1979

Geothermal Development and Western Water Law

A. Dan Tarlock
Indiana University School of Law

Owen Olpin
O'Melveny & Myers

Carl F. Austin
Naval Weapons Center

Geothermal Development and Western Water Law†

*Owen Olpin**
*A. Dan Tarlock***
*Carl F. Austin****

TABLE OF CONTENTS

I. INTRODUCTION 774
II. THE ROLE OF GEOTHERMAL ENERGY IN MEETING ENERGY NEEDS 776
III. THE GEOSCIENCE OF THE RESOURCE 777
A. The Nature of the Resource 777
B. A Closer Look at Geothermal Fluids 781
IV. CHARACTERISTICS OF A PROPERTY RIGHTS REGIME .. 792
V. THE INITIAL PROPERTY CLASSIFICATIONS ATTEMPTS 797
A. The Ownership Lawsuits 798
B. State and Federal Legislation 803
VI. POSSIBLE WATER RIGHTS CLAIMS BY FEDERAL LESSEES 807
VII. THE CASE AGAINST APPLICATION OF WESTERN WATER LAW DOCTRINES TO GEOTHERMAL DEVELOPMENT 810
A. Assumptions Underlying Mineral and Water Exploitation 812
B. Western Water Law Doctrines Inapplicable to Geothermal Development 813
1. Inappropriate Forms and Procedures 817

† This article was written pursuant to a grant to Indiana University and the University of Utah to study the relationship between Western water law and geothermal resources development, funded by the United States Department of Energy. We gratefully acknowledge the support. The authors and the Utah Law Review Society expressly disclaim copyright in this article, thereby placing it in the public domain as mandated by the DOE grant.

Professors Olpin and Tarlock would like to thank Vilate Stewart, J.D., 1978, University of Utah; John Davis, J.D., 1979, University of Utah; Dan Stewart, J.D., 1979, Indiana University, Bloomington; and Richard Waller, J.D., 1977 Indiana University, Bloomington, for their valuable research assistance in the preparation of this article.

* Partner, O'Melveny & Myers, Los Angeles, Cal.; B.S., 1955, Brigham Young University; LL.B., 1958, Columbia University; Member, California and Washington, D.C., Bars.

** Professor of Law, Indiana University, Bloomington; A.B., 1962, LL.B., 1965, Stanford University.

*** Head of the Geothermal Utilization Division of the Naval Weapons Center, China Lake, California; involved in geothermal exploration for both industry and government for the past 18 years. A.A., 1952, College of Marin; B.S., 1954, M.S., 1955, Ph.D., 1958, University of Utah. Dr. Austin is primarily responsible for the technical and scientific material, especially the section on geothermal fluids and their relationship to groundwater sources.

2. *Necessity to Prove an Adequate Available Supply* . . . 817
3. *Denial of Entry to Groundwater Basin in Overdraft* . . . 818
4. *Protection of Prior Surface Users' Rights* . . 818
5. *Groundwater Mining* . . . 820
6. *Assertion of a Right to Lift* . . . 821
7. *Restrictions on Use of Groundwater in California and Arizona* . . . 821
8. *Application of Public Interest Restrictions on Right to Appropriate* . . . 822
9. *Application of the Relation Back Doctrine* . 823
VIII. STATE GEOTHERMAL AND GROUNDWATER LAWS . . . 824
A. *Arizona* . . . 824
B. *California* . . . 829
C. *Colorado* . . . 834
D. *Hawaii* . . . 840
E. *Idaho* . . . 843
F. *Montana* . . . 847
G. *Nevada* . . . 851
H. *New Mexico* . . . 854
I. *Oregon* . . . 857
J. *South Dakota* . . . 861
K. *Utah* . . . 862
L. *Washington* . . . 867
M. *Wyoming* . . . 871
IX. THE WATER POLLUTION PROBLEM . . . 874
A. *Reinjection and Geothermal Waste Water* . . . 874
B. *Federal and State Pollution Laws Affecting Reinjection* . . . 876
X. CONCLUSION . . . 881

I. INTRODUCTION

Geothermal energy is derived from heat beneath the earth's surface. High temperature geothermal resources can be used to generate electricity. Moderate and low temperature resources are less likely to be used in the generation of electricity, but can be used for space heating, food processing, and cooling. Geothermal resources are also potential sources of extractable minerals and irrigation water.

A geothermal deposit is an accumulation of heat within the crust of the earth. Temperatures beneath the earth's surface "are controlled principally by conductive flow of heat through solid rocks, by convective flow in circulating fluids, or by mass transfer

in magma."[1] With present technology, exploitable geothermal resources are confined to hydrothermal convective systems in which heat is transferred by circulating fluids—hot water or steam—rather than by conduction, and the heat can be extracted by wells. In the United States these geothermal "anomalies" are located principally in the Far West.[2] Fourteen western states, including Alaska and Hawaii, have geothermal deposits of potential economic significance.

To exploit a natural resource, some form of property rights regime in the resource must be established. The laws of hard rock minerals, oil and gas, and water provide tempting analogies for the assignment of geothermal property rights. No analogy is perfect, however, because the geothermal resource is direct heat energy ready to be put to use. The resource is not a substance, although substances are necessary to transfer heat to the surface. Still, broadly stated, geothermal resources are common pool resources; therefore, rights must be defined correlatively, as are rights to oil, gas and water. But geothermal resources present more complex ownership problems than conventional oil and gas and groundwater resources. Not only may several overlying surface owners be able to tap a common supply, but the supply may be physically interconnected with other natural resources, primarily groundwater devoted to conventional beneficial uses. For this reason, geothermal rights must be defined not only to allocate the resource among users *inter se,* but geothermal rights must also be defined in relation to other competing resource users.

This article is an analysis of the relationship between geothermal resources development and western water law. The principal thesis advanced here is that it is undesirable to regulate geothermal resources merely as groundwater resources. The blanket application of doctrines designed to protect the correlative rights of groundwater users and society's interest in the optimum use of water resources where there is no significant physical interrelationship between geothermal and groundwater reservoirs will result in the imposition of costly constraints on geothermal development with no corresponding gains to conventional water users or society. We suggest a

1. White, *Characteristics of Geothermal Resources,* in GEOTHERMAL ENERGY 69, 71 (P. Krueger & C. Otte eds. 1973).

2. One view in vogue today is that hydrothermal systems are generally associated with tectonicplate boundaries in areas of recent vulcanism. *See,* L. GODWIN, L. HAIGLER, R. RIOUX, D. WHITE, L. MUFFLER & R. WAYLAND, CLASSIFICATION OF PUBLIC LANDS VALUABLE FOR GEOTHERMAL STEAM AND ASSOCIATED GEOTHERMAL RESOURCES 6 (U.S. Geological Survey Circular No. 647, 971) [hereinafter cited as GODWIN].

largely physical solution for integrating geothermal development and protecting conventional groundwater uses which both frees geothermal resources from unnecessary contraints and protects the legitimate interests of vested water rights holders.

II. The Role of Geothermal Energy in Meeting Energy Needs

Geothermal resources currently occupy a small niche in United States' energy policy. Various estimates of the geothermal potential have been made which optimistically assert that geothermal resources could provide as much as 100,000 megawatts of electrical power for thirty years, at prices between one and two times current power costs.[3] But recent government studies estimate that the impact on regional energy supplies will be negligible through 1985.[4] The Carter Administration's National Energy Plan provides no production target goals for geothermal resources as it does for oil, gas, and coal.[5] For the foreseeable future, geothermal resources will be limited to a supplemental source of electrical generation in the Far West and, somewhat more widely, to direct heat process applications near reservoirs.[6] On one level, the macroperspective on geothermal energy is irrelevant to this study, for the conflicts we discuss must be fairly resolved whether few or many wells are drilled. On another level, however, the macroperspective is relevant because federal and state governments are likely to continue to promote this resource as it is a relatively clean resource.

Federal and state resource promotion policies, such as direct financial subsidies,[7] and indirect supports such as tax advantages[8]

3. In 1975 the installed global geothermal electrical generating capacity was only 1,400 megawatts. At the present time only one geothermal field in the United States, the Geysers, north of San Francisco, produces electricity commercially. The present total output of the Geysers is about 500 megawatts. Commercial production is also anticipated in California's Imperial Valley and the Roosevelt Hot Springs area in Utah. In the early 1960's and 1970's projections for geothermal production were very optimistic, but these projections have now been revised downward in response to a more realistic understanding of the limits of current technology to exploit the resource at rates competitive with conventional power sources. In 1976, 52 geothermal wells were drilled in the states of California, Idaho, Nevada, Oregon, and Utah. Of these, "39 (75%) are now considered to have successfully found at least potentially commercial quantities of steam or hot water . . . ." Smith, Isselhardt & Matlick, *Summary of 1976 Geothermal Drilling—Western United States,* 5 Geothermal Energy 8 (May 1977).

4. Comptroller General of the United States, Rocky Mountain Energy Resource Development: Status, Potential, and Socioeconomic Issues 24 (1977).

5. Congress of the United States Office of Technology Assessment, Analysis of the Proposed National Energy Plan 64-65 (August 1977).

6. The basic reason is that "all of the steps in the fuel cycle are localized at the site of the power production facilities." R. Bowen, *Environmental Impact of Geothermal Development* in Geothermal Energy 197 (P. Kruger & C. Otte eds. 1973).

7. The Geothermal Energy Reseach, Development, and Demonstration Act of 1974, 30

and favorable regulatory policies, often evolve into specific legal rules. In the past, excessive promotion has caused society to ignore the environmental side-effects of geothermal development, and in the future it could be urged that the societal benefits to be gained by the aggressive development of geothermal resources should lead to the subordination of competing resource use claims. This article makes the case for the adoption of rules that do not unduly constrain geothermal development by subjecting it to a resource regime—water—which is not suited to promotion of the resource's development. However, we caution that although geothermal energy is a relatively clean resource warranting development, there are costs to be taken into account. An appreciation of the limited role of the resource serves to remind us that we should not give undue weight to the values of geothermal development when that development poses significant social costs.

III. The Geoscience Of The Resource

A. *The Nature of the Resource*

The term "geothermal resources" is both a scientific and economic concept. Broadly defined, geothermal resources are resources which "derive from the distribution of temperatures and thermal energy beneath the earth's surface."[9] This definition is purely a scientific one, for it describes all heat that is recoverable by current or projected technologies as well as heat that is not recoverable by any projected technology. The U.S. Geological Survey (USGS) has adopted a more limited technological definition of the resource, defining geothermal resources as "stored heat, both identified and undiscovered, that is recoverable using current or near-current tech-

U.S.C. §§ 1101-1164 (1976) allows the federal government to enter into joint federal-nonfederal demonstration projects. *Id.* § 1125(c). The Department of Energy is authorized to guarantee loans made by lendors for the purpose of financing nonfederal resource base evaluations, extraction and utilization technology reseach, the acquisition of geothermal rights, and demonstration projects. *Id.* § 1141.

8. A recent amendment to the Internal Revenue Code allows geothermal developers to deduct intangible drilling costs as expenses rather than capitalize them, thus placing the geothermal industry on an equal footing with the oil and gas industry. Energy Tax Act of 1978, Pub. L. No. 95-618, § 402(a)(1), 92 Stat. 3201 (amending I.R.C. § 269). Another amendment allows a geothermal development to claim a percentage depletion deduction for geothermal deposits according to a schedule which slides from 22 percent in 1979-80 to 15 percent in 1984. *Id.* § 403(a)(1), 92 Stat. 3203 (amending I.R.C. § 613).

9. Austin, *Technical Overview of Geothermal Resources,* 13 Land & Water L. Rev. 9 (1977) (quoting White, *supra* note 1, at 69).

nology, regardless of cost."[10] This "space-program" definition of the resource is not an economic one since it does not take into account the cost of utilizing the resource. The USGS has also adopted economic classifications of these technologically recoverable resources based on the cost of their recovery, which are relevant to exploitation and regulatory decisions. The three classes of economically recoverable resources are: (1) *submarginal geothermal resources,* recoverable only at a cost that is more than two times the current price of competitive energy systems, (2) *paramarginal geothermal resources,* recoverable at a cost between one and two times the current price of competitive energy, (3) *geothermal reserves,* consisting of those identified resources recoverable at a cost that is competitive now with other commercial energy sources.[11] By analogy to a distinction used in the hard rock-minerals industry, these are geothermal deposits, not merely geothermal occurrences.

Two physical elements of a geothermal reservoir—the heat source and the transfer medium—will determine its commercial potential. The ultimate source of most of the earth's subterranean heat is radioactive decay. In order for such a diffuse heat source to be exploited with current or projected technologies, the heat must be trapped in a relatively confined area reasonably close to the earth's surface; the heat then must be carried to the surface by a transfer medium so it can be captured in a concentrated form. A geothermal reservoir occurs when a concentrated heat source such as molten rock within the earth's crust migrates upward toward the surface. Heat from such a zone can be transferred to the surface "by conductive flow of heat through solid rocks, by convective flow in circulating fluids, or by mass transfer in magma."[12] Because we are unable to exploit the normal thermal gradient with current or anticipated technology, commercial use of geothermal systems in the foreseeable future will be confined to hydrothermal convection systems and hot dry-rock formations where water can be injected into a heated rock formation and returned to the surface.[13] This latter

10. RENNER, WHITE & WILLIAMS, UNITED STATES GEOLOGICAL SURVEY PAPER NO. 726 (1975).

11. A geothermal reservoir with appreciable commercial potential has four characteristics identified by the United States Geological Survey. They are: (1) a temperature between 150-400°F, (2) a depth of less than 10,000 feet to permit drilling, (3) sufficient permeability of the rocks to allow the heat transfer agent—water or steam—to flow continuously at a high rate, and (4) sufficient water recharge to maintain production for a number of years. Godwin, *supra* note 2, at 6.

12. White, *supra* note 1, at 71.

13. *See* Ewing, *Stimulation of Geothermal Systems,* in GEOTHERMAL ENERGY 217, 221 (P. Kruger & C. Otte eds. 1973).

source of energy is still in the research stage and will be discussed only briefly in this paper.

Hydrothermal convection systems are subdivided into liquid- and vapor-dominated systems according to the amount of fluid pressure. Most known hydrothermal convection systems contain water as the dominant fluid in the fractures and pores of the reservoir rock. A few systems, under appropriate temperature and pressure, appear to be vapor-dominated, containing steam as the dominant fluid. There are currently only two large vapor-dominated systems in production in the world—Larderello, Italy, and The Big Geysers, California. Unifortunately, the general structural, geologic, and hydrologic setting for near-surface heat accumulation means it is unlikely that many additional vapor-dominated systems will be discovered. Thus, the likely heat transfer medium for most commercial systems will be liquids.[14]

Hot-water convection systems are characterized by circulating liquid that acts to transfer heat along fractures and through porous rock from the hot, deep areas in the reservoir to areas closer to the surface. The heat transfer medium is water, trapped by a relatively impermeable formation with few fractures or interconnected pores. This water may contain high-salinity brines and can be "flashed" to produce steam or converted by other technologies such as the binary cycle.[15] Hot-water systems have been subdivided by temperature range for the economic assessment of geothermal resources, as temperature is the single most important factor in estimating the potential use of given systems. Systems with temperatures above 150°C are considered to have potential for generation of electricity, although electricity is being produced from deposits down to 99 C. Intermediate-range systems, from 90°C to 150°C, are believed most useful for space and process heating. Systems with maximum temperatures not exceeding 90°C are considered useful primarily for space heat and other industrial uses in locally favorable circumstances.[16]

---

14. RENNER, WHITE & WILLIAMS, *supra* note 10.

15. "Flashing" converts a hot liquid into steam by lowering the pressure of heat transfer medium as the liquid is injected into a flash separator which separates the vapor from the remaining liquid fraction. A binary cycle concept uses a heat exchange system to transfer a fraction of the brine enthalpy to vaporize a secondary working fluid. Expansion through a turbine to a lower pressure, fixed by the heat rejection temperature, provides the means for power generation.
Austin, *Prospects for Advances in Energy Conversion Technology for Geothermal Development,* III SECOND U.N. SYMP. 1925, 1927 (1976).

16. Direct temperature measurements are taken in surface hot springs or in wells. These provide minimum reservoir temperatures. Chemically indicated subsurface temperatures are

For purposes of assessing the recoverable heat content of reservoirs, a logical, although somewhat arbitrary, technique has been devised, subject to alteration as more data on the various systems become available. First, the temperature of the system is predicted by surface measurement of water temperature, geochemical content analysis, and other surface evidence. This is then applied to the assumed volume of the system, determined by multiplying the reservoir's assumed area by its thickness. The product of the temperature and the specific heat of the rock times the assumed volume of the system equals the heat content. The theoretical simplicity of the model is tempered by the lack of reliable data. The result has been the assignment of an arbitrary minimum area extent and thickness to the majority of known intermediate, and many higher, termperature systems.[17]

The assumed depth of heat reservoirs is economically limited to less than five kilometers, although many separate systems may be connected at depths greater than five kilometers. The tops of the systems are generally not well-defined but are given an average depth depending upon the assumed shape of the convection system and inferred similarities to other areas.

The origin of the heat in the system is important in the discovery of geothermal resources and is directly related to the general pattern of distribution in the United States. The western part of the country, which has undergone the most recent episodes of vulcanism, contains the vast majority of hydrothermal convection systems. Certain types of volcanic rock, high in silica, are thought to have risen slowly through the earth's crust and are associated with magma chambers at shallow levels (two to ten kilometers). These masses can sustain high-termperature convection systems for many thousands of years. Some convection systems which do not appear to be linked to such volcanic systems may have as a heat source either very old or very young volcanic systems which, in either case, lack surface expression. The heat in a system may also be a result

derived from analysis of water samples. Certain constituents in the water (particularly Sio_2 and common clay minerals and feldspars) react in temperature-dependent ways which allow prediction of subsurface temperature through examination of mineral content. This method of measurement assumes, among other things, that water flows to the surface without chemical change and that no mixing occurs with cool, shallow water, neither of which is ever strictly true. More sophisticated "mixing" models can predict temperatures at deeper levels despite probable mixing with cooler water. The presence of active deposition of siliceous material around the hot spring itself is another indication of subsurface temperature.

17. The subsurface area of the reservoir is determined from surface expression, *viz*, hot springs, spring deposits and bleaching, and geology. Geophysical data on subsurface conditions and exploratory drilling results have also been utilized to this end.

of the geothermal gradient, *i.e.*, heat from increasing depth, but there is some doubt as to whether gradient alone can sustain near-surface high temperatures over long periods.

A geothermal operator who finds a deposit will need to know more about the nature of the deposit, specifically, the relationship between the reservoir and other reservoirs used for purposes such as groundwater withdrawals. We now turn to an analysis of the relationships between geothermal and groundwater reservoirs.

B. A Closer Look at Geothermal Fluids

The growing importance of the geothermal industry in the United States presents a new and complex series of definitional problems for water and mineral law. These problems stem from the multiple uses to which groundwater is put and the widespread geologic variability in the modes of occurrence of water within the crust of the earth. Geothermal operators are likely to classify the resource as a mineral to urge the application of the rule of capture, whereas the conventional groundwater user will urge that the resource be treated as water so that prior or equal rights can be asserted. A paramount technical issue, which must be answered to classify the resource legally, is whether or not conventional groundwater is even involved with or affected by any given geothermal project. It is therefore necessary to discuss in some detail the origin of water in the earth and the kinds of waters that are involved in the various known and hypothesized geothermal systems. The classification problems flow from the widely varying potential uses of water resources.

There are five readily recognized uses for water. These are briefly defined and illustrated as follows:

(1) *Production of water for its water content*—This use is typified by the traditional range of beneficial uses recognized in western water law such as agricultural or domestic uses.

(2) *Production of water for its inherent chemical constituents*—Although this use is of minor importance at this time, the electrolysis of water to produce hydrogen is an extremely simple process. The use of water in the production of "water gas," which is made by passing steam over hot coal, and the production of "oil-water gas," which is made by spraying crude oil and steam onto heated bricks, have been of more historic importance. Such uses are distinguished by the fact that the water is chemically broken down and incorporated into the final product. Agricultural or other biologic processes are not considered in this category.

(3) *Production of water for its dissolved mineral content*—The simplest example of this category is the operation of brine wells for the production of various salts. These are common throughout the world. A more specialized and complex use is the production of copper or other metals from mine drainage waters. Water is injected to facilitate *in situ* mining; steam is injected to facilitate hydrocarbon recovery. Such uses pose legal problems in identifying the solution produced.

(4) *Production of water for its dissolved gas content*—Carbon dioxide has been produced from water or brine wells at many geothermal sites as well as other locations. A typical example is the former dry ice production facilities at what is now the Salton Sea geothermal area of California. With the increasing interest in geopressured fluids in the Gulf Coast, especially as gas pricing and tax structures provide incentives, the production of methane from water-rick geopressured wells can be expected to increase sharply in the next few decades.

(5) *Production of water for its caloric content*—In this instance, the incentive for producing the water is its temperature. In the geothermal industry, it is normally the elevated temperature that is desired; however, many uses for abnormally cold water exist historically, such as the production of ice from caves and the use of some frigid mine waters to increase machinery efficiency. Is the production of cold groundwater for direct cooling a geothermal operation? The water is clearly being produced for its caloric content, which in this case is low. But the narrow view in vogue today is that "geothermal" means elevated temperature. How highly elevated the temperature must be to be economically important depends on many factors, including climate and technology. Water produced for space heating is considered a geothermal operation. Springs are called "thermal" if their temperature exceeds the average annual surface temperature by 9° C or more.[18] Thus in Wyoming, which has an average annual surface temperature of 5.3° C, a spring emits thermal water if over 14.3° C. The same spring, if located in the Mojave Desert of California, would not be a thermal spring. There is no corresponding definition for a "cold" spring.

In brief, there are multiple uses of individual water sources. For example, a shallow well producing water at 170°F is used solely to irrigate crops in Nevada; a single shallow well is used to provide domestic water, heat a house, and irrigate crops in California; a

18. BRECKENRIDGE & HINKLEY, THERMAL SPRINGS OF WYOMING 1 (Geological Survey of Wyoming Bull. No. 60, 1978).

shallow hot well is used to provide both irrigation water and methane for space heating in Nevada; and steam wells are used to generate electricity, provide space heat, and to provide condensate to operate a sewage system in California.

To further complicate matters, water sources often have multiple interconnected origins. The resource allocation questions we are considering would probably be simpler if there were discrete, isolated aqueous systems. Unfortunately, there are few self-contained systems, although some such systems are more clearly identifiable as to origin than others. The small emergent underflow from a localized accumulation of gravel in a desert wash on a granitic bedrock is clearly simple groundwater derived from local precipitation (barring local geologic complications). On the other hand, a geothermal well could easily produce a fluid that is a mixture of groundwater, connate brines, and water derived from a cooling igneous mass. The amounts of each could vary with time as well as with the depth and location within a given well field.

It is essential for those involved in the geothermal industry to recognize what constitutes a geothermal resource. Part of the delay in the development of geothermal energy in the United States is related to the argument over the assignment of royalties in the event of commercial production. Some operators, landowners, and states have insisted that geothermal energy belongs to those who control the water rights. This, of course, completely ignores that water is just the carrier of the commodity sought, which is heat.[19]

Having sketched the dimensions of the problem, detailed consideration must be given to the questions of what water is and how different types of water are defined. On the whole, the geothermal industry argues that geothermal resources are mineral resources. Thus, the first question is, what is a mineral? One authority defines a mineral as:

> A body produced by the processes of inorganic nature, having a definite chemical composition and, if formed under favorable conditions, a certain characteristic molecular structure is exhibited in its crystalline form and other physical properties. A mineral must be a homogeneous substance, even when minutely examined by the microscope; further, it must have a definite chemical composition, capable of being expressed by a chemical formula.[20]

19. Combs & Muffler, *Exploration for Geothermal Resources,* in GEOTHERMAL ENERGY 95, 95 (P. Kruger & C. Otte eds. 1973).

20. FAY, A GLOSSARY OF THE MINING AND MINERAL INDUSTRY 438 (U.S. Bureau of Mines, Dep't of Interior Bull. No. 95, 1920).

Water can clearly fit within this definition. Furthermore, Dana's System of Minerology lists water as a "simple oxide" with the Dana Number 412.[21] The fact that water is usually liquid, rather than solid, is commonly cited as the reason water should not be considered a mineral. Interestingly, there has never been any such controversy over calling native mercury (liquid mercury) a mineral. Indeed, liquid mercury deposits are locatable under the Mining Law of 1872. In short, it is by law and by custom, not by science, that liquid mercury is a locatable mineral while liquid water is not.

If we conclude that water is the medium of transport for the valuable commodity calories, then perhaps the water could be considered as an industrial mineral or non-metallic mineral commodity. By common usage, the term "industrial mineral" has now supplanted the older term "non-metallic mineral."[22] The U.S. Bureau of Mines has defined industrial mineral as "[r]ocks and minerals not produced as sources of the metals but excluding mineral fuels."[23] Thus, ice is mined for its low calorie content, steam is produced for its high calorie content, and both are physical conditions of the "mineral" water.[24]

Water can also be defined and classified according to its mode of occurrence. This is true even with metallic minerals, at least legally. As an example, lode gold is subject to one set of laws and placer gold to another. The resulting definitions and difficulties in resolving origins and modes of occurrence often lead to legal disputes. In the case of water, the modes of occurrence of general interest are: meteoric water, connate water, juvenile water, and magmatic water.

When we speak of groundwater, we are usually speaking of meteoric water, which is "water that previously existed as atmospheric moisture, or surface water, and that entered from the surface into the voids of the lithosphere."[25] This definition would appear to be far too broad and inclusive for operational use since it fails to recognize time of rest in the ground and intermediate and

21. C. PALACHE, H. BERMAN & C. FRONDEL, THE SYSTEM OF MINEROLOGY 494 (7th ed. 1944).

22. AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, INDUSTRIAL MINERALS AND ROCKS VII (2d ed. 1949).

23. BUREAU OF MINES, U.S. DEP'T OF INTERIOR, A DICTIONARY OF MINING, MINERAL AND RELATED TERMS 577 (1968).

24. The Supreme Court has recently reaffirmed that water is not a mineral within the contemplation of federal mining law. The Court wrote that "in the context of the 1872 law, the notion that water is a 'valuable mineral' . . . is simply untenable." Andrus v. Charlestone Stone Products Co., 436 U.S. 604, 614 (1978).

25. Fay, *supra* note 20, at 431.

subsequent geologic processes. What was originally meteoric water may be converted by geologic processes into any of the other types of water. The principal classifications are:

(1) Connate Water—Connate water has been defined as "water which was deposited simultaneously with the deposition of solid sediments, and which has not since its deposition existed as surface water or atmospheric moisture."[26] If heated by subsequent geologic processes, a geothermal fluid composed of connate water would be the result. Most geopressured reservoirs appear to fall into this category.

(2) Juvenile and Magmatic Water—Juvenile water and magmatic water are terms that have led geologists into long-standing and continuing semantic controversies. The following definitions illustrate the confusion: "*Juvenile water.* Water from the interior of the earth which is new or has never been a part of the general system of groundwater circulation. See Magmatic water."[27] "*Magmatic water.* Water derived from cooling igneous magma. See also Juvenile water."[28]

The "juvenile water" definition is explicit and useable. This is new water that has never been meteoric water. The problem lies with the concept of "magmatic water."[29]

Unfortunately, we can safely conclude only that all geothermal water, regardless of its near term history and with the exception of minor traces of juvenile water, has at some time been either truly meteoric water or sea water (ignoring the ultimate origin of sea water). The problem is to establish, identify and quantify the geologic processes between water's meteoric or sea water period and the time of fluid production from the geothermal well, presuming the produced fluid to be primarily water. The picture will become more complex as soon as the first energy producing well that is non-aqueous goes on line, which will probably occur within this century. The working fluid in a non-aqueous system is hot CO_2 or hot methane. However, this article is concerned only with the problems of geothermal water, primarily aqueous systems.

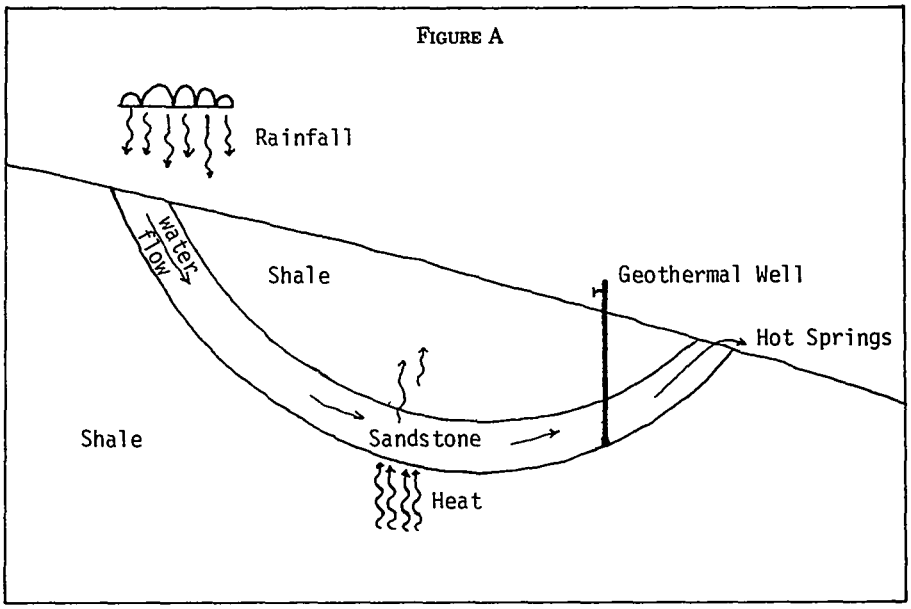
If the origin of the water alone cannot yield simple distinctions between ground and other "water" resources, can heat itself be the basis of a workable distinction? Heat can be encountered as the result of the geothermal gradient. Rocks produce measurable heat

26. *Id.* at 177.
27. *Id.* at 373.
28. *Id.* at 414.
29. Kennedy, *Some Aspects of the Role of Water in Silicate Melts in Crusts of the Earth, Special Paper 62*, in THE GEOLOGICAL SOCIETY OF AMERICA 489 (1955).

through radiometric decay, friction during folding, faulting, pore space collapse, and chemical processes. All of these phenomena combine to result in generally increased temperatures with increased depth—the result of both time and insulation by overlying materials. Typically, the gradient in the crust of the earth is 30°C per kilometer, though this ranges from 10°C to 50°C per kilometer depending on broad geologic variables.[30] In addition, locally very high gradients are associated with near surface geothermal systems where gradients of hundreds of degrees per kilometer can be obtained from shallow bore holes. However, we must recognize that water of any origin can be heated by conduction, convection, gaseous transfer, or other mixing processes, and water of any origin or any degree of former heat that has cooled off prior to discovery or production can be encountered.[31]

It is the combination of heat and a heat transfer medium that creates a geothermal deposit. Distinctions between geothermal and conventional groundwater resources must be based on these two factors. The following series of descriptions and illustrations show typical variations in conditions that can be expected.

FIGURE A



30. B. MASON, PRINCIPLES OF GEOCHEMISTRY 29-30 (1952).

31. An interesting collateral problem area might involve heat that is the result of man's activities. *In situ* combustion of coal and oil or tar sands has the potential for creating large amounts of heat. This may be as a by-product of hydrocarbon recovery or for the direct production of heat. Less widely known but equally possible is the *in situ* combustion of

In Figure A we have a permeable bed (transmits water easily) that collects rain water, conveys this water as meteoric water to depths where the normal (or an abnormal) geothermal gradient heats the water, and this heated meteoric water then is tapped by "geothermal" wells or emerges as hot springs. Variations on this theme involve: *time* because the emerging water may be quite old; *chemical composition* because the emerging water may have picked up a significant dissolved load of chemicals with time and distance from the recharge area; the emerging waters may be *original connate waters* still being flushed from the system; and the *heat source* itself may be adding both water and chemicals to the circulation system as well.

