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Snake River Basin Environmental Program

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ABSTRACT

The Snake River Basin Environmental Program was designed to evaluate existing environmental data with respect to potential geothermal development in eight Known Geothermal Resource Areas (KGRAs) in Idaho. State and federal agencies, public interest groups, consulting groups, and universities participated in the DOE program. Final reports for the program are intended to be utilized as reference documents and planning tools for future environmental studies. Evaluation of the data indicated that the majority of the existing data base is adequate for small-scale direct-use developments. The potential impacts of development on water quality and water supply are the primary environmental concern. Preliminary data suggest that subsidence and induced seismicity may be a problem in several of the KGRAs. Sensitive animal species and habitats have been identified in each area; development in the Castle Creek KGRA may be restricted due to the Birds of Prey Natural Area. Two workshops provided public input on area and land use planning for geothermal development in Idaho. Based on the data evaluation and public input, a plan for supplementing the existing environmental data base was prepared.

INTRODUCTION

The purpose of the Snake River Basin Environmental Program, initiated in 1978, was to evaluate the environmental concerns related to planned and potential geothermal development in Idaho. The program, which was funded by the Department of Energy, Office of Health and Environmental Research, evaluated the eight KGRAs in Idaho: Vulcan Hot Springs, Crane Creek, Castle Creek, Bruneau, Mountain Home, Raft River, Island Park, and Yellowstone (fig. 1). A ninth KGRA, Conda, was designated as the program was nearing completion. Comprehensive environmental programs had already been implemented for the Raft River, Island Park, and Yellowstone KGRAs; therefore, to avoid duplication of effort, most of this program concentrated on the remaining five areas.

The program was designed to assess the existing environmental baseline data for the KGRAs in the Snake River Basin, to evaluate those data for adequacy and applicability, and to develop a plan for supplementing the existing data to achieve a solid environmental data base prior to geothermal development in those areas with significant geothermal potential. A steering committee, established to

serve as program consultants, included representatives from the U. S. Bureau of Land Management, the U. S. Fish and Wildlife Service, the U. S. Geological Survey, the Idaho Department of Water Resources, the Idaho Conservation League, the National Oceanic and Atmospheric Administration, Lawrence Livermore Laboratory, and the U. S. Department of Energy. Researchers from the Idaho Water Resources Research Institute, GeoTechniques, Lewis & Associates, and Brigham Young University evaluated data for each of the following program elements: air quality, meteorology, geology, subsidence, seismicity, water quality, hydrology, heritage resources, soils, land use, flora, fauna, socioeconomics, and demography. EG&G Idaho, Inc., through the Idaho National Engineering Laboratory, provided technical direction and program management.

Products from this program include a summary evaluation of the environmental concerns related to geothermal development in each of the KGRAs, a program plan identifying future research needs, and a comprehensive data file. These will serve: (1) as planning tools for state and federal energy, environmental and land management agencies, (2) as reference documents for developers to shorten and simplify required project environmental evaluations, and (3) to identify the significant environmental concerns in each KGRA such that mitigation measures can be incorporated early in the development process. The ultimate goal of the program is to reduce the delays in geothermal development while minimizing detrimental environmental impacts.

DATA EVALUATION

Based on the results of the data evaluation, a table was prepared summarizing the adequacy of existing environmental data and potential resource use limitations relating to geothermal development in the Snake River Basin region (table 1). With the exception of water quality, hydrology, and heritage resources, the existing data were considered adequate for most types of small-scale direct use developments. Most of the data were not considered adequate to address the potential environmental concerns or to evaluate environmental impacts following resource development for power production and large-scale direct-use applications.

In most cases, the resource use limitations presented by each component of the environment for the KGRAs can be reduced or eliminated through design and project location considerations. These limitations are:

