in this file.

1. Study name.
2. Area name.
3. Principal - repeat for each party involved in the study.
4. Date study started.
5. Date study finished.
6. Preliminary plant design.
    - 6.1. Application - such as: agriculture, desalination, electricity, ore drying, plant drying, space heating.
    - 6.2. Energy delivered to plant.
        - 6.2.1. Inlet temperature.
        - 6.2.2. Inlet pressure.
        - 6.2.3. Inlet power requirement.
        - 6.2.4. Inlet mass flow rate.
        - 6.2.5. Inlet volume flow rate.
    - 6.3. Plant output power.
    - 6.4. Design remarks - repeat for each remark.
7. Preliminary financial analysis.
    - 7.1. Estimated cost of facility - repeat for each estimate.
        - 7.1.1. Date of estimate.
        - 7.1.2. Estimated cost.
        - 7.1.3. Remarks.

7.2. Estimated fuel energy cost - repeat for each estimate.

7.2.1. Date of estimate.

7.2.2. Estimated cost.

7.2.3. Remarks.

7.3. Estimated product price - repeat for each estimate.

7.3.1. Date of estimate.

7.3.2. Estimated price.

7.3.3. Remarks.

8. Preliminary list of parties.

8.1. Fuel supplier - repeat for each supplier.

8.2. Utility - repeat for each utility.

9. General reference - repeat for each reference.

9.1. Short code.

9.2. Comment.

10. Remarks - repeat for each remark.

A.12. FINANCIAL NEGOTIATIONS RECORD

Every financial negotiation performed for a area included in the Resource Areas Database will have a descriptive record in this file.

1. Area name.

2. Operator name - repeat for each operator involved.

3. Date negotiations started.

4. Date negotiations finished.

5. Terms of financing.

5.1. Loan amount.

5.2. Interest rate.

5.3. Duration.

5.4. Lender.

5.5. Guarantor.

5.6. Insurer.

6. Reference - repeat for each reference.

6.1. Short code.

6.2. Comment.

7. Remarks - repeat for each remark.

A.13. PLANT CONSTRUCTION AND OPERATION RECORD

Every plant constructed or being constructed on a area included in the Resource Areas Database will have a descriptive record in the Plant File.

1. Plant name.

2. Area name.

3. Type of use - repeat for each expected use.

3.1. Application - such as: agriculture, desalination, ore drying, electricity, plant drying, space heating.

3.2. Plant type.

3.3. Rated power output.

3.4. Remarks - repeat for each remark.

4. Fluid supplier.

5. Utility.

6. Date design finished.

7. Date construction began.

8. Date construction finished.

9. Geothermal fluid characteristics.

    9.1. Inlet temperature.

    9.2. Inlet pressure.

    9.3. Total mass flow to plant.

    9.4. Total volume flow to plant.

    9.5. Outlet temperature.

    9.6. Outlet pressure.

    9.7. Number of wells feeding plant.

    9.8. Expected well life.

    9.9. Well replacement per year.

    9.10. Pumping power required.

10. Plant area selection.

    10.1. Date selection finished.

    10.2. Plant location.

        10.2.1. County.

        10.2.2. Meridian.

        10.2.3. Township line.

        10.2.4. Range line.

        10.2.5. Section.

        10.2.6. Size.

11. Economic concerns.

    11.1. Reported geothermal fuel cost per year.

        11.1.1. Date cost reported.

        11.1.2. Cost.

11.1.3. Remarks.

11.2. Total plant construction cost.

11.2.1. Date cost reported.

11.2.2. Cost.

11.2.3. Remarks.

11.3. Operating cost per year.

11.3.1. Date cost reported.

11.3.2. Cost.

11.3.3. Remarks.

11.4. Product price.

11.4.1. Date reported.

11.4.2. Price.

11.4.3. Remarks.

12. Startup.

12.1. Date started.

12.2. Date finished.

12.3. Problem encountered - repeat for each problem.

13. Commercial production.

13.1. Date commercial production started.

13.2. Remarks.

14. Reference - repeat for each reference.

14.1. Short code.

14.2. Comment.

15. General remarks - repeat for each remark.

A.14. REFERENCE RECORD

Every reference given anywhere in the Resource Areas Database will have a reference record in the Reference File.

1. Reference code - abbreviation (short code) for reference, consisting of author's last name, year of publication, and an optional sequence number.
2. Author - repeat for each author.
3. Title.
4. Source - complete source, in standard format.
5. Remarks.

APPENDIX B. GEOTHERMAL AREAS IN THE UNITED STATES

This tabulation is intended to include all proven, potential, and inferred geothermal areas in the United States that are economically important. The current list is only an approximation to this goal. We have undoubtedly omitted some areas, and included areas with no credible geothermal possibilities. Areas frequently have several names -- it is possible that in some cases, we have included a area several times, under such different names. It will be greatly appreciated if readers who find errors or omissions let us know of them.

Sources frequently disagree about reservoir temperatures. We have used GEOTHERM [1] if possible. Otherwise, we give a value estimated from one or more of the cited references. As these tend to vary among themselves, the temperature values should be used with caution.

The current list includes over 800 areas in 31 states.