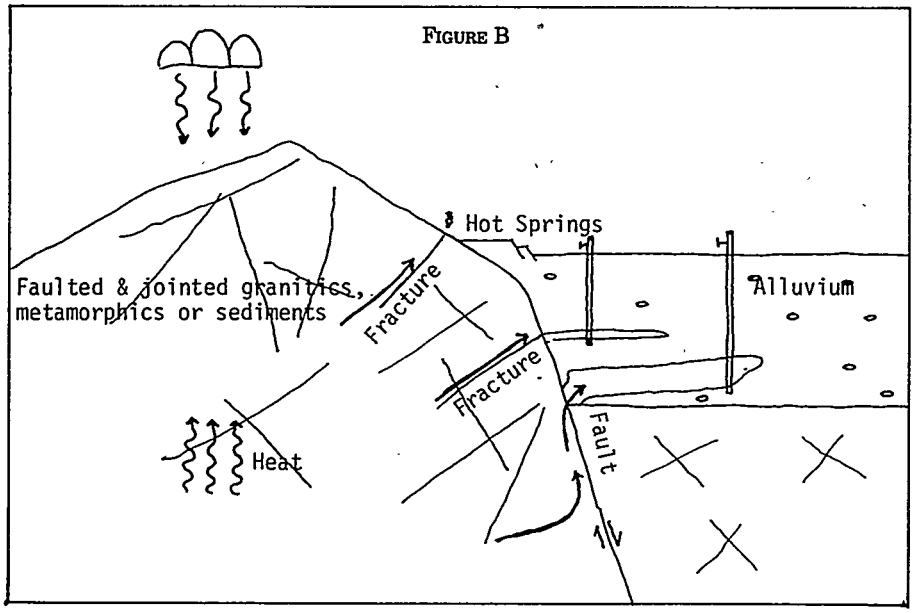
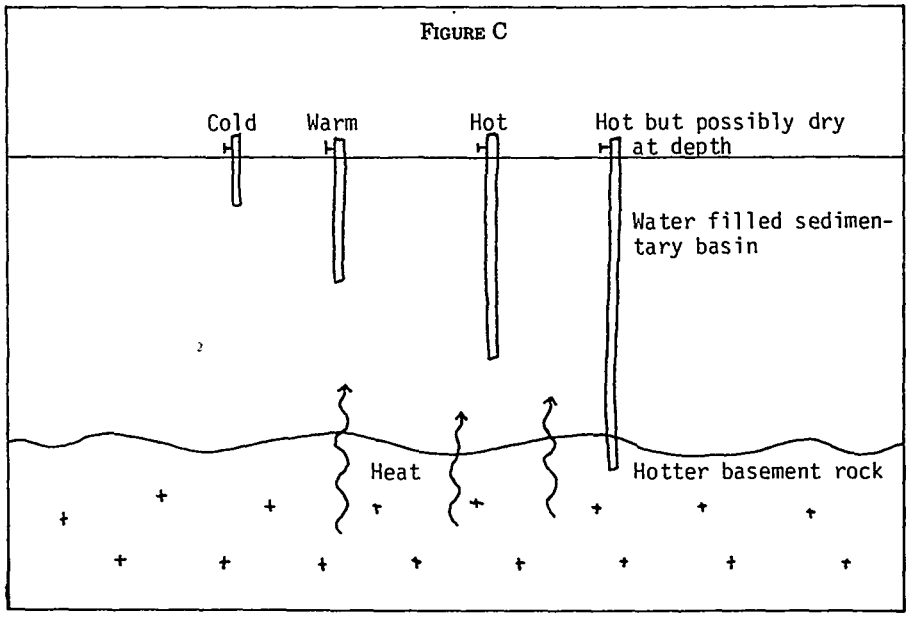


FIGURE B

In Figure B the fracture pattern, rather than a permeable bed, serves as the heat exchange system. Once again, heated meteoric water then emerges as a hot spring, or is tapped by wells in the subsurface alluvial environment adjacent to the frontal fracture system. The two "geothermal" wells may show very different chemistry. The fluids in these wells and springs may be simple meteoric water of varying ages, old hydrothermal fluids, magmatic, metamorphic, connate fluids, or a mixture of these. The present heat source may or may not contribute fluids and chemicals.

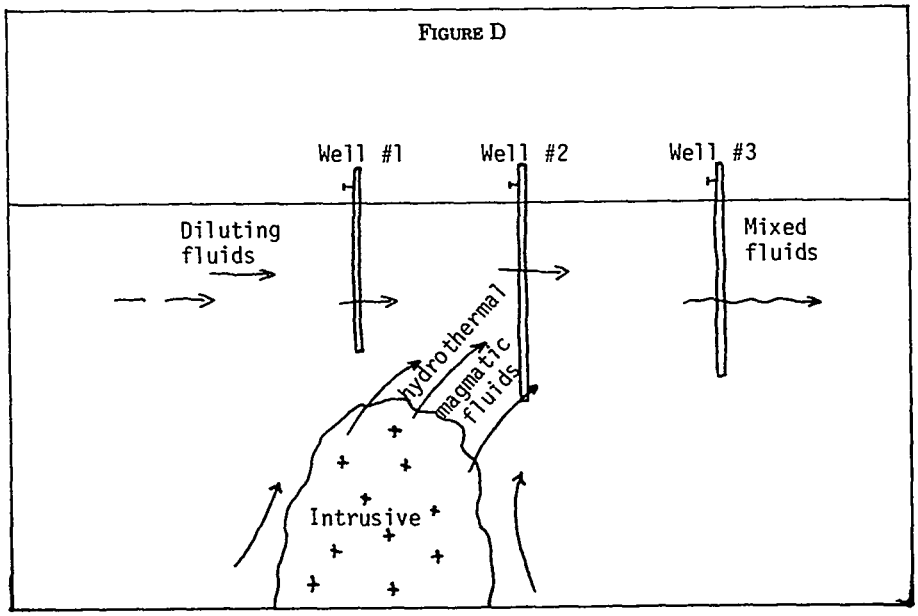
sulfides. This has been a perennial problem in the mining industry and is a phenomenon that may ultimately be exploitable.

FIGURE C



With Figure C we can have all three producing wells simply provide meteoric water at varying temperatures. Since the sediment filled basin may not be vertically homogenous with regard to "groundwater" quality, there may be considerable difference in the chemistry of the three wells in sediments. If the heat source is losing fluids, the picture becomes even more complex.

FIGURE D



With Figure D we are dealing with an identifiable heat source, that is, some sort of intrusion (mobilized or incipient). This intrusive system is pumping mineralized fluids from itself and its host into the overlying shallower potential reservoir. As illustrated, well #1 will produce cool to cold diluting fluids which are most apt to be meteoric water of some age but may in reality be any fluid type. If drilled deep enough, well #1 would pass into increasingly hotter and ultimately mineralized metamorphic and magmatic fluids. Well #2 at relatively modest depths should pass from diluting fluids into mineralized hydrothermal, metamorphic, or magmatic fluids. Well #3 should go through a fairly broad zone of mixed fluids, probably seeing a considerable span of nearly constant temperature. And if drilled to great depth, well #3 should undergo a constant or even reversed temperature gradient before finally seeing a renewed increase due to the regional geothermal gradient.

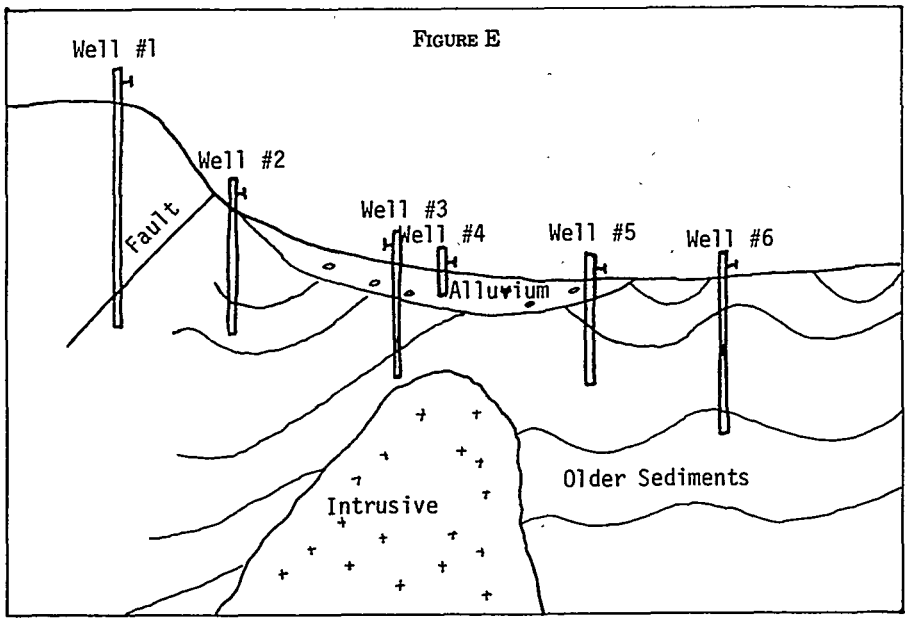


FIGURE E

As shown in Figure E, someone seeking to distinguish water from mineral can have a vexing problem. Well #1 is probably producing meteoric water heated by the geothermal gradient. Well #2 is producing meteoric water heated by the intrusive system. Well #3 is producing mineralized hydrothermal-magmatic fluids. Well #4 is probably producing ordinary meteoric potable water, but may in fact be producing a steam condensate that is totally unrelated to the surrounding ground water system. Well #5 is producing heated connate water and Well #6 is producing oil and gas.

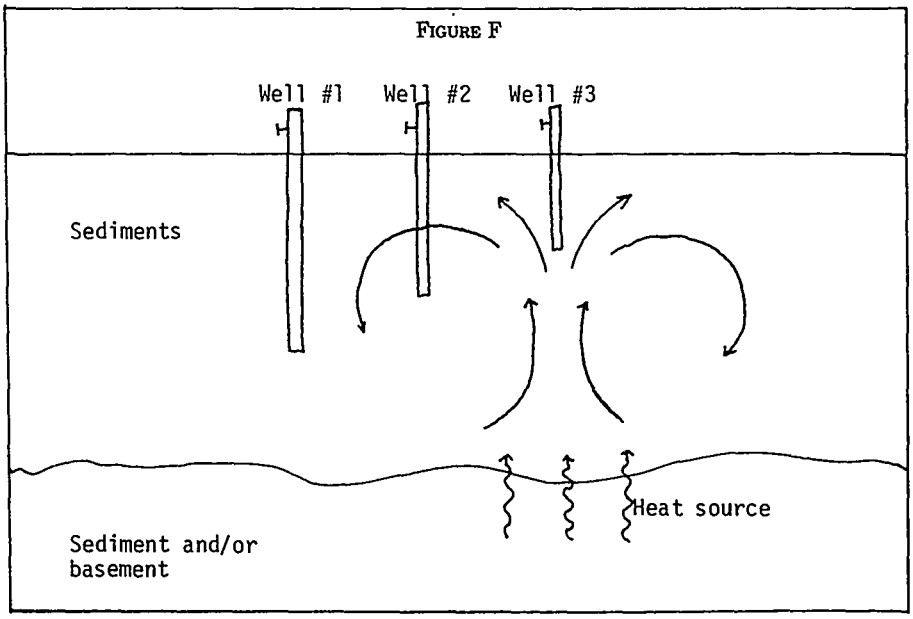
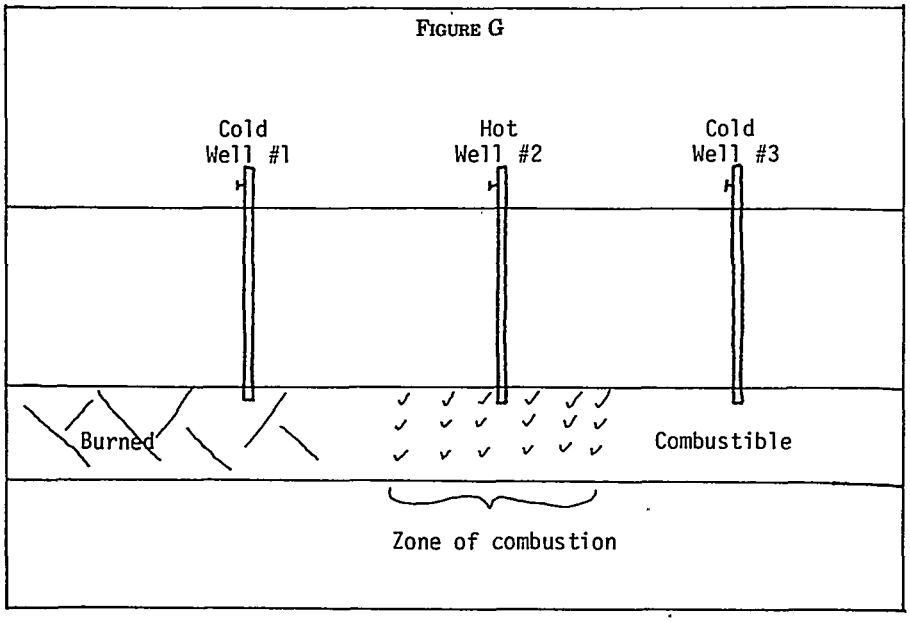


Figure F is simply the idealization of a convection cell (a Van Hise convection system). The fluids mixing in the central plume can be meteoric water, connate water, new mineralized hydrothermal water (from the current system), old mineralized hydrothermal water (from a former ore depositing system but still present as a residual fluid), mineralized magmatic or metamorphic waters derived from the heat source, or any mixture or combination of these. It is obvious that Wells #1, #2, and #3 will have quite different depth-temperature profiles and quite probably different depth-chemistry profiles. The term hydrothermal is used here to indicate fluids clearly capable of creating epigenetic ore deposits and their associated alteration halos.[32]

With Figure G we see an artificial combustion system. In the case of bedded and relatively thin deposits, the hot zone will slowly traverse an area. This will mean that wells will start as cold water wells, become hot wells, and then revert to cold status again. With a more vertical zone, as with many sulfide mineral systems, the hot front will not migrate. The water that is heated in relatively shallow systems is most apt to be shallow meteoric water, either naturally present or deliberately injected.

32. *See generally* A. BATEMAN, ECONOMIC MINERAL DEPOSITS (1942); T. CROOK, THE HISTORY OF THE THEORY OF ORE DEPOSITS (1933); C. PARK, JR., & R. MACDIARMID, ORE DEPOSITS (1964); Lindgren, *Ore Deposits of the Western States*, 1 AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS (1st ed. 1933).

FIGURE G



The problem, as shown in figures A through G, is to try to achieve a geologic interpretation that is legally functional and acceptable to competing claimants, operators, and near neighbors of any given geothermal system. There are no chemical or isotopic indicators that are universally accepted as defining a particular kind of water. Also, it is obvious that the use of any particular water is not always or even often related to the origin of the water, although meteoric water is more apt to be potable or usable for irrigation while connate, magmatic, and metamorphic are generally more mineralized (brines).

At the present time the problems of identifying the heat source, the fluid source for specific fluids produced, and the reservoir geometry continue to stretch the state of the geothermal art to its farthest limits and beyond. At many, if not all, geothermal systems we immediately run into conflicting geologic schools of thought, ranging from major concepts to minute details.

It is unfortunate that the early drive to consolidate conflicting commercial positions prior to full scale field development may force the premature acceptance of various technologic models. In the geothermal business, the inability of technology to identify kinds and sources of water in many instances is apt to remain real for the foreseeable future.[33] Whatever is done to establish the legal identity

33. A classic example of the difficulty of identifying and interpreting the results of a former geothermal system can be seen at the Yerington, Nevada, open pit copper mine. At

of geothermal deposits, it must at the very least accept that the origin of the fluids and the structure of the reservoir will rarely be identifiable with certainty. Usually, the origin and structure can only be predicted, hypothesized, and decided by a process of which the ultimate claim to legitimacy will be procedural fairness rather than scientific accuracy.

IV. Characteristics of a Property Rights Regime

Natural resources may be allocated at the discretion of the sovereign so long as vested rights are not impaired. Most would agree that once a government decides to allow the exploitation of a resource, the primary goal should be to promote efficient allocation of the resource. Efficiency is promoted by a legal system that provides the clearest possible definition of exclusive property rights and the simplest rules for the minimization of external costs.

Property rights that promote an efficient allocation of resources have at least three characteristics. Rights must be defined to accomplish (1) the maximum possible exclusivity, (2) the fullest transferability at the minimum possible cost of exchange and enforcement, and (3) the minimization of external costs.[34] As common pool resources, geothermal resources present difficult property rights assignment problems because physical interdependencies among overlying claimants demand that rights be defined correlatively. Nuisance-like externalities may exist[35] and geothermal resources present an additional definitional problem because rights must also be defined to allocate them between the geothermal developers and the other resource users.

The problem with which we are most concerned is the definition of geothermal property rights in relation to the property rights of water users. The minimization of external costs and the accomplishment of the objective of a clearly defined property right are often inconsistent with the first objective, exclusivity, of property rights assignment. A property right does not meet the criterion of effi-

this deposit (a fossil geothermal deposit which was excavated as an open pit for its copper content), it was not until nearly the entire former geothermal zone of deposition had been excavated—a hole some 6,000 feet long, over 2,000 feet wide, and 800 feet deep—that it was recognized that the entire former geothermal system and resulting copper deposit had been rotated and was lying on its side. It is most doubtful that an operator with data from only a scatter of drill holes could ever have interpreted the structure and minerology of this deposit.

34. *See generally* DeVany, Eckert, Meyers, O'Hann & Scott, *A Property System for Market Allocation of the Electromagnetic Spectrum: A Legal-Economic-Engineering Study*, 21 Stan. L. Rev. 1499, 1505-10 (1969).

35. *See* Tarlock & Waller, *An Environmental Overview of Geothermal Resources Development*, 13 Land & Water L. Rev. 289, 291-95 (1977).

ciency if promotion is not exclusive. Thus, a property right holder must be protected from interference from other users. To achieve exclusivity, rights must be defined so that one resource user's exercise of the right does not interfere with the legitimate enjoyment expectations of similarly situated users.

Sometimes it is technically possible to define rights exclusively in a way to avoid interference with third-party use. For example, property rights to radio frequencies have to be defined in terms of allowable output so there will be mutual protection from interference by other emitters. If we knew the relationship between geothermal and conventional groundwater reservoirs, a technical definition of geothermal rights that minimized interference might be possible. But, as previously demonstrated, we do not now know enough to confidently assign rights with the assurance that there will be no interference with conventional groundwater users.

The problem of assigning property rights efficiently in the face of uncertainty is similar to the choices a court must make in deciding whether an activity is a common law nuisance, and if so, whether the damaged property owner is entitled to damages or to injunctive relief. A geothermal property rights regime must choose between a rule which allows exploitation on the understanding that there may be liability after the fact and a rule which allows exploitation only after proof of no injury to holders of vested rights. Similarly, the choice in nuisance liability is whether an activity which interferes with the rights of others can continue if the damages it causes are paid, or only if it causes no damage.

A standard starting point to analyze these problems is the Coase theorem which postulates that, absent transaction costs, economic efficiency is independent of the initial entitlement decision.[36] With respect to geothermal resources, the lack of adequate scientific knowledge insures that the transaction costs—knowledge acquisition and organization of claim bargaining—may be substantial in any given conflict. Thus, the issue becomes: how should entitlements be distributed in the face of high transaction costs? In this situation Calabresi and Melamed have proposed the following allocation schedule: (1) rights should be first allocated to the most efficient user; (2) in the absence of certainty as to who this party is, rights should be allocated to the party who can best make a benefit-cost analysis of undertaking the activity; and finally, (3) in the absence of certainty as to who this party is, rights should be

36. Coase, *The Problem of Social Cost*, 3 J. L. & ECON. 1 (1960).

assigned to the party who can correct an allocation error with the lowest transaction cost.[37]

Calabresi and Melamed further argue that entitlement assignment involves a choice between property and liability rules. A property rule entitles the holder to keep the property unless he voluntarily relinquishes it at a price he sets. A liability rule protects only the holder's right to damages measured by objective standards and thus subjects the holder to a public or private taking with just compensation. A property rule usually affords protection by an injunction.[38] For example, conventional water users could claim a property rule against a geothermal developer on grounds (1) that geothermal developers can reduce the costs of interference with other resource users more cheaply than groundwater pumpers or (2) that transaction costs were low enough to enable geothermal developers to buy out groundwater pumpers.

The contention here is that the proper assignment of entitlements would give the conventional groundwater user an entitlement protected by a liability rather than a property rule. It is difficult, if not impossible, to decide in advance which resource claimant in any given conflict will be the more efficient. The suggestion that the geothermal operator is in the best position to make a preliminary benefit-cost analysis and act in mitigation if necessary is somewhat undercut by the scientific uncertainty under which a geothermal developer must act. However, despite this uncertainty, it seems fair to place some burden on a new resource use claimant given the reliance interests of existing users and the ability of a new user to collect the necessary information to gauge the impact of his activity on existing claimants. But a rule which assigns the conventional groundwater users an entitlement protected by a property rule is not socially desirable because an inefficient allocation of resources could result if a geothermal development could be enjoined solely because of possible interference with existing water rights. It would be both efficient and fair to confine existing water users to an entitlement protected by a damage rule. The geothermal operator could proceed knowing he would be liable to third parties for proved damages caused by his activity.

Another question is whether the entitlement should be exclusive. Efficient resource allocation requires that the right be exclusive. If the right is exclusive—within the constraints posed by the

37. Calabresi & Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral,* 85 HARV. L. REV. 1089, 1096-97 (1972).

38. *Id.* at 1105-10.

necessity to prevent third-party externalities—the issue becomes the manner in which one obtains an exclusive right. We argue that exclusive geothermal resource rights can best be created by assigning the exploitation right to overlying owners and then allocating rights among pumpers by a quota system. This can be done by assigning extraction quotas and adapting the oil and gas concepts of pooling and unitization to limit production by treating the common pool as a single operating unit subject to the shares of various overlying owners. Pooling and unitization would avoid the inefficient allocation of resources that would result from a pure rule of capture.[39]

Another examination of a proposed legal regime for geothermal development seems to reach an opposite conclusion.[40] Sato and Crocker argue that geothermal resources which are not subject to federal mineral ownership should be allocated by state law, even though a federal patent will be the source of title in most instances, because there is no federal interest sufficient to invoke the federal power under the property clause to control the disposition of the public domain.[41] This conclusion comports with the most recent Supreme Court case on the subject.[42] Sato and Crocker extend the Supreme Court's rule for the resolution of title disputes between rival claimants whose title traces back to a federal patent to a conclusion which does not logically follow from the rule. They argue that the states should reject the *cujus usque ad coelum* doctrine, which would assign ownership to the overlying owner, and instead allocate geothermal resources on a modified prior appropriation model.

Sato and Crocker find the *ad coelum* doctrine neither socially efficient nor constitutionally mandated. For the latter proposition, three analogies are offered: (1) western state precedents upholding the shift from the common law of overlying ownership of groundwater to prior appropriation; (2) the precedents upholding limitations on the surface owner's claims to super-adjacent airspace by declaring airspace suitable for flight; and not "used" by the landowner as navigable and thus subject to a public easement of flight; and (3) the recognition of the navigation servitude which denies compensa-

39. Goldstein, *Unitization for Geothermal Resources: United We Save*, 13 LAND & WATER L. REV. 159, 163-76 (1977).

40. Sato & Crocker, *Property Rights to Geothermal Resources*, 6 ECOLOGY L.Q. 250, 481 (1977).

41. *Id.* at 285-321.

42. Oregon v. Corvallis Sand & Gravel Co., 429 U.S. 363 (1977).

tion to those injured by the destruction or alteration of the bed or flow of a navigable water body.[43]

The first two analogies are inapt, and the third should not be extended beyond navigable waters. The application of the doctrine of prior appropriation to groundwater and the limitation of ownership of the super-adjacent airspace are instances where courts and legislatures recognized and protected the correlative rights of other deserving users. Prior appropriation was introduced because the common law provided no standards by which a common pool could be apportioned among similarly situated users. Thus, in return for "giving up" the right to pump at will, groundwater users were given the right to claim a certain amount. Similarly, the common law had never clearly defined the rights of landowners to the super-adjacent space. There was a need to make an initial assignment of rights which recognized both the claims of surface owners and the interests of society in noncompetitive uses.[44]

Unlike these situations, the purpose of the Sato and Crocker proposal is to redistribute natural resources from overlying landowners to those to whom the state chooses to grant the right to exploit geothermal resources. The navigation servitude analogy provides some precedent for such a shift as the servitude is a form of redistribution which subordinates private claims to public rights. However, the reasons for the continued recognition of the servitude do not support the refusal to recognize the geothermal ownership claims of overlying owners, for the navigation servitude is an inefficient doctrine. The servitude was originally recognized to deny compensation when a federal navigation improvement interfered with private improvements in navigable waters.[45] Subsequently, the doctrine was extended to deny riparian owners the value of land as fast land when the federal government condemned fast lands for navigation improvements.[46] The first group of cases are arguably justified on the theory that investments which interfere with long standing public uses are unreasonable. A similar "notice" theory has been used to support the denial of compensation in the second group of cases, but the case is a weak one.[47] Clearly, the notice rationale does not apply to geothermal resources. There is no historical basis for

43. Sato & Crocker, *supra* note 40, at 309-38.

44. *See* R. WRIGHT, THE LAW OF AIRSPACE (1968).

45. *E.g.*, Greenleaf Johnson Lumber Co. v. Garrison, 237 U.S. 251 (1915).

46. *See, e.g.*, United States v. Twin City Power Co., 350 U.S. 222 (1956).

47. The notice justification is soundly questioned in Morreale, *Federal Power in Western Waters: The Navigation Power and the Rule of No Compensation*, 3 NAT. RESOURCES J. 1, 23-25 (1963).

an argument that the state has put overlying landowners on notice that private claims will not be recognized.

The final problem with the Sato and Crocker proposal is their suggestion that a modified prior appropriation system is superior because it produces new revenues for the state. The gains in potential revenues seem to be offset by the direct costs of administering the system and the social losses from the increased uncertainty in obtaining a geothermal right. Any system that requires administrative supervision of resource exploitation will be costly, but the Sato and Crocker proposal suffers from the further defect that its administrative costs and potential social costs are high because it pointlessly increases the uncertainties of obtaining a protected geothermal right. The proponents do attempt to promote some certainty by insuring relation back from the time of the filing of applications,[48] but relation back fails to cure the basic flaws in the adoption of the law of prior appropriation to geothermal rights.

The major defect in the proposal is that it delegates too much discretion to the state agency to evaluate the activity in advance of field work. "The agency . . . must determine the applicant's ability to undertake the proposed program, the reasonableness of the proposed detailed exploratory activities, the time within which the program must be completed, whether the exploratory program complies with environmental regulations, and whether ultimate development . . . will interfere with prior appropriative rights."[49] Given the youth of the geothermal industry, the assignment of exclusive property rights, subject to reasonably clear constraints, seems the better way to achieve the societal goal of obtaining alternative energy sources.

V. The Initial Property Classification Attempts

Geothermal resources have now been classified by legislatures and courts, but, on the whole, the classifications were not directed at the problems with which this article is concerned. Legislatures have classified the resource (1) to assign geothermal development to an existing regulatory regime, (2) to provide a definition of a leasable resource on publicly owned lands, and, to a lesser extent, (3) to provide a definition of a leasable resource on private lands. Legislatures have given only limited attention to the problem of defining the correlative rights of geothermal developers *inter se* and

48. Sato & Crocker, *supra* note 40, at 552.
49. *Id.* at 534.

to the resolution of conflicts among rival claimants to the resource. Where mineral and surface estates in lands have been severed prior to the recognition of the potential of geothermal development, the classification task has largely fallen on the courts where, for constitutional reasons, it will likely remain as to historic mineral severances.

A. The Ownership Lawsuits

Cases have arisen between mineral owners and surface owners, claiming that the resource was not mineral but water, which have implications for the regulatory choices available to geothermal resources. In these cases the courts have exhibited a willingness to look behind labels and inquire what kind of water is involved in geothermal phenomena.[50] This same willingness to discriminate should allow regulatory choices to be made on more substantial grounds than labels such as water and mineral. It may make sense to apply some but not all of the laws and regulations dealing with water resources or with mineral resources. On the other hand, it may make sense to create new laws and regulations tailored specifically for geothermal resources.

Land ownership is often divided into a severed mineral estate and a surface estate. When there is such a severance, are the rights to the geothermal resources vested in the mineral owner or in the surface owner?[51] Or do the two estates in some manner share in the resources? Or, to state all of the possibilities, is the sovereign the proprietor with neither the nongovernment mineral owner nor the surface owner having any interest?

The initial ownership contest was between the federal government and a private surface owner claiming under a federal patent and involved the interpretation of the Stock Raising Homestead Act

50. For example, the Ninth Circuit was satisfied that congressional action with respect to water for livestock raising did not establish the legal order that should be applied to "underground sources of energy for use in generating electricity." United States v. Union Oil Co., 549 F.2d 1271, 1279 (9th Cir. 1977), *cert. denied sub nom.*, Ottoboni v. United States, 435 U.S. 911 (1977). A California court rejected the argument that the surface owner should have geothermal rights because it had rights to freshwater when, for the surface owner's purposes, "there is no realistic basis to find that the water condensed from the steam is or could be beneficial." Geothermal Kinetics, Inc. v. Union Oil Co., No. 75314, at 17 (Cal. Super. Ct. for Sonoma County, June 1, 1976).

51. The issue is one that is posed regardless of whether the overlying land owner is regarded as the "owner" of groundwater. In states where groundwater is a public resource, there is little likelihood that a geothermal developer will be allowed to exploit without securing rights from either the mineral owner or the surface owner and, perhaps, the state as well.

of 1916.[52] In that Act, Congress had provided for patenting federal land chiefly valuable for grazing and raising forage crops, but had also provided that all entries made and patents issued must "contain a reservation of coal and other minerals" which would be subject to disposal by the United States in accordance with coal and mineral laws.[53] At that early date, Congress did not have geothermal resources specifically in mind. Later, when it passed the Geothermal Steam Act of 1970,[54] Congress recognized the existence of possibly conflicting claims between its previous patentees and the United States and disclaimed any intent to legislate the answer. The Attorney General was authorized to initiate an appropriate judicial proceeding to test whether geothermal resources were retained by the United States.[55] The Act did provide, however, that future United States mineral reservations would "be deemed to embrace geothermal steam and associated geothermal resources."[56]

In 1972, the contemplated lawsuit was filed in the United States District Court for the Northern District of California to try title to geothermal resources in lands in The Big Geysers area. The court decided the case on cross motions for summary judgment and held for the surface owners.[57] In so doing, the court relied in part on opinions of the office of the Solicitor of the Interior Department during the 1960's. These opinions had concluded that geothermal steam water was essentially subterranean water heated to high temperatures, that water had been historically treated as a nonmineral in the public land laws, and that therefore the reservation of minerals should not be deemed to encompass geothermal steam.[58] The opinions cautioned, however, that any minerals connected with the steam "would, however, appear to be subject to the reservation."[59] The court accepted this characterization uncritically, rejecting the government's contention that superheated water or steam should be treated as a mineral within the meaning of the mineral reservation.[60]

52. Ch. 9, §§ 1-11, 39 Stat. 862 (1916) (repealed in part by the Federal Land Policy and Management Act of 1976, Pub. L. No. 94-579, § 702, 90 Stat. 2787 (1976)). This act repealed all of the old act except § 9 (codified at 43 U.S.C. § 299 (1976)).

53. 43 U.S.C. § 299 (1976).

54. 30 U.S.C. §§ 1001-1025 (1976).

55. *Id.* § 1020(b).

56. *Id.* § 1024.

57. United States v. Union Oil Co., 369 F. Supp. 1289 (N.D. Cal. 1973).

58. *Id.* at 1300-02.

59. *Id.* at 1300.

60. "Such a construction will not hold water: the authorities are convincing that water was not considered a mineral when § 9 was enacted, nor is water considered a mineral today." *Id.* at 1297.

The decision was unanimously reversed by the Ninth Circuit which found the Gertrude Stein analysis that "water is water" too facile and simplistic.[61] That analysis simply failed to take account of the actual nature of geothermal resources, the functions that they serve, and their dissimilarities to conventional groundwater. The water right that government patentees were to enjoy was freshwater for the use of livestock, not water for underground sources of electricity. In its opinion, the Ninth Circuit stated:

> Geothermal resources contribute nothing to the capacity of the surface estate to sustain livestock. They are depletable subsurface reservoirs of energy, akin to deposits of coal and oil, which it was the particular objective of the reservation clause to retain in public ownership. The purposes of the Act will be served by including geothermal resources in the statute's reservation of 'all the coal and other minerals.' Since the words employed are broad enough to encompass this result, the Act should be so interpreted.[62]

The court of appeals was unimpressed with the opinion of the Interior Solicitor. By specifically authorizing the litigation to try title, Congress had not approved the Solicitor's opinion. Therefore, the court of appeals deemed itself free to decide the question unfettered by any deference to agency interpretations or congressional approval of agency interpretations.[63]

The State of California found itself in the same position as the United States with respect to lands it had transferred subject to mineral reservations. In litigation over the effect of the state's reservations, the state has prevailed in a trial court,[64] and the surface owners have filed an appeal which is still pending. The trial court in its unreported opinion concluded that the following statutory language authorizing the state's mineral reservation was broad enough to include geothermal resources.

