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Water and Geothermal Energy Development in the Western U.S.: Real World Challenges, Regulatory Conflicts and Other Barriers, and Potential Solutions

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ABSTRACT

The development of geothermal resources for power generation can help meet power demands and renewable energy goals in the western United States. Given current technology, geothermal projects require water in potable or nonpotable form for energy transfer. Federal and state geothermal laws present potential barriers to development, in part because they are based on principles of two different and sometimes contrasting bodies of natural resources law—mining law, which encourages development by holders of private interests in land, and Western water law, which creates usufruct rights in a shared public resource. In addition, geothermal energy needs are not currently represented in western water planning. This article discusses legal and regulatory barriers to geothermal energy development and recommends development of a Model Geothermal Code, greater participation in water planning, and other solutions to support and facilitate geothermal resource development and use in the arid West.

I. INTRODUCTION

Development and use of geothermal energy - the heat energy of the earth - for electric power generation and heating and cooling applications is attracting substantial interest in the western United States. Geothermal resources are plentiful in the region and, unlike wind and solar resources, they are available twenty-four hours a day, 365 days a year. In most cases, water in some form is needed for heat transfer. Water may originate in highly mineralized form in the geologic formation that is the source of heat energy, or it may be introduced into the formation as the medium for heat transfer. Because both water and heat energy are used in geothermal projects, state geothermal laws include elements of water law as well as principles of resource extraction found in mining laws. This results in inconsistent, confusing and sometimes conflicting laws and regulations. Water is scarce throughout the West, and increasing competition is straining limited water resources. Any uncertainty relating to the regulation of geothermal resources and water resources presents risks to geothermal developers. These risks are not being adequately addressed in planning processes for water resources or for renewable energy development in the West. These regulatory and planning gaps present barriers to geothermal development.

This article provides an overview of water use in geothermal projects, discusses potential conflicts of laws and gaps in water planning efforts, and proposes development of a Model Geothermal Code and more robust representation of geothermal interests in water planning as potential solutions to support renewable energy goals in the western United States. The discussion is presented in the following sections: Section II provides an overview of water needs for geothermal development in the context of water scarcity in the West. Section III briefly describes relevant federal geothermal laws and their relation to state water laws. Section IV discusses potential conflicts and inconsistencies in state geothermal laws and limitations on local government authority to regulate geothermal resource use. Section V outlines potential barriers to water use under western water law principles and other water-related laws and programs. Section VI provides recommendations to reduce barriers to geothermal development, including development of a Model Geothermal Code and greater participation by the geothermal community in western water planning.

II. WATER IN GEOTHERMAL DEVELOPMENT

Water in potable or nonpotable form is a central requirement of most geothermal projects. Hot water or steam is used to generate power and/or provide direct use heating and cooling benefits. Water may also be used to cool geothermal resources prior to reinjection into the source reservoir. The quantities needed at each stage of a project will depend on the type of project. Geothermal projects may be broadly categorized as follows: conventional geothermal, Enhanced Geothermal Systems (EGS), or ground source heat pump systems. The information provided below is intended to give the reader a sense of scale regarding geothermal energy potential in the West, and the water needs of geothermal projects.

A. Potential Geothermal Energy Resources in the West and Estimated Water Needs

1. Geothermal Energy Potential

The Geothermal Energy Association (GEA) National Summary for 2008 states:

> The United States continues to be the world leader in online capacity of geothermal energy and the generation of electric power from geothermal energy. According to EIA [U.S. Energy Information Administration, a federal agency], geothermal energy in 2005 generated approximately 16,010 Gigawatt hours (GWh) of electric generation or about 0.36% of U.S. annual electricity generation. As of August 2008, geothermal electric power generation is occurring in seven U.S. states with capacity rated at 2957.94 MW.[1]

The United States Geological Survey (USGS) estimates that a total of 9,057 MWe are available from identified moderate and high temperature geothermal sources in the West. Of these, about sixty percent are in California and fifteen percent are in Nevada. Approximately 30,033 MWe are available from undiscovered moderate to high temperature resources, of which about thirty-eight percent are in California and fifteen percent in Nevada. Additionally, the USGS estimates a total of 517,800 MWe are available from Enhanced Geothermal Systems (discussed below), twenty percent of which are in Nevada, thirteen percent in Idaho, and the rest distributed among the western states.[2]

2. Water Requirements for Geothermal Energy Projects

Geothermal or water resource requirements will vary, depending on the type and design of the project, project phase, temperature of the resources and other factors. For a general sense of scale, for electric power generation, 1000 gpm of geothermal resources at 120 degrees C. (240 degrees F.) will produce 1 megawatt of electric power ("MWe"). 3

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1. Geothermal Energy Association, *Power Plants*, http://www.geo-energy.org/plants.aspx (last visited Nov. 9, 2009).

2. U.S. GEOLOGICAL SURVEY, ASSESSMENT OF MODERATE- AND HIGH-TEMPERATURE GEOTHERMAL RESOURCES OF THE UNITED STATES FACT SHEET 2008-3082 (2008), *available at* http://pubs.usgs.gov/fs/2008/3082/pdf/fs2008-3082.pdf.

3. Telephone Interview with Dr. Gordon Bloomquist, Former Director, Geothermal and District Energy Programs, Wash. Energy Office (Nov. 9, 2009). Resource estimate is calculated based on conventional geothermal, binary system.