The references given in this appendix will be found at the end of the appendix.

Alaska - 115 areas

Area Name	Reservoir Temp. (C)	References
Adak Island HS [Adak Island PGRA]	187	5
Akun HS [Akun Island PGRA]		5
Akutan HS [Akutan Island PGRA]		5
Alatna HS [Alatna River PGRA]		5
Amagat HS		5
Attu HS [Attu Island PGRA]		5
Arctic Springs - see Serpentine Springs		
Bailey Bay HS [Bell Island-Unuk PGRA]	165	1,2,4,5
Baker HS - see Manley HS		
Balboa HS [Balboa PGRA]		5
Baranof HS [Baranof PGRA]	125	2,5
Barton-Saks HS [Bell Island-Unuk PGRA]		5
Battleship HS - see Kwiniuk HS		
Bell Island HS [Bell Island-Unuk PGRA]	135	1,2,4,5
Bogoslof HS [Bogoslof PGRA]		5
Capital Site	76	5
Chena HS [Chena PGRA]	97	1,2,4,5
Chief Shakes Springs - see Shakes Springs		

Chuginadak HS [Chuginadak Island PGRA]		5
Circle HS [Circle PGRA]	134	1,2,4,5
Clear Creek [Darby Mountain PGRA]	99	1,2,4,5
Cold Bay HS [Cold Bay PGRA]	145	5
Conway HS - see Minook HS		
Courtney HS [Mt. McKinley NP]		5
Craig HS		5
Dall HS		5
Dulbi	126	1,4,5
East of Cold Bay	117	1,2,4
El Capitan Spring [El Capitan PGRA]		5
Emmons HS [Pavlof Volcano PGRA]		5
False Pass HS [Bechevin Bay PGRA]		5
Fish Bay HS [Fish Bay PGRA]		5
Flat HS [Flat PGRA]		5
George Inlet Spring [George Inlet PGRA]		5
Geyser Bight [Geyser Spring Basin KGRA]	182	1,2,4,5
Glacier HS [Mt. McKinley NP]		5
Goddard HS	148	1,2,4,5
Granite Mountain [Granite Mountain PGRA]	130	5
Great Sitkin Island [Great Sitkin PGRA]	125	1,2,4,5
Gut Bay HS [Gut Bay PGRA]		5
Hale HS		5
Hawk HS [Selawik River PGRA]		5
Hooniah HS [Chichagof Yakobi Island PGRA]	136	1,2,4,5
Horner HS [Melozi-Horner PGRA]		5
Hot Springs Bay [Akutan Island PGRA]	136	1,2,4,5
Hot Springs Cove [Geyser Springs Basin KGRA]	148	1,2,4,5
Hutlinana Creek HS [Hutlinana PGRA]		5
Immachuk HS [Imuruk Lake PGRA]		5
Imuruk Lake [Imuruk Lake PGRA]		5
Kachauik HS [Darby Mountain PGRA]		5
Kagamil HS [Kagamil PGRA]		5
Kanaga Island [Kanaga Island PGRA]		5
Kanuti	120	1,2,4,5
Katni HS [Mt. Katmi PGRA]		5
Kiana HS		5
Kilo HS [Ray River PGRA]		5
Klawasi [Wrangell Mountains PGRA]	650	5
Kliuchef HS [Atka Island PGRA]		5
Korovin HS [Atka Island PGRA]		5
Kotzebue	72	5
Kruzgamepa HS - see Pilgrim HS		
Kwiniuk HS [Darby Mountain PGRA]		5
Lava Creek	90	1,2,4,5
Le Donne - see Dulbi		
Lisianski HS [Chichagof Yakobi Is. PGRA]		5
Little Melozitna HS [Little Melozitna PGRA]	125	1,2,4,5
Little Sitkin Island HS [Little Sitkin PGRA]		5
Lituya Bay [Lituya Bay PGRA]		5
McCartney HS [Flat Creek PGRA]		5

Vank HS [Vank Island PGRA]	5
West Shakes HS [Stikine River PGRA]	5
White Suplhur Springs - see Hooniah HS	
Wolfe HS [Big Windy Creek PGRA]	5
Woodchopper Spring [Woodchopper PGRA]	5
Zarembo Springs [Zarembo PGRA]	5

Arizona - 40 areas

Area Name	Reservoir Temp. (C)	References
Avra Valley	100	10
Buckhorn Mineral Bath	89	10
Casa Grande - see Coolidge Dam HS		
Castle HS	110	2,10
Chandler	178	3,4
Clifton HS [Clifton KGRA]	110	2,3,5,10
Coffers HS	130	10
Coolidge	53	10
Coolidge Dam HS	125	3,10
Eagle Creek	85	1,2,4
Friendly Corners	37	10
Gila Bend	48	10
Gillard HS [Gillard KGRA]	134	1-5,10
Glenbar - Ashurst	55	10
Goodyear - Phoenix West	52	10
Harquahala Plains	77	10
Hookers		3,10
Hoover Dam		10
Hualapai Valley	50	10
Hyder Valley	150	10
Kingman-Aquarius Region	90	10
McMullen Valley	37	10
Mammoth - San Manuel	35	10
Mesa - Buckhorn Area	45	10
Mt. Graham	110	2
Papago Farms	107	10
Picacho Reservoir	113	10
Power Ranches Inc. Wells	165	1,10
Rainbow Valley	120	10
Safford Area		10
Safford East	110	10
San Bernardino Ranch	94	10
San Bernardino Valley	90	10
San Simon Valley	57	10
San Simon Well	134	1,4,10
Sells	80	10