> Mineral deposits reserved to the State shall include all *mineral deposits* in lands belonging to, or which may become, the property of the state, including but not limited to, oil and gas, oil shale, coal, phosphate, alumina, silica, fossils of all geological ages, sodium, gold,

61. United States v. Union Oil Co., 549 F.2d 1271 (9th Cir.), *cert. denied sub nom.*, Ottoboni v. United States, 435 U.S. 911 (1977).

62. *Id.* at 1279.

63. The court distinguished the case from those such as Udall v. Talman, 380 U.S. 1 (1965), where deference was accorded to a contemporaneous construction by administrators who participated in drafting an act. 549 F.2d at 1279-80.

64. Pariani v. State, No. 657-921 (Cal. Super. Ct. for San Francisco County, memorandum of intended decision filed June 30, 1977; judgment entered, December 13, 1977).

> silver, metals, and their compounds, alkali, alkali earth, sand, clay, gravel, salts and *mineral waters* . . . .[65]

Geothermal fluids were found to be "mineral waters" and also "mineral deposits" under the above statutory language because of their genesis in and involvement with mineral phenomena. The court declined to decide the case on any general intent or functional analysis, which it believed improper in view of the specific mineral reservation language in the statute.[66] Nevertheless, the court found the specific language sufficient to support the state's claim under the patent reservations.

The final case in the mineral-owner-versus-surface-owner trilogy involved a mineral severance on privately owned California land.[67] In 1951, the owner of a parcel of land at The Big Geysers had granted to another

> [a]ll minerals in, on or under those certain lots . . . owned by the grantors of standing or record in their names lying south of Sulfur Creek . . . together with all easements and other rights necessary or convenient for the mining, production, extraction, milling and processing of such minerals, and including the right to erect, maintain and remove buildings, machinery and equipment . . . .[68]

The trial judge ruled in favor of the mineral owner, reasoning that the proper road to decision was through a functional analysis that looked beyond labels. He specifically rejected as "over-simplistic" the approach of the federal district court in the case involving the United States' reservation.[69] At that time the court of appeals had

---

65. CAL. PUB. RES. CODE § 6407 (West 1977) (emphasis added).

66. The trial court's conclusion that it could not inquire concerning any general intent is surely incorrect. There is nothing in the statutory language supporting the notion that only minerals named by name were reserved by the state. Indeed, the very language "mineral deposits" on which the court in part relies supplies the catch-all phrase to enfold unnamed minerals.

67. Geothermal Kinetics, Inc. v. Union Oil Co., No. 75314 (Cal. Super. Ct. for Sonoma County, June 1, 1976) (one of the authors of this paper was consulted in this case on the side of the mineral owner and assisted in the briefing).

68. *Id.* at 2.

69. The court stated:

> The traditional reasons for giving water to the surface ownership no longer exist in the case before the court. Here it is shown that water is brought to the surface only after a tremendously expensive extraction process. It emerges not in the form of water but as super-heated steam. Without very costly condensation facilities, it would escape in the air and be lost to the land forever by evaporation. Even with the best cooling facilities presently available, 75% of the water is still lost through evaporation. The 25% which is recovered through condensation is highly toxic and corrosive. It is dangerous to or destructive of vegetation and will not meet current requirements for drinking purposes. It cannot be used agriculturally or domestically without first undergoing a filtering

not yet reversed the district court. Geothermal resources were found analogous to coal, oil, and gas, which are clearly regarded as mineral resources in California, and the fluid content of the resource was found to be entirely unlike the water that is owned and used by surface owners. The opinion leaves room for others to argue for contrary results when they can show water properties different from those at The Big Geysers. The decision was affirmed by California's intermediate appellate court and the California Supreme Court subsequently refused to hear the case.[70]

Although the three cases have distinguishable facts, they do suggest an evolving principle classifying geothermal resources as part of the mineral estate. For the moment, the cases are unanimous that geothermal sources are more akin to minerals than nonmineral surface values, and that the functions served by geothermal resources parallel the functions served by oil, gas, and coal. Therefore, they should be part of the severed mineral estate. It is possible, of course, that divergent answers could be reached in different jurisdictions.

Colorado recently faced, in a different context, the issue of what water is. An appropriator had historically received silt-laden water which helped prevent seepage losses in his naturally lined distribution canals. After the Federal Government built an upstream dam and began delivering clean water, the appropriator brought an action in the United States Court of Claims on the ground that the clean water would not irrigate as much land due to seepage losses. Thus, the Government had interfered with a prior vested water right. On certification from the Court of Claims, the Colorado Supreme Court denied the claim, reasoning that "[s]ilt . . . is not a component of water. Rather, it is suspended sediment which comes principally from the banks and bottom of an onrushing stream and which settles to the bottom when there is no longer movement of the water."[71] The case illustrates a welcome willingness on the part of state courts to adopt definitions of water that turn on the use made of the components, although such a functional analysis might have suggested the opposite result in the case.

---

process which is said to be prohibitively expensive. The water is so impure that the Water Quality Control Board requires that it be reinjected into the earth. Steam, as steam, is not beneficial to the land, and there is no realistic basis to find that the water condensed from the steam is or could be beneficial.

Id. at 16-17.

70. Geothermal Kinetics, Inc. v. Union Oil Co., 75 Cal. App. 3d 56, 141 Cal. Rptr. 879 (1977), *hearing denied* by California Supreme Court, January 25, 1978.

71. A-B Cattle Co. v. United States, 589 P.2d 57, 59 (Colo. 1979) (4-3 decision).

It is useful, of course, to have the question of ownership answered, regardless of the ultimate victor, since the elimination of doubt will remove a potential deterrent to development. Proprietorship, however, does not determine whether or how state water laws might apply to geothermal development. It would not be illogical to assign proprietorship to the mineral owner and, at the same time, regulate geothermal wells pursuant to water laws. This would merely multiply the number of stops for the would-be developer who would have to secure both a geothermal lease or other property right from the mineral owner (or, the surface owner if the cases should go the other way) and an appropriative right from the state for any water to be produced.

B. State and Federal Legislation

The federal government and thirteen western states have some form of regulation of geothermal development, generally passed subsequent to 1965. Prior to the passage of federal and state legislation, there was great uncertainty over the proper legal classification of geothermal resources, and it was believed that this uncertainty impeded development. Two competing classifications were suggested—mineral and water. Most legislation followed one of these models, although some states classified them *sui generis* to no particular end.[72] The primary objective of most legislation was to provide a legal structure which would induce development of the resource.[73] The federal government and most states authorized leasing on lands they owned. Most states undertook to provide a definition to regulate drilling on privately owned lands to deal with the risks of blowouts, pollution, and other perceived problems. Some states also enacted unitization statutes to increase the efficiency of resource recovery.

By and large, however, integration of the resources into the property rights regimes of other resources has been a secondary

72. A useful discussion of the purpose of classification, emphasizing the need to separate geothermal from water resources, is an address by B. Scarto, State Policies for Geothermal Development: Uncovering a Major Resource, at 43-46 (National Conference of State Legislatures, Nov. 1976). *See also,* Elmer & Rogers, *Legal Issues in the Development of Geopressured-Geothermal Resources of Texas & Louisiana Gulf Coast,* V SECOND GEOPRESSURED-GEOTHERMAL ENERGY CONF. (1976). The article contains a useful discussion of existing resources. The authors emphasize the need to define more precisely the different sources of geothermal energy. The latest classification and analysis is *ABA Geothermal Energy Comm., Annual Review of Significant Activities,* 10 NAT. RESOURCES LAW. 64 (1977).

73. The lack of suitable legal rules was the focal point of the first major survey of the law of geothermal resources. Olpin, *The Law of Geothermal Resources,* 14 ROCKY MTN. MIN. L. INST. 123 (1968).

objective of classification. For this reason, to solve the problems we are addressing, no great weight can be assigned to existing definitions. This is unfortunate because it makes a difference where geothermal resources are placed in the scheme of previously recognized property right systems. Constitutional protections of vested property rights prevent legislatures from solving all conflicts by the simple expedient of classification, but a definition can avoid some needlessly constraining conflicts and provide a framework for the solution of others.

Because the object of state legislation has been to lease geothermal resources, it is not surprising that many states elected to treat geothermal resources as minerals, either expressly or implicitly. In most western states, water is said to be the property of the state in the sense that the state, in its sovereign capacity, is trustee for the public. In general, private rights can be acquired but only by a state-granted license based on priority of appropriation (or in Colorado by a valid appropriation). If geothermal resources are classified as water, the overlying landowner would have no right to lease them. Further, "ownership" by that state could be invoked to assert a right to lease all nonfederally-owned geothermal resources. There have been vigorous constituencies within each state urging treatment as water; states that seem to elect to classify geothermal resources as minerals often have, in fact, dual classifications embedded within their statutes.

California and New Mexico were the first states to regulate geothermal development, and other states have either followed their lead or that of the Geothermal Steam Act of 1970. The California Act defines geothermal resources as

> [t]he natural heat of the earth, the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or which may be extracted from, such natural heat, and all minerals in solution or other products obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth, but excluding oil hydrocarbon gas or other hydrocarbon substances.[74]

The federal definition, by contrast, is:

> [G]eothermal steam and associated geothermal resources means (i) all products of geothermal processes, embracing indigenous steam hot water and hot brines; (ii) steam and other gases, hot water and hot brines resulting from water, gas, or other fluids artificially intro-

74. CAL. PUB. RES. CODE § 6903 (1977).

> duced into geothermal formations; (iii) heat or other associated energy found in geothermal formations; and (iv) any by-product derived from them . . . .[75]

New Mexico[76] and Hawaii follow the California model with regulatory jurisdiction assigned to the state oil and gas commission or the state lands department. In addition, Hawaii expressly classifies the resource as mineral.[77]

An immediate problem presented by the California definition is the characterization of the heat transfer medium. The definition does not clearly include water as a geothermal resource. The energy and extracted solution minerals clearly are geothermal resources, whereas oil, hydrocarbon gas, and other hydrocarbon substances are not. It could be argued that water is part of the resource by virtue of the provision including energy "in whatever form" since the energy is usually in fluids that transport geothermal energy. But a contrary argument can be made from the definition's inclusion of minerals and other products derived from fluids.

If the exploitation of hot rocks proves commercially feasible, the medium will be injected water. The heat transfer medium therefore links geothermal reservoirs to conventional sources of water. On the other hand, the use to which geothermal resources are likely to be put, *e.g.*, the generation of electricity, links them economically to the hydrocarbon minerals, oil and gas, although the mechanics of an oil and gas reservoir and a geothermal reservoir are quite different. Thus, geothermal resources are potentially linked to two resources that are governed by quite different regulatory regimes.

Oregon and Idaho have adopted the California definition but go further and take a position on the heat transfer medium thus blending the California and federal definitions. Oregon excludes hot waters of less than 250°F bottom hole temperature from its geothermal steam act.[78] This results in a dual mineral water regime for geothermal resources. The 250° or over limitation was designed to exclude the hot-water wells around Klamath Falls and other areas of the state which have long been used for space heating. These wells are treated as water wells and to date the state has not restricted hot-water pumping. Idaho adds the following to the California definition: "Geothermal resources are found and hereby declared to be *sui generis,* being neither mineral resource nor a water resource, but

75. 30 U.S.C. § 1001(c) (1976).
76. N.M. STAT. ANN. § 71-5-3A (1978).
77. HAW. REV. STAT. § 182-1(1) (1976).
78. OR. REV. STAT. § 522.025 (1977).

they are also found . . . to be closely related to and possibly affecting and affected by water and mineral resources in many instances."[79] Geothermal resources in Idaho might be characterized more aptly as *quasi sui generis* resources because the resource is potentially regulated as water. Geothermal development is regulated by the Idaho Department of Water Administration. Idaho has a leasing statute, but an appropriation is required if the geothermal well involves the use of water "for any beneficial purpose other than as a mineral source."[80] What the Idaho solution teaches is that just as assignment to a traditional natural resource category does not solve hard inter-resource user conflicts, the creation of a meaningless new classification is equally ineffective. Idaho's neighbor, Montana, has adopted the Idaho definition for leasing on state lands. Perhaps recognizing the difficulties, however, Montana adds: "unless the context requires otherwise."[81]

The other competing definition of the resource, the federal definition, differs from the California definition in that it includes the heat transfer medium. Otherwise, both definitions treat geothermal heat as essentially a mineral resource. Arizona[82] and Colorado[83] have adopted the federal definition. Arizona goes further by including "any artificial stimulation or induction" of the geothermal reservoirs and it has a slightly different by-product definition. Arizona has anticipated the possibility that steam may be produced by injecting water into hot rocks.[84] Washington's statute is similar to the federal model. The heat transfer medium is included in the definition of the resource but geothermal resources are limited to those "from which it is technologically possible to produce electric energy commercially . . . ."[85]

A final group of states has adopted neither of these definitions but treats the resource as water. Wyoming amended the definition of underground water in 1973 to include "geothermal steam and hot water," and an appropriation permit is required.[86] Utah has apparently reached the same result. The resource is not yet defined in Utah law, but in 1973 the Division of Water Rights was given juris-

79. IDAHO CODE § 42-4002(c) (1977).
80. *Id.* § 42-4003(b).
81. MONT. REV. CODES ANN. § 81-2602(1) (Supp. 1977).
82. ARIZ. REV. STAT. ANN. § 27-651(b) (Supp. 1978).
83. COLO. REV. STAT. § 34-70-103(6)(a) (Supp. 1976).
84. ARIZ. REV. STAT. ANN. § 27-651(6) (Supp. 1978).
85. WASH. REV. CODE ANN. § 79.76-030 (Supp. 1978).
86. WYO. STAT. § 41-3-90(6)(ii) (1977). Wyoming uses three California definitions in its lease forms.

diction over "all wells for the discovery and production of water to be used for geothermal energy production in the State of Utah . . . ."[87] Similarly, Montana includes geothermal resources within the definition of groundwater.[88] Nevada, which has a great deal of potential geothermal sites, classified the resource as water by a 1965 opinion of the Deputy Attorney General and requires all drillers to obtain a permit to appropriate.[89] In 1975 the situation became somewhat more confused when the legislature defined the resource simply as "heat or other associated geothermal energy found beneath the surface of the earth."[90] Regulation is still by the State Engineer's Office, but the 1975 legislation allows him to adopt special regulations for geothermal development.[91]

These statutory definitions are not the only place where the relationship between geothermal and water resource development is addressed. States have references to water used in geothermal development, water recovered from steam and liquid brines, and waste disposal. However, these additional references add little to the resolution of the conflicts with which we are concerned.

VI. Possible Water Rights Claims by Federal Lessees

Geothermal development may occur on lands owned by the federal and state governments and on privately held land. It seems relatively clear that the applicable state property law regime for geothermal resources will apply to development on state and privately held land. The question of whether conflicts between federal geothermal lessees and conventional water users claiming under state law will be resolved by federal or state law is more complicated. In a previous article two of the authors have discussed at length whether federal or state law applies,[92] and we only summarize our conclusions here.

The Geothermal Steam Act of 1970[93] opens considerable public land to geothermal leasing. It appears that the Act requires that the right to use commercially demineralized water obtained incident to the conversion of geothermal fluids to electricity or heat be secured under state law.[94] But, Congress left to the courts the issue of

87. Utah Code Ann. § 73-1-20(1) (Supp. 1979).
88. Mont. Rev. Codes Ann. § 81-2602 (Supp. 1975).
89. Garside, Geothermal Development in Nevada Through 1973, at 8 (1974).
90. Nev. Rev. Stat. § 322.005 (1977).
91. *Id.* § 534 A.020(1).
92. Olpin & Tarlock, *Water That Is Not Water,* 13 Land & Water L. Rev. 391 (1978).
93. 30 U.S.C. §§ 1001-1025 (1976).
94. *Id.* § 1008. The Secretary of the Interior's regulations require the geothermal

whether federal or state water law applies to lessee-conventional pumper conflicts.[95] Under Supreme Court opinions[96] interpreting the Desert Land Act of 1877,[97] state law will apply unless the geothermal developer can claim federal reserved rights to trump state-based water rights.[98] A federal reserved water right arises when land is withdrawn from entry for a purpose which can be said to carry with it either express or implied water rights. These water rights are not defined by state law, do not depend on an actual application to a beneficial use, and are superior to state-based rights which arise subsequent to the date of the water-related withdrawal.[99] A geothermal lessee would base his reserved rights claim on three withdrawals, two of them expressly withdrawing land for geothermal development,[100] and *United States v. Cappaert,*[101] which appears to extend reserved rights to groundwater.

We conclude that a federal lessee should not be given reserved rights for geothermal development. We further conclude that if the federal government finds that the application of state water law to geothermal development would frustrate the objectives of the

---

operator to make royalty payments on recovered, demineralized water, 43 C.F.R. § 3200.05(e) (1978), but a persuasive argument can be made that the royalty payment called for in the regulation is contrary to the 1970 Act. If state water laws are fully applicable to commercially demineralized water, no by-product royalty should be owed to the United States.

95. 30 U.S.C. § 1021 (1976) provides: "Nothing in this chapter shall constitute an express or implied claim or denial on the part of the Federal Government as to its exemption from State water laws."

96. California-Oregon Power Co. v. Beaver Portland Cement Co., 295 U.S. 142 (1935); Winters v. United States, 207 U.S. 564 (1908).

97. 43 U.S.C. § 321 (1976).

98. The leading case is Winters v. United States, 207 U.S. 564 (1908).

99. United States v. Cappaert, 426 U.S. 128 (1976). *See* Meyers, *Federal Groundwater Rights: A Note On* Cappaert v. United States, 13 LAND & WATER L. REV. 377 (1978).

100. The first withdrawal is an executive order issued by President Hoover, Exec. Order No. 5389 (July 7, 1930), withdrawing vacant and unappropriated lands containing hot springs from development. The second is a 1967 withdrawal of all lands valuable or prospectively valuable for geothermal steam from appropriation under all mineral location or mineral leasing laws. 32 Fed. Reg. 2588 (1967), *as amended by* 32 Fed. Reg. 4317 (1967). The amendment limited the location of the withdrawn land to quiet a furor which arose over the scope of the earlier withdrawal. On the history and scope of mineral appropriation laws see R. Swenson, *Legal Aspects of Mineral Resources Exploitation,* in HISTORY OF PUBLIC LAND LAW DEVELOPMENT (1968). The third withdrawal is the Geothermal Steam Act of 1970, 30 U.S.C. §§ 1001-1025 (1976). A 1961 Solicitor's opinion holds that the 1930 withdrawal effectively withdrew geothermal sites but this conclusion seems wrong. Op. Solic. Dep't of Interior, M-36625 (August 28, 1961). The 1967 withdrawal is a sounder basis for geothermal lessees, but the validity of the withdrawal is in question because it seems to rest on the implied authority of the executive and does not comply with the Pickett Act, 43 U.S.C. § 141 (1976). The Federal Land Policy and Management Act of 1976, 43 U.S.C. §§ 1701-1782 (1976), creates a statutory procedure for future executive withdrawals but the validity of pre-FLPMA withdrawals must be determined by prior law.

101. 426 U.S. 128 (1976).

Geothermal Steam Act of 1970, the federal government should exercise its power under the supremacy clause to override state law. A supremacy clause solution is a fairer accommodation of federal and state interests than the recognition of federal reserved rights would be because the holders of state water rights who claimed injury as a result of federal development could urge their constitutional claims under the fifth amendment if they can show that their property has been taken for public use without just compensation.[102]

Our conclusion follows from the premise that reserved water rights have historically been limited to instances where a specific tract of withdrawn land was identified *and* the contemplated water use was reasonably necessary to accomplish the purposes of the withdrawal. Geothermal development on federal lands will differ markedly from the historic case where reserved rights have been recognized. Apart from the specification of geothermal prospect areas in one withdrawal, it is not possible to ascertain from the withdrawals the lands to which federal reserved rights might attach. Thus, even the weak notice provided by withdrawals of specific tracts of land for a water-related purpose is absent here. A court would have to recognize an inchoate federal reserved right in all federal lands awaiting development, and to further complicate the issue, the priority date of the withdrawal is not clear as plausible arguments can be made for either 1967 or 1970. Furthermore, not only have reserved rights historically attached to specific tracts of withdrawn land, but the recognition of these rights has been limited to cases where the use of water by the federal government was reasonably necessary to serve the values for which the land was withdrawn at the site of the withdrawal. In contrast, the purpose of geothermal development would presumably be to serve values away from the lands on which the extraction occurs; geothermal fluids would not be used in relation to the land in the same way that conventional waters have been used on withdrawn lands.[103]

Our conclusions are supported by the recent Supreme Court opinion in *United States v. New Mexico*[104] and an opinion of the Solicitor of the Department of the Interior on federal non-Indian

102. *See, e.g.*, Dugan v. Rank, 372 U.S. 609, 624-25 (1963); Ivanhoe Irrigation Dist. v. McCracken, 357 U.S. 275, 290-91 (1958).

103. In dictum, however, the Supreme Court has alluded to the possibility that naval petroleum and oil reserves for oil shale carry with them reserved rights "to accomplish the purpose for which the reservation was made." United States v. District Court, 401 U.S. 527, 529 (1971). The contrary argument is made in Holland, *Mixing Oil and Water: The Effect of Prevailing Water Law Doctrines on Oil Shale Development*, 52 DEN. L.J. 657, 682-88 (1975).

104. 98 S. Ct. 3012 (1978).

reserved rights. *United States v. New Mexico* arose out of a Forest Service claim for reserved rights for instream flow maintenance, recreation enhancement, and stock watering in the Gila National Forest which was created pursuant to the Creative Act of 1891[105] and the Organic Administration Act of 1897.[106] In a five-to-four opinion, the Court, per Justice Rehnquist, held that reserved rights would only be recognized if the federal government needed the water to prevent the purpose of the withdrawal from being frustrated. In dictum, the Court introduced a new distinction into the law of reserved rights by suggesting that not only must the water be necessary to carry out the purpose of the withdrawal in cases where the water right arises by implication, but the water-related purpose must be a primary, not secondary, purpose of the withdrawal. Justice Rehnquist's analysis is open to question, but for our purposes the important point is that the Court has made the indentification of a specific tract of land for which a water right is used essential to the accomplishment of the objective of the withdrawal. Equally important for our analysis is that all members of the Court agreed that the Forest Service could not claim reserved rights for stockraising permitees. A recent opinion from the Solicitor of the Department of Interior regarding federal non-Indian reserved rights extends the analysis of *United States v. New Mexico* to deny reseved water rights for oil shale development and for Taylor Grazing Act permittees.[107] In our view this reading of *United States v. New Mexico* is the right one, for there is no need to give a federal lessee a water right potentially superior to those created under state law. The federal objective of permitting energy development on the public lands is not, without clearer congressional guidance, so important that it should require that a federal lessee be put in a better position than a lessee on state or private land. To do so would allow the destruction of some state-created rights without compensation.

VII. The Case Against Application of Western Water Law Doctrines to Geothermal Development

If geothermal resources are characterized as water, they doubtless will be further classified as groundwater. This classification could frustrate the exploitation of geothermal resources as the expe-

105. 16 U.S.C. § 471 (1976).

106. *Id.* § 473 (1976).

107. Op. Solic. Dep't of Interior, M-36914 (1979) *reprinted in* BLM, Bureau of Reclamation & Fish & Wildlife Service, Dep't of Interior, Federal Water Rights of the National Park Service 35-37 (July 25, 1979).

rience of western states in regulating groundwater use is not a promising model for geothermal development. The consequence of this classification is that, in all western states except Arizona and California, rights to geothermal resources might have to be acquired by perfecting a valid appropriation. It is only within the past two or three decades that most western states have required that groundwater rights be appropriated and thus the contours of groundwater appropriation law remain undefined in many crucial areas.

The withdrawal rates that may be optimum for a groundwater reservoir are unlikely to be optimum for a geothermal reservoir. For example, the states with extensive experience in applying the appropriation doctrine to groundwater in declining basins have found it easier to cut off access to a basin at some point and let all the previous pumpers draw equally than to try to adjudicate priorities among pumpers. The law of groundwater either provides unnecessary constraints to the geothermal developer or troublesome uncertainties.

A geothermal developer may face two basic types of water-related conflicts. First, he may be in competition with conventional users and, second, his disposal of geothermal wastes may threaten contamination of a common source of supply. Supply conflicts may arise (i) when existing pumpers seek to stop the drilling of a geothermal well, (ii) when a producing well has been drilled and existing pumpers seek damages or injunction or both, or (iii) when the state attempts to block a well on the ground that the development will involve a use of water that is not in the public interest. Pollution conflicts will generally arise when the geothermal developer either inadequately seals off wells from groundwater aquifers or reinjects wastes for conservation, and environmental reasons, causing existing ground and surface water users or the state to complain of the resulting pollution.

In the case of supply conflicts, geothermal development should be presumed *not* to interfere with conventional water users. This presumption must be a rebuttable one. The purpose is not to allow a geothermal developer to injure prior vested water right holders, unless the state makes an explicit choice that some injury is in the public interest. Rather, the purpose is to minimize the needless constraints on geothermal development by eliminating conflicts based on hypothetical interferences with conventional water sources. No such comparable presumption in favor of the geothermal developer is warranted when the alleged injury is water pollution. Geothermal development is simply a form of waste-generating

activity and should be subjected to the ordinary operation of federal and state pollution laws.

An appreciation of the proper resolution of geothermal-water supply conflicts must start with an understanding of the differences between the law of mineral exploitation and western water use. If existing states' water laws are applied across the board to the geothermal development, it could hinder development of geothermal resources. Generally, mineral laws provide a more apt model.

The argument that there should be no blanket application of state and federal water laws to exploitation proposals is developed as follows: (i) an examination of the different assumptions underlying mineral and water exploitation; (ii) an examination of the possible constraining aspects of the groundwater law of the fourteen western states which possess potential for geothermal development in the immediate future; and finally, (iii) an examination of the means of implementing the presumption of noninterference and an examination of situations where the presumption might be overcome.

A. Assumptions Underlying Mineral and Water Exploitation

This section contrasts the assumption underlying the exploitation of oil and gas, which are the minerals most closely analogous to geothermal resources, and water.

The law governing the exploitation of oil and gas proceeds on the assumption that these resources are finite, exhaustible, and generally should be exploited according to market demand. The law implements this by giving overlying landowners, public and private, the right to capture oil and gas beneath their lands.[108] The right to capture is subject to the equal right of adjacent landowners to do likewise so long as each landowner confines his drilling to vertical planes extending downward from the surface.[109] There are three

108. Due to the early scientific uncertainty about oil and gas reservoir mechanics, different theories to describe the surface owner's interest were advanced. Some states adopted the non-ownership theory of oil and gas which holds that no person owns the oil and gas until it is produced. Most major producing states now follow the ownership-in-place theory which equates ownership of oil and gas with ownership of solid subsurface minerals. A survey of the impact of these theories on the landowner's right to produce, and the state's power to regulate, concludes: "[T]he theory held by the state is of little importance apart from its influence on the classification of mineral, royalty, and leasehold interests as corporeal or incorporeal . . . ." 1 H. WILLIAMS & C. MEYERS, OIL AND GAS LAW § 204.9 (1959). For this reason we speak of the rule of capture without any further effort to distinguish between those states which follow the non-ownership theory and those which follow the ownership-in-place theory. For a classification of states, *see id.* at § 203.1-3.

109. *Id.* at § 227.

major exceptions to the law of capture, but they do not challenge the premise that finite resources should be exploited according to market demand. First, federal and state governments as landowners can either withdraw land from leasing to meet future needs *(e.g.,* to assure adequate supplies in time of war) or reserve resources from exploitation to serve higher public purposes[110] *(e.g.,* some potentially valuable geothermal lands are unavailable for development because they are in areas reserved as national parks). Also, state governments can, in effect, withdraw resources from production by establishing, as was done before the 1973 Arab oil embargo, production quotas to avoid physical waste or to maintain prices.[111] Second, the judicial and statutory recognition of correlative rights constrains the right to capture.[112] Judicial correlative rights in oil and gas are not recognized to allocate a common supply on some principle of fairness, but only to assure each pumper the right of fair access to the common supply.[113] The doctrine prevents the deliberate waste of a resource by depleting a common source of supply,[114] negligent drilling operations that waste the common supply,[115] and actions such as the negligent failure to plug an abandoned well, resulting in the

110. 1 AMERICAN LAW OF MINING § 2.1 (1978). Increasingly, the terms "withdrawal" and "reservation" are used interchangeably to describe legislative or executive action which segregates a designated area of federally owned land from access under the federal laws relating to entry, location, or lease. Courts, however, occasionally refer to reservations as permanent withdrawals, and withdrawals as temporary withdrawals. United States v. Consolidated Mines & Smelting Co., 455 F.2d 432, 444-45 (9th Cir. 1971). We maintain this distinction between reservation and withdrawal in order to differentiate between actions which require congressional action to reverse, and, where such action is unlikely to occur, interim executive or legislative classifications which may change in response to new conditions. For a discussion of the various reservations and withdrawals of federally owned land and of the status of the mineral claimant on them, see 1 AMERICAN LAW OF MINING §§ 2.46-.63 (1978).

111. Proration was instituted to insure maximum possible reservoir recovery and to restrict statewide production to the estimated demand for the next ensuing period. For a discussion of pre-1973 market-demand proration, see W. LOVEJOY & P. HOMAN, ECONOMIC ASPECTS OF OIL CONSERVATION REGULATION 127-84 (1967).

112. In Ohio Oil Co. v. Indiana, 177 U.S. 190 (1900) the Supreme Court defined correlative rights for the purpose of sustaining a state law requiring that gas wells be capped as follows:

> Hence it is that the legislative power, from the peculiar nature of the right and the objects upon which it is to be exerted, can be manifested for the purpose of protecting all the collective owners, by securing a just distribution, to arise from the enjoyment by them, of their privilege to reduce to possession, and reach the like end by preventing waste.

Id. at 210.

113. The leading discussion of correlative rights is Kuntz, *Correlative Rights of Parties Owning Interests in a Common Source of Supply of Oil or Gas,* SEVENTEENTH ANN. INST. OIL & GAS LAW & TAX. 217 (1966).

114. Louisville Gas Co. v. Kentucky Heating Co., 117 Ky. 71, 77 S.W. 368 (1903).

115. Elliff v. Texon Drilling Co., 146 Tex. 575, 210 S.W.2d 558 (1948).

spoilage of the common supply.[116] Third, to encourage the maximum physical recovery of the resource, conservation measures may be imposed. These measures are generally designed to conserve reservoir pressure, thus extending the reservoir's useful life by limiting the number of wells that can be drilled in the field. Pooling and unitization are state regulatory schemes that recognize and protect correlative rights and extend judicial correlative rights by actually dividing the pool among overlying owners.[117] Subject to these limitations on the rule of capture, the pumper obtains title to all oil and gas he brings to the surface.

Western water law is also based on the capture principle, but the similarity between oil and gas and water fades quickly. As is the case with oil and gas, the first person to divert water lawfully to a beneficial use obtains a prior right against all subsequent appropriators. Capture and appropriation, however, are not the same thing. Under the law of oil and gas, a subsequent pumper can capture oil and gas that might otherwise have been recovered by a prior pumper so long as there is neither physical trespass nor violation of correlative rights. A subsequent water appropriator, however, cannot displace a prior one when the supply is not adequate for both.[118] Thus, unlike a prior oil and gas pumper, a prior appropriator may be able to block subsequent uses if he can prove that available supplies are necessary to protect his vested rights. This result stems from two crucial differences between water and oil and gas. First, there is no substitute for water as there are substitutes for oil and gas; second, water is generally treated as a flow rather than a stock resource. For example, groundwater withdrawals can be limited to some level of safe yield,[119] and surface streams are increasingly subject to minimum flow requirements.[120]

There is an important exception to the principle that water resources should be managed to balance withdrawals against safe yields that is relevant to geothermal development. Groundwater

116. Higgins Oil & Fuel Co. v. Guaranty Oil Co., 145 La. 233, 82 So. 206, 212 (1919).

117. "Pooling" refers to the bringing together of small tracts to create a drilling unit to qualify for a well permit under applicable well spacing laws. "Unitization" means the joint operation of all or part of a reservoir. The reason for pooling and unitization is the same: the prevention of physical and economic waste, and the protection of correlative rights. *See generally* 6 H. WILLIAMS & C. MEYERS, OIL & GAS LAW § 907, at 3 (1977).