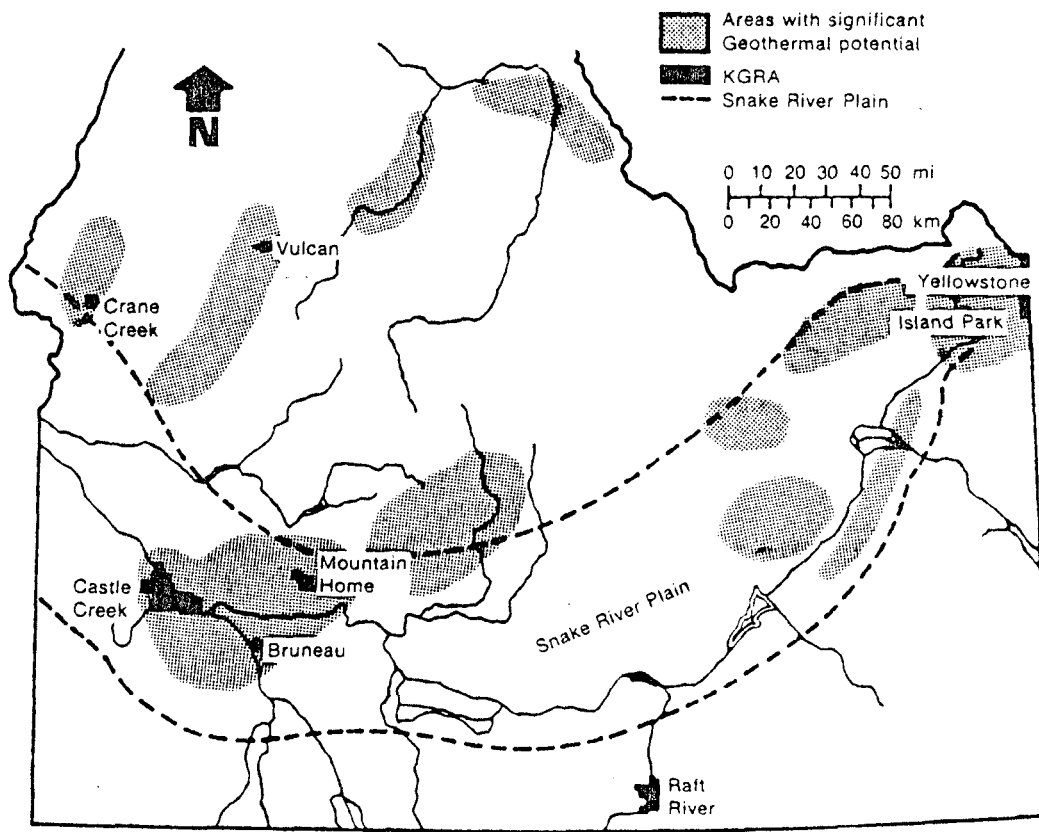
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Fig. 1 Map location of the eight KGRAs.

1. Geology - Although surficial geologic data are fairly complete for each of the KGRAs, subsurface geologic information is either sketchy or non-existent for all but the Raft River KGRA. Additional data would not only aid in defining the resource, but would provide the basis for evaluating the potential for induced seismicity and subsidence in each area.

2. Subsidence - Geologic materials in the Mountain Home, Castle Creek, Crane Creek, Bruneau, and Raft River KGRAs are prone to subsidence. Geothermal development could accelerate the declines in groundwater levels caused by irrigation pumping in these areas, resulting in subsidence.

3. Seismicity - The Vulcan Hot Springs, Crane Creek, Island Park, and Yellowstone KGRAs are in areas of high regional seismic activity. The remaining KGRAs appear to be more closely related to the aseismic Snake River Plain. All of the KGRAs lie within potentially active seismic zones; however, definite conclusions concerning the potential of earthquake damage due to natural and induced causes cannot be drawn without additional site-specific data.

4. Climate and Meteorology - Although a significant amount of data are available on the general climate of each KGRA, little information is available on air

flow patterns. The geography of four of the KGRAs is such that stagnation may be a problem.

5. Air Quality - Very little information is available on ambient air quality of the KGRAs. Data from those studies which have been conducted in the region indicate that, although chemical pollutants are generally not a problem, fugitive dust can be a serious problem, particularly in agricultural areas. Noncondensable gases will probably not be a concern in several of the KGRAs.

6. Soils and Land Use - Physical limitations as a result of soil erosion potential exist for all the KGRAs. Soils occurring in the Crane Creek, Vulcan Hot Springs, Yellowstone, and Island Park KGRAs are highly erodible, and steep slopes present topographic limitations. The Mountain Home soils contain cemented pan layers which inhibit percolation and increase surface runoff. Land and water use patterns present possible conflicts for development in the Raft River, Bruneau, Castle Creek, Crane Creek, and Mountain Home KGRAs.

7. Hydrology and Water Quality - This is considered the most important area of concern related to geothermal development in the Snake River Basin, particularly since none of the geothermal systems in the KGRAs appear to be unique. Those areas where geothermal development presents the greatest