Area Name	Reservoir Temp. (C)	References
Springerville South	85	10
Tucson South	79	10
Verde HS	150	2,10
Whitewing Ranch - see Hyder Valley		
Willcox	87	10
Yuma	138	10

Arkansas - 2 areas

Area Name	Reservoir Temp. (C)	References
Caddo Gap Springs	35	4
Hot Springs	64	4

California - 94 areas

Area Name	Reservoir Temp. (C)	References
Aetna Springs	135	2
Arrowhead HS	137	1-4
Baker Soda Spring	130	2
Bartlett		3
Basset HS	88	1,4
Beckworth Peak [Beckworth Peak KGRA]		3
Benton HS	115	2
Bieber		3
Big Bend HS	120	1,2,4
Black Rock Point HS - see North Shore Mono Lake		
Blayney Meadows HS	105	2
Bodie [Bodie KGRA]		3
Borax Lake		3
Border [East Mesa KGRA]	160	1,2,4
Brawley [Brawley KGRA]	250	1-4
Bridge-Port	108	3
Brockway HS	120	2
Buckeye HS	93	1,2,4
Calistoga HS [Geysers-Calistoga KGRA]	141	1-4
Casa Diablo HS [Mono-Long Valley KGRA]		
Chalk Mtn. Area [Geysers-Calistoga KGRA]	105	1,4
Champagne Springs - see Fouts Springs		
Clear Lake Volcanic Field Area [Geysers KGRA]	195	1,4
Cooks Spring - see Love Lady Ridge		
Cornelian HS - see Brockway HS		

Coso HS [Coso HS KGRA]	230	1-4
Crabtree HS - see Little Horse Mountain		
Deadshot Springs	135	2
Dunes [Dunes KGRA]	120	1-4
East Brawley - see Glamis		
East Mesa [East Mesa KGRA]	180	1-4
Fales HS	119	1-4
Ford Dry Lake [Ford Dry Lake KGRA]		3
Fort Bidwell Area	126	1,4
Fouts (Champagne) Springs	130	2
Fouts (Redeye) Springs	150	2
Glamis [Glamis KGRA]	120	1-4
Glamis East [Glamis KGRA]	120	1,2,4
Glass Mountain [Glass Mountain KGRA]		3
Grovers HS	130	1,2,4
Heber [Heber KGRA]	180	1-4
Honey Lake		3
Hopland		3
Hot Bolata - see Sulphur Bank Mine		
Hot Mineral Well		3
Hunt HS	105	2
Jackson's Spring - see Napa Soda Spring		
Kelley HS	116	1-4
Knoxville [Knoxville KGRA]	150	2,3
Lake Crowley		3
Lassen [Lassen KGRA]	240	1-4
Lava Mountain		3
Lick Spring - see Tuscan Spring		
Little Horse Mtn. [Little Horse Mtn. KGRA]	150	2,3
Long Valley Caldera [Mono-Long Valley KGRA]	230	1-4
Los Guilicos Warm Springs	135	2
Love Lady Ridge [Love Lady Ridge KGRA]	141	2,3
Mammoth Lakes [Mono-Long Valley KGRA]		3
Mark West Springs	140	2
Mayacamas Mountains		3
Menlo		3
Mercey HS	125	2
Morgan Springs-Growler Sp. Area [Lassen KGRA]	230	1,2,4
Mt. Konocti		3
Napa Soda Springs	150	2
Napa Soda Springs Rock	145	2
Near Black Point	125	2
Near Glenbrook		3
Neill's HS - see Scovern HS		
Newberry		3
Niland		3
North Shore Mono Lake [Mono-Long Valley KGRA]	94	1,4
One-Shot Mining Co - see Knoxville		
Ornbaun Springs	125	2
Orr's HS	115	2
Paoha Island	125	2

Pilgér Estates HS	96	1,2,4
Point Area HS	105	2
Priest Spring - see Napa Soda Springs Rock		
Randsburg Area [Randsburg KGRA]	150	1-4
Red's Meadow	165	2
Redeye Springs - see Fouts Springs		
Saline Valley [Saline Valley KGRA]		3
Salt Springs (1)	110	2
Salt Springs (2)	150	2
Salton Sea Area [Salton Sea KGRA]	330	1-4
Saratoga Springs	140	2
Scovern HS	114	1,4
Seigler Springs	150	2
Sespe HS [Sespe HS KGRA]	136	1-4
Sierra Valley Area	131	1,3,4
Skaggs HS	95	1-4
Soda Springs	150	2
Sulphur Bank Mine [Geysers-Calistoga KGRA]	186	1,2,4
Surprise Valley Area [Surprise Valley KGRA]	143	1-4
Susanville	105	3
Tecopa HS	137	1,3,4
The Geysers [Geysers-Calistoga KGRA]	240	1-4
Travertine HS Area	110	1,2,4
Tuscan Springs	140	2
Vichy Springs	135	2
Walter Springs	135	2
Warner HS	145	2
Wendel-Amadee Area [Wendel-Amadee KGRA]	128	1-4
West Valley Reservoir HS	138	1,4
Westmorland	215	1,4
Wilbur Springs Area	141	1-4