118. *See* Holland, *supra* note 103, at 670-72.

119. *See, e.g.*, Baker v. Ore-Ida Foods, Inc., 95 Idaho 575, 513 P.2d 627 (1973).

120. *See generally* Tarlock, *Appropriation for Instream Flow Maintenance: A Progress Report on "New" Public Western Water Rights*, 1978 UTAH L. REV. 211; Tarlock, *Recent Developments in the Recognition of Instream Uses in Western Water Law*, 1975 UTAH L. REV. 871, 888-95.

basins that are not located in alluvial fields and that replenish very slowly are often milked. In at least one case a basin has been adjudicated as a wasting asset for purposes of the Internal Revenue Code's allowance of cost depletion deductions.[121] Some of these basins are managed on the assumption that they should be mined, but ironically this may present greater problems for the geothermal developer than if the basin were not mined, since access may be severely restricted.[122]

Further, there is a "public interest" qualification to water withdrawals that is less defined than the "public interest" restrictions on the right to capture oil and gas. Compared to mineral development, the state has always asserted a substantial interest in the uses to which water is put beyond the prevention of physical waste.[123] The more substantial interest has been asserted because water is a scarce resource in the Far West, and there are a variety of competing uses of widely disparate economic value and social importance. Grossly inefficient uses are curtailed by the doctrine that an appropriation is valid only if the water is applied to a beneficial use, but a stronger state interest in the use to which water is put is asserted through statutory preferences. Further, it has long been the rule in the Far West (except in Hawaii) that the state "owns" the water within its boundaries in trust for the public. Declarations of state ownership are simply assertions of the state's police power over natural resources,[124] but the ownership concept serves to underscore the extent of the state's power to deny access to water in order to allocate it to a perceived higher use. Occasionally, prior appropriations have been subordinated to subsequent ones under this standard.

Today, however, there is increasing pressure to supplant or temper the doctrine of prior appropriation by using the public interest standard as a means of allocating scarce supplies. The thrust of the "new" public interest limitations is to require a greater consideration of alternative water uses. The resulting planning process could serve to limit the amount of water available for geothermal use and impede development.[125] The differences between the oil and

121. United States v. Shurbet, 347 F.2d 103 (5th Cir. 1965). *See* Sato, *Tax Problems Relating to Water Rights*, in WATERS AND WATER RIGHTS § 87.4 (Clark ed. 1967).

122. *See* Trelease, *The Use of Fresh Water for Secondary Recovery of Oil in the Rocky Mountain States*, 16 ROCKY MTN. MIN. L. INST. 605 (1971).

123. *See* Trelease, *New Water Legislation: Drafting for Development, Efficient Allocation, and Environmental Protection*, 12 LAND & WATER L. REV. 385, 404-16 (1977).

124. *See* Trelease, *Government Ownership and Trusteeship of Water*, 45 CALIF. L. REV. 638, 648 (1957).

125. *E.g.*, Environmental Defense Fund, Inc. v. East Bay Mun. Util. Dist., 125 Cal.

gas law and water law can be nicely summed up. A water right is usufructuary, entitling the holder to use a certain quantity of water under certain conditions rather than giving him title to the source of supply itself.

The argument made here that geothermal resources should be treated as minerals depends on the answer to the question: Are geothermal resources more closely analogous to stock resources or to flow resources? This question is legally important for two reasons: (1) reservoirs must be classified as exhaustible or inexhaustible for federal and state tax purposes,[126] and (2) the physical characteristics should control the conservation strategy adopted by the states and federal government. Unfortunately, this question cannot always be answered because not enough is known about individual reservoirs to ascertain whether or not they are recharging and, if so, at what rates.[127] The Geysers Field in Northern California has been adjudicated as a depleting resource,[128] but there is considerable evidence that some hot water fields are recharged and might sustain production for up to 1,000 years. Still, it seems reasonable to conclude that geothermal resources are stock resources. Rates of recharge may be negligible in many cases, and the conservation strategies that must be applied to sustain the optimum rate of heat recovery are more

Rptr. 601 (Ct. App. 1975), *vacated*, 20 Cal. 3d 327, 572 P.2d 1128, 142 Cal. Rptr. 904 (1977). An intermediate appellate court held that an allegation that a utility must reclaim waste water before seeking supplemental fresh water supplies states a cause of action under the California Constitution which provides, *inter alia*, that "[t]he waste or unreasonable use or unreasonable method of waste be prevented . . . ." CAL. CONST. art. XIV, § 3. The California Supreme Court reversed, without reaching the merits, on the ground that the doctrine of primary jurisdiction required the State Water Resources Control Board to first consider the problem. *See generally* Lee, Legal Aspects of Water Conservation in California (Governor's Commission to Review California Water Rights 1977). North Dakota also recently expanded the public interest discretion available to the state engineer. United Plainsmen Ass'n v. North Dakota State Water Conservation Comm'n, 247 N.W.2d 457 (N.D. 1976). *United Plainsmen* holds that the state's waters are subject to a public trust and, citing, Sax, *The Public Trust Doctrine in Natural Resource Law: Effective Judicial Intervention*, 68 MICH. L. REV. 471, 556-57 (1969), reasoned that, at a minimum, the state engineer must determine the potential impact of an allocation sought in an appropriation permit on the present water supply and future needs of the state. This suit challenged the issuance of all water permits for coal-related energy production, and plaintiffs obtained a trial on the merits of whether or not existing state water allocation planning was sufficient to meet the public trust requirements.

126. I.R.C. § 611 provides that to qualify for a depletion allowance the resource must be a natural deposit, occur in exhaustible deposits, and be used in income-producing activity. *See* Maxfield, *Income Taxation of Geothermal Resources*, 13 LAND & WATER L. REV. 217, 218-26 (1977); Note, *The Application of Depletion to Geothermal Resources*, 9 U. MICH. J. L. REF. 233 (1976).

127. Banwell, *Geothermal Energy and Its Uses: Technical Economics, Environmental and Legal Aspects*, III SECOND U.N. SYMP. 2257, 2260 (1976).

128. Reich v. Commissioner, 52 T.C. 700 (1969), *aff'd*, 454 F.2d 1157 (9th Cir. 1972).

closely analogous to those used to maintain the pressure of oil and gas fields.[129]

> To extract energy from the host rock formation in cases where there is an adequate natural water supply, it is essential that boiling occur in the formation so that temperature gradients are established in the rock media when the pressure (and the water temperature) declines as a result of steam production.[130]

When a reservoir with this characteristic is discovered and delineated, efficient reservoir management will seek to recover the maximum possible amount of energy for the particular reservoir rather than to balance withdrawals with recharge over an indefinite period. Both these objectives are, of course, resource conservation objectives, but different strategies will be followed to obtain the optimum fluid production rate for geothermal rather than for groundwater reservoirs. These may include well spacing[131] and high initial production rates.[132]

B. Western Water Law Doctrines Inapplicable to Geothermal Development

The differences between oil and gas exploitation and water use manifest themselves more concretely in various water law doctrines and state regulatory systems. The following analysis identifies nine features of western water law and administration which may operate to constrain geothermal development.

1. Inappropriate Forms and Procedures—The forms and procedures of water administration are not suited to geothermal development.[133] Required data on the rate of diversion, point of diversion, and expected return flow may not be applicable to geothermal development. This may ultimately be a minor problem since forms can be adapted; nevertheless, this problem underscores the differences between the two resources.

2. Necessity to Prove an Adequate Available Supply—A

---

129. Goldstein, *supra* note 39, at 165 (reaching a similar conclusion).

130. Humbedt, London & Kruger, *Laboratory Studies of Simulated Geothermal Reservoirs,* III SECOND U.N. SYMP. 1663 (1976).

131. James, *Optimal Well Spacing for Geothermal Power,* III SECOND U.N. SYMP. 1681 (1976).

132. Robinson & Morse, *A Study of the Effects of Various Reservoir Parameters on the Performance of Geothermal Reservoirs,* III SECOND U.N. SYMP. 1773 (1976).

133. *See* Aidlin, *Representing the Geothermal Resources Client,* 19 ROCKY MTN. MIN. L. INST. 27 (1974). "It is not possible to know in advance how many gallons of geothermal water or how many pounds of geothermal steam will be required to produce one kilowatt hour of electricity . . . ." *Id.* at 38.

would-be appropriator must establish that an adequate supply of unappropriated water is available for use. Because the connection between a geothermal reservoir and an aquifer devoted to conventional water uses will probably not be well understood prior to geothermal development, placement of such a burden on the geothermal developer is a way for existing groundwater pumpers to block a geothermal development even though no actual conflict may result.[134]

3. Denial of Entry to Groundwater Basin in Overdraft—The problem of proof of available supply is especially important in states where access to groundwater basins in overdraft is blocked by legislation closing certain basins to new pumpers by designating them as critical groundwater areas. Once a pumper is in the basin it may be a free-for-all, but getting in may be a substantial problem. All western states, except California and Utah, have a procedure by which an administrative agency can designate a groundwater basin as critical.[135] This action generally closes the basin to new pumpers, but existing pumpers are generally allowed to keep pumping at preexisting rates. Thus, should a geothermal reservoir overlap a critical groundwater area, a geothermal developer might be denied entry. In Idaho, groundwater management may be taking a yet more aggressive stance unfavorable to geothermal development. Idaho law specifies "reasonably anticipated average rate of future recharge"[136] as the standard for basin management, and this has resulted in junior pumpers being shut down on the ground that there is not enough recharge to satisfy senior rights.[137]

4. Protection of Prior Surface Users' Rights—A geothermal developer not only competes with other groundwater pumpers, but also with surface users. States are moving to close the artificial distinction between ground and surface waters by administering all water rights together. In practice, this means prior surface users now have rights senior to junior groundwater pumpers. The result is that the geothermal developer has another set of potential claimants arguing that development may interfere with prior rights.

Such a problem could occur in Colorado. The state adopted

134. *See* Vranesh & Musick, *Geothermal Resources Water and Other Conflicts Encountered by the Developer—An Alternative Source Which is "Gathering Steam"*, 13 LAND & WATER L. REV. 109 (1977).

135. *See* R. CLARK, WATER AND WATER RIGHTS 442 (1972); Harnsberger, Oeltjen & Fischer, *Groundwater: From Windmills to Comprehensive Public Management*, 52 NEB. L. REV. 179, 270-79 (1973).

136. IDAHO CODE § 42-237a(g) (1977).

137. Baker v. Ore-Ida Foods, Inc., 95 Idaho 575, 513 P.2d 627, 635 (1973).

legislation in 1965 and 1969 to extend the doctrine of prior appropriation to "designated" non-tributary groundwater, which had been held not subject to appropriation,[138] and to coordinate surface and prior rights. The legislation declared that it was the policy of the state that "[w]hile the doctrine of prior appropriation is recognized, such doctrine should be modified to permit the full economic development of groundwater resources."[139] Coordination of ground and surface rights will often mean greater protection of surface rights because they are generally prior in time to pumpers, and the legislature therefore attempted to implement the "full economic development" policy by codifying the "futile call" doctrine which allows a junior to refuse a senior call when the junior's forbearance will not contribute water at the senior's point of diversion.

The "futile call" doctrine might be of some use to a geothermal developer, but the Colorado experience suggests that groundwater legislation with protection of prior rights as the primary objective might constrain geothermal development. Courts and administrators will opt for protection of prior rights rather than balancing the costs and benefits of new entrants against existing pumpers in a basin. This is a simpler and perhaps fairer solution if the problem is assumed to be one of allocating supply among conventional pumpers. In the leading case of *Hall v. Kuiper,*[140] for example, the Colorado Supreme Court approved the state engineer's decision to prohibit two new wells in a designated groundwater basin to protect surface rights in a stream fed in part by groundwater that moved at the rate of three-tenths of a mile per year. The state engineer conceded it would be difficult to show a causal connection between the new wells and any particular surface right, but the "futile call" doctrine could not be invoked simply by showing that there was no causal connection between particular wells and surface rights.[141]

138. COLO. REV. STAT. §§ 37-90-102 to -109 (1973). "Designated groundwater" is defined as

> ground water which in its natural course would not be available to and required for the fulfillment of decreed surface rights, or ground water in areas not adjacent to a continuously flowing natural stream wherein ground water withdrawals have constituted the principal water usage for at least fifteen years preceding the date of the first hearing on the proposed designation of the basin . . . .

Id. § 37-90-103(6).

139. *Id.* § 37-90-102 (1973).

140. 181 Colo. 130, 510 P.2d 329 (1973).

141. *Id.* at 132, 510 P.2d at 331 (following Fellhauer v. People, 167 Colo. 320, 447 P.2d 986 (1968)). The "futile call" policy has been recognized, however, in a case holding that groundwater that would take between 178 and 356 years to reach a surface stream eight miles away is nontributary. Junior pumpers have been able to continue pumping through participation in plans of augmentation. Kuiper v. Lundvall, 187 Colo. 40, 529 P.2d 1328 (1974), *cert.*

5. Groundwater Mining—One aspect of recent groundwater legislation is potentially favorable to geothermal development. Both Colorado and New Mexico have decided to allow groundwater mining in some basins.[142] Formulas have been developed which space the amount of extraction over a definite period. Limits on the amount that can be withdrawn and the number of new pumpers have been established in order to keep the basin productive for the mining period. The groundwater mining precedents could possibly be adapted to geothermal development. The experience in Colorado suggests the contrary, however, because mining works to the disadvantage of junior appropriators. For example, Colorado developed a scheme to tie depletion of a designated basin to the time necessary to amortize the investment in irrigation equipment. To protect existing pumpers, a zone of influence concept was developed, and a new pumper was denied a permit on the ground that it would cause a forty percent depletion of exiting wells within a three-mile radius.[143]

Colorado allows a form of mining in nondesignated groundwater areas,[144] but the amount that may be mined may not be sufficient for a geothermal developer. If the state engineer finds that there is unappropriated water available and that the well will not interfere with the vested rights of others, the permit may be issued. In considering whether the permit should be issued, only the quantity of water underlying the land owned by the applicant is considered to be unappropriated, and the minimum useful life of the aquifer is one hundred years, assuming there is no substantial artificial recharge within that period.

---

denied, 421 U.S. 996 (1975). In cases where junior wells interfere with prior surface rights, Colorado law provides a procedure that allows junior wells to keep pumping. A junior well owner may participate in a plan for augmentation that allows the burden of replacement water to be shared among pumpers. COLO. REV. STAT. § 37-92-103(9) (Supp. 1978). The standards the courts have established in reviewing plans are favorable to geothermal development. A plan of augmentation need not introduce any new water into the system to be valid. Kelly Ranch v. Southeastern Colo. Water Conservancy Dist., 550 P.2d 297 (Colo. 1976). The participants in the plan must prove that existing right holders are not injured. However, existing right holders are not entitled to require the participants in the plan to replace total diversions when they cannot otherwise prove injury. Cache LaPoudre Water Users Ass'n v. Glacier Meadows, 550 P.2d 288, 294 (Colo. 1976).

142. *See* Fundingsland v. Colorado Ground Water Comm'n, 171 Colo. 487, 468 P.2d 835 (1970); Mathers v. Texaco, Inc., 77 N.M. 239, 421 P.2d 771 (1966). *See* F. Trelease, Developments in Groundwater Law (September 1976) (unpublished paper delivered at American Water Resources Association Symposium on Advances in Groundwater Hydrology).

143. Fundingsland v. Colorado Ground Water Comm'n, 171 Colo. 487, 468 P.2d 835 (1970).

144. COLO. REV. STAT. § 37-90-137 (1973 & Supp. 1978).

> The net effect is to limit pumping from these deep aquifers in any given year to 1 percent of the water stored under the applicable area. Any water derived from geothermal sources would probably fall into this category, and this production of geothermal resources which can be classified as ground water by the State Engineer will be limited by the Colorado Ground Water Management Act.[145]

6. Assertion of a Right to Lift—A geothermal developer's status will be further complicated if the state recognizes a senior appropriator's right to a fixed hydrostatic pressure. Originally, it appeared that states would recognize a right to lift as incident to a senior groundwater right. But, due to the practical problem of proving cause and effect relationships in a basin where there are multiple pumpers and because of the argument that some decline in the water level is necessary to promote efficient use of the basin, courts and legislatures have backed away from giving senior pumpers an absolute right to lift.[146] The issue is, however, unresolved in many states, and state engineers, or their modern equivalent, have great discretion to recognize some right to pressure levels in any given situation.

7. Restrictions on Use of Groundwater in California and Arizona—Groundwater is not allocated exclusively by appropriation in all western states. In California and Arizona, percolating groundwater is defined as groundwater that is not "tributary" to a surface water source. Such groundwater is allocated under common law regimes which define rights in relation to ownership of the overlying land. Waters diffused in "vagrant wandering drops moving by gravity in any and every direction along a line of least resistance" are governed by the *ad coelum* doctrine, and the right to use them does not depend on a diversion and application to a beneficial use.

The doctrine that percolating groundwater may not be subject to appropriation might seem to benefit the geothermal developer, but he may have the burden of segregating it from the appropriative regime. This problem is important in Arizona and California, which, alone among the western states, do not apply prior appropriation to groundwaters. In Arizona, groundwater is presumed nontributary

145. Schlauch & Worcester, *Geothermal Resources: A Primer for the Practitioner,* 9 LAND & WATER L. REV. 327, 353 (1974).

146. *See, e.g.,* Wayman v. Murray City Corp., 23 Utah 2d 97, 458 P.2d 861, (1969). Nebraska has recently stated that there is no right to lift among members of the same class of well owners, but has held that the state's statutory preference scheme gives domestic pumpers a right to lift as against high capacity agricultural pumpers. Prather v. Eisenmann, 200 Neb. 1, 261 N.W.2d 766, 771 (1978). The issue is very much open, however, because courts and legislatures have broad discretion to define the appropriator's method of diversion.

and is the property of the overlying owner. The right to capture is restricted by the rule of reason, which, as developed by the courts, greatly restricts the use of water on nonoverlying land by nonmunicipal appropriators.[147] California, which has a mixed system of riparian rights and prior appropriation, applies a rule of correlative rights in groundwater controversies which carries forward the surface law of riparian and appropriative rights to groundwater controversies. Basically, the California courts distinguish between overlying and nonoverlying pumpers. All overlying owners are entitled to a fair allocation of the safe annual yield in times of shortage, but the water must be used on the overlying land. Only if there is a surplus of unused water not in excess of safe annual yield can the water be appropriated for use on nonoverlying land.[148] The correlative rights rule is not, therefore, suitable for a stock resource such as a geothermal reservoir; the safe-annual-yield standard does not permit mining, yet it is economically efficient to encourage geothermal reservoirs to be mined.

8. Application of Public Interest Restrictions on Right to Appropriate—In most western states, an appropriator must meet the three requirements of intent, diversion and application to a beneficial use and, in all states but Colorado, he must convince the permit-granting agency that the appropriation is in the public interest. Historically, state engineers have found appropriations to be in the public interest when there is no interference with prior vested rights and unappropriated water is available.[149] Occasionally, smaller projects have been subordinated to larger diversion projects on the ground that there was a public interest in providing a right for a project that would yield greater economic benefits.[150] Today, state agencies may use the public interest standard to subject appropriation applications to a crude cost-benefit analysis, to take diffuse environmental considerations into account, and to insure that new uses are consistent with state water plans and policies. Washington and California have held their state environmental

147. Farmers Inv. Co. v. Bettwy, 113 Ariz. 520, 558 P.2d 14 (1976).

148. *See* City of Los Angeles v. City of San Fernando, 14 Cal. 3d 199, 537 P.2d 1250, 1318 n.100, 123 Cal. Rptr. 1 (1975). *See generally* Hanks & Hanks, *The Law of Water in New Jersey: Groundwater*, 24 RUTGERS L. REV. 621, 630-50 (1970).

149. Meyers, A Historical and Functional Analysis of Appropriation Law (National Water Commission, Legal Study No. 1, 1971).

150. *See generally* Trelease, *Policies for Water Law: Property Rights, Economic Forces, and Public Regulation*, 5 NAT. RESOURCES J. 1 (1965). A useful summary of the statutes and cases construing them is CLYDE, WATER ACQUISITION FOR MINERAL DEVELOPMENT INSTITUTE: LEGAL OVERVIEW—CURRENT PROBLEMS (Rocky Mtn. Min. L. Inst. Paper No. 2, 1978).

quality acts to apply to appropriation applications.[151] At a minimum, many applications require an environmental impact statement. Geothermal developers are, of course, already subject to an impact statement requirement in these states, so application of the public interest standard in water law would only introduce more uncertainty.

9. Application of the Relation Back Doctrine—A major public interest limitation asserted in water use was the idea that speculation in water rights should be discouraged. One anti-speculative doctrine firmly entrenched in water law is the doctrine that a water right must be perfected with due diligence after an intent to appropriate has been manifest in order that the priority date "relate back" to the commencement of the first step toward completion of the diversion. Uncertainties concerning the potential production from geothermal reservoirs undercut any assurance that the first well drilled will result in production. Thus, a geothermal developer forced to abandon a well and drill another may encounter a lack of due diligence challenge from other claimants.

The discussion to this point indicates the unsuitability of a blanket application of western water law to geothermal development. The doctrines emerging in the law of groundwater are symptomatic of the fact that most important contemporary water disputes no longer involve a single *A* against a single *B*. Rather, classes of *A*'s sue classes of *B*'s, often with *C*'s and *D*'s joining the suit, and

151. Stempel v. Dep't of Water Resources, 82 Wash. 2d 109, 508 P.2d 166 (1973); County of Inyo v. City of Los Angeles, 61 Cal. Rptr. 167 (1976) (good summary of California law on the applicability of the state's little NEPA to water resources regulations). Legislation is pending in California to establish "protective zones" around three designated hot springs because their "medicinal, therapeutic, cultural, religious, historic or fish and wildlife values" require protection from the adverse impacts of geothermal development. Other springs may be added by the legislature upon the recommendation of the Secretary of the Resources Agency after consultation with the American Heritage Commission. One of the listed springs is Coso Hot Springs which is on the China Lake Naval Reservation. The proposed legislation gratuitously provides that the law shall apply to Coso Hot Springs "to the extent that such designation does not conflict with existing federal law." Assembly Bill No. 3009, March 21, 1979.

Claims by tribal groups that certain public lands are sacred may be a new source of quasi-withdrawals directly affecting the development of geothermal resources. In 1978, Congress passed the American Indian Religious Freedom Joint Resolution, Pub. L. No. 95-341 (to be codified in 42 U.S.C. § 1996). The resolution requires public agencies to determine if agency policies impact upon Indian, Alaskan, and native Hawaiian access to sites necessary for traditional rites. When access may be impaired, the agency must consult with native traditional leaders to determine appropriate changes necessary to protect and preserve "Native American religious cultural rights and practices." The resolution is vague but it is a firm basis for challenges to federal leases which include traditional sacred sites.

water rights litigation looks to future, as well as to past damage. Courts and administrators, therefore, seek formulas to allocate aggregate scarce water resources between classes and to conserve the resource. This is good for water allocation, but not mineral development. The techniques of pooling and unitization developed in oil and gas seem better suited to prevent waste of geothermal resources. At some point, the geothermal developer may have to confront surrounding water users, but the time to put him in the system is when the presumption of noninterference is overcome.

VIII. State Geothermal and Groundwater Laws

This section describes the groundwater regimes of the Western States and the possible impact of those regimes on geothermal operations. Our discussion makes one of two alternative assumptions. First, geothermal resources are or will be classified as water. Second, even if groundwater resources are classified as mineral or *sui generis,* the geothermal developer may be challenged on the ground that a geothermal well field will interfere with vested water rights or with a state interest in the allocation of groundwater. In this situation, a geothermal resource developer must bear the burden of disentangling himself from the state water law regime.

The law of each state is discussed separately, and the discussion focuses on the following topics: (1) the classification of geothermal resources and their relationship to water law, (2) the general law of groundwater allocation, (3) the defined correlative rights of geothermal and groundwater users, and (4) state public interest constraints that may be applicable to geothermal development.

A. Arizona

Arizona groundwater law assigns ownership of percolating groundwater to overlying landowners. An early Arizona Supreme Court case, decided prior to statehood, descriptively characterized groundwater as:

> [F]iltrating or percolating water oozing through the soil beneath the surface in undefined and unknown channels, and therefore a component part of the earth, having no characteristic of ownership distinct from the land itself, and therefore not the subject of appropriation by another, but belonging to the owner of the soil.[151.1]

The adoption of the Arizona Constitution in 1910 could have been read as a rejection of overlying rights in percolating groundwater,

151.1. Howard v. Perrin, 8 Ariz. 347, 76 P. 460, 462 (1904).

but it has not. The constitution rejected the concept of riparian rights[152] and confirmed prior existing water rights "for all useful or beneficial purposes."[153] Some years later the supreme court concluded that the constitutional provision was not intended to affect percolating groundwater that remained the property of overlying landowners.[154]

As in California, overlying owners' rights extend only to percolating groundwater. Surface water sources and groundwaters that are subflows of rivers and streams or that are flowing in definite underground channels are subject to prior appropriation. Also, as in California, there is a presumption that underground water is percolating, but rebutting that presumption seems much more difficult in Arizona than in California.[155] The probability seems high, therefore, that geothermal fluids in Arizona, if treated as groundwater at all, would be treated as percolating groundwater.

By statutes enacted in 1972 and 1977, Arizona has addressed some important geothermal development issues. For regulatory and fiscal purposes, the state has elected to treat geothermal resources as mineral rather than water. It has also reposed regulatory authority in the Oil and Gas Conservation Commission.[156] And, consistent

---

152. ARIZ. CONST. art. XVII § 1.

153. *Id.* XVII § 2.

154. Maricopa County Mun. Water Conserv. Dist. No. 1 v. Southwest Cotton Co., 39 Ariz. 65, 4 P.2d 369 (1931).

155. In *Southwest Cotton Co.* the court stated:

> While surface indications such as trees, shrubs, bushes, and grasses growing along the course and the topographical features of the surface are the simplest and surest methods of proof, we think they are by no means exclusive. Other methods may be used, such as a series of wells or borings, tunnels, the color and character of the water, the sound of water passing underneath the earth, the interruption of the flowing of other wells on the line of the alleged subterranean stream, geologic formation, and perhaps others. But all of these, when examined, must be such as to afford clear and convincing proof that there are subterranean waters, but that such waters have a definite bed, banks and current within the ordinary meaning of the terms as above set forth, and the evidence must establish with reasonable certainty the location of such bed and banks. It is not sufficient that geologic theory or even visible physical facts prove that a stream *may* exist in a certain place, or probably or certainly does exist somewhere. *There must be certainty of location as well as of existence of the stream before it is subject to appropriation.*

Id. 4 P.2d at 377 (emphasis in the original).

One Arizona legal scholar has gone so far as to assert that proving the existence of underground channels "is questionable, if not impossible, in Arizona." Clark, *Arizona Groundwater Law: The Need for Legislation,* 16 ARIZ. L. REV. 799, 800 (1974).

156. ARIZ. REV. STAT. ANN. §§ 27-651 to -652 (1976). Following the enactment, the Oil and Gas Conservation Commission promulgated regulations that add little to what the statute itself says on the questions that concern us. ARIZONA GENERAL RULES AND REGULATIONS GOVERNING THE CONSERVATION OF GEOTHERMAL RESOURCES (July 1, 1972). Those regulations carry forward the formal separation of geothermal resources and water and provide for the

with this, oil and gas models were followed for taxation[157] and for the leasing of state lands.[158]

The Arizona definition of geothermal resources adopted in the 1972 statute is comparable to the federal definition and clearly includes water.

> "Geothermal resources" means:
>
> (a) All products of geothermal processes embracing indigenous steam, hot water and hot brines.
>
> (b) Steam and other gases, hot water and hot brines resulting from water, other fluids or gas artificially introduced into geothermal formations.
>
> (c) Heat or other associated energy found in geothermal formations, including any artificial stimulation or induction thereof.
>
> (d) Any mineral or minerals, exclusive of fossil fuels and helium gas, which may be present in solution or in association with geothermal steam, water or brines.[159]

This definition avoids the ambiguity in the California and Hawaii definitions on the water content, but it does not necessarily eliminate application of water laws.

However, in the 1977 enactment, the legislature attempted to draw a line between geothermal resources and the conventional groundwater resources that are governed by the state's water laws. The statute provides:

> Geothermal resources and their development shall be exempt from the water laws of this state unless:
>
> 1. Such resources are commingled with surface waters or groundwaters of this state; or
>
> 2. Such development causes impairment of or damage to the groundwater supply.[160]

One state official has stated that this provision was enacted to avoid another "*Union Oil* case," but the language is not particularly well-suited to solve the ownership question involved in the mineral severance cases (there are now three of them) identified with the Union Oil Company. Whether the owner of the severed mineral estate or the surface estate "owns" the geothermal resource is not necessarily answered by exempting geothermal resources from water

---

protection of freshwater resources. There are procedures by which a geothermal well may be converted to a freshwater well, taking care to require that the well be plugged to a point immediately below the fresh water to protect if from contamination. *Id.* § G-204.

157. ARIZ. REV. STAT. ANN. § 42-277.04 (Supp. 1977).

158. *Id.* § 27-668 (Supp. 1978).

159. *See id.* § 27-651.

160. *Id.* § 27-667.

laws. At most, the language merely suggests a mineral-like treatment tending to support inclusion in the mineral estate. The statute does not, however, foreclose the possibility of ownership being assigned to the surface owner rather than the mineral owner.

The more important focus of the statute is the exemption itself. On its face, the quoted language seems to free the geothermal developer of the need to concern himself at all with the intricacies of groundwater law so long as neither of the two limiting qualifications to the exemption exist. But the statutory qualifications could be interpreted to limit the exemption severely. It is uncertain how often geothermal resources will be found "commingled with surface waters or groundwaters." And, whether or not there is commingling, development may be found to cause "impairment of or damage to the groundwater supply." Arizona's sensitivity to water scarcity might well lead the state's courts to tilt the statute toward these water concerns in doubtful cases.

The statute gives no meaningful answers regarding when the exemption from water laws is found to be unavailable. Does the unavailability of the exemption mean that geothermal resources *are* groundwater? Or does selectivity remain possible, allowing the application of only those water laws that are reasonably required to protect water values? For example, it is easy to imagine circumstances where water pollution laws should apply to protect conventional groundwater resources but where there may be no need to apply the complex overlying ownership doctrines. The statute's silence in these areas could greatly minimize its ultimate utility to geothermal developers.

Despite its incompleteness and flaws, the Arizona attempt has virtues in its conception and purpose. It is preferable to treat geothermal resources separately from water resources. The statute should, however, go further and attempt to fashion solutions to the problem that will arise when completely separate treatment is not possible. That requires dealing with the conditions under which access may be had to groundwater resources.