Table 1. Potential Resource Use Problems of Geothermal Development\*

GEOTHERMAL RESOURCE USES	Geology	Seismicity	Subsidence	Meteorology & Climate	Air Quality	Soils/Land Use	Hydrology	Water Quality	Ecology	Heritage Resources	Socioeconomic
Greenhouses	Minimal	Minimal	Minimal	Destructive winds in some areas	Minimal	Land use & erosion problems	Water rights problems	Fluoride problem Return flow quality concern	Minimal	Potential problems	Minimal
Tree Farming	Minimal	Minimal	Minimal	Destructive winds in some areas	Minimal	Land use & erosion problems	Water rights problems	Fluoride problem Return flow quality concern	Minimal	Potential problems	Minimal
Fish Farming	Minimal	Minimal	Minimal	Minimal	Minimal	Land use & erosion problems	Water rights problems	Fluoride problem Return flow quality concern	Minimal	Potential problems	Minimal
Feed Lots	Minimal	Minimal	Minimal	Minimal	Minor local problems	Land use & erosion problems	Water rights problems	Fluoride problem Return flow quality concern	Potential habitat conflicts	Potential problems	Minimal
Space Heating	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Water rights problems	Fluoride problem Return flow quality concern	Minimal	Potential problems	Minimal
Refrigeration	Minimal	Minimal	Minimal	Micro-climate change	Minimal	Minimal	Water rights problems	Fluoride problem Return flow quality concern	Minor problems	Potential problems	Minimal
Potato Processing	Minimal	Minimal	Minimal	Micro-climate change	Minimal	Land use & erosion problems	Water rights problems	Fluoride problem Return flow quality concern	Minor local problems	Potential problems	Potential problem (especially during construction)
Power Plants	Major exploration problems	Possible problems	Possible problems	Micro-climate change	Possible problems	Land use & erosion problems	Water rights & recharge problems	Fluoride problem Return flow quality concern	Local habitat problems (especially during construction)	Potential problems	Potential problem (especially during construction)

\*The questions posed are not whether an economic possibility exists for development; rather, would a reasonable resource manager be concerned about potential environmental consequences.

potential for adverse impacts include the Bruneau, Castle Creek, Vulcan Hot Springs, and Raft River KGRAs. Reports of high fluoride contents in the Bruneau, Castle Creek, and Raft River KGRAs are of particular concern. Water rights may impose some development constraints in each of the KGRAs.

8. Ecology - Sensitive species and key habitats occur in each of the KGRAs and should be given consideration in planning geothermal developments. One-third of the Castle Creek KGRA overlaps the BLM Birds of Prey Natural Area. It is recommended that the boundaries of this KGRA be re-evaluated in view of the potential for adverse impacts to the sensitive raptor species inhabiting the area.

9. Socioeconomics and Demography - Although the existing data base is considered adequate, additional data on the education and health care facilities for the five western KGRAs would be valuable. Major geothermal development could cause a shift from a rural environment; however, the pace and magnitude of changes would be relative to the size of the communities involved and thus would not be likely to be significant.

10. Heritage Resources - Most of the KGRAs have been heavily exploited by human groups for over 10,000 years and thus have a high potential for heritage resources. Remnants of emigrant trails occur in and near the Raft River and Mountain Home KGRAs. Development of any kind could adversely impact heritage resources if sites remain undocumented.

#### WORKSHOPS

An important part of the Snake River Basin program was obtaining input from industry and the private sector. This was accomplished by sponsoring two public workshops to discuss issues of concern

related to geothermal development in each of the eight KGRAs. The purpose of the first workshop was to identify and evaluate general environmental concerns. Detailed environmental information for each of the KGRAs was presented at the second workshop and formed the basis for discussions of topic- and site-specific concerns.

Land use planning played an important role in the workshops. Participants were presented with a "simulated" geothermal resource area and were asked to identify locations they would consider for geothermal development, given existing conditions such as land ownership and use, protected habitat, migration routes, heritage resources, water resources, wilderness considerations, and known geothermal occurrences. The objective of this exercise was to require participants to set their priorities relative to resource use, considering all components of the environment and typical uncertainties relating to knowledge of environmental conditions and the geothermal resource. As established by responses of all participants, land use priorities were:

1. Watershed protection
2. Consideration for fish and wildlife
3. Agriculture
4. Geothermal development for direct use applications
5. Geothermal development for electrical production
6. Range
7. Timber
8. Aesthetics
9. Roadless/wilderness areas
10. Minerals
11. Nonmotorized recreation
12. Archaeological/historical resources
13. Motorized recreation.

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The relative priority of geothermal development to other land uses probably resulted from the characteristics of the participants, most of whom had some interest in geothermal.

#### CONCLUSIONS AND THE FUTURE

The program plan prepared as a result of this effort recommends several areas where further environmental research is warranted. An analysis of the geothermal potential for the state of Idaho (McClain, 1979; Mitchell, 1979) was incorporated. The plan identifies geographic areas where environmental information is lacking and where the potential for geothermal development is significant. These areas are Vulcan Hot Springs, Weiser-Crane Creek, Boise-Caldwell, Castle Creek, Mountain Home, Bruneau, and Conda-Grays Lake.

This plan is being coordinated with several federal and state agencies with regard to implementation. Researchers are providing environmental support for various geothermal developments in Idaho on the basis of the work completed and are establishing an environmental data center to facilitate information and technology transfer. Reports produced as part of this program were published during 1979 and are available to interested parties by contacting the authors of this paper.

#### ACKNOWLEDGMENTS

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