Colorado - 62 areas

Area Name	Reservoir Temp. (C)	References
Antelope Warm Springs	45	11
Avalanche Springs - see Penny HS		
Birdsie Warm Springs	45	11
Brands Ranch	48	11
Brown's Grotto Warm Springs	75	11
Canon City HS		11
Cebolla HS	105	1,2,4,11
Cement Creek Warm Spring	45	11
Chalk Creek HS Area	175	1,11
Clark Artesian Well	35	11
Colonel Chinn Hot Water Well		11

Wagon Wheel Gap HS	100	1,2,4,11
Waunita HS	143	1,2,4,11
Wellsville Warm Spring	45	11

Delaware - 5 areas

Area Name	Reservoir Temp. (C)	References
Bridgeville		
Camp Barnes		
Dover Air Force Base		
Lewes		
State Tree Nursery		

Florida - 2 areas

Area Name	Reservoir Temp. (C)	References
Big Salt Spring	30	4
Little Salt Spring		4

Georgia - 7 areas

Area Name	Reservoir Temp. (C)	References
Barker Spring		4
Brown's Spring		4
Lifsey Spring		4
Parkman Spring		4
Taylor Spring		4
Thundering Spring		4
Warm Springs	34	4

Hawaii - 4 areas

Area Name	Reservoir Temp. (C)	References
Kamaili Homesteads Area, East Rift	290	
Kapoho Reservoir (Puulena Area, Puna)	290	
Steaming Flats (Sulphur Bank) Area	150	
Upper Kau Area	100	

Idaho - 105 areas

Area Name	Reservoir Temp. (C)	References
Arling HS	179	6
Ashton Warm Springs	91	1,2,4
Banbury Area	108	1,4
Barron's HS	95	1,2,4
Barth HS		12
Battle Creek HS - see Wayland HS		
Belvidere HS	163	6
Ben Meek Well - see Riverdale Area		
Bergdorf HS		6
Big Creek HS	157	1,2,4,6,12
Blackfoot Reservoir	240	12
Boiling Springs	100	1,2,4
Boise Urban Area	77	3,6
Bonneville HS	91	1,2,4,12
Bruneau-Grand View Area [Bruneau KGRA]	110	1-4,6,12
Burgdorf HS	125	2,12
Cabarton HS	99	1,2,4,6
Cache Valley		6
Camas Prairie		6
Cascade HS	140	6
Castle Creek - see Bruneau-Grand View Area		
Clarendon HS	130	2,6
Conda [Conda KGRA]		6,12
Cow Flats HS	59	12
Crane Creek-Cove Creek Area [Crane Creek KGRA]	163	1-4,6,12
Dry Creek Area [Boise]	76	6
Dutch Frank Springs	125	2
Elk Creek HS	120	2
Flat Creek HS	158	6
Givens HS		6
Gold Fork HS	165	6
Grandview-Oreana		3
Gravel Pits Area	109	1,2,4

Gray's Lake		3
Guyer HS	135	2,6
Hailey HS	135	2,6,12
Heise		3
Hot Creek Springs	115	2
Hot Springs Ranch - see Wardrop HS		
Indian Creek HS	142	12
Island Park [Island Park KGRA]	120	3,6,12
Jerry Johnson HS	100	6,12
Kelley Hot Springs-Barber Area [Boise]		6
Kirkham HS	120	2,4
Kitty's Hot Hole - see Murphy HS		
Krigbaum HS	96	1,2
Latty HS	125	1,2,4
Lava Creek HS - see Magic Reservoir Area		
Lava Hot Springs		6
Little Creek HS	168	6
Madison County	125	6
Magic Reservoir Area	140	1,2,4,12
Malad	133	12
Maple Grove HS	95	1,2,4
Molly's HS	135	2
Mountain Home [Mountain Home KGRA]	188	3,6,12
Murphy HS	99	1,2,4
Near Banbury	140	2
Near Bennett Creek	135	2
Near Bridger Springs	115	2
Near Brockie Airport	110	2
Near Cambridge	180	2
Near Cedar Hill	120	2
Near Chalk Mine	140	2
Near Clover Creek	120	2
Near Cove School	125	2
Near Deer Creek	110	2
Near Grimes Pass	115	2
Near Midvale	135	2
Near Midvale Airport	125	2
Near Punkin Corner	125	2
Near Ryegrass Creek	135	2
Neinmeyer HS	93	1,2,4
Newdale Area	93	1,2,4
N. E. Boise Thermal Area	125	2
Oakley Warm Springs	120	2
Owl Creek HS	131	1,4
Palisades		3
Paradise HS	120	2
Parma		3
Payette River Area Near Banks	138	1,2,4
Pocatello-Chubbuck		6
Preston	250	3,12
Radio Towers Area	124	1,2,4