The first condition of access to a groundwater basin in Arizona is ownership of overlying land, and this condition might preclude a geothermal developer from claiming any rights to exploit geothermal resources in instances where the statutory exemption from water laws in unavailable. Under Arizona's reasonable use doctrine, groundwater may be withdrawn by an overlying owner, and there is no liability to other overlying owners for resulting damage, so long as the withdrawal is for the purpose of making reasonable use of the

overlying land.[161]

The second condition of access to groundwater is compliance with the "critical areas" legislation. The Arizona Legislature enacted a Ground Water Code in 1948.[162] The code establishes a permit procedure for drilling new wells for agricultural use in areas that have been classified as "critical groundwater areas." The State Land Commissioner administers the law and is obliged to issue a permit to an applicant unless the proposed well is to be drilled for irrigating acreage not previously irrigated. If the well is for new acreage or acreage that has not been cultivated within five years, the permit must be denied.[163] The weakness of the law is manifest by the absence of any power to reduce existing overdrafts from critical areas by restricting existing wells from pumping at full capacity. This legislation, combined with the restrictive definition of overdraft, might prevent a geothermal developer from entering a groundwater basin if he is not entitled to the statutory exemption from water laws.[164]

If geothermal wells that do not qualify for the 1977 exemption from water laws are considered groundwater wells, most geothermal applications should qualify as beneficial uses. The provisions of the Ground Water Code arguably would not prevent drilling wells since the wells would not be for irrigation of new acreage, but it is unlikely that Arizona courts would hold energy generation to be for the purpose of making reasonable use of percolating groundwater on overlying lands. The strict Arizona rule on this point would probably hold

161. Bristor v. Cheatham, 75 Ariz. 277, 255 P.2d 173 (1953). In a later case, Farmers Inv. Co. v. Bettwy, 113 Ariz. 520, 558 P.2d 14 (1976), the Arizona Supreme Court gave a strict interpretation of what constitutes "the land" from which water is drawn for purposes of the reasonable use rule. The court held that water is used off the land even when it is transported for use on other land overlying the same general underground water source. The case involved a conflict among a mining company, a large agricultural user, and the city of Tucson. The mining company pumped the water four miles to its mill, but argued that the reasonable use rule was satisfied so long as some water was returned to the basin. The court held that because the groundwater was being depleted in the area, the plaintiff "need not wait for its farms to be devastated before applying to the court for injunctive relief against unlawful acts." *Id.* at 526, 558 P.2d at 20. The decision was partially revised in 1977 by the Arizona Legislature. ARIZ. REV. STAT. ANN. § 45-317.01-.05 (Supp. 1978). The relief granted was essentially a grandfather right protecting persons making pre-1977 transfers within critical groundwater areas, relief that would therefore be of little worth to geothermal operators.

162. ARIZ. REV. STAT. ANN. §§ 45-301 to -324 (1956 & Supp. 1978).

163. *Id.* § 45-314 (Supp. 1978).

164. The Ground Water Code was challenged on the ground that it prevented overlying owners from using water "owned" by them under Arizona law and that it denied equal protection by favoring those who had drilled water wells prior to its enactment. The Arizona Supreme Court sustained the law as a valid exercise of the police power in allocating a scarce resource. Southwest Eng'r Co. v. Ernst, 79 Ariz. 403, 291 P.2d 764 (1955).

that even energy generation on the precise land overlying the owner's percolating water would not qualify. And an Arizona Supreme Court's ruling[165] would almost surely preclude any argument where the power plant is removed from the immediately overlying land even though it might be in the same groundwater basin. Accordingly, if the production of geothermal energy is deemed to be a production of groundwater, other overlying owners might be entitled to enjoin geothermal development if they can establish that their groundwater resources are being damaged or threatened with damage.

B. California

California follows a dual system of water rights. There has been no move to eliminate common law riparian or overlying rights in groundwater, although these rights have been limited in the name of efficient use. Prior to 1928, the riparian doctrine had gained some ascendancy in California court decisions.[166] Fears that the riparian system would not serve California's needs spurred a constitutional amendment that year. The result was a unique amalgam of riparian and appropriation doctrines.[167] Riparian rights were not abolished, but they were limited to such water as is reasonably required for the beneficial use to be served. The rights of appropriators were explicitly recognized and afforded protection. The constitution proclaimed a policy favoring beneficial use of the state's waters "to the fullest extent" and declared that unreasonable uses and unreasonable methods of use are to be prevented. These policies are fully applicable to overlying rights in percolating groundwaters, which are closely analogous to riparian rights.[168] The courts, however, have never directly limited overlying rights.

California has adopted the correlative rights rule for percolating groundwater. California landowners, therefore, enjoy proportionate rights to use the percolating water in the soil and need not secure appropriative rights in order to withdraw water for reasonable uses in relation to overlying lands. But an overlying owner may not sell or transport the water for use on other lands if by so doing he will injure others having correlative rights in the common groundwater source. If there is surplus water in excess of the needs of overlying

165. Farmers Inv. Co. v. Bettwy, 113 Ariz. 520, 558 P.2d 14 (1976). See note 161, *supra*.

166. City of Los Angeles v. Hunter, 156 Cal. 603, 608, 105 P. 755, 758 (1909).

167. *See* CAL. CONST. art. XIV, § 3.

168. Tulare Irrigation Dist. v. Lindsay-Strathmore Irrigation Dist., 3 Cal. 2d 489, 45 P.2d 972 (1935).

lands, that water may be "appropriated" by overlying owners or by persons who are not overlying owners and transported for use beyond the basin from which it is withdrawn. No statutory mechanism exists in the California Water Code for appropriations of this variety, and the appropriation is made by the act of diverting the water and applying it to beneficial use. Appropriated rights in percolating groundwaters are subject to the paramount rights of overlying owners both as to their present uses and future reasonable uses in relation to overlying lands. The overlying rights are appurtenant to the overlying lands and are not dependent on use to preserve them. They may be lost only by prescription.

The California Legislature first passed statutes dealing with geothermal resources in 1965. An interest similar to the state's established policies concerning water is asserted:

> It is hereby found and determined that the people of the State of California have a direct and primary interest in the development of geothermal resources, and that the State of California, through the authority vested in the State Oil and Gas Supervisor, should exercise its power and jurisdiction to require that wells for the discovery and production of geothermal resources be drilled, operated, maintained and abandoned in such manner as to safeguard life, health, property and the public welfare, and to encourage maximum economic recovery.[169]

The statutes provide for the detailed regulation of geothermal wells, including their drilling, operation, maintenance, and abandonment. Provisions were also made to lease state-owned land for geothermal development and to define the rights of lessees, their development obligations, and the royalties to be paid to the state. All of these statutes were added to the California Public Resources Code (rather than the Water Code), and the regulatory powers were reposed in the State Oil and Gas Supervisor of the Division of Oil and Gas within the Department of Conservation (rather than in the water regulatory agencies). The general thrust of these statutes suggests that they were patterned after the jurisprudence applicable to oil, gas, and minerals rather than state water laws. But, no total escape from the water laws was possible and none was attempted.

The statutory definition of geothermal resources states:

> For the purposes of this chapter, "geothermal resources" shall mean the natural heat of the earth, the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or which

169. CAL. PUB. RES. CODE § 3700 (Deering 1976).

> may be extracted from, such natural heat, and all minerals in solution or other products obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth, but excluding oil, hydrocarbon gas or other hydrocarbon substances.[170]

As noted previously, this definition does not clearly say whether water is part of the geothermal resource.

The geothermal regulatory statutes do recite, however, that nothing therein "shall be construed as superseding any of the provisions of Division 7 (commencing with Section 13,000) of the Water Code,"[171] but that reference is to the water quality laws, and there is obvious good sense in applying water pollution constraints to geothermal development. Negating supersession of water quality laws alone leaves open the question of the application of other water laws. And only in the water pollution context are the interrelationships of water law and geothermal development articulated with any precision. Duties are imposed to protect water suitable for irrigation or domestic purposes. Geothermal wells must be properly cased "to shut out detrimental substances from strata containing water suitable for irrigation or domestic purposes and from surface water suitable for such purposes, and to prevent the infiltration of detrimental substances into such strata and into such surface water."[172] Before abandoning a geothermal well, the owner or operator must "endeavor to protect any underground or surface water suitable for irrigation or domestic purposes from the infiltration or addition of any detrimental substances."[173]

In only one section of the geothermal statutes did the California Legislature purport to deal directly with possible conflicting claims to use water produced from geothermal wells. That section allows a developer to obtain a certificate of primary purpose. It states:

> Any person having drilled a well or wells on state, federal or private lands which are producing or, according to the Geothermal Resources Board, are capable of producing geothermal resources, may, at any time, apply to the board for a certificate of primary purpose. When the board determines that such well or wells are primarily for the purpose of producing geothermal resources and not for the purpose of producing water usable for domestic and irrigation purposes, the board shall issue a certificate of primary purpose to such person.

170. *Id.* § 6903.
171. *Id.* § 3718.
172. *Id.* § 3740.
173. *Id.* § 3746.

> Such certificate shall establish a rebuttable presumption that such person has absolute title to the geothermal resources reduced to his possession from such well or wells. Such presumption may be rebutted only upon a showing that the water content of the geothermal resources is useful for domestic or irrigation purposes without further treatment thereof, but not by virtue of any production of such water as a byproduct incident to the production of the geothermal resources.[174]

That this procedure is less than a final and satisfactory solution is manifest by the Board's failure to issue a single certificate of primary purpose in the ten-plus years since this statute was passed. Further, no geothermal well driller has yet even applied to the board to obtain a certificate.

The certificate of primary purpose makes at least one modest contribution by suggesting the answer to whether the water content of geothermal well production is or is not part of the "geothermal resource." If the operation of the section is to result in vesting absolute title in the geothermal resources reduced to a driller's possession, it would seem that the water content would be so vested. It would make little sense to hold that the certificate did not result in the driller getting title to the water content on the ground that the water content is excluded from the geothermal resource.

The initial prerequisite to obtain a certificate is either actual production of geothermal resources from a well or a determination by the Board of capacity to produce geothermal resources. Another requirement is that the Board must determine that the well or wells are "primarily for the purpose of producing geothermal resources and not for the purpose of producing water usable for domestic and irrigation purposes."[175] If that finding is made, the certificate must be issued.[176]

It is likely, however, that the certificate will yield little of value. The geothermal well driller probably will have "title" to what he produces, but that alone is not worth much. Of more importance is the driller's right to continue to produce, but the statute does not address that issue.

---

174. *Id.* § 3742.2.

175. *Id.*

176. It is unknown how the statute applies in the circumstance where the primary purpose is to produce geothermal resources but there exists a secondary purpose to produce water usable for domestic and irrigation purposes. A literal reading could result in denial of the certificate whenever there is a purpose to produce usable water. The probable intent was for the certificate to issue unless the *primary* purpose of the driller is to produce usable water for domestic and irrigation purposes.

If the geothermal driller is the owner of a fee simple estate in the land or lessee of the fee owner, the operation of California law will probably give him bare "title" to the production from his well whether or not the water is usable for domestic and irrigation purposes. Even if he is found to be producing pure, usable groundwater through the well, the water actually reduced to his possession would probably be his either as part of the geothermal resource or as percolating groundwater taken pursuant to an overlying right or by appropriation.

If, on the other hand, there has been a severance of the mineral estate in the land from the surface estate, the question of title to produced water could be more complicated. If mineral owners remain successful in classifying geothermal resources as minerals and if a particular geothermal driller claims through the mineral estate, the certificate of primary purpose could provide assurance of absolute title to the produced water if the water is not suitable for traditional purposes without treatment. In a geothermal field where usable water is produced, the result would probably be otherwise. Under California law, the primary rights to usable water would probably be in the surface owner, but by analogy to oil, gas, and mining law, the mineral owner would have a usufructuary right to make reasonable use of the water in exploiting his severed mineral interest. All of this, of course, presumes that the surface owner has first rebutted the certificate's presumption by showing that the water content is in fact useful for domestic and irrigation purposes without further treatment.

In the final analysis the certificate only provides security of title to geothermal resources that are reduced to possession. That does not assure the right to continue to produce.[177] Assume, for example, that a nearby overlying owner can establish that the geothermal production is in fact polluting his well water. There is nothing in the statute or the certificate of primary purpose that bars the overlying owner from obtaining injunctive relief against the harmful operation whether or not the water produced from the geothermal wells is useful for domestic and irrigation purposes without treatment.

To make a claim of correlative right, the geothermal driller would have to establish that his withdrawals were for reasonable use in relation to the overlying land, and it is quite likely that courts

177. A possible purpose for the certificate is to protect utilities from liability for steam purchased for their power plants. This would not, of course, protect the right of the utilities to continue purchasing steam and therefore does not ultimately protect the power plant investment.

would hold that the use of geothermal resources to generate electricity, though a beneficial use, is not the kind of utilization the law contemplates. This would mean that the geothermal operator could only claim as an appropriator. As an appropriator, the operator would only be able to appropriate surplus groundwater in excess of overlying owner needs.

In sum, it is understandable that the certificate of primary purpose has not been utilized by geothermal developers. It does not define secure property interests. Some California lawyers have indicated that they would prefer to litigate the issue in court rather than risk adverse results in such a marginal administrative option.

California geothermal operators will likely encounter more water law problems in the future. The large majority of the geothermal wells drilled to date and all of the existing commercial production are centered in the Geysers area where conventional underground aquifers are physically separated from deeper geothermal fluids. As drilling takes place in other areas there will likely be closer relationships between groundwater and geothermal fluids and even direct conflicts over rights to the water. California does not now have a legal order designed to resolve such conflicts of efficiently.

C. Colorado

Colorado is the classic prior appropriation state. In 1882, the Colorado Supreme Court decisively rejected riparian rights,[178] and the lower courts took the lead in creating a strong prior appropriation doctrine. Two features of Colorado water law are of special importance to the geothermal developer. First, there is no administrative adjudication of surface water rights. Rights are adjudicated by the courts. The State Engineer's Office is limited to enforcing court-decreed priorities, but since 1969 the state has imposed a limited scheme of administrative regulation over groundwater. The courts remain, however, the principal mechanism for the settlement of water rights disputes.[179] Second, until recently, ground and surface rights remained uncoordinated. Today the state has moved to close this artificial hydrological gap as well as to regulate all ground-

178. Coffin v. Left Hand Ditch Co., 6 Colo. 443, 447 (1882).

179. COLO. REV. STAT. §§ 37-92-201 to -307 (1973 & Supp. 1978). Until 1969 the state made no attempt to develop statewide or even regional division records of decreed priorities drawing on a common source. Since 1969 the state has improved the system of water adjudication and record keeping in an effort to develop more accurate accounting of common source priorities.

water pumping; the position of a groundwater user has therefore drastically changed in the past ten years. Groundwater rights dependent on supplies that are tributary to a stream are subordinated to surface rights; access to groundwater basins is being restricted to protect the supplies of prior pumpers. The recent history of Colorado water law is an attempt to escape from the inefficiencies resulting from the rigid protection of senior rights at the expense of junior rights in the coordination of ground and surface rights[180] and in the adjustment of rights among groundwater pumpers.

The problem in adjudicating appropriation rights among pumpers is not determining who can make a call and shut down another's well, for there is generally enough water for all users at some depth. The problem is, rather, who must pay whom as the pressure levels and water tables decrease. In an effort to give the State Engineer and the courts some flexibility in adapting the doctrine of prior appropriation to pressure level maintenance, a 1965 act introduced a new, perhaps even revolutionary, concept into Western water law by declaring that "while the doctrine of prior appropriation is recognized, such doctrine should be modified to permit the full economic development of designated groundwater resources."[181]

The 1965 Act collapsed after the state supreme court declared it unconstitutional because of arbitrary enforcement.[182] This decision was practically inevitable since the division engineer developed no guidelines to determine which wells should be shut down. It proved to be only a temporary setback because all the important statutory concepts were reenacted in 1969 legislation.[183] Great interest, however, was taken by Colorado resource lawyers in the court's dictum that the state was on the verge of a new era of water law.

> As administration of water approaches its second century the curtain is opening upon the new drama of *maximum utilization* and how constitutionally that doctrine can be integrated into the law of *vested rights.* We have known for a long time that the doctrine was lurking in the backstage shadows as a result of the accepted, though oft violated, principle that the right to water does not give the right to waste it.[184]

180. *See* Carlson, *Has the Doctrine of Appropriation Outlived Its Usefulness,* 19 ROCKY MTN. MIN. L. INST. 529 (1974).

181. Groundwater Resources Act, ch. 318, § 1, 1965 Colo. Sess. Laws 1244.

182. Fellhauer v. People, 167 Colo. 320, 447 P.2d 986 (1968).

183. For the background of this legislation, see Hillhouse, *Integrating Ground and Surface Water Use in an Appropriation State,* 20 ROCKY MTN. MIN. L. INST. 691 (1975).

184. Fellhauer v. People, 167 Colo. 320, 447 P.2d 986, 994 (1968) (emphasis in original).

Colorado's Water Right Determination and Adjudication Act of 1969 streamlines the judicial procedures for adjudication of surface water rights and carries forward the 1965 experiment with the administrative determination of groundwater use. Procedurally, the Act provides for the tabulation of all decreed rights and conditional decrees within each of seven newly consolidated water divisions. The Act classifies groundwater as "designated, tributary and undesignated, nontributary." Designated groundwater is defined as water within the boundaries of a designated groundwater basin

> which in its natural course would not be available to and required for the fulfillment of decreed surface rights, or groundwater in areas not adjacent to a continuously flowing natural stream wherein groundwater withdrawals have constituted the principal water usage for at least fifteen years preceding the date of the first hearing on the proposed designation of the basin . . . .[185]

New groundwater pumpers in designated basins are governed by the doctrine of prior appropriation but, unlike the case of surface appropriations, an administrative permit from the Groundwater Commission is a prerequisite to a valid right.[186] A permit can only be granted if there is unappropriated water, if senior rights will not be unreasonably impaired, and if the new right will not cause unreasonable waste. Again, unlike surface appropriators, the priorities of pumpers in designated groundwater basins are determined by the Commission after a quasi-judicial proceeding.[187]

To construct a well outside the boundaries of a designated goundwater basin, a permit from the State Engineer is required.[188] If the State Engineer finds that there is unappropriated water available and the well will not interfere with the vested rights of others,

185. COLO. REV. STAT. § 37-90-103(6) (1973).

186. The Ground Water Management Act does not clearly delineate the respective jurisdictions of court and agency to consider water rights questions. If a claim for a conditional groundwater right has been filed in a judicial proceeding prior to the designation of a ground basin, a court can complete the adjudication provided the claimant can show that he "was entitled to a conditional decree prior to the time of the designation and creation of the basin." Sweetwater Dev. Corp. v. Schubert Ranches, Inc., 188 Colo. 379, 535 P.2d 215, 218 (1975). On the other hand, if the water right claim is made after designation of the area, jurisdiction to adjudicate lies in the Ground Water Commission. Larrick v. North Kiowa Bijou Management Dist., 181 Colo. 395, 510 P.2d 323 (1973).

187. The Colorado Supreme Court has joined the other Western States in holding that administrative adjudication of water rights applications is not an unconstitutional delegation of judicial powers to a nonjudicial body. Kuiper v. Lundvall, 187 Colo. 40, 529 P.2d 1328 (1974); Larrick v. North Kiowa Bijou Management Dist., 181 Colo. 395, 510 P.2d 323 (1973). The leading case is Farm Inv. Co. v. Carpenter, 9 Wyo. 110, 61 P. 258 (1900).

188. The permit entitles the holder to a conditional decree if the well is completed with due diligence. COLO. REV. STAT. § 37-90-137(3)(a) (1973).

the permit may be issued.[189]

Colorado's first geothermal legislation[190] was passed in 1974. It follows the federal model. Geothermal resources are defined as "geothermal heat and associated geothermal resources" and include the heat transfer medium as well as the heat energy itself.[191] The resource is regulated as a mineral. Regulatory authority is assigned to the Oil and Gas Conservation Commission.[192] The Commission has the same powers that it has over oil and gas deposits to conserve the resource by waste prevention regulations, pooling, and the establishment of drilling units.[193] Correlative rights similar to those enjoyed by oil and gas producers are recognized. Finally, the Commission may issue leases for resources located on state lands.[194] It would be tempting to conclude that Colorado therefore classifies geothermal resources as minerals, but that would be premature. Colorado does regulate geothermal development as it regulates mineral exploitation, but it does so by superimposing the geothermal regime over the water law regime. The Colorado statutes provide that:

> Nothing in this article alters or amends the existing law of this state relating to water and water rights; such law is fully applicable to water produced or used in connection with geothermal resources.
>
> Nothing in this article alters or amends the authority of the state engineer or ground water commission to regulate the production or use of water from geothermal wells, whether in liquid or gaseous form.[195]

No geothermal permit can be issued until the applicant receives the finding of the State Engineer that is required under the general groundwater law.[196] The geothermal developer must prove that ei-

189. In considering whether the permit should be issued,

> only the quantity of water underlying the land owned by the applicant is considered to be unappropriated, and the minimum useful life of the aquifer is presumed to be one hundred years, assuming there is no substantial artificial recharge within such period. "The net effect is to limit pumping from these deep aquifers in any given year to 1% of the water stored under the applicable area. Any water derived from geothermal sources would probably fall into this category, and thus production of geothermal resources which can be classified as ground water by the State Engineer will be limited by the Colorado Ground Water Management Act.

Schlauch & Worcester, *supra* note 130, at 353.

190. COLO. REV. STAT. §§ 34-70-101 to -110 (Supp. 1978).

191. *Id.* § 34-70-103(b)(6)(I) to (III).

192. *Id.* § 34-70-103(1).

193. *Id.* § 34-70-106.

194. *Id.*

195. *Id.* § 34-70-107(1) to (2).

196. *Id.* § 37-90-137 (1973).

ther there is unappropriated water available or that the two resources are physically separate. A geothermal right may not therefore be able to be established short of some form of water rights adjudication. To date, there has been only one application by a geothermal driller for a water right, but the application was not pursued.[197]

Another way out of the appropriation system would be to claim that the water content of the reservoir is "developed" water. The success of this argument depends on the resolution of the geochemical problems discussed earlier in this article.[198] However, if the water is classified as developed, the law provides a useful concept. Developed water is defined as water which would not have been in the river and groundwater basin on which rights holders rely, except for the efforts of the claimant. A recent Colorado case listed four categories: (1) transbasin diversions, (2) capture and storage of flood waters, (3) waters that would never have normally reached the river or its tributaries, and (4) water trapped in an underground saucepan composed of impervious shale.[199] The last category provides a basis for the geothermal developer to prove that his water is magmatic or connate in origin and thus is not public water of the state subject to appropriation.

There are at least two barriers a geothermal developer might face in gaining access to a basin where there is a potential physical interconnection between geothermal and groundwater resources. First, the geothermal developer must prove that unappropriated water is available. Second, if the geothermal developer seeks access to a designated groundwater basin, he must establish his right to mine against other groundwater pumpers.

Another barrier may exist if tributary groundwater is involved. Groundwater which is tributary to a natural stream is administered as part of an integrated ground and surface system. Groundwater rights can therefore be subordinate to prior rights, whatever their source. Placing all water rights in the same system is sound in theory, but this step—long called for by Western water experts—makes it difficult to achieve a fair adjustment of rights among pumpers. The problem is that, unlike surface appropriators along a stream, there is no assurance that shutting down wells to

197. Application of Mapco, Inc., No. W-3247, Water Div. No. 3, Alamosa, Colorado.

198. See part I-*B supra*.

199. Southeastern Colo. Water Conserv. Dist. v. Shelton Farms, Inc., 187 Colo. 181, 529 P.2d 1321 (1975).

satisfy a call by a senior surface *or groundwater right holder* will cause the junior's water to reach the senior's diversion point.

Any new water allocation statute must work with the tension between protection of vested rights and the achievement of physical and economic efficiency.[200] Colorado attempts to resolve this tension in a manner that could be helpful to the geothermal developer. On one level, the Act impedes the achievement of efficiency because it extends vested rights protection to a new class of water users, groundwater pumpers. However, if the presumption of noninterference can be scientifically sustained, Colorado law is consistent with this approach to geothermal water conflicts because the 1969 legislation seeks to make greater use of the futile call doctrine.[201]

Conflicts between ground and surface pumpers have generally served to strengthen the rights of surface holders and increase the costs of entry for a new pumper since the Colorado Supreme Court has upheld the State Engineer's discretion to construe the futile call doctrine for the benefit of senior surface appropriators. The leading case is *Hall v. Kuiper*[202] which upheld a State Engineer's decision to protect surface rights by prohibiting two new wells in a designated groundwater basin. It was established that the groundwater moved toward the Cache Le Poudre at three-tenths of a mile per year; moreover, the evidence established only that "the flow of the water from the proposed wells would reduce the amount of underground water reaching the Poudre, but it would be difficult to show material injury to any particular *surface* water right by reason of this reduction."[203] The pumpers naturally asserted that they could only be shut down when the surface user could prove his call would cause him to receive his decreed share and that this rigid protection of senior rights was inconsistent with the principles of maximum utilization announced in *Fellhauer v. People.*[204] The *Hall* court held that this high standard of proof of cause in fact was rejected in *Fellhauer,* and that "there was just no way" to implement the "new era."[205] A year later, however, the court did apply the futile call policy of the 1969 Act by recognizing a *de minimis* exception rule to the State Engineer's duty to protect vested rights.[206]

200. *See* Note, *The Groundwater-Surface Water Conflict and Recent Colorado Water Legislation,* 43 U. COLO. L. REV. 1 (1971).

201. *See* Fundingsland v. Ground Water Comm'n, 171 Colo. 487, 468 P.2d 835 (1970).

202. 181 Colo. 130, 510 P.2d 329 (1973).

203. *Id.* at 330 (emphasis in original).

204. 167 Colo. 320, 447 P.2d 986 (1968).

205. 510 P.2d at 332.

206. Kuiper v. Lundvall, 187 Colo. 40, 529 P.2d 1328, *cert. denied,* 421 U.S. 996 (1974).

Another potentially useful precedent for the geothermal driller is the State Engineer's decision to allow groundwater mining. In 1970, the court approved a zone plan to allow mining in a basin, while at the same time protecting vested rights. One of the nation's great stock groundwater basins is the Ogallala formation which extends from Colorado to Texas. The Groundwater Commission determined that the formation would be forty percent depleted in twenty-five years' time and that pumping would no longer be reasonable. Therefore, it was decided to prolong the life of existing wells for twenty-five years—the average well construction amortization period. A permit for a new well was denied on the ground that it would result in forty percent depletion within a three-mile radius of lands within the state.[207] This decision was upheld by the Colorado Supreme Court which concluded that existing rights would be unreasonably impaired and that "[w]hen . . . water is being mined from a ground water basin, and a proposed new appropriation would result in unreasonable harm to senior appropriators, then a determination that there is no water available for appropriation is justified."[208]

D. Hawaii

Hawaii's water law is unlike that of any other state. Influenced by the ancient customs of Hawaii's period as a monarchy, the water law retains much of the feudal flavor of the early land title system. The King, as owner of all lands and natural resources, allocated lands together with appurtenant water rights in a feudal manner to his inferior chiefs. Water is essentially privately owned; there is no notion of public ownership or dedication to public use. Over time,

Groundwater which would take 178 and 356 years, respectively, to reach a surface stream was held nontributary. *Id.*

207. Thompson v. Colorado Ground Water Comm'n, 575 P.2d 372 (Colo. 1978), held that the state can exclude lands lying in Nebraska from the circle which determines the volume of available water. The court also held that the Ground Water Commission could not estimate the amount of water actually being used by the amounts claimed in a conditional permit but had to issue final permits before a new well could be denied on the basis the formation was overappropriated. The opinion suggests that a final permit cannot be issued until there has been an independent field investigation of the amount of water actually being used. The duty to make an independent field investigation to determine beneficial use instead of waiting for individual challenges would require the impossible. There are, for example, 4,000 wells in the Northern High Plains Designated Ground Water Basin. Thus, *Thompson* further illustrates the thesis of this article that placing geothermal resources in the groundwater regime will be unduly costly.

208. Fundingsland v. Colorado Ground Water Comm'n, 171 Colo. 487, 468 P.2d 835, 839-40 (1970).

however, the importance of water resources has resulted in increased public regulation.

Groundwater is defined by statute to include subsurface waters of all descriptions—"in perched supply, dyke-confined, flowing, or percolating in underground channels or streams, under artesian pressure or not, or otherwise."[209] The language is sufficiently broad to include geothermal fluids, but there is no certainty that it does.

The drilling of wells in Hawaii is subject to a relaxed form of public regulation. Notice and record keeping requirements exist to keep the Hawaii Board of Land and Natural Resources advised of well-drilling activities.[210] Permits are required only in "designated ground-water areas."[211]

Regulation in designated groundwater areas, however, may turn out to be comparable to those of the appropriation system. On its own motion or upon the petition of any interested person, the Board of Land and Natural Resources can, after notice and hearing, establish designated groundwater areas where any of the following conditions exist:

(A) The use of groundwater exceeds the rate of recharge;
(B) Groundwater levels are declining or have declined excessively;
(C) Chloride content of the water is increasing to a level that materially reduces the value of the use to which water is being put;
(D) Excessive preventable waste of water is occurring;
(E) Any proposed water development or developments which if constructed would in the opinion of the board lead to one of the above conditions.[212]

Once a designated groundwater area has been established, all future withdrawals must be authorized by a permit issued by the Board, except preserved existing uses and domestic uses. No permit will be issued unless there is water available in the source and the proposed use is beneficial and will not impair more beneficial uses of water resources. Finally, reminiscent of the appropriation system, a permit will be refused unless "[g]ranting the permit will not substantially and materially interfere with preserved uses, or with domestic or permitted uses made previously."[213] No designated groundwater areas yet exist, but it is expected that they may soon be established on the Island of Oahu.

209. HAWAII REV. STAT. § 177-2(6) (1976).
210. *Id.* § 177-5.
211. *Id.* § 177-19.
212. *Id.* § 177-5(5).
213. *Id.* § 177-22(4).

Hawaiian groundwater rights bear resemblance to correlative rights. The Board is vested with emergency powers to establish rules limiting, apportioning, or prohibiting the use of water in emergency situations.[214] Unlike states adopting the correlative rights doctrine, however, it apparently is not required that groundwater be used solely in relation to the lands or in the basin from which it is withdrawn.

In its only statute expressly dealing with geothermal resources, Hawaii lists geothermal resources as "minerals" that are subject to a reservation and disposition by the state.[215] Accordingly, mining leases for geothermal resources may now be issued on state lands or on lands sold or leased by the state with a reservation of minerals. The definition of geothermal resources is functionally identical to California's definition; it has the same vagueness on whether the produced fluids are part of the resource.[216]

The Board of Land and Natural Resources has adopted geothermal regulations which deal both with the leasing of state geothermal rights and the drilling of geothermal wells generally.[217] The well drilling portion imposes a more detailed and complete scheme of control than previously existed. No geothermal well can now be drilled until the Board first issues a permit, and there are requirements relating to bonding, well spacing, casing, blowout prevention, and well maintenance and abandonment.[218]

The state's mineral lessees pay royalties fixed by the Board subject to some specified statutory limitations.[219] Royalty rates are not specified by statute for geothermal resources. Under the regulations, the royalty is determined by the Board prior to the issuance of leases and must be not less than ten percent nor more than twenty percent of the production value of the geothermal resources. The royalty for "by-products" is not to be less than five percent nor more than ten percent.[220] "Geothermal by-products" are defined as "(1) any mineral or minerals (exclusive of oil, hydrocarbon gas and helium) which are found in solution or developed in association with geothermal resources and (2) demineralized or desalted effluent

214. *Id.* § 177-34.

215. *Id.* § 182-1(1).

216. *Compare id.* § 182-1(9) *with* CAL. PUB. RES. CODE § 6903 (Deering 1976).

217. HAWAII BOARD OF LAND AND NATURAL RESOURCES, REGULATIONS ON LEASING OF GEOTHERMAL RESOURCES AND DRILLING FOR GEOTHERMAL RESOURCES IN HAWAII, R. 8 (March 10, 1978) [hereinafter cited as HAWAII REGS.].

218. HAWAII REGS., R. 1.1.

219. HAWAII REV. STAT. § 182-7(2) (1976).

220. HAWAII REGS., R. 3.13.

water."[221] Royalty would not be payable on any demineralized or desalted water used for cooling or generation of electric energy or reinjected into the subsurface. In providing royalties on usable water, the draft regulations suggest that water is regarded as part of the geothermal resource. Hawaii groundwater doctrines, however, would presumably support the state's sale of water from its own lands whether or not the water were to be technically classified as part of the geothermal resource.

In the Islands, nature has partially supplied a physical solution to conflicts between groundwater uses and geothermal development.[222] The underground volcanic hydrology usually provides a separation of the freshwater and the saltwater bodies, and the geothermal potential seems to be almost entirely in the deeper saltwater zones. Fresh groundwater percolating into the surface collects in a freshwater lens in volcanic rocks that extend from some distance above sea level to a somewhat greater depth below sea level. Underneath this freshwater lens is the much larger water body that is influenced by saltwater inflow from the ocean. The freshwater has a slightly lower density than saltwater; thus, it tends to remain above the saltwater zone. There is some mixing of freshwater and saltwater at the interface, but the inflow of freshwater from above continually recharges the upper part of the freshwater lens.