Raft River Area [Raft River KGRA]	147	1-4,6,12
Red River HS	83	1,2,4,6,12
Riggins HS	95	1,2,4,6,12
Riverdale Area	97	1,2,4
Roystone HS	135	1,2,4,6,12
Salmon HS		6
Schultz' HS		6
Sharkey HS	107	1,2,4,6
Slate Creek HS	101	1,2,4,6
Squaw HS Area	124	1,4
Stanley HS	110	2
Starkey HS	115	2
Sun Valley Ketchum	80	12
Sunbeam HS	124	1,2,4,6
Twin Falls	130	6,12
Vulcan Hot Springs [Vulcan Hot Springs KGRA]	138	1-4,6,12
Wardrop HS	89	1,2,4
Warren HS		12
Wasewick HS - see Worswick HS		
Wayland HS	116	1,2,4
Weir Creek HS	100	6,12
Weiser Area	142	1-4,6,12
West Boise Area	76	6
White Arrow HS	100	1,2,4
White Licks HS	140	
Worswick HS	93	1,2,4
Yellowstone [Yellowstone KGRA]	145	3,6,12
Yoghann HS - see Zim's HS		
Zim's HS	120	2

Louisiana - 4 areas

Area Name	Reservoir Temp. (C)	References
Acadia Parish	164	18
Calcasieu Parish	141	18
Cameron Parish	140	18
Vermilion Parish	165	18

Maryland - 1 area

Area Name	Reservoir Temp. (C)	References
Crisfield Municipal Airport		

Massachusetts - 1 area

Area Name	Reservoir Temp. (C)	References
Sand Springs	24	4

Montana - 69 areas

Area Name	Reservoir Temp. (C)	References
Alhambra HS	86	1,2,4,13
Anaconda	75	13
Anderson's HS	30	13
Anderson's Pasture	45	13
Apex HS	76	13
Avon HS		13
Barkel's HS - see Silver Star HS		
Bear Creek HS		13
Bearmouth	35	13
Beartrap HS - see Norris HS		
Beaverhead Rock		13
Bedford HS	30	13
Big Hole HS - see Jackson HS		
Blue Joint	45	13
Boulder Hot Springs [Boulder Hot Springs KGRA]	136	1-4,13
Bozeman	80	13
Bridger Canyon	25	13
Broadwater HS	120	1,2,4,13
Brook's HS	25	13
Brown's HS	30	13
Camas	100	13
Camp Aqua	100	13
Carter Bridge	40	13
Chico	58	13
Corwin Springs		3
Deer Lodge	40	13
Durfee Creek	30	13
Elkhorn	65	13
Ennis HS	135	1,3,4,13
Fairmont HS - see Gregson HS		
Gallogly	56	13
Garrison	35	13
Granite	80	13
Green Springs		13

Gregson HS	124	1,2,4,13
Greyson	25	13
Hapgood HS - see Norris HS		
Helena HS - see Broadwater HS		
Hunter's	78	13
Jackson HS	125	2,13
Jardine HS - See Jackson HS		
La Duke	73	13
Landusky	35	13
Landusky Plunge	30	13
Little Warm Springs	35	13
Lodgepole	35	13
Lolo	83	13
Lowell's HS	30	13
Lukas' HS	60	13
McMenoney Ranch		13
Marysville Test Well [Marysville KGRA]	117	1,3,4,13
New Biltmore	71	13
Nimrod	30	13
Norris HS	103	1,2,4,13
Pipestone	88	2,13
Plunkett's HS	20	13
Potosi	60	13
Puller's HS	90	13
Quinn's HS	99	13
Renova		13
Ringling HS	60	13
Silver Star HS	135	1,2,4,13
Sleeping Child	125	13
Sloan Cow Camp	85	13
Staudermeyer Ranch	45	13
Sun River	35	13
Symes' HS	102	13
Thexton HS - see Ennis HS		
Toston	20	13
Trudeau	23	13
Vigilante	35	13
Warm Springs	79	3,13
Warner	23	13
West Fork Swimming Hole	30	13
White Sulphur Springs	125	2,13
Wolf Creek	77	13
Yellowstone		3

Nevada - 67 areas

Area Name	Reservoir Temp. (C)	References
Alkali Flats		3,14
Allen's HS		3,14
Baltazor HS [Baltazor HS KGRA]	158	1-4,14
Bartholomae HS	130	2,14
Beowawe HS [Beowawe KGRA]	226	1-4,14
Black Rock Point Area [Double HS KGRA]	122	1,3,4,14
Blossom HS - see Hot Pot		
Bog HS	115	2,14
Brady HS [Brady-Hazen KGRA]	155	1-4,14
Buffalo Valley HS	135	1-4,14
Butte Springs [Trego KGRA]	124	1,2,4,14
Carlin Area	90	1,2,4,14
Cherry Creek Area	114	1,4,14
Clayton Valley		3
Colado Area	101	1,3,4
Crescent Valley HS		3,14
Darrough HS [Darrough HS KGRA]	132	1-4,14
Desert Peak Area [Brady-Hazen KGRA]	225	1,4
Dixie HS [Dixie Valley KGRA]	145	1-4,14
Double HS Area [Double HS KGRA]	127	1-4,14
Dyke HS	106	1,2,4,14
Elko HS - see Hot Hole		
Fernley Area [Brady-Hazen KGRA]	166	1,4,14
Fish Lake Valley		3
Fly Ranch HS [Fly Ranch KGRA]	100	1-4,14
Fly Ranch NE [Fly Ranch Northeast KGRA]		3
Gabbs		3
Gerlach HS - see Great Boiling Spring		
Gerlach Northeast [Gerlach Northeast KGRA]		3
Gilbert's HS - see Sou HS		
Golconda HS	86	1-4,14
Great Boiling Spring [Gerlach KGRA]	170	1-4,14
Hot Hole [Elko HS KGRA]	86	1-4,14
Hot Pot	114	1,2,4,14
Hot Springs Point [Hot Springs Point KGRA]	87	1-4
Hot Springs Ranch	150	1,2,4,14
Hot Sulphur Springs (Tuscarora)	167	1,2,4,14
Hot Sulphur Springs (Sulphur Springs)	102	1,2,4,14
Howard HS	130	2,14
Humboldt House	230	1,4
Jersey Valley HS	185	2
Kyle HS [Kyle HS KGRA]	161	1-4,14
Leach HS [Leach HS KGRA]	160	1-4,14
Lee HS	162	1,2,4,14
Mineral HS	100	1,2,4,14
Moana Area [Moana Springs KGRA]	96	1,3,4

Monte Neva HS [Monte Neva KGRA]		3,14
Near Black Rock	150	2
Near Soldier Meadow	115	2
Near Wells	180	2
Needle Rocks - see The Needles		
Nevada HS	105	2
Pinto HS (East and West) [Pinto HS KGRA]	176	1-4,14
Pyramid Lake - see The Needles		
Rye Patch [Rye Patch KGRA]		3
Salt Wells Basin [Salt Wells Basin KGRA]		3
San Emidio Desert Area [San Emidio Desert KGRA]	185	1,3,4
San Jacinto HS - see Mineral HS		
Silver Peak [Silver Peak KGRA]		3,14
Smith Creek Valley Area	143	1-4,14
Soda Lake Area [Stillwater-Soda Lake KGRA]	161	1-4
Soldier Meadow [Soldier Meadow KGRA]		14
Sou HS [Dixie Valley KGRA]	86	1,2,4,14
Spencer HS	95	1,2,4,14
Steamboat Springs [Steamboat Springs KGRA]	207	1-4
Stillwater Area [Stillwater-Soda Lake KGRA]	159	1-4
Sulphur HS [Ruby Valley KGRA]	181	1,2,4,14
Sulphur Springs - see Hot Sulphur Springs		
The Needles	116	1-4,14
Trego [Trego KGRA]	124	3,14
Tuscarora - see Hot Sulphur Springs		
Wabuska HS [Wabuska KGRA]	140	1-4
Wally's HS	110	2,3,14
Walti HS	120	2,3,14
Warm Springs [Warm Springs KGRA]	125	2,14
Ward's HS - see Fly Ranch HS		
Wilson HS [Wilson HS KGRA]		3

New Hampshire - 1 area

Area Name	Reservoir Temp. (C)	References
Conway Granite		

New Jersey - 5 areas

Area Name	Reservoir Temp. (C)	References
Atlantic City		
Cape May		
Forked River		
Fort monmouth		
Sea Girt		

New Mexico - 55 areas

Area Name	Reservoir Temp. (C)	References
Albuquerque		15
Aleman	110	15
Animas Valley		3
Baca Location [Baca Location No. 1 KGRA]	278	1-4,15
Berino-Mesquite	120	15
Black Mountain West Mesa	95	15
Blue Mesa	98	15
Carne	40	15
Cliff Area		15
Closson	150	15
Columbus Area	155	15
Cotton City		3
Crocker		15
Crown Point	150	15
Derry Warm Spring	100	15
Fayword HS		15
Freiborn Canyon		15
Fort Windale		15
Garton Well		15
Gila HS [Gila KGRA]	125	2,3,15
Gila HS Doc Campbell	77	15
Guadalupe Area	170	15
Guadalupe Spring	120	15
Hot Well	100	15
Isleta	33	15
Jemez Reservoir	150	15
Jemez Springs	96	1,2,4,15
Jicarilla Apache Indian	98	15
Kilborne Hole [Kilborne Hole KGRA]	155	3,15
Laguna	50	15
Las Alturas	120	15
Las Palomas		15

Lightning Dock Area [Lightning Dock KGRA]	158	1,2,4,15
Lordsburg	150	15
Lower Frisco HS - see San Francisco HS		
Mambys	125	15
Mancisco Mesa	72	15
Mimbras HS		15
Montezuma HS	130	15
Ojo Caliente	130	15
Playas Valley	144	15
Ponce de Leon	105	15
Prewitt Northeast	150	15
Radium Hot Springs [Radium Springs KGRA]	96	1-4,15
Rincon East		15
San Augustine Plain		15
San Diego Mountain	125	15
San Francisco HS [Lower Frisco HS KGRA]	99	1-4,15
San Ysidro [San Ysidro KGRA]	100	3,15
Socorro	35	3,15
Spence Spring [Baca Location No 1 KGRA]	110	1,4
Tohatchi Area		15
Truth or Consequences	100	3,15
Turkey Creek		15
Tularosa Basin South	150	15
Valles Caldera - see Baca Location		
White Sands Missile Range	150	15