Conventional groundwater values lie exclusively in this freshwater lens. Since to this point the geothermal values appear to lie deep in the saltwater zone, the physical separation appears sufficiently complete to warrant treating the two sources as though they were essentially separate. Apparently, only the need to prevent pollution and saltwater encroachment demand attention at this time.

E. Idaho

Perfection of all water rights in Idaho is by appropriation under the administrative responsibility of the Director of the Department of Water Resources.[223] Since 1971 the sole method of acquiring new rights is through the statutory procedures administered by the Director.[224]

Today all groundwater in Idaho is "public" and hence subject to the state appropriation regime. A 1951 statute adopted the view

221. HAWAII REGS., R. 1.5.

222. This paragraph is based on an interview with Daniel Lum, Geologist-hydrologist, Hawaii Department of Land and Natural Resources, in Lihue, Hawaii (June 8, 1977).

223. IDAHO CODE § 42-202 (1977).

224. *Id.* §§ 42-201 to -202.

expressed in an earlier Idaho Supreme Court decision[225] that groundwaters are the property of the state and can be acquired only by appropriation.[226] The statute provides a procedure for the designation of critical areas.[227] Groundwater was defined in that statute as "all water under the surface of the ground whatever may be the geological structure in which it is standing or moving."[228] This definition on its face is broad enough to enfold geothermal fluids, and, at least before 1972, one could plausibly argue that appropriation was the way to acquire rights to produce the material medium of geothermal resources.

Also relevant to the geothermal operator, Idaho recognizes a qualified right in senior groundwater appropriators against reduction of underground pumping levels.[229] The qualification derives from Idaho's commitment to use its water resources for economic development.[230] Sympathetic administration of this statute (which can never be safely assumed in a western state) could be an aid to the geothermal developer. In fact, a geothermal driller may face more difficult water rights problems in Idaho than in other Western States. Idaho, in contrast to Colorado and New Mexico, has shown a willingness to administer basins in overdraft by a strict enforcement of priorities rather than by the implementation of physical solutions.[231] Legislation enacted in 1978,[232] however, may alleviate some fears of the effects of intensive geothermal development by

225. Hinton v. Little, 50 Idaho 371, 296 P. 582 (1931).

226. IDAHO CODE § 42-226 (1977). State *ex rel.* Tappen v. Smith, 92 Idaho 451, 444 P.2d 412, 417 (1968), holds that the state constitutional provision guaranteeing the right to appropriate, IDAHO CONST. art. XV, § 1, does not preclude the legislature from making an application for a permit the exclusive method for perfecting an appropriation. In 1978 Idaho amended its water code to allow the Director of the Department of Water Resources to deny permits on five separate grounds, despite proof of available unappropriated water or proof that it will not conflict with the local public interest, which is defined as "the affairs of people directly affected by the proposed use." IDAHO CODE § 42-203 (Supp. 1979).

227. IDAHO CODE § 42-233(a) (Supp. 1979).

228. *Id.* § 42-230(a) (1977).

229. *Compare* Nampa & Meridian Irr. Dist. v. Petrie, 37 Idaho 45, 223 P. 531 (1923) (holding that a prior groundwater pumper did not have the right to insist that the water level be kept at an existing level) *with* Noh v. Stoner, 53 Idaho 651, 26 P.2d 1112 (1933) (enjoining junior pumpers from actions causing a prior appropriator's pumps to go dry).

230. Idaho law provides that

> while the doctrine of "first in time is first in right" is recognized, a reasonable exercise of this right shall not block full economic development of underground water resources, but early appropriators of underground water shall be protected in the maintenance of reasonable groundwater pumping levels as may be established by the Director of the Department of Water Resources as herein provided.

IDAHO CODE § 42-226 (1977).

231. Baker v. Ore-Ida Foods, Inc., 95 Idaho 575, 513 P.2d 627 (1973).

232. *See* IDAHO CODE § 42-4202 (Supp. 1979).

authorizing the formation of groundwater recharge districts and surface water spreading programs.

Idaho's Geothermal Resources Act of 1972[233] classifies geothermal resources as neither mineral nor water resources but as *sui generis.*

> "Geothermal resources" means the natural heat energy of the earth, the energy, in whatever form, which may be found in any position and at any depth below the surface of the earth present in, resulting from, or created by, or which may be extracted from such natural heat, and all minerals in solution or other products obtained from the *material medium* of any geothermal resource. Geothermal resources are found and hereby declared to be sui generis, being neither a mineral resource nor a water resource, but they are also found and hereby declared to be closely related to and possibly affecting and affected by water and mineral resources in many instances.[234]

The term "material medium" is in turn defined in a manner that suggests something interconnected with, but perhaps separate from geothermal resources themselves.

> "Material medium" means any substance, including, but not limited to, naturally heated fluids, brines, associated gases, and steam, in whatever form, found at any depth and in any position below the surface of the earth, which contains or transmits the natural heat energy of the earth, but excluding petroleum, oil, hydrocarbon gas, or other hydrocarbon substances.[235]

Idaho's *sui generis* classification of geothermal resources is not entirely meaningful absent a legal regime for the resource. The Geothermal Resources Act was codified with the water statutes, and regulatory control was reposed in the Department of Water Resources. Throughout the Act, water rights receive attention.[236]

With few exceptions, a permit to drill a geothermal well must be obtained from the Director of the Department of Water Resources.[237] In addition, a permit from the Director to appropriate a

233. *Id.* §§ 42-4001 to -4015 (1977).

234. *Id.* § 42-4002(c) (emphasis added).

235. *Id.* § 42-4002(e).

236. This concern for water rights is also manifest in the implementing regulations promulgated by the Director in 1974. DEPARTMENT OF WATER RESOURCES, DRILLING FOR GEOTHERMAL RESOURCES, RULES AND REGULATIONS ON MINIMUM WELL CONSTRUCTION STANDARDS (1975).

237. IDAHO CODE § 42-4003 (1977). The Director is given discretion to exempt categories of wells upon a finding that the purpose of the Act does not require permits. *Id.* § 42-4003(d). Further, there is a statutory exemption for specified activities supported by valid water rights permits: greenhouse, hot house, swimming pool, hot spring baths, hot water fish propagation, space heating, or a "similar facility, unless such operation is in conjunction with geothermal

conventional groundwater right may or may not be required. Two circumstances can result in requiring both permits. A water appropriation permit must be obtained if the well "will involve the use of water, or . . . may be expected to yield water to be used, for any beneficial purpose, other than as a mineral source, an energy source, or otherwise as a material medium . . . ."[238] This provision would seemingly not require appropriation for any uses integral to the utilization of geothermal resources themselves—*e.g.*, uses of the material medium as cooling water in power plants. A water appropriation permit is also necessary when the Director finds that the well operator "will unreasonably decrease groundwater available for prior water rights in any aquifer or other groundwater source for water for beneficial uses, other than uses as a mineral source, an energy source, or otherwise as a material medium . . . ."[239] If this finding is made, the Director is not to issue a geothermal permit until the applicant has obtained a groundwater appropriation permit under the water laws.

The Act does not explicitly deal with how rights are harmonized when both geothermal and water appropriation permits are required. It is clear that the later water appropriation of a geothermal operator is junior to a senior water appropriator. It also appears that subsequent water appropriators will also take their place in line. By implication, the relations *inter se* among geothermal operators, however, are not governed by prior appropriation principles. The absence of an independent appropriation regime for geothermal wells and the suggestion that geothermal utilization of the material medium does not itself involve a water appropriation requirement suggest that the material medium is governed by correlative rights among geothermal well operators.[240]

The perceived physical separation between freshwater aquifers and geothermal separation between freshwater aquifers and geothermal reservoirs has come to assume that there is essentially no competition for the same fluids. Consequently, some geothermal well operators have applied for geothermal well permits, but have not applied to appropriate conventional water rights.

Idaho has established a leasing system for geothermal resources

resource use not specified in this subdivision." *Id.* § 42-4003(e). On the other end of the spectrum, no well may be drilled to a depth of 3,000 feet or more "for any purpose, without obtaining a geothermal well permit." *Id.* § 42-4003(g).

238. *Id.* § 42-4003(b).

239. *Id.* § 42-4005(e).

240. This is further supported by the statutory provisions for both voluntary and involuntary unitization of geothermal resource areas. *Id.* § 42-4013.

in state-owned lands that follows the usual pattern of mineral leasing.[241] The Geothermal Resources Act regulatory provisions apply to operations by lessees on state-owned lands (and presumably on federal lands as well).

F. Montana

Montana has a relatively new and untested groundwater regime. Conflicts among pumpers are just beginning to be litigated. Prior to 1961, the Montana Supreme Court announced several times in dicta that percolating groundwaters were subject to the American rule of reasonable use.[242] However, in 1961, the legislature applied the prior appropriation doctrine to groundwater.[243] "Groundwater" is defined in the Ground Water Act as any fresh water under the surface of the land, including any water under any surface body of water.[244] Thus, Montana has avoided the problems of the tributary-nontributary distinction.

Surface appropriations before January 2, 1962, take priority over all prior and subsequent groundwater rights. As among post-1962 ground and surface appropriators, strict priority governs with no distinction made as to the source of water. Thus, a geothermal developer might be in conflict with surface as well as groundwater pumpers.

In 1973 Montana became a strong permit state. Post-1973 rights can only be acquired by permit.[245] Since 1973 permits have been required for all groundwater appropriations except for wells that pump less than one hundred gallons per minute or water produced exclusively by an oil and gas well. The power to manage controlled areas is contained in the new system of water rights.[246]

Because geothermal resources in private lands are classified as goundwater resources, the geothermal developer may have difficulty ascertaining who the potential competing claimants are. Actual use patterns[247] and court decrees are probably the only available evi-

241. *Id.* §§ 47-1601 to -1611.

242. *See* W. HUTCHINGS, 2 WATER RIGHTS LAWS IN THE NINETEEN WESTERN STATES, 643 (1974).

243. MONT. REV. CODES ANN. §§ 89-2911 to -2936 (Supp. 1975). Prior rights are recognized if the user files the requisite notices. *See also* Clark, *Groundwater Management: Law and Local Response*, 6 ARIZ. L. REV. 178, 200-01 (1965).

244. MONT. REV. CODES ANN. § 89-2911(a) (Supp. 1977).

245. *Id.* § 89-880.

246. *Id.* § 89-2918.

247. The Department of Natural Resources and Conservation is mandated to begin proceedings to determine existing rights, *id.* §§ 89-870 to -879 (Supp. 1977), but it is estimated that it would take 100 years and 50 million dollars to adjudicate the entire state.

dence of most water rights which vested long before 1973. This theoretical problem fades in actuality because groundwater pumping is virtually unrestricted in the state at the present time. Thus, a geothermal developer *qua* groundwater appropriator may not encounter a serious challenge from groundwater pumpers.

Montana has considerable geothermal potential, but little present development. Major drilling operations have been conducted around the Marysville area, but these operations have not produced sufficient hot water to merit commercial development.[248]

The state has a dual classification for geothermal resources depending on the origin of the resource. Resources on state lands are leasable and are classified as *"sui generis,* being neither mineral nor a water resource."[249] This definition was borrowed from Idaho, but Montana chose to modify the definition by adding "unless the context requires otherwise."[250] This qualification is probably an attempt to harmonize the definition of geothermal resources on state lands with the classification of geothermal resources on private lands. In 1973 Montana added "geothermal water" to the definition of water that is subject to appropriation.[251] Thus, unless the resource is on state lands, a geothermal developer must perfect an appropriation. If the development of geothermal resources threatens to interfere with existing beneficial uses of water, the state has the option of treating a state lessee as a water appropriator to protect the rights of competing water users or geothermal developers.

Water required to develop state geothermal leases can be secured by a written application to the Board of Land Commissioners. The Commission must approve the application before a right can be perfected. If Commission approval is won, then the right must be secured in accordance with the general Montana water code and be held in the name of the state.[252]

On both state and private lands the treatment of geothermal resources as water is continued in the 1973 and 1975 Montana Utility Siting Act. The Act applies to "any use of geothermal resources, including the use of underground space in existence or to be created, for the creation, use, or conversion of energy."[253] A person constructing an energy conversion facility must obtain a certificate of envi-

248. Interview with Mr. Ted Doney, General Counsel, Montana Department of Natural Resources, in Helena, Montana (Aug. 15, 1977).

249. MONT. REV. CODES ANN. § 81-2602(1) (Supp. 1977).

250. *Id.*

251. *Id.* § 89-867(1).

252. MONT. ADMIN. CODES ANN. § 26-2.6(2)-S60130(3) (1975).

253. MONT. REV. CODES ANN. § 70-803(3)(d) (Supp. 1977).

ronmental compatibility and public need. The certificate is issued after the Board makes findings on a detailed list of environmental criteria, including water resource impacts and findings on the "changes in quantity and quality of water . . . relationship to projected uses [and] relationship to water rights."[254] Were a geothermal plant to be evaluated under this Act, the Board could explore water quantity impacts beyond interference with vested rights. The impace impact of the development on vested water rights will undoubtedly be the primary area of inquiry, but the statute seems to allow the state to consider future impairment beyond the level permitted under existing water rights law.[255]

A controlled groundwater area may be established by the Montana Department of Natural Resources after notice and hearing, if: (1) groundwater withdrawals are in excess of recharge in the area, (2) excessive withdrawals are likely to occur in the near future, or (3) significant disputes concerning rights exist in the area.[256] If the Board finds that withdrawals exceed the safe yield, it can order the aggregate withdrawal decreased to a safe yield. Except for domestic use, any ordered decrease must be done by right of priority. The Board may not grant a permit if the proposed withdrawal exceeds the capacity of the aquifer.[257]

The law recognizes that a limited right to pressure for the capacity of an aquifer or aquifer system includes the right to reasonable and feasible pumping lifts or artesian pressures. The 1973 Act specifically provides that priority does not include the right to prevent changes by later appropriators such as "the lowering of a water table, artesian pressure or water level, if the prior appropriator can reasonably exercise his water right under the changed conditions."[258]

The Montana Supreme Court has rendered an important decision, *Montana Department of Natural Resources v. Intake Water*

254. *Id.* § 70-816(3)(g).

255. *Id.* § 89-895. This section lists six factors which must be taken into account in considering whether to grant a permit. They are: (1) is unappropriated water available? (2) will vested rights be impaired? (3) are the proposed diversion means adequate? (4) is the use beneficial? (5) will the use interfere with planned uses for which a permit has been issued or water reserved? and (6) the contemplated appropriation is for over 10,000 acre feet, has the applying appropriator met the high burden of showing that the rights of a prior appropriator will not be adversely affected?

256. *Id.* § 89-2914.

257. *Id.* § 89-2918.

258. *Id.* § 89-891. Montana case law does not presently define the pressure rights of senior appropriators, but in a suit filed by the Department of Natural Resources the court decided a right to lift exists under Montana law. Department of Nat. Resources and Conserv. v. Crumpled Horn, No. 7076 (Mont. 9th Dist. Ct. June 30, 1976).

Co.,[259] on the ability of appropriators to "reserve" large amounts of water for energy-related projects. This decision may prove to be a favorable precedent for geothermal development, for it may alleviate the fear that a developer faced with a long lead time will lose a claimed right on due diligence grounds. Intake Water Co. planned to divert 80,650 acre feet per year from the Yellowstone River to supply agricultural, municipal, recreational and energy-related users, coal mining, and coal gasification. Montana's pre-1973 appropriation procedure required only that an appropriator post notice at the point of diversion and then proceed to excavate the diversion ditch within forty days. After the notice was posted, Intake Water Co. spent some $311,000 for on-site related studies to comply with state and federal environmental statutes and other requirements, but no excavation was started within the forty-day period. The Department of Natural Resources subsequently brought suit to declare that no right with a 1973 relation-back priority existed. The court, however, held that the expenditure of money for the environmental surveys was sufficient to comply with the statute. The same result could be reached under the current statute, which allows the Department of Natural Resources to limit the time for commencement of construction and completion of a project, taking into account its financial magnitude.[260] Of long term interest for geothermal developers in Montana and elsewhere was the Department of Natural Resources' policy argument that because there were so many legal and practical hurdles to overcome, it was not in the public interest to allow future water rights in the Yellowstone River to be in limbo for so speculative a project. The court held that so long as the project proceeds with reasonable diligence the appropriation could relate back to 1973.

The antispeculative policies incorporated into the law of prior appropriation at a time when water was quickly put to use have been gradually adapted to the needs of large projects. A secure water right must be waiting at the end of the planning, financing, and construction steps, and techniques such as California's state filing and assignment procedure and Colorado's conditional decrees have achieved this result. Geothermal developers are entitled to a due diligence doctrine that recognizes reservoir and marketing uncertainties, although at some point antispeculative policies may dictate forfeiture.

259. 558 P.2d 1110 (Mont. 1977).
260. MONT. REV. CODES ANN. § 89-886 (Supp. 1977).

G. Nevada

Nevada is the most arid of the Western States. Water is appropriately revered there. By statute, all surface and subsurface waters belong to the public and are subject to appropriation for beneficial use.[261]

Water rights may be obtained in Nevada only by filing an application to appropriate with and securing the approval of the State Engineer.[262] Acquisition by prescription is not allowed.[263] To perfect an appropriation after obtaining a permit, the applicant must submit proof that he has applied the water to beneficial use.[264]

There is currently no important distinction in Nevada between surface waters and groundwaters so far as the prior appropriation doctrine is concerned. Nor does Nevada subscribe to distinctions between types of groundwater. Groundwater appropriation is subject to the same general conditions that apply to the appropriation of surface waters, but provision is made requiring the right of each appropriator to "allow for a reasonable lowering of the static water level at the appropriator's point of diversion."[265]

The State Engineer may designate a groundwater basin on his own motion or he may be petitioned by forty percent or more of the appropriators of record in the area involved. The only statutory standard prescribed for the State Engineer's decision is his determination that "administration would be justified" or that the area is "in need of administration."[266] Once a groundwater basin has been designated, the State Engineer possesses substantially increased regulatory powers.[267]

Prior to the enactment of the 1939 groundwater statute, Nevada accepted the "developed water doctrine." An early case defined developed water as water produced "artificially, by means of labor and appliances, at great expense of money and labor"[268] and held

261. NEV. REV. STAT. §§ 533.025, 534.020 (1973).

262. *Id.* § 533.325 (1975).

263. *Id.* § 533.060(3) (1973).

264. *Id.* § 533.400. Subject to limited exceptions, *id.* § 533.374(2), (6) (1977), the State Engineer must issue the permit if the proper procedures are followed, if there is unappropriated water in the source, and if the proposed use neither impairs the value of existing rights nor is otherwise detrimental to the public welfare. *Id.* § 533.370(1), (4). If these conditions cannot be met, the State Engineer must deny the permit. *Id.* § 533.370(4). The limits on the scope of the State Engineer's discretion and power to fix water rights are discussed in Salmon River Canal Co. v. Bell Brand Ranches, Inc., 564 F.2d 1244 (9th Cir. 1977).

265. NEV. REV. STAT. § 534.110 (1973).

266. *Id.* § 534.030.

267. *Id.* § 534.120 (1977).

268. Cardelli v. Comstock Tunnel Co., 26 Nev. 284, 286, 66 P. 250, 252 (1901).

that percolating groundwater pumped from the famous Comstock mine tunnel qualified as developed water.[269] In the court's view, absent the developer's labor, no water would have been available for appropriation. The resulting water was held to be owned absolutely by the developer and not subject to appropriation. Although no Nevada cases have expressly repudiated the developed water doctrine, an opinion of the Attorney General takes the position that the developed water cases have been superseded by the 1939 groundwater statute declaring all groundwater to be publicly owned and subject to appropriation.[270] The opinion would arguably foreclose a geothermal developer from invoking the developed water doctrine or any kindred doctrine with respect to water produced from his wells. Even if such a doctrine might otherwise have been available, the express statutory requirement to appropriate steam and water from geothermal wells would control.[271]

Nevada's treatment of geothermal resources has thus far been intimately linked with Nevada water law. Regulatory responsibility has been reposed in the State Engineer who is given authority to "adopt such regulations as are necessary to insure the proper development, control and conservation of Nevada's geothermal resources."[272] Statutory water appropriation procedures are expressly applicable to "any water and steam encountered during geothermal exploration."[273]

In 1975 a bill was introduced in the Nevada Legislature that would have made geothermal resources subject to the public water appropriation procedures *in toto*.[274] The bill was not adopted by the legislature. A special committee formed to study geothermal regulation filed a brief report in December of 1976, recommending no new legislation, but the report did indicate that new legislation might be

269. *Id.*

270. Nev. Att'y Gen. Op. No. 331 (1966).

271. NEV. REV. STAT. § 534A.040 (1977). Nevada has shown a jealous concern for its prerogatives in controlling groundwater appropriation. When the United States Navy refused to follow the statutory appropriation procedures in connection with wells drilled on lands reserved for a naval depot, the State Engineer sued to prohibit further pumping. Nevada *ex rel.* Shamberger v. United States, 165 F. Supp. 600 (D. Nev. 1958), *aff'd on other grounds*, 279 F.2d 699 (9th Cir. 1960). The case was decided in favor of the Navy primarily on the basis of the federal reserved rights doctrine. The state has shown a resolve to apply Nevada water law to geothermal wells drilled on federal lands, and there is a potential conflict over possible application of the reserved rights doctrine in that setting as well. The probable outcome of such a conflict is not now clear.

272. NEV. REV. STAT. § 534A.020(1) (1977).

273. *Id.* § 534A.040.

274. Nev. S.B. 158, § 3 (1975).

required in the future.[275]

Nevada's present geothermal law is a patchwork of specific leasing statutes and a vague and general regulatory regime. Different provisions in the Nevada statutes even define the resource in different ways. The first statute to use the term "geothermal resources" was passed in 1973 and simply provided for the leasing of tax delinquent property for geothermal development.[276] In that statute geothermal resources were broadly defined,[277] similar to the federal scheme.

Without amending or repealing the 1973 definition, bills enacted in 1975, providing for leasing of state-owned lands and for general regulation by the State Engineer, defined geothermal resources as simply "[h]eat or other associated geothermal energy found beneath the surface of the earth."[278] While it could be argued that the terse 1975 definition was intended to include all that was in the more complete 1973 definition, that argument requires straining of the text. The different definitions on the books could produce troublesome uncertainties, the most important for our purposes being the omission of any mention of steam or water in the 1975 definitions.

The State Engineer has yet to promulgate regulations or even prepare draft regulations controlling geothermal development. In its practices and informal communications, however, the State Engineer's office has made clear its intention to regulate drilling throughout the state on federal, state, and private lands. The statutory requirement to follow appropriation procedures for all water and steam encountered in geothermal exploration is interpreted by the State Engineer as a grant of power to control geothermal activi-

275. SPECIAL COMMITTEE ON GEOTHERMAL REGULATION, REPORT TO THE GOVERNOR AND THE 1977 LEGISLATURE ON THE COMMITTEE TO STUDY GOVERNMENT ACTIONS PERTAINING TO GEOTHERMAL RESOURCES IN NEVADA (Dec. 1, 1976).

276. NEV. REV. STAT. §§ 361.606-.608 (1977). In 1961 the legislature gave authority to lease fish and game lands for "thermal power," *id.* § 504.147(7) (1973), and state lands for "natural steam," *id.* § 149.080 (1975).

277. Nevada law defines "geothermal resources" as:

> 1. All products of geothermal processes, embracing indigenous steam, hot water and hotbrines;
>
> 2. Steam and other gases, hot water and hot brines resulting from water, gas or other fluids artificially introduced into subsurface formations;
>
> 3. Heat or other associated energy found beneath the surface of the earth; and
>
> 4. Byproducts of any of the items enumerated in subsections 1 to 3, inclusive, such as minerals (exclusive of oil or hydrocarbon gas that can be separately produced) which are found in solution or association with or derived from any of such items.

NEV. REV. STAT. § 361.027 (1975).

278. *Id.* §§ 322.005, 534A.010 (1977).

ties in all areas where the State Engineer has responsibilities to administer appropriation procedures for conventional water sources. Specifically, the lessee of a federal geothermal lease is not regarded as exempt from appropriation requirements. No wells appear to have been drilled yet on federal leases in Nevada, but when that happens, developers in most cases will probably attempt to comply with Nevada appropriation procedures rather than challenge the State Engineer's claimed jurisdiction.

A number of applications to appropriate have been filed in connection with geothermal wells drilled on privately owned lands. For the most part, these proceedings have been uneventful, as usuers of conventional water resources have not perceived them as threatening. One application filed in 1976 was protested by an irrigation district which expressed concern that geothermal development might interfere with a water project.[279] The geothermal applicant contacted the district and assured it that all targeted drilling depths were well below all freshwater sources. The protest was then withdrawn by the irrigation district on the understanding that no water would be drawn from the underground sources above 5,000 feet from the surface. Confrontation, however, may not be so easily avoided in situations where closer relationships are perceived.

The public leasing statutes provide the only instances where the Nevada Legislature has accorded mineral-like treatment of geothermal resources. The classification of geothermal resources as leasable, with royalties being payable to the state, does not square with treating geothermal resources as identical to water. State geothermal leases will require a royalty of ten percent on geothermal resources and a five percent royalty on any by-product.[280] The statute defines by-product as "a tangible substance produced or extracted in the utilization of a geothermal resource."[281] The term is broad enough to include water, but it seems unlikely that water would be regarded as a royalty-bearing by-product. More likely, the geothermal developer will have to secure his water rights by following prescribed appropriation procedures and no royalty will be charged.

H. New Mexico

New Mexico has historically been the strongest regulator of groundwater pumping in the West. Groundwater was made subject

279. Application to Appropriate No. 30685 (filed Sept. 20, 1976).
280. NEV. REV. STAT. § 322.030(1)(b) (1977).
281. *Id.* § 322.030(3).

to appropriation in 1927,[282] and the supreme court's decision in *Bliss v. Dority*[283] established the foundation precedent for Western groundwater regulation. An understanding of New Mexico's strong groundwater regulatory tradition is important because although geothermal resources are classified as mineral and regulated by the Oil Conservation Commission, the state's water laws and policies potentially apply to much geothermal development. To date, there has been geothermal drilling in the Valles Caldera area and reservoirs have been located, although there is no current commercial production. Potential regulatory conflicts merit legislative consideration of the role of appropriation in geothermal development. Presently, the potential concurrent jurisdiction of the Oil Conservation Commission and the State Engineer may cause undue delay.

Four classes of groundwater are recognized in New Mexico. Much of the state has been divided into designated groundwater basins. A permit from the State Engineer is required for any new well in a designated basin.[284] Groundwater in a nondesignated area may be appropriated without obtaining a permit from the State Engineer.[285] In addition to the designated-nondesignated distinction, there are two classes of exempt groundwater: small domestic wells[286] and deep aquifers.[287]

A geothermal developer wishing to drill a well in a designated basin faces the greatest problems. The geothermal act contains the typical disclaimer that the jurisdiction of state agencies other than the Oil Conservation Commission is not superseded.[288] Consequently, the State Engineer's Office takes the position that a geoth-

282. Act of Mar. 16, 1927, ch. 182, 1927 N.M. Laws 450. This legislation was held to violate the state constitutional provision against the extension of legislation by reference. Yeo v. Tweedy, 34 N.M. 611, 286 P. 970 (1929). This technical defect was corrected in 1931. Act of Mar. 18, 1931, ch. 131, 1931 N.M. Laws 229. The current statutes regulating underground water are found in N.M. STAT. ANN. §§ 72-12-1 to -28 (1978 & Supp. 1979).

283. 55 N.M. 12, 225 P.2d 1007 (1950), *appeal dismissed,* 341 U.S. 924 (1951). Landowners challenged the Act as an unconstitutional taking on the theory that the Desert Land Act, ch. 107, 19 Stat. 377 (1877) (current version at 43 U.S.C. § 1321 (1976)), granted the underlying water as well as the surface to the federal patentee. The court held that the Desert Land Act of 1877 severed waters from the land so that a patentee received only the title to the land (and nonretained minerals), but that a right to water must be acquired under state law. Hence, the state is free to apply any law it chooses so long as vested rights and rights not in actual use at the time of the change are unimpaired. In Cappaert v. United States, 426 U.S. 128 (1976) the Supreme Court affirmed the holding in *Dority* as it applies to waters on lands *not* withdrawn from entry.

284. N.M. STAT. ANN. § 72-12-3 (1978).

285. *Id.* § 72-12-20.

286. *Id.* § 72-12-1.

287. *Id.* § 72-12-25.

288. *Id.* § 72-5-6 (Supp. 1979).

ermal well in a designated basin may be an appropriation. For example, in a letter to the Bureau of Land Management commenting on the environmental impact of proposed United States geothermal leases in the Rio Grande Basin the State Engineer asserted concurrent jurisdiction along with the Oil Conservation Commission.[289]

In New Mexico the State Engineer may initiate water rights adjudications, and the exercise of this power has often been a major factor in the state's groundwater basin management policies. For example, the Roswell Basin in southeastern New Mexico has been closed to new appropriators for many years, and in the late 1960's a large water rights adjudication was completed.[290] The final decree required "substantial water-saving provisions, including the requirement of metering of all groundwater usage."[291] Geothermal development in such a basin could be difficult if the developer were subjected to the jurisdiction of the State Engineer. One possible alternative for the developer would be compliance with the State Engineer's groundwater mining policies, if applicable.

A groundwater appropriator in New Mexico faces further problems if the basin is tributary to a surface stream. This is because surface and groundwater rights have long been coordinated. To protect the rights of senior pumpers, the State Engineer has allowed new wells to be sunk in tributary basins containing unappropriated water only if the new appropriator retires surface water rights to offset the adverse effects of increased groundwater pumping on the river.

Even if a groundwater appropriator successfully gets into a basin, he may be bumped or his share of water reduced in quantity or pressure by a senior surface appropriator exercising his *Templeton* doctrine rights. *Templeton v. Pecos Valley Artesian Conservancy District*[292] held that a senior surface holder may follow

289. Letter from D.E. Gray, Chief, Water Rights Division of the State Engineer, to R.K. Miller, District Manager, Bureau of Land Management (March 8, 1976) (copy on file with the authors). The letter reads in part:

> In addition to any permits that may be required by the Oil Conservation Commission, it will be necessary for the person desiring to drill a geothermal well from which water, either in gaseous or liquid state, will be withdrawn from geologic formations within a declared underground water basin for the purpose of utilizing the thermal energy to first obtain a permit from the State Engineer to drill a well and appropriate public waters. The State Engineer may grant such a permit only upon his finding that its exercise will not impair existing water rights. Any person desiring to drill a well for water within a declared groundwater basin must be licensed by the State Engineer.

290. State *ex rel.* Reynolds v. Lewis, 74 N.M. 442, 394 P.2d 593 (1964).

291. *See* Flint, *Groundwater Law and Administration: A New Mexico Viewpoint*, 14 ROCKY MTN. MIN. L. INST. 545, 562 (1968).

292. 65 N.M. 59, 332 P.2d 465 (1958).

the water, which was the original source of the surface appropriation, into a groundwater basin. The *Templeton* doctrine, despite criticism,[293] has become a cornerstone of New Mexico water law. The State Engineer has attempted to resist extensions of the doctrine by arguing that it, in effect, allows an appropriator to change his diversion point without proving that injury will not result to vested-right holders. Nonetheless, the supreme court extended the doctrine in 1971.[294] There is one escape from the *Templeton* doctrine which is of potential significance to a geothermal developer. A 1978 case[295] refused to apply the doctrine where there was proof that the recapture area was physically sealed by an impermeable geologic formation from the area of surface flow loss.

The National Conference on State Legislatures has proposed legislation which would distinguish between high and low temperature geothermal fluids and provide the geothermal driller with the opportunity to obtain advance approval from the State Engineer. The proposed New Mexico legislation[296] and a similar bill, also drafted by the National Conference on State Legislatures, which was defeated in the 1979 session of the Utah Legislature, are discussed in detail in the conclusion to this article. The proposed legislative solution was also rejected in New Mexico by the dean of state water engineers, S.E. Reynolds. Instead of a legislative accommodation of geothermal and water interests, the State Engineer has formulated an administrative accommodation policy based on his power under New Mexico water law to condition new appropriations. A geothermal driller will have to acquire a water right, but he will not have to prove that third party rights will be unimpaired. The geothermal developer whose project threatens to dewater an area must provide offset rights for senior water right holders. This policy is being applied in Union Oil's Baca project in the Valles Caldera area.[297]

I. Oregon

Oregon is a water-rich, mineral-poor state, where environmental values are afforded great weight in decision-making. These three

293. *See* Comment, *Water Law—The Rise and Fall of New Mexico's Templeton Doctrine*, 6 NAT. RESOURCES L.J. 325 (1966).

294. Langenegger v. Carlsbad Irr. Dist., 82 N.M. 416, 483 P.2d 297 (1971).

295. Brantley v. Carlsbad Irr. Dist., 92 N.M. 280, 587 P.2d 427 (1978).

296. NATIONAL CONFERENCE ON STATE LEGISLATURES, PROPOSED GEOTHERMAL LEGISLATION (34th N.M. Legis., 1st Sess. 1979).

297. Telephone interview with Kenneth A. Wonstolen, National Conference of State Legislatures, Denver, Colorado (Sept. 26, 1979).

factors play an important role in the legal rules and administrative policies that the state has developed to regulate development of geothermal resources. Oregon has numerous potential geothermal areas, mostly along the Cascade range and adjacent to or astride major fault areas in the Basin and Range Province of southeastern Oregon. Some twenty-five deep well exploration permits have been issued, but only four holes have been drilled for production and all of them have been dry. To date, the important geothermal controversies have centered on the land use and air pollution effects of geothermal development and on standards for drilling and abandonment of wells.[298]

Oregon originally followed a dual system of water rights, but all surface riparian rights have been cut back to the amount of water in actual use in 1909.[299] Oregon followed the reasonable use rule for groundwater pumping[300] until the enactment of The Ground Water Act of 1955. It followed the pattern of the 1909 surface water legislation, cutting all pre-1955 groundwater rights back to those in actual use prior to 1955.[301] All post-1955 rights must be acquired by perfecting an appropriation for a beneficial use.[302]

The Water Resources Director has broad powers to limit access by declaring a critical groundwater area[303] where (1) groundwater levels are declining, or have declined excessively, (2) the wells of two or more claimants interfere with each other, (3) the available groundwater supply in the area is overdrawn, or (4) the purity of the

298. *See* Wimer, La Mori & Grant, *Potential Environmental Issues Related to Geothermal Power Generation in Oregon,* 39 THE ORE BIN 73 (1977).

299. Taylor v. Welch, 6 Or. 199, 205 (1876), which recognized riparian rights, was in effect overruled by Act of 1909, ch. 216, 1909 Or. Laws. *See* OR. REV. STAT. § 539.010 (1955). The constitutionality of the legislation has been upheld in state and federal courts. California-Oregon Power Co. v. Beaver Portland Cement Co., 73 F.2d 555 (9th Cir. 1934), *aff'd,* 295 U.S. 142 (1935); *In re* Hood River, 114 Or. 112, 227 P. 1065 (1924); *In re* Willow River Creek, 74 Or. 592, 144 P. 505 (1914). The issue reached the Supreme Court in *Portland Cement,* but the Court held that the Desert Land Act of 1877 gave to the states the discretion to adopt whatever water rights system they choose for the recognition of water rights on lands that were originally part of the public domain. Thus, the Court did not pass on the question of Oregon's constitutional authority to switch from riparian to prior appropriation rights.

300. *See, e.g.,* Bull v. Siegrist, 169 Or. 180, 126 P.2d 832 (1942).

301. OR. REV. STAT. §§ 537.585, .595 (1977).

302. *Id.* § 537.615. An exception to this rule is the right to use springs arising on the property of the claimant. Oregon law has always recognized a land-owner preference to small springs arising on the claimant's property, but it is unlikely that this law would benefit a geothermal developer, because a geothermal well is unlikely to be classified as a spring. *See id.* § 537.800. The Oregon Supreme Court has explained this rule on the theory that the landowner owns the stream because the water is part and parcel of the land itself. Skinner v. Silver, 158 Or. 81, 75 P.2d 21, 27 (1938); Henrici v. Paulson, 134 Or. 222, 293 P. 424 (1930).

303. OR. REV. STAT. § 537.735 (1977).

water in the area is about to be harmed.[304] If the area is designated as critical, it may be closed to further appropriation, existing pumping may be cut back, or rotation may be ordered.[305] Several areas have been so designated in Oregon, but they do not overlap known or potential geothermal areas, although one is close. The major use of hot water at the present time is in the Klamath Falls area where well owners are beginning to compete among themselves. Some allocation of the rights to low temperature hot groundwater may have to be made in the future.[306]

Groundwater pumpers cannot claim an absolute right to static pressure although pressure maintenance is a relevant factor in groundwater basin management. The Water Resources Director has discretion to refuse to recognize an absolute right to pressure in a critical area. For example, he has the power to determine the total withdrawals which will be allowed per day in the area insofar as practicable, and to apportion such withdrawals in accordance with priority dates. This gives the Director the power to adopt a rule which guarantees each appropriator a right to take a certain quantity of water regardless of depth.

Until 1971, Oregon treated geothermal resources as water resources. After some friction arose between a developer and the Department of Water Resources over requirements for a drilling permit, the present statutory scheme was enacted in 1971.[307] The Department of Water Resources was deprived of jurisdiction over geothermal wells over 2,000 feet in depth where the geothermal fluids are less than 250°F.[308] although the Department of Environmental Quality, also within the umbrella Resources Agency, retains

304. *Id.* § 537.730(1)(a)-(d).

305. *Id.* § 537.735(3)(a)-(h).

306. Interview with Christopher L. Wheeler, Deputy Director, Division of Water Resources, Dep't of Environmental Quality, in Salem, Oregon (Aug. 13, 1977) [hereinafter cited as Interview with C. Wheeler].

307. According to the ex-State Engineer, Mr. Christopher L. Wheeler, the problem started when Magma Power "came across the border (from California) in June of 1959, drilled the well, left it full of mud and pulled out and it blew two days later with a mixture of steam and hot water." Mr. Chris L. Wheeler, State Engineer, Natural Resources Comm'n, Statement on House Bill 3019 (May 10, 1971) (Oregon State Archives). Mr. Wheeler's testimony contains the history of hot water well development in the Klamath Falls area and the State Engineer's regulations asserting jurisdiction over geothermal wells prior to 1971. The Department of Geology and Mineral Industries asserted jurisdiction over geothermal drilling on the ground the activity was mineral exploration and thus the Department had greater competence to regulate. The 1969 decision in Reich v. Commissioner, 52 T.C. 700 (1969), *aff'd*, 454 F.2d 1157 (9th Cir. 1972), was used to bolster this argument. *See* Memorandum from Raymond C. Corcoran, State Geologist, to Lee Johnson, Attorney General (Dec. 9, 1969).

308. Interview with C. Wheeler, *supra* note 306.

jurisdiction over reinjection. A desire to promote geothermal resources has kept the resource classified as a mineral.[309]

Geothermal resources are defined as "the natural heat of the earth, the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or which may be extracted from, the natural heat, and all minerals in solution or other products obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form. . . ."[310] Both heat and by-products, including hot water, are included in this definition, adapted from the federal one.[311] The first sentence of the ownership section vests geothermal resources in the overlying surface owner unless the rights have been reserved or conveyed.[312] But, the very next sentence somewhat confuses this ownership allocation: "However, nothing in this section shall divest the people or the state of any rights, title or interest they may have in geothermal resources."[313] Thus, the claims of those who advocate that geothermal resources should be water continue to echo in Oregon law, although experts in the Department of Water Resources do not anticipate conflicts between deep wells and wells drawing from shallow sources because they do not expect the content of water from deep geothermal wells will be suitable for irrigation.[314] However, the state has practically no geological or geochemical knowledge of existing reservoirs. To date,

309. *See* Memorandum from Janet McLennan to the Honorable Robert Straub, Governor (April 21, 1975). The Memorandum relied upon an analysis developed by the authors and others at the Workshop on Geothermal Energy and the Law presented by the University of Southern California Law Center with the support of the National Science Foundation; Christopher D. Stone, principal investigator, Joseph W. Aidlin, program chairman. The Attorney General was the leading advocate of the position that geothermal resources were water. *See* Letter from the Honorable Lee Johnson to Representative Dave Frohnmayer (April 14, 1975). The letter noted that a declaration of geothermal resources held in trust for the public "could conceivably serve as a basis for the state demanding royalties from any such resource."

However, arguments that geothermal resources be regulated as water, advanced by the Attorney General and hot water users of the southern and eastern parts of the state, played a substantial role in the repeal of Oregon's Certificate of Primary Purpose. In 1975 a proposal was made to amend OR. REV. STAT. § 522.220 (1973), which borrowed the California concept of a Certificate of Primary Purpose, which would have created a presumption that geothermal resources were not water and therefore not subject to appropriation. *See* Memorandum of Janet McLennan to the Honorable Robert Straub, Governor (April 21, 1975). In the end, Oregon opted to follow the federal model since 52% of the state is federally owned. The Attorney General, however, seems to have won the battle of the Certificate of Primary Purpose because the legislature simply repealed OR. REV. STAT. § 522.220. *See* ch. 552, § 55, 1975 Or. Laws.

310. OR. REV. STAT. § 522.005(7) (1977).

311. 30 U.S.C. § 1001(c) (1976).

312. OR. REV. STAT. § 522.025 (1977).

313. *Id.*

314. Interview with Vernon Jordan, Department of Geology, in Portland, Oregon.

concern has been expressed by the Department of Water Resources over possible pollution from thermal gradient research wells, and some problems with this dual administration have arisen because the department regulations to prevent blow-outs require cementing at 2,200 feet. The required cementing makes it difficult to convert an unsuccessful geothermal well to a water well because the cementing will make it difficult or impossible to achieve the large flows needed for successful water well operation.

J. South Dakota

South Dakota is the one Western state that has some geothermal potential, but does not have any statutory framework for the regulation of geothermal development. The state's high grade geothermal potential is believed at this time to be confined to the Black Hills area and has not been extensively explored.[315] There is a widespread low grade (heating-type uses) potential in the Madison formation, water which is widely produced for more commercial water uses already. An example is the school at Midland, South Dakota, now heated by a water well.[316]

South Dakota adopts the trust theory prevalent in the West,[317] and classifies groundwater as the "property of the people of the state," subject to appropriation.[318] If geothermal resources were to be classified as water, rights could be acquired by perfecting an appropriation. South Dakota maintained a dual system of water rights until 1955 when riparian and common law groundwater rights were cut back to the amounts of water applied to a beneficial use in the three years prior to 1955.[319]

South Dakota statutes provide no mechanism for the creation of groundwater control areas, but the Water Rights Commission of the Department of Natural Resources has adopted procedures and standards for designating such critical control areas,[320] and the stan-

315. Shoon & MacGregor, *Report of Investigations No. 110, Geothermal Potential in South Dakota,* S.D. GEOLOGICAL SURVEY (1974).

316. C. Austin & J. Whelan, *Geothermal Potential at U.S. Air Force Bases,* Civil and Environmental Engineering Development Office, Air Force Systems Command, Tyndall Air Force Base, Florida, Rep. CEEDO-TR-78-47 (1978).

317. Garton, *South Dakota's System of Water Management and Its Relation to Land Use and Economic Development,* 21 S.D. L. REV. 1, 11-12 (1976).

318. S.D. COMP. LAWS ANN. § 46-1-3 (1976).

319. *Id.* § 46-6-1 (1972). The constitutionality of the legislation was upheld in Knight v. Grimes, 80 S.D. 517, 127 N.W.2d 708 (1964).

320. S.D. RULES OF THE WATER RIGHTS COMMISSION 46B.503 (1972) [hereinafter cited as S.D. RULES]. S.D. CODIFIED LAWS ANN. § 46-6-6.1 (Supp. 1978) authorizes the Commission to adopt rules.

dards are liberal.

Prior to 1972, South Dakota followed the 1933 Idaho Supreme Court's opinion in *Noh v. Stoner*,[321] and recognized a senior pumper's absolute right to artesian pressure. In 1972 the Water Resources Commission was given the right to adopt rules which provide "for regulation of the use of large-capacity wells in the degree necessary to maintain an adequate depth of water for reasonable domestic needs and for a prior appropriator at his point of diversion."[322] Water Rights Commission rules require "reasonable efforts to maintain sufficient artesian pressure in the aquifer to maintain water supplies in existing individual domestic wells which are dependent upon such artesian pressure but continuance of such artesian pressure at all times will not be assured."[323]

The Commission has power to deal with seasonal shortages which threaten domestic supplies. It may suspend the doctrine of prior appropriation.[324] Large capacity wells may be subjected to pro rata cutbacks or other methods such as rotation and limitations on pumping hours "to assure domestic water supplies in adequate wells."[325]

K. Utah

Utah's water laws grew out of the Mormon colonizing practices, rewarding those whose industry put the water to use and discouraging speculation and monopolization. By statute all waters in Utah, whether above or under the ground, are declared public property.[326] Utah gradually adopted the appropriative water rights regime of the Far West. Rights in all categories of water may be obtained only by application for appropriation to the State Engineer, and acquisition of water rights by adverse use or adverse possession is specifically precluded.[327]

An application to appropriate water must be approved by the State Engineer if the following conditions are met:

> (1) There is unappropriated water in the proposed source; (2) The proposed use will not impair existing rights, or interfere with the more beneficial use of the water; (3) The proposed plan is physically and

321. 53 Idaho 651, 26 P.2d 1112 (1933). *See* Comment, *South Dakota's Artesian Pressure—Should It Be a Protected Means of Diversion*, 16 S.D. L. REV. 481 (1971).

322. E.D. RULES, *supra* note 320, 46B.504-506, 46B.201-217.

323. *Id.* 46B.506 (3).

324. S.D. COMP. LAWS ANN. § 46-6-6.2 (Supp. 1978).

325. S.D. RULES, *supra* note 320, 46B.508.

326. UTAH CODE ANN. § 73-1-1 (1968).

327. *Id.* § 73-3-1.

> economically feasible unless the application is filed by the United States Bureau of Reclamation and would not prove detrimental to the public welfare; and (4) The applicant has the financial ability to complete the proposed works and the application was filed in good faith and not for purposes of speculation or monopoly.[328]

It is up to the applicant to provide evidence of his entitlement to an appropriative right, but, in keeping with the state's policy to promote development, the State Engineer must resolve doubts in favor of the applicant.[329] After final proof that the appropriation procedure has been followed and the water has been put to beneficial use, the State Engineer issues a certificate of appropriation which is prima facie evidence of the water right.[330]

Utah's system generally follows the customary prior appropriation pattern: a senior appropriator is entitled to receive his whole supply before a subsequent appropriator obtains any right.[331] A statutory hierarchy of preferences, however, qualifies this. In times of scarcity, while priority of appropriation gives the better right between those using water for the same purpose, domestic use without unnecessary waste has preference over all other purposes and agricultural uses have preference over all uses except domestic.[332]

In 1935, the Utah Supreme Court abandoned the overlying ownership and correlative rights doctrine, and held that percolating groundwater was publicly owned and subject to appropriation.[333] Later that same year, the legislature provided that rights in groundwater could only be acquired by appropriation, and presently the same appropriation procedures apply to both groundwater and surface water.[334]

Utah may recognize a senior's right to pressure, which would likely impede geothermal development. The Utah Supreme Court initially held, over a strong dissent, that the rights of a prior appropriator extended not only to a quantity of water, but also to the static pressure in the underground water source.[335] The court or-

328. *Id.* § 73-3-8 (Supp. 1979).

329. Little Cottonwood Water Co. v. Kimball, 76 Utah 243, 289 P. 116 (1930).

330. UTAH CODE ANN. § 73-3-17 (1968).

331. *Id.* § 73-3-21.

332. *Id.*

333. Wrathall v. Johnson, 86 Utah 50, 40 P.2d 755 (1935). There is a minor qualification in that the overlying owner has been held to own the nontributary soil moisture that immediately nourishes the plants growing in his soil. Riordan v. Westwood, 115 Utah 215, 203 P.2d 922 (1949). This qualification appears to cause no significant problems in water rights administration.

334. UTAH CODE ANN. § 73-3-1 (1968).

335. Current Creek Irr. Co. v. Andrews, 9 Utah 2d 324, 344 P.2d 528 (1959).

dered a junior appropriator to compensate a senior appropriator for the cost of pursuing water to greater depths. A subsequent case reached a somewhat contrary conclusion, but did not overrule the earlier case. In the later case, a city attempted to change its point of diversion, and a claim was made that the city's improved well would reduce the pressure for the wells of others.[336] The Utah court distinguished this case from the earlier one in that "this is not a situation where [there is] a *new* withdrawal in a basin which adversely affects the flow of wells prior in time and right . . . ."[337] The court went on to articulate a "rule of reasonableness."[338] With the earlier case not being overruled, it may still be that Utah law protects static pressure of senior appropriators. If such a rule were rigorously applied, the geothermal developers may be liable to earlier appropriators and even to early geothermal drillers who possess prior water rights. The more recent opinion indicates that a rule of reasonableness will control the issue; if so, geothermal development will benefit from the change.

Developed water rights are recognized in Utah. One who can demonstrate that he has developed a supply of water that is not a part of a known system or source of supply is entitled to the developed water.[339] The appropriation procedure, however, must be followed.

One of the earliest attempts at legal classification of geothermal resources in Utah occurred in 1963. The Director of the Utah State Land Board (the agency responsible for mineral development on state lands) requested an attorney general's opinion on (i) whether the state could lease geothermal rights in lands containing reserved state mineral rights and (ii) whether the State Engineer had any control over geothermal uses. The Attorney General issued a lengthy opinion which drew a sharp distinction between minerals in solution in geothermal fluids and "water."[340] If solution minerals are valuable in themselves and justify mining, the Attorney General concluded they would be covered by the state's reservation. If, on the other hand, the minerals are merely an inseparable part of the

336. Wayman v. Murray City Corp., 23 Utah 2d 97, 458 P.2d 861 (1969).

337. *Id.* at 101, 458 P.2d at 863.

338. The court explained:

> All users are required where necessary to employ reasonable and efficient means of taking their own waters in relation to others to the end that wastage of water is avoided and the greatest amount of available water is put to beneficial use.

Id. at 104, 458 P.2d at 865.

339. UTAH CODE ANN. § 73-3-1 (1968). *See, e.g.*, Bullock v. Tracy, 4 Utah 2d 370, 294 P.2d 707 (1956); Silver King Consol. Mining Co. v. Sutton, 85 Utah 297, 39 P.2d 682 (1934).

340. Utah Att'y Gen. Op. No. 63-016 (Mar. 6, 1963).

water, the water rights regime alone would cover them and there would be no state mineral ownership. Although the opinion is unclear on the application of water laws, the Attorney General expressed the belief that all associated water would be governed in toto by Utah water laws. Thus, the State Engineer would have control of geothermal fluid uses—including the beneficial use of heated and pressurized fluids—to generate power.

A Utah statute enacted ten years ago followed the Attorney General's lead and gave primary control of geothermal resources to the State Water Agency.

> The division of water rights is given jurisidction and authority to require that all wells for the discovery and production of water to be used for geothermal energy production in the state of Utah, be drilled, operated, maintained, and abandoned in such manner as to safeguard life, health, property, the public welfare, and to encourage maximum economic recovery.[341]

The geothermal law embodied in this statute and the Attorney General's opinion could logically support acquisition of a water right, but the State Land Board has taken the position that more than a water right is needed to recover geothermal resources from state-owned land. The State Land Board prepared a lease form for state-owned lands indicating an intention to act as proprietor and collect royalties. The royalties are expressly payable on the sale of "water, steam and any other product."[342] In other respects, the lease form follows traditional mineral concepts.

In order to carry out his assigned statutory responsibilities,[343] the State Engineer has now promulgated regulations which provide the first Utah definition of geothermal resources.

> "Geothermal Resource" means the natural heat energy of the earth, the energy in whatever form which may be found in any position and at any depth below the surface of the earth, present in, resulting from or created by, or which may be extracted from such natural heat and

341. UTAH CODE ANN. § 73-1-20 (Supp. 1979).

342. Utah State Land Board form "Geothermal Steam Lease and Agreement." There is a provision in the form acknowledging a possibly conflicting claim of state patentees who received titles subject to state mineral reservations. In the event the supreme court adjudges geothermal rights to be in such patentees, the state agrees to refund previously paid royalties but not previously paid rentals. In no event, however, does the State Land Board form take account of any possibility that geothermal rights in state lands could be obtained merely by appropriating a water right. In lands wholly owned by the state, the form clearly contemplates that woule-be geothermal developers need both a geothermal lease and an appropriative water right.

343. *See* Wells Used for the Discovery and Production of Geothermal Energy in the State of Utah, AD. RULES, UTAH § A63-01-2 (1978).

> all minerals in solution or other products obtained from the material medium of any geothermal resource.[344]

Predictably, water notions predominate in the draft, and one section would provide redundant proceedings for any water used outside the geothermal operations. An appropriation right would have to be obtained prior to drilling and producing a geothermal well. That appropriation, however, does not make the produced fluids interchangeable with water for any other purposes; any water, brine, steam, or condensate produced may be subjected to a further appropriation "if physical conditions permit."[345]

The first full-fledged geothermal appropriation proceeding before the Division of Water Rights occurred in December of 1974, when the Phillips Petroleum Company filed an application to appropriate 1,680 cubic feet per second of groundwater for power purposes in the Roosevelt Hot Springs area of Utah.[346] The application was filed in connection with federal geothermal leases acquired by Phillips under the Geothermal Steam Act of 1970, but the Interior Department took no position in the matter and left the entire proceeding to Phillips.

In a lengthy hearing before the State Engineer in April of 1976, Phillips attempted to prove its entitlement to an appropriation by introducing evidence on each of the statutory appropriation requirements with particular attention to availability of water in the source and nonimpairment of existing rights. These were important issues because the area's conventional groundwater sources were already fully appropriated, and there was a moratorium on further water well drilling. Phillips attempted to counter this by invoking the developed water doctrine, contending that the water source it sought to tap was 5,000 feet below the groundwater source and therefore physically distinct. Phillips also argued that the water produced from its geothermal wells would be totally unusable for irrigation. Although some interconnection was conceded, Phillips contended that the flow from the groundwater source to the geothermal reservoir took hundreds of years and that geothermal production would not significantly hasten this flow since eighty percent of the produced fluids would be reinjected.

Several protests to the Phillips application were filed, but a full-scale water conflict was avoided. Phillips secured the with-

344. *Id.* § A63-01-2(2)(k).

345. *Id.* § A63-01-2(3)(a)(1)(b).

346. Applications to Appropriate Water No. 44509 (71-3274, 71-3299), filed by Phillips Petroleum Company (Dec. 20, 1974).

drawal of these protests by promising to monitor any possible interference with prior appropriators.[347]

Protests were also filed by Utah Power & Light Company and an associated geothermal developer. The stated ground for their protests was to protect their prior applications to appropriate for geothermal development.[348] They alleged that the Phillips appropriation "would diminish, deplete or otherwise adversely affect the appropriations" sought by them under their prior applications. Subsequently, those protests were also withdrawn, but the withdrawals were without prejudice to the protestants' rights to later assert prior rights and to seek protection.

Utah Power & Light has staked out a simple, if not simplistic, geothermal-is-water position and has held fast to that position. The company has blanketed prospective geothermal areas in Utah with applications to appropriate water rights and has maintained that only appropriative water rights are required to authorize geothermal operations. It has not bothered to secure development rights from either public or private landowners by lease or otherwise. The implausibility of the company's positon on federal lands is self-evident, and there will clearly be no geothermal development on federal lands except by holders of geothermal leases issued pursuant to the Geothermal Steam Act of 1970. As to nonfederal lands, the company's position is only slightly less ludicrous. Would-be geothermal developers armed with leases regard the Utah Power & Light applications as nuisances that will have to be addressed in administrative process before the State Engineer, in court proceedings, or perhaps in direct negotiations with the company.[349]

L. Washington

Washington, like Oregon, lies outside the Rocky Mountain energy basket. The Cascade range and Eastern Washington have the right geology for the existence of geothermal reservoirs, and there

347. The only protest that has not been withdrawn as of this time is that of a miner claiming water rights in the area.

348. The Phillips' application is still pending before the State Engineer.

349. A bill was introduced in the Utah Legislature in the 1979 general session to provide a comprehensive regulatory regime, and in particular, to deal specifically with the water law issues that here concern us. Regulatory powers would have continued in the water agency, but mechanisms would have been provided to substantially extricate geothermal fluids from the prior appropriation system and treat geothermal rights *inter se* as correlative. S.B. 279 Utah Legis. (1979). The bill passed the Senate, but an amendment in the House of Representatives gutted the bill of any meaning, and its sponsors let the bill die. Utah Power & Light is credited with engineering the amendment that resulted in the bill's demise. The unsuccessful Utah bill is discussed at greater length in the concluding section of this paper.

has been great interest in Washington to promote geothermal development to supplement hydroelectric energy. Geothermal may be the least costly alternative source of energy for Washington, so it occupies a higher priority in state energy planning than it does in most other states. To date, most exploration attention has focused on the Cascade range around Mount Baker and Mount Ranier. The younger volcanoes of Mount Adams and Mount Saint Helena in the southern Cascades have not yielded springs with silica temperatures above 150°C. Nonetheless, the Department of Natural Resources estimated in 1974 that if reservoirs exist in only ten percent of the young intrusive rocks with the potential to yield exploitable geothermal resources, ten percent of the state's energy needs for 110 years could be supplied by geothermal energy.[350]

Washington originally followed the dual California theory of water rights,[351] but is now almost purely a statutory appropriation state.[352] Surface water rights have been integrated with groundwater rights since 1945. Both ground and surface water are governed by the doctrine of prior appropriation,[353] and first in time, first in right prevails between ground and surface users as well as among groundwater pumpers.

Washington's geothermal statute classifies geothermal resources as "neither a mineral resource nor a water resource" but rather as *"sui generis."*[354] The ownership assignment has not yet been resolved by the legislature. The legislation is simply silent on who owns the resource.[355] Washington's definition of geothermal resources combines scientific and economic criteria.

> "Geothermal resources" means only that natural heat energy of the earth from which it is technologically practical to produce electricity commercially and the medium by which such heat energy is extracted from the earth, including liquids or gases, as well as any minerals contained in any natural or injected fluids, brines and asso-

350. DEPARTMENT OF NATURAL RESOURCES, ENERGY RESOURCES IN WASHINGTON (1976).

351. Crook v. Hewitt, 4 Wash. 749, 31 P. 28 (1892); *see* ch. 142, §§ 2-4, 1891 Wash. Laws.

352. *See* WASH REV. CODE ANN. § 90.14.170 (Supp. 1978). State v. American Fruit Growers, Inc., 135 Wash. 156, 237 P. 498 (1925); Brown v. Chase, 125 Wash. 542, 217 P. 23 (1923) (cutting riparian rights back to the amount of water actually being used or that would be used in the near future). Corker & Roe, *Washington's New Water Rights Law—Improvements Needed,* 44 WASH. L. REV. 85, 87 (1968).

353. Previously, Washington had applied the American reasonable use rule, and had held that the owner of land overlying percolating groundwater which fed a spring could not use the water on nonoverlying land. *E.g.,* Evans v. City of Seattle, 182 Wash. 450, 47 P.2d 984 (1935).

354. WASH. REV. CODE ANN. § 79.76.040 (Supp. 1978).

355. *Id.*

> ciated gas, but excluding oil, hydrocarbon gas and other hydrocarbon substances.[356]

A close reading of the geothermal legislation, enacted in 1974, reveals it would be more accurate to say that geothermal resources are both mineral and water resources, for the statute papers over important conflicts between two important state regulatory agencies. Both the Department of Natural Resources (DNR), which promotes timber and mineral development, and the Department of Ecology (DOE), which regulates water use, sought jurisdiction over geothermal development. After an intense inter-agency struggle, the DNR prevailed in the 1974 legislation. Thus, geothermal resources are resources subject to private appropriation (development?) by the landowner or his lessee. In short, they are minerals.

The legislation, however, contains a section which may, in effect, require that all geothermal wells be treated as water wells. This section provides that the DNR

> shall not allow operation of a well under permit if it finds that the operation of any well will unreasonably decrease goundwater available for prior rights in any aquifer or other groundwater source for water for beneficial uses, unless such affected water rights are acquired by condemnation purchase or other means.[357]

The last sentence of the section provides that copies of all permits will be forwarded to the DOE within five days of issuance. When this section is read together with the sections providing for judicial review of DNR permits by third parties, a basis emerges by which the DOE can become a party to any geothermal permit proceeding. As a result, a prudent course for the DNR, as its attorney has suggested, would be for it to treat every geothermal permit as a water well permit.

If geothermal resources are treated *de facto* as water, it is difficult to speculate about the consequences of this classification. To date, Washington has had no geothermal well permit applications, and the state has had little experience with groundwater regulation. However, Washington's long history of a dual system of water rights may increase the costs of negotiating with water rights claimants.

A major problem facing any new water user is the poor state of water records, and the problem is more complex in Washington because there are pre-1917 riparian rights, unadjudicated appropriative rights, pre-1945 common law groundwater rights, post-1945

356. *Id.* § 79.76.030.
357. *Id.* § 79.76.080.

exemptions, and prescriptive rights outside the state's records. A geothermal developer, therefore, will find it difficult to discover who might contest his application and who should be bought out if necessary. Legislation passed in 1967[358] strives to introduce more certainty into water planning by providing an accurate record system for all water rights. The 1967 legislation would have brought claims for all of those water rights within the state's records by providing that water rights not already the subject of permit or certificate would be relinquished unless the claimant filed prescribed information with the state prior to July 1, 1972. This part of the 1967 legislation originally failed. The problem was eliminated in 1969, however, when legislation extended the time limit to file until June 30, 1974.[359]

To balance withdrawals against recharge where the rate of pumping exceeds a safe level of recharge, the Supervisor of the Division of Water Resources divides areas in which there are many wells into groundwater areas, subareas, and zones. To prevent an overdraft or a lowering of the groundwater table, the Supervisor has the authority to regulate the use of water in the area involved to assure that the "safe sustaining yield" is not exceeded.[360]

Groundwater mining is apparently prohibited in Washington, and a pumper has a statutorily defined right of pressure to a safe yield level. Yet, if no pumper exceeds the safe sustaining yield, then there is no right to pressure by one pumper against another, and a junior may cause a senior to deepen his well without liability. Thus, application of current Washington groundwater doctrines to geothermal developers poses no substantial burden because groundwater resources are not now perceived as scarce.

As we have previously discussed, a geothermal driller *qua* appropriator may face problems if the reservoir cannot immediately produce in commercial quantities. Washington's groundwater act provides that a person who voluntarily fails without sufficient cause to put water to beneficial use shall lose his right.[361] A geothermal driller who is forced to sit on his deposit faces a risk that his lack of use will be classified as an abandonment. The statute does not define what constitutes sufficient cause, but commercial exigencies should be a good defense. Still, the uncertainties caused by the application of the law of abandonment and forfeiture are yet an-

358. *Id.* § 90.14.170.
359. *Id.* § 90.14.041.
360. *Id.* § 90.44.130 (1970).
361. *Id.* § 90.14.160 (Supp. 1978).

other illustration of the inappropriateness of water law concepts. The antispeculative doctrines incorporated into the implied covenants applicable to oil and gas development, especially the implied covenant of further exploration, are better suited to assure adequate energy supplies in the public interest.

It is likely that either an application for a geothermal well permit or an application for a water right will trigger Washington's State Environmental Policy Act (SEPA),[362] because the supreme court has held that a water appropriation permit application is subject to SEPA.[363] Thus, an environmental impact statement for the project must be filed unless the agency files a negative declaration upon finding no significant environmental impacts.

The DOE may assume the primary responsibility for the environmental impact statement regardless of whether a geothermal well permit or water right application is filed.[364] If a permit applicant chooses, he may file a master application with DOE requesting the issuance of all the necessary permits. DOE is then required to supply the applicant with the necessary forms, to hold a public hearing, and to mandate that all agencies make final permit decisions within a specified time after the hearing.

M. Wyoming

In Wyoming, groundwater is fully subject to the state's appropriation system, and groundwater rights can only be obtained by permit from the State Engineer.[365] A would-be appropriator, before drilling a well, must apply for a permit which is normally issued as a matter of course "if the proposed use is beneficial and . . . the proposed means of diversion and construction are adequate."[366] For groundwaters not in a designated "control area," the procedures are simple and the showings required of the applicant are minimal. If groundwater rights are sought in a control area, the permit requirements become more rigorous.