New York - 1 area

Area Name	Reservoir Temp. (C)	References
Lebanon Spring	51	4

North Carolina - 1 area

Area Name	Reservoir Temp. (C)	References
Hot Springs	50	4

North Dakota - 1 area

Madison Aquifer

Area Name	Reservoir Temp. (C)	References

Oregon - 37 areas

Area Name	Reservoir Temp. (C)	References
Alvord HS [Alvord KGRA]	164	1-4,7
Antelope HS [Crumps Geyser KGRA]		7
Austin HS - see Carey HS		
Barry Ranch HS - see Lakeview Area		
Belknap HS [Belknap-Foley KGRA]	108	1-4,7
Beulah HS [Vale HS KGRA]	130	2,3,7
Blue Mountain HS	130	2
Borax Lake - see Hot Lake Area		
Breitenbush HS [Breitenbush HS KGRA]	127	1-4,7
Carey HS [Carey HS KGRA]	98	1-4,7
Cove HS [La Grande PGRA]		7
Crane HS [Burns Butte KGRA]	124	1,2,4,7
Crumps Spring [Crump Geyser KGRA]	173	1-4,7
Fisher HS [Crump Geyser KGRA]	123	1,2,4,7
Foley HS [Belkap-Foley HS KGRA]	106	1,4,7
Glass Butte		3,7
Harney Lake Area [Burns Butte KGRA]	105	1-4,7
Hot Lake Area [Alvord KGRA]	176	1,3,4,7
Hot Lake Springs [La Grande PGRA]	120	2,7
Hunter's HS - see Lakeview Area		
Kahneetah HS	113	1,2,4
Kitson HS [McCredie HS KGRA]		7
Klamath Falls Area [Klamath Falls KGRA]	104	1-4,7
Klamath Hills Area [Klamath Falls KGRA]	131	1,4,7
Lakeview Area [Lakeview KGRA]	149	1-4,7
Little Valley Area [Vale HS KGRA]	118	1,2,4,7
McCredie HS [McCredie HS KGRA]	96	1,3,4,7
McDermitt Area	90	1,2,4
Medical HS [La Grande PGRA]	97	1,2,4,7
Mickey Springs [Alvord KGRA]	207	1,2,4,7
Mitchell Butte HS [Vale HS KGRA]	130	7
Mt. Hood Area [Mt. Hood KGRA]	125	1-4,7
Neal HS [Vale HS KGRA]	181	1,2,4,7
Newberry Caldera [Newberry Caldera KGRA]	230	1,3,4,7
Paisley		3
Radium HS [La Grande PGRA]	130	2,7

Ritter HS	125	2
Riverside Area	116	1,2,4
Summer Lake HS [Summer Lake KGRA]	112	1-4,7
Trout Creek Area [Crumps Geyser KGRA]	143	1,2,4
Umpqua HS	104	1,4
Vale HS [Vale HS KGRA]	157	1-4,7
Weberg HS	100	1,2,4
Winino HS - see McCredie HS		

Pennsylvania - 1 area

Area Name	Reservoir Temp. (C)	References
Perry County Warm Springs	36	4

South Carolina - 4 areas

Area Name	Reservoir Temp. (C)	References
Liberty Hill		
Lilesville		
Pageland		
Winnsboro		

South Dakota - 5 areas

Area Name	Reservoir Temp. (C)	References
Buffalo Gap Springs		4
Cascade Springs	35	4
Hot Brook Creek Spring		4
Hot Springs	44	4
Madison Aquifer		

Texas - 10 areas

Area Name	Reservoir Temp. (C)	References
Big Bend # 2 [Big Bend Nat'l Park]	40	4
Brazoria Fairway	146	
Capote Warm Spring	57	4
Hot Springs	41	4
Hot Springs Ruidosa	55	4
Indian HS	60	4
Las Cienagas Spring	60	4
Nixon Spring	60	4
Red Bull Spring	56	4
Rio Grande Village	36	4

Utah - 50 areas

Area Name	Reservoir Temp. (C)	References
Abraham HS [Crater Springs KGRA]	89	1-4
Baker HS - see Abraham HS		
Beaver Valley		16
Beck's HS	55	16
Beryl	149	3,16
Black Rock Desert - see West Cove Fort		
Blue Creek Valley		16
Bonneville Salt Flats	88	16
Brigham City		3
Cache Valley	49	16
Canyonlands		16
Castilla HS	40	16
Cedar City and Parowan Valley		16
Cedar Valley		16
Central Virgin River Basin	42	16
Como Warm Springs		16
Cove Fort-Sulphurdale [C. F.-Sulphurdale KGRA]	170	1-4,16
Crater HS - see Abraham HS		
Crystal HS	86	2,16
Curlew Valley	43	16
Diamond Fork Warm Springs		16
East Shore Area	62	16
Enoch		3
Escalante Desert	149	16
Escalante Valley	85	16
Fish Springs	61	16
Grouse Creek Valley	42	16