Wyoming, more clearly than any other state, has seemingly classified geothermal resources as water and has placed them squarely in the water appropriation system. The groundwater law was amended in 1973 to define groundwater as "including hot water

362. *Id.* § 43.21C.

363. Stempel v. Department of Water Resources, 82 Wash. 2d 109, 508 P.2d 166 (1973).

364. Corker & Elliot, *The Environmental Coordination Procedures Act of 1973, or ECPA! ECPA! RAH, RAH, RAH!!*, 49 WASH. L. REV. 463 (1974).

365. WYO. STAT. ANN. § 41-3-930 (1977).

366. *Id.* § 41-3-931.

and geothermal steam."[367] This suggests that groundwater jurisprudence is fully applicable.

Despite the statutory definition, the state has prepared a geothermal lease form for state lands. It is patterned after leases which assume that the landowner controls the resource as a proprietor. The lease contains the usual grant of development rights and calls for the payment of royalties on production.[368] This, of course, is entirely inconsistent with the treatment accorded groundwater as being held by the public and available for appropriation for beneficial uses. The steps the state has taken with respect to its land suggest the appropriateness of similar conduct by private landowners, but public and private geothermal leases will remain subject to doubt so long as geothermal resources remain within the definition of groundwater.

The State Board of Control is authorized to designate a control area if use of underground water is approaching the current recharge rate, if groundwater levels have declined excessively, if conflicts among users are occurring or are foreseeable, if waste is occurring or may occur, or if "other conditions exist or may arise that require regulation for the protection of the public interest."[369] After such a designation, the State Engineer's powers are greatly enhanced. The rights to underground water in control areas are subject not only to prior rights, but also to greatly diverse methods of protecting prior rights.[370]

Superimposed on the prior appropriation system are statutory preferences among water users. Rights "not preferred, may be condemned."[371] Significant for our purposes is the fact that use of water for "steam power plants" falls under an enumerated third preference group ranking behind a first preference for drinking purposes

367. *Id.* § 41-3-901(b)(ii). Scholarly comment has acknowledged the inadequacy of this response and the unanswered questions that remain. *See* Sato & Crocker, *supra* note 40, at 490-92; Schlauch & Worcester, *supra* note 130, at 351-52. In implementing the statute, the State Engineer has issued regulations and instructions stating:

> Geothermal steam and hot water are considered groundwater for the purpose of administration. A permit to appropriate groundwater must be obtained . . . to explore for or before geothermal steam or hot water can be utilized. Anyone contemplating the development of geothermal steam or hot water should contact the State Engineer's Office for additional information.

Id. at 351.

368. State of Wyoming form, "Geothermal Resources Lease" (effective Nov. 1, 1975). *See also* STATE OF WYOMING RULES AND REGULATIONS GOVERNING THE ISSUANCE OF GEOTHERMAL RESOURCES PERMITS AND LEASES (1975).

369. WYO. STAT. ANN. § 41-3-912 (1977).

370. *See generally, id.* § 41-3-915.

371. *Id.* § 41-3-906.

and a second preference for municipal purposes.[372] Nevertheless, a condemnation action against a geothermal operation, although possible, does not seem likely.

Wyoming recognizes a limited right to pressure in senior appropriators.[373] Any appropriator who has obtained a permit may complain of later activities which reduce pressure to an extent that impairs "maximum beneficial use of water in the source of supply."[374] That he may not otherwise complain may prove important to the geothermal developer when geothermal operations appear to impact conventional water wells or, indeed, other geothermal wells.

In the same year that Wyoming added geothermal resources to its groundwater definition, it enacted a system of appropriation for "by-product water." In essence, the developed water doctrine was codified. By-product water is defined as "water which has not been put to prior beneficial use, and which is a by-product of some nonwater-related economic activity and has been developed only as a result of such activity."[375] As nonexclusive examples of by-product water, the statute identifies water resulting from operation of oil well separators and from mining activities such as draining mines. One intending to appropriate by-product water is required to file an application with the State Engineer after the pattern of groundwater applications. The by-product water is considered to be groundwater and treatable as such if it "is intercepted while it is readily identifiable and before it has commingled with the waters of any live stream, lake, reservoir or other surface watercourse, or part of any groundwater aquifer."[376] The developer of the water must be the applicant or the applicant must have an agreement with the developer giving permission to use the water as proposed in the application.[377]

On its face, it would seem that the water content of geothermal processes would often qualify as by-product water. Doubts might arise, however, in cases where a geothermal deposit is closely interconnected with or seems to be closely related to conventional

372. *Id.* § 41-3-102(b).

373. The groundwater statute provides:

> It is an express condition of each underground water permit that the right of the appropriator does not include the right to have the water level or artesian pressure at the appropriator's point of diversion maintained at any level or pressure higher than that required for maximum beneficial use of the water in the source of supply.

Id. § 41-3-933.

374. *Id.*

375. *Id.* § 41-3-903.

376. *Id.* § 41-3-904(a)(i).

377. *Id.* § 41-3-904(a)(ii).

groundwaters. When geothermal fluids are classified as by-product water, the statute does not answer questions that may arise among competing pumpers from a common pool. The simplistic assumption of the statute seems to address only the case of a single developer who makes available a single source of by-product water.

IX. The Water Pollution Problem

As stated at the outset, there does not appear to be any particular reason to regard geothermal pollution problems as different from pollution problems posed by other mineral exploitation activities. Water pollution laws, however, should not be applied mechanistically when the disposal of geothermal fluids is not likely to contaminate "fresh" water sources but only to return fluids to geothermal deposits.

A. Reinjection and Problems Regarding Geothermal Waste Waters

Waste results from geothermal energy production because the natural thermodynamic constraints placed on any steam cycle require the rejection of sixty to seventy percent of the total energy produced. Condensed steam and fluids from hot water fields can be disposed of in four ways: (1) waste heat can be rejected directly into the atmosphere, (2) waste heat and fluids can be discharged into surface streams or holding ponds, (3) fluids can be reinjected into the reservoir, or (4) fluids can be recycled for other uses such as space heating. The use of cooling towers is feasible for dry steam fields such as The Geysers, but may not be suitable for geothermal fluids from hot water systems, which may have a higher percentage of dissolved solids than do nonthermal waters.

A power plant fueled by a hot water system must generally discharge waste fluids onto the surface, inject them into the reservoir, or develop a recycling program. Waste fluids will have two potentially injurious components: dissolved solids and heat. The discharge may consist of geothermal fluids, in the case of a liquid dominated system, and also supplemental cooling water. Geothermal plants that use direct or flashed steam generally do not require a supplemental source of cooling water. The most promising technology for low temperature systems or systems with a high content of total dissolved solids is the binary system being developed in the Imperial Valley of California. It requires large amounts of supplemental cooling water. In the binary system geothermal fluids

usually remain in a closed system; since total extracted volume, excluding losses, is reinjected into the reservoir, the fluids are not available for cooling the water supply.

For most hot water systems, either reinjection or recycling will be the only viable alternative. The reasons are both geographical and legal. In many parts of the West there simply may not be a sufficient amount of surface water available at the power plant site (which, of course, must be located near the deposit) into which fluids can be discharged. And, should a surface stream be available, it probably will not be possible to secure the requisite discharge permits. A geothermal power plant would be a point source discharger under the Clean Water Act.[378] The operator of the plant would be subject to both the technology-forcing effluent limitations and receiving water quality standards designed to implement the Act's no discharge goal. Moreover, the effluent limitations promulgated under the Act increasingly foreclose surface discharges. A limited variance in the Act does allow once-through cooling water to be discharged directly into a stream if no environmental damage would result from the discharge,[379] But its relevance to geothermal power plants remains problematic.

It is highly unlikely that a geothermal power plant could obtain a permit for a direct surface discharge. For example, once-through discharges of cooling tower blowdowns into local streams have been stopped at The Geysers. Thus, geothermal fluids will usually be reinjected, evaporated, or recycled. If the standards for a once-through discharge cannot be met, cooling towers and evaporation ponds will be used.

Liquid geothermal wastes may contain brines as well as heat. Implementation of the no discharge goal will make the use of deep reinjection to dispose of these brines more and more attractive. Some geologists, however, have asserted that hyper-saline brines may be confined to the Salton Sea in California's Imperial Valley so the pollution problem may be more localized than has been assumed. Deep-well reinjection is the preferred method of disposing of brines for conservation as well as pollution control because surface and groundwater contamination is prevented and reservoir pressure is maintained.[380]

378. Ch. 758, tit. I, § 101, 86 Stat. 816 (codified in scattered sections of 33 U.S.C.) (1976 & Supp. I 1977).

379. 33 U.S.C. § 1326(a) (1976).

380. It is not clear, however, that higher reservoir pressures are always better. The lowering of pressures can result in fluids changing from a liquid to a vapor condition, to the possible advantage of development.

Reinjection poses many environmental, in-plant, and recovery hazards, but most reinjection experiments evaluated in the Second United Nations Symposium on Geothermal Energy report that the problems can be overcome.[381] In addition to traditional spillover problems, there are problems which are internal to the plant or the reservoir. All reinjection must be carried out at sufficiently high temperatures so that the bore hole and surface installations are not clogged by scaling and mineral deposits—mainly silica and calcium carbonate.[382] Reservoir problems may depend on the individual formation. Unless there is a sufficient distance (1.1 to 1.5 kilometers) between the reinjection and projection zones, the productive capacity of the field could suffer a lowering of fluid temperature.[383]

Resource conservation may be promoted because reinjection may increase the productive life of the reservoir by recirculating the heat transfer fluid. Although the reinjected water will be colder than the water being withdrawn to produce energy, the reinjected water will be hotter than natural recharge water derived from the surface which must originate in a relatively cold environment and be heated by the reservoir rocks. Reinjection means

> reduction of the heat needed from the reservoir in order to bring it up to high temperature. These two factors could conserve energy in a very significant way, increase the total potential production of useful energy over the life of the field and in fact, make the efficiency of the conversion of extracted heat energy to electric energy comparable to the generally higher efficiency of vapor dominated steam fields.[384]

B. Federal and State Water Pollution Laws Affecting Reinjection

At the present time neither the federal government nor the states have a clear legal strategy for regulation of reinjection of waste fluids taken from a reservoir. Geothermal reinjection is part of the larger problem of oil and gas and mining waste reinjection and deep well injection generally. The federal and state governments have been slow to integrate the traditional regulation of oil and gas and mining reinjection into recent water pollution control legislation.

The federal government can regulate mining reinjection under

381. II U.N. SYMP. (1975).

382. Einarsson, Vides & Cuillar, *Disposal of Geothermal Waste Water by Reinjection,* II U.N. SYMP. 1349, 1360 (1975).

383. *Id.* at 1362.

384. *Id.* at 1361.

two statutes—the Clean Water Act[385] and the Safe Drinking Water Act of 1974.[386] And, as proprietor and sovereign of the public lands, the federal government can and does regulate the injection activities of federal lessees.[387] The Geothermal Steam Act regulations authorize the Department of Interior to apply whatever waste disposal standards it deems necessary to protect public lands from geothermal pollution.[388] In addition, a federal lessee must comply with state pollution standards and procedures. In 1976, the Supreme Court held that federal activities must only comply with state substantive standards,[389] but the Clean Water Amendments Act of 1977 gives the states the power to apply both their substantive standards and their procedures.[390] Thus, the states may regulate deep-well reinjection by imposing requirements on federal lessees over and above those imposed by the Bureau of Land Management and the United States Geological Survey.

With one exception, the courts have held that the Environmental Protection Agency (EPA) cannot require a National Pollution Discharge Elimination System (NPDES) permit for a deep waste well reinjection unless the reinjection will cause wastes to migrate into surface waters.[391] The EPA can, however, withhold approval of a state program if a state lacks adequate authority to "control the disposal of pollutants into wells,"[392] but it cannot impose controls over an individual subsurface discharge which will not cause pollution of surface waters.

The Safe Drinking Water Act of 1974[393] is designed to provide health-based standards for drinking water delivered to ultimate consumers and to protect underground sources of public drinking

385. Ch. 758, tit. I, § 101, 86 Stat. 816 (codified in scattered sections of 33 U.S.C.) (1976 & Supp. I 1977).

386. Ch. 373, tit. XIV, § 1401, 88 Stat. 1661 (codified in scattered sections of 5, 21, 42 U.S.C.) (1976 & Supp. I 1977).

387. *See* Kleppe v. New Mexico, 426 U.S. 529, *rehearing denied,* 429 U.S. 873 (1976).

388. 43 C.F.R. § 3204.1 (1978).

389. EPA v. California *ex rel.* State Water Resources Control Bd., 426 U.S. 200, 227 (1976); Hancock v. Train, 426 U.S. 167, 198-99 (1976).

390. 33 U.S.C.A. § 1323 (Supp. 1978).

391. Exxon Corp. v. Train, 554 F.2d 1310 (5th Cir. 1977). *Accord,* United States v. GAF Corp., 389 F. Supp. 1379 (S.D. Tex. 1975). *But see* United States Steel Corp. v. Train, 556 F.2d 822, 851-53 (7th Cir. 1977). *See* Note, *United States v. GAF Corp.: A Leak in the FWPCA?,* 6 ENVT'L L. 561 (1975). The arguments for EPA jurisdiction are made in Eckert, *EPA Jurisdiction Over Well Injection Under the Federal Water Pollution Control Act,* 9 NAT. RESOURCES LAW. 455 (1975), and Ipsen & Raisch, *Enforcement Under the Federal Water Pollution Control Act Amendments of 1972,* 9 LAND & WATER L. REV. 369, 386-87 (1974).

392. 33 U.S.C. § 1342(b)(1)(D) (1976).

393. Ch. 373, title XIV, § 1401, 88 Stat. 1661 (codified in scattered sections of 5, 21, 42 U.S.C.) (1976 & Supp. I 1977).

water supply from contamination. The Act contemplates a regulatory scheme similar to that established in the Clean Water Act. The EPA can establish standards for an approved state regulatory program and then turn underground source protection regulation over to the states. If a state fails to enact the necessary qualifying legislation or is delinquent in administering its program, the EPA can impose and administer a regulatory program itself. The guidelines for aquifer protection (1) prohibit underground injections not authorized by a state permit, and (2) place upon the injection permit applicant the burden of "proving to the state that its injection will not endanger drinking water sources."[394]

The heart of a drinking water source protection program will be the regulation of deep-well injections into aquifers that are potential sources of public drinking water supplies.[395] The entire mining industry is therefore naturally interested in the definition of a protected aquifer, for deep-well injection regulations directly impact on mining activities. This interest is sharpened by the EPA's mission to err on the side of public safety. The oil and gas industry has long enjoyed legislation which places salt water and secondary recovery injections outside the framework of pollution control laws on the ground that there is no threat of contamination to public drinking water supplies when reservoir fluids are replaced and that injection is best regulated by the Oil and Gas Conservation Agency in the context of general correlative rights protection and conservation legislation. Underground injections of brine and other fluids from hydrocarbon formations are thus exempt from regulation under the Safe Drinking Water Act unless regulation is "essential to insure that underground sources of drinking water will not be endangered by such injection."[396] No similar exemption exists for other mining activities such as geothermal drilling.

Fixing the relationship between mining activities and the protection of drinking water supplies has proven to be more difficult than the EPA imagined. Draft regulations were published in 1976 but were withdrawn in the face of widespread opposition. New regulations, however, should soon be promulgated.

The Safe Drinking Water Act defines an aquifer as "a geological formation, a group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant

394. 42 U.S.C. § 300n(b)(1)(A), (B) (1976).

395. Underground injection "means the subsurface emplacement of fluids by well injection." 42 U.S.C. § 300h(d)(1) (1976).

396. 42 U.S.C. § 300h-1(c) (1976).

quantities of water to wells or springs."[397] It can be argued that geothermal reservoirs could be included under this regulation; however, proof of a substantially closed system such as that made in *Geothermal Kinetics, Inc. v. Union Oil Co.*,[398] segregating geothermal resources from groundwater, suggests that some reservoirs could be segregated. It is unlikely that the principal fluid from a geothermal reservoir involving a magmatic or similar heat source would serve as a sole or principal source of drinking water, but it is not unreasonable geologically to encounter potable hot water systems based on convection or flow in deep folds or even natural condensate layers in a geothermal area. Development of a geothermal reservoir in any area containing such an identified potable source might be economically prohibited because federal dollars would not be available unless it can be shown that the system is, in fact, separated from the surface aquifer and that the recharge areas for the two systems are distinct. Thus it would appear that there is no *per se* exemption for geothermal reservoirs under this provision; a well-by-well determination is probably necessary. The burden of proof rests with the individual seeking to inject.

In the absence of a clear federal policy on mining reinjection, the Safe Drinking Water Act will be implemented through the administration of state groundwater pollution control laws. These state laws generally distinguish between injections which are likely to degrade drinking and irrigation groundwater sources and those which pose no substantial threat of degradation. States have broad categories of exempt discharges and procedures to allow dischargers to prove that their discharges will not cause degradation of public waters. In short, the states have attempted to avoid the application of pollution control regulations to mining activities in situations where there is minimal threat of contamination of potable water supplies. This is in accord with the presumption of noninterference advocated here. Therefore, many existing groundwater pollution control laws provide a precedent for an efficient regulatory regime.

The reinjection of oil and gas brines has long been exempt from state pollution laws. Oil and gas formations are considered closed systems, and the injection of saline brines back into the stratum of origin for the purpose of secondary recovery or waste disposal is not considered to be a source of pollution. Arizona,[399] New Mexico,[400]

397. Safe Drinking Water Act of 1974, ch. 373, tit. XIV, § 1401, 88 Stat. 1661 (codified in scattered sections at 5, 21, 42 U.S.C.).

398. 75 Cal. App. 3d 56, 141 Cal. Rptr. 879 (1977).

399. ARIZ. REV. STAT. ANN. § 36-1851(11) (Supp. 1978-1979).

400. N.M. STAT. ANN. § 79-36-11(G) (Supp. 1977).

Nevada,[401] and Wyoming,[402] expressly exclude oil and gas injections from pollution regulation. Only Washington has extended this exclusion to geothermal wastes by defining a geothermal "energy transfer system" to include "reinjection wells."[403] Only waste products which escape or are released from the energy transfer system are subject to the state's water pollution laws.[404]

In states such as New Mexico where geothermal resources are primarily regulated by the Oil and Gas Conservation Agency, it could be argued by analogy that closed cycle geothermal reinjections should be exempt or that an applicant should be allowed to prove that degradation of usable supplies is unlikely. A similar argument could also be made in Nevada which excludes replacement of "natural waters" from its definition of pollution.[405] A more difficult case is presented in Idaho where waste disposal well injections are specifically regulated. However, a close reading of the Idaho statute indicates that the purpose of regulation is only to prevent the pollution of waters used for domestic, recreational, or aesthetic purposes. Irrigation waste water disposal is excluded from the requirement that the discharges be treated to bring them into conformity with Idaho drinking water standards.[406] A geothermal operator ought to be allowed to make the same showing because the case for noncontamination appears to be stronger for geothermal waste waters than it does for irrigation waste waters.

Other states expressly include disposal wells in their definitions of "disposal system"[407] but arguments can be made that either (1) a reinjection of geothermal brines is not within the definition of "waters of the state"[408] because the liquid dominated system is a

401. NEV. REV. STAT. § 445.178 (1977).

402. WYO. STAT. ANN. § 35-11-103(c)(i) (1977).

403. WASH. REV. CODE ANN. § 79.76.030 (Supp. 1978).

404. *Id.* § 79.76.060.

405. NEV. WATER POLLUTION CONTROL REGS. art. 1:1.12. "Natural waters" means waters which have not been degraded or enhanced by actions attributable to man.

406. IDAHO CODE §§ 42-3901 to -3914 (1977).

407. *E.g.*, MONT. REV. CODES ANN. § 69-4802(8) (Supp. 1975); OR. REV. STAT. § 468.700 (1977). Oregon imposes liability on geothermal operators for the failure to protect ground and surface water supplies. *Id.* § 522.155.

408. *See, e.g.*, UTAH CODE ANN. § 73-14-2(f) (1961):

> "Waters of the state" means all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, . . . except that bodies of water confined to and retained within the limits of private property, and which do not develop into or constitute a nuisance, or a public health hazard, or a menace to fish and wildlife, shall not be considered to be "waters of the state" under this definition.

Although this exclusion probably was aimed at private sewage disposal systems (*e.g.*, leach line systems or dry wells), arguably it also applies to deep well brine disposal.

closed reservoir or (2) a reinjection of geothermal brines is not within the definition of "pollution or pollutant" because disposal in this manner is not "likely to create a public nuisance or render such waters harmful, detrimental, or injurious to public health, safety, or welfare . . . ."[409]

State pollution laws are, therefore, also an appropriate place to apply the presumption that geothermal reservoirs are *separate* from conventional groundwater aquifers.[410] One objection to this analysis is that there is a difference between the rights of prior water rights appropriators against a geothermal operator and the rights of the public to clean water. A prior appropriator has a property right in the water put to beneficial use, and, should a geothermal development in fact interfere with the right, after-the-fact compensation can make the water right holder substantially whole. If, however, a geothermal well causes groundwater contamination, any after-the-fact damage remedy will not make the public whole except at great expense. This risk can be minimized by subjecting geothermal development to state pollution laws with a recognition that geothermal development is a special problem, and a regulatory structure that allows the developer to present his case for exemption before making a substantial capital investment should be provided.

X. CONCLUSION

There is a temptation to solve new resource allocation problems by reasoning from analogy to a familiar legal classification. Sometimes this process is satisfactory, but if the familiar category is un-

409. ARIZ. REV. STAT. ANN. § 36-1851(8) (1974). Arizona defined pollution as

> such contamination, or other alteration of the physical, chemical, or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is likely to create a public nuisance or render such waters harmful, detrimental, or injurious to public health, safety, or welfare, or to domestic, agricultural, commercial, industrial, recreational, or other beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

Id. Recently, Arizona adopted a more streamlined definition of pollution. "'Pollution' means the man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of water." *Id.* § 36-1851(12) (Supp. 1978-1979).

410. This was recognized in the well-reasoned California Superior Court opinion in Geothermal Kinetics, Inc. v. Union Oil Co., 75 Cal. App. 3d 56, 141 Cal. Rptr. 879 (1977), which held that the owner of the severed mineral estate was entitled to the geothermal resource because, in part, the reservoir litigated (at The Geysers) was sealed off from shallower groundwater aquifers. California water pollution laws define pollution as "an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects: (1) such waters for beneficial uses, or (2) facilities which serve such beneficial uses." CAL. WATER CODE § 13050(1) (West 1971).

suitable, reasoning by analogy can impede the development of fair and functional allocation rules. The suggested adoption of groundwater rules for geothermal resources illustrates the dangers of reasoning by analogy. The two resources differ significantly. The application of water law doctrines to geothermal resources results in a legal regime where constraints on development are not offset by clear benefits.

The efficient allocation of geothermal resources will be served best by a presumption that geothermal deposits are separate from freshwater aquifers. Thus, geothermal resource exploitation can be governed by a separate legal regime. In some instances there will be a physical interconnection between geothermal and freshwater resources. Efficiency will be better served, however, by a legal regime that starts from a presumption of noninterference, and provides a mechanism for the early assessment of potential interference to assure prior vested water right holders that the geothermal developer will be liable for any injuries caused.

The right to exploit the resource should be assigned to the overlying property owner. Recognizing a presumption of noninterference between ground and geothermal resources is a logical corollary of this basic principle. A geothermal right should be a right to capture the resource. Judicial rules designed to prevent waste and to protect correlative rights should modify the right to capture. Judicial protection of correlative rights should be supplemented—as it already has been in some states—by pooling and unitization statutes. Oil and gas law provides useful analogies, although there is a need to realize that the geothermal resource is heat, not the heat transfer medium. To promote the capture of geothermal resources, the overlying owner needs the maximum possible assurance that his right to exploit will not be challenged by others unless he is wasteful. Because geothermal resources may be physically interconnected with other resources, it is not possible to give an overlying owner complete assurance that his exploitation will be exclusive. The best that the law can do is to give the overlying owner the benefit of a presumption of noninterference.

The presumption would be implemented by assigning the appropriate state agency the responsibility and authority to gather information and make findings concerning the relevant physical facts early in the development of a geothermal area. In extreme cases, it may even be appropriate for the agency to drill additional wells to monitor the interrelationships of freshwater pumping and geothermal production. The proposed inquiry would extend beyond the narrow scope of the certificate of primary purpose device avail-

able by statute in California,[411] which deals only with geothermal wells and inquires only whether the water content of those wells is fit for domestic and irrigation uses without further treatment. Rather, the proposed inquiry by the state agency would deal with all matters that bear on the possible relationship between freshwater pumping and geothermal development.

Temperature, pressure connection, and depth are the most likely variables for monitoring a physical interconnection. As information is accumulated over time, the agency might be able to formulate *per se* categories of noninterference through administrative rulemaking. Although depth and temperature appear to be the best basis for *per se* rules, legislation is not the best way to implement a *per se* rule. A common theme that emerged from our study of western state geothermal legislation is that legislative classifications were usually designed to solve jurisdictional conflicts among state agencies, and not based on the best available scientific information about the resource. For the foreseeable future the presumption will have to be applied on a reservoir-by-reservoir basis.

The presumption of noninterference must, of necessity, be a rebuttable one. Vested water rights are protected by the due process clause of the federal Constitution and by state constitutions as well. It might be argued that the presumption is unconstitutional because it takes groundwater rights. This should not be the case, however, because groundwater pumpers can be adequately protected. The presumption rests on a sound scientific basis, designed to insure that a geothermal driller's right is not a water right. The presumption also recognizes that interference with vested rights is a defense to a geothermal well, but it seeks to limit the application of the defense to situations where there is a substantial risk of actual interference.

The major problem with classifying geothermal resources as water is that the protection of existing groundwater pumpers is accomplished at too high a cost. A water right is only good if the holder can make a call against rival claimants under the worst foreseeable hydrological conditions. The resulting shadow boxing in water rights disputes could impede geothermal development since a geothermal developer placed in this regime may never be given the opportunity to demonstrate noninterference. Socially useful energy development may be precluded because of hypothetical situations which never materialize.

411. See note 169 *supra* and accompanying text.

The proposed presumption of noninterference strikes a balance between would-be geothermal developers and vested water rights holders. At a minimum, a pumper is guaranteed compensation should a geothermal driller interfere with his water right. The pumper also has an administrative remedy equivalent to a suit for injunctive relief, since arguments about interference can, of course, be raised before the administrative agency. The benefit of the agency remedy is that a more accurate assessment of impairment can be made. Remedies such as physical solutions can be more easily developed before the rival resource claimants commit themselves to rigid positions.

New Mexico and Utah have recently considered legislation which would address geothermal-water conflicts more directly than does California's certificate of primary purpose. The proposed legislation, drafted with the assistance of the National Conference of State Legislatures, provides a useful model for other states to follow with appropriate revisions for local conditions and other modifications which we suggest. Unfortunately, the defeat of the proposed legislation in the Utah Legislature demonstrates the power of one strong lobbyist to preclude a rational accommodation in the public interest.

A. New Mexico

As we discussed in the section on New Mexico, both the State Engineer and the Oil Conservation Division presently assert jurisdiction over geothermal resources. Legislation proposed in 1978 would have eliminated the jurisdictional split by limiting the state's definition of geothermal resources to "the natural heat of the earth at temperatures greater than 120° centigrade."[412] A reservoir containing thermal water below 120° centigrade is designated as a "low-temperature thermal reservoir."[413] A geothermal driller must apply to the State Engineer for a permit to drill a geothermal well. Protestors may appear, but the State Engineer's discretion to deny a permit is limited, as a permit must be granted if:

> The intended geothermal operation will not cause substantial interference with and impairment of existing surface and groundwater rights or existing stream flows; or
>
> . . . As a condition of the granting or the permit of amendment, . . . the geothermal owner [has obtained] adequate water rights to

412. See note 296 *supra* and accompanying text.
413. *Id.*

> offset any impairment to existing water rights or stream flows . . . .[414]

The date of the application for a permit is the priority date between a geothermal developer and a conventional water right holder. The permit creates no priority among geothermal drillers because the rule of capture applies except as modified by rules of the New Mexico Oil Conservation Division to protect correlative rights. The significance of giving the geothermal developer a water priority is basically to protect him against subsequent water users. The State Engineer may set economic drilling levels for any groundwater basin associated with a geothermal field, and a geothermal driller is not liable for any additional lifting costs imposed on groundwater pumpers so long as water levels remain at the designated economic drilling level. New Mexico law does not recognize a fixed right to lift on the part of senior groundwater pumpers. The State Engineer has the discretion to permit pumpers to lower groundwater tables in designated basins without liability to senior pumpers for increased lifting costs. However, the State Engineer also has discretion to recognize rights to fixed pumping levels, and thus the proposed legislation would somewhat limit the State Engineer's discretion to protect groundwater pumpers from geothermal developers. The term "economic drilling levels" makes it clear that existing pumpers could be made to suffer some disadvantage in the interest of geothermal development.

A second reason why the placement of the geothermal developer in the New Mexico water rights regime will not benefit prior pumpers to the same extent as if the new entrant were a conventional water user is the burden of proof placed on existing pumpers to demonstate impairment of a vested right. After an allegation of impairment of vested rights, the proposed legislation provides:

> The State Engineer shall hold a hearing on the matter at which the complaining party shall have the burden of establishing such interference and impairment. Should the complaining party sustain such burden of proof, the State Engineer shall instruct the geothermal owner to remedy the impairment through the provision of offset water, if available, or the payment of compensation. The right of eminent domain is hereby granted geothermal owners for the purpose of payment of compensation as provided herein. The protection of this section shall extend to only those water rights which predate the date of an application for a permit to produce geothermal fluids.[415]

414. *Id.*
415. *Id.*

A New Mexico appropriator must bear the burden of proving that unappropriated water exists and that vested rights will not be impaired. The proposed legislation would place on the geothermal developer the burden of demonstrating that unappropriated water is available, and give the existing water right holder the burden of showing interference and impairment. This allocation effectively allows a geothermal developer to enter a basin with adequate assurance that existing pumpers cannot bar the development. The reversal of the burden of proof is necessary; otherwise geothermal development may be frustrated in situations where the risk of impairment of vested rights is small. In effect, the proposed legislation precludes the award of injunctive relief against a geothermal development by giving the geothermal driller a preference against conventional water users.[416]

B. Utah

A comparable bill, also drafted by the Conference of State Legislatures, failed to gain passage in the 1979 general session of the Utah Legislature.[417] The Utah bill also would have provided ways to accommodate geothermal development at some cost to those whose claims are grounded solely on water law doctrines. That is what caused the bill's ultimate downfall.

As indicated in the Utah section above, Utah Power & Light Company blanketed many of the state's promising geothermal areas with water rights applications.[418] This course of conduct was premised on the assumption that geothermal resources *are* water, pure and simple, and that no property rights other than water rights and incidential surface and subsurface user rights would be required to exploit the resource. No attempt was made by the company to secure geothermal leases from either private or public landowners.

Before the legislative session convened, attempts were made to accommodate divergent interests, and several meetings were held which were attended by representatives of concerns interested in geothermal development in the state. Utah Power & Light participated in those discussions, but that company alone insisted that the existing law made geothermal resources simply water. The company

416. A legislature may not immunize an activity which results in a taking from all common law liability. But, subject to this Constitutional constraint, the state is free to restrict a property right holder's choice of remedies. *See* W. ROGERS, ENVIRONMENTAL LAW § 2.10 (West 1977).

417. See note 349 *supra*.

418. See text accompanying notes 348-49, *supra*.

would not agree to any legislative solution that failed to accord a priority or an exception for its existing water applications. Because of the wide area blanketed by the Utah Power & Light applications, the other participants in the discussion were unwilling to agree to a bill that failed to address the status of claims solely grounded on prior water filings. An impasse was reached and the bill died.

The Utah problem presents a classic case in the difficulty of achieving idealistic reform in a real and political world. A great deal of give and take in the legislative process by all participants, save one, resulted in a good, but far from perfect, bill being introduced. The complete intransigence of Utah Power & Light Company prevented reasonable accommodation from becoming law.