Hatton		3
Heber Valley	44	16
Hobo HS	55	16
Hooper HS	105	2,16
Jordan Valley	86	16
Joseph HS [Monroe-Joseph KGRA]	104	1,2,4,16
Lower Bear River Area	105	16
Lund [Lund KGRA]		3
McKean's HS - see Roosevelt HS		
Meadow HS	105	2
Midway	44	16
Minersville		3
Monroe-Red Hill HS [Monroe-Joseph KGRA]	109	1-4,16
Navajo Lake [Navajo Lake KGRA]		3
Neels		3
Newcastle Area [Newcastle KGRA]	143	1,4,16
North Cove Fort		16
Northern Juab Valley		16
Ogden HS	62	16
Park Valley		16
Pavant Valley	67	16
Promontory Mountains Area		16
Roosevelt HS [Roosevelt HS KGRA]	269	1-4,16
Rush Valley		16
Sevier Desert	82	16
Sevier Valley	77	16
Skull Valley		16
Snake Valley		16
Thermo HS [Thermo HS KGRA]	144	1-4,16
Tooele Valley		16
Tule Valley		16
Udy HS	54	16
Uintah Basin	55	16
Utah Valley	46	16
Wah Wah Valley		16
Wasatch HS	55	16
West Cove Fort		16

Virginia - 14 areas

Area Name	Reservoir Temp. (C)	References
Accomac		
Bolar Spring	30	4
Bragg Spring		4
Eastville		
Falling Spring	40	4

Hampton		
Healing Spring	43	4
Hot Springs	41	4
Layton Spring		4
Rockbridge Bath Springs		4
Smith Point		
Suffolk		
Sweet Chalybeate Spring		4
Warm Springs	41	4

Washington - 51 areas

Area Name	Reservoir Temp. (C)	References
Bacon Creek Spring	80	8
Baker HS [Mt. Baker PGRA]	139	1-4,8
Bear Creek Spring	198	8
Bonneville HS	80	8
Bubbling Mike Spring	88	8
Cispus River	300	8
City of Blaine Spring	300	8
City of Vancouver Spring	300	8
Clear Creek	198	8
Diamond Mineral Spring	80	8
East Fork Lewis River	93	8
Edwards Spring	300	8
Flaming Geysers Well	80	8
Gamma HS [Kennedy HS KGRA]	161	1,2,4,8
Garland Mineral Spring	150	2,8
Gifford Peak		3
Gotchen Creek Spring	300	8
Indian Heaven [Indian Heaven KGRA]		3,8
Iron Mike Spring	89	8
Kennedy HS [Kennedy HS KGRA]	160	2,3,8
Landslide Spring	137	8
Larabee Spring	250	8
Leonardo Springs	300	8
Lewis River	300	8
Little Iron Mike Spring	80	8
Little Soda Spring	300	8
Little White Salmon River	228	8
Lonesome Sale Road Spring	188	8
Longmire HS [Mt. Rainier Nat'l Park]	170	2,8
Malotte Springs	300	8
Mt. Adams [Mt. Adams PGRA]		8
Mt. St. Helens [Mt. St. Helens KGRA]		3,8
Muddy River	145	8

Mulford Spring	300	8
Nisqually River	300	8
North Fork Toutle River	163	8
Ohanapecosh HS [Mt. Rainier Nat'l Park]	135	1-4,8
Olympic HS	130	2,8
Pine Creek	238	8
St. Martin HS	80	8
San Juan - see Garland		
Scenic HS		8
Soda - see Summit Creek		
Sol Duc HS	150	2,8
Spring 72	260	8
Spring 710	204	8
Sulphur Creek HS [Kennedy HS KGRA]	125	2,8
Summit Creek [Mt. Rainier Nat'l Park]	170	2,8
Trout Lake Creek	244	8
U. S. Forest Service Spring	300	8
Yakima	100	8
White Creek	225	8
White Salmon River	300	8
Wind River	212	8

West Virginia - 3 areas

Area Name	Reservoir Temp. (C)	References
Berkeley Spring	38	4
Minnehaha Spring	34	4
Old Sweet Spring	23	4

Wyoming - 18 areas

Area Name	Reservoir Temp. (C)	References
Afton		3
Alcova HS		9,17
Auburn HS	96	1,2,4,9,17
Big Spa		17
Countryman Well		9
Glenrock		9
Granite HS	83	1,4,9,17
Hobo Pool - see Saratoga		
Huckleberry HS	124	1,2,4,9,17

Jackson Lake HS		9,17
Johnson Spa		17
Little Sheep Mountain Spring	125	9
Midwest/Salt Creek		9
Mud Volcano Area [Yellowstone National Park] . .	230	1,2,4
North Buffalo Fork Spring		9,17
Saratoga	120	9,17
Strawberry		3
Thermopolis		9
Yellowstone Caldera Area [Yellowstone Nat. Pk.]	270	1,2,4,9

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