B. Water Needs for Different Types of Projects

The following discussion describes the general water needs of different types of geothermal projects. Each project varies, and project-specific needs should be analyzed carefully.

1. Conventional Geothermal Projects

Also referred to as hydrothermal, conventional geothermal projects utilize geothermal resources with temperatures sufficiently high to generate power either through direct steam generation or through a binary system.[4] Conventional geothermal resources may also be used to provide direct use benefits for district heating and cooling or industrial use, or to provide combined heat and power benefits. The water resource needs of this type of project will vary depending on the temperature of the source reservoir, the type of technology used to extract heat or power, and other variables.[5]

An example of this type of geothermal project is the Ormat Steamboat Galena complex near Reno, Nevada. The project withdraws geothermal resources at an estimated rate of 44,000 gallons per minute on a continuous basis.[6] Of that total withdrawal, 500 gpm is make-up water for system and evaporative losses. The balance represents resources that are used and then injected back into the source reservoir downstream from the production well field. At full build-out, Steamboat will have the estimated capacity to meet the power needs of the City of Reno.[7]

This type of use has the advantage of relying on a natural source that is replenished continually. The risk is that over time the reservoir of naturally available resources may diminish. For that reason, careful assessment of the source reservoir and careful design of injection to maintain reservoir pressures are critical in this type of project.

2. Enhanced Geothermal Systems (EGS)

Enhanced Geothermal Systems, or Engineered Geothermal Systems, (EGS) involve fracturing a deep "hot rock" formation, injecting water into the formation to create a reservoir, and circulating heated water from the reservoir to ground

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4. ENERGY & GEOSCIENCE INST. OF THE UNIV. OF UTAH, GEOTHERMAL ENERGY: CLEAN SUSTAINABLE ENERGY FOR THE BENEFIT OF HUMANITY AND THE ENVIRONMENT (2001), *available at* http://www.geothermal.org/GeoEnergy.pdf.

5. *See* Geothermal Resources Council, What is Geothermal?, http://www.geothermal.org/what.html (last visited Oct. 4, 2009).

6. Interview with Staff, Ormat Steamboat Complex, Nev. (Oct. 2008).

7. *Id.*

surface to generate power. Following use, the water is re-injected to the reservoir to capture additional heat energy, and the process is repeated.

A 2006 study by the Massachusetts Institute of Technology (MIT) stated that the need for water or other fluid in this type of project depends on reservoir design, pressures and temperatures in the formation.[8] According to this study; "[I]t is expected that in most advanced EGS applications, surface water will be needed to both stimulate and operate the reservoir . . . and produce the circulation patterns needed . . . . In the Western part of the United States, where water resources are in high demand, water use for geothermal applications will require careful management and conservation practice."[9] The report identifies CO_2 as a possible substitute for water, although that alternative is not currently feasible.[10]

From a water resources standpoint, key project risks are related to the technical challenges of deep drilling, reservoir development and management, and securing water resources to establish and maintain the reservoir.[11] In theory, substantial water savings can be achieved if the reservoir is developed so that losses to the fractured rock formation are minimized. The technology needed to optimize design and development of the EGS reservoir is currently under development. The MIT study identifies the need for further research.[12] On March 4, 2009, the U.S. Department of Energy announced the availability of grant funding in the amount of $84 million primarily for projects to improve EGS reservoir design and development.[13]

Another important risk relates to the physical unavailability of water resources at remote locations where geothermal resources are often found, often at high elevations and in rugged terrain, with limited road access. Substantial quantities of water may be unavailable at high elevations, and the diversion of water that is available at those locations may impact downstream water users and interest groups. Additionally, the cost of development of conveyance or storage facilities may affect the feasibility of the project.

3. *Ground Source Heat Pump Systems*

These types of systems, also referred to as geothermal heat pump systems, use thermal energy transfer to heat and cool residential and commercial buildings. Shallow trenches or shallow wells are developed, and water or other liquid is circulated in an open or closed loop system connected to a heat pump

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8. MASS. INST. TECH., THE FUTURE OF GEOTHERMAL ENERGY 8-11 (2006), *available at* http://geothermal.inel.gov/publications/future_of_geothermal_energy.pdf.

9. *Id.*

10. *Id.* at 1-23.

11. *Id.* at 8-11, 9-7.

12. *See Id.* at 1-3, 1-6.

13. Press Release, U.S. Dep't. of Energy, DOE Announces Investment of up to $84 Million in Geothermal Energy (Mar. 4, 2009), *available at* http://www.energy.gov/news2009/6961.htm.

where thermal transfer takes place. From a water resources standpoint, this type of system has the significant benefit of requiring relatively small amounts of water. For closed loop systems, water may be secured from a local utility; for open source systems, from onsite wells.[14]

C. Water Shortages in the West

For geothermal projects requiring water in substantial quantities, securing water supply can be a significant challenge. If water is not available from a local utility, the developer may need to secure water rights or water supply though regulatory permitting processes and/or supply agreements. These permits and agreements will be secured in the context of a competitive water environment. A recent U.S. Bureau of Reclamation survey of western regions assessed future water supply scenarios, and predicted potential water supply crises by 2025.[15] The survey noted the following critical supply areas: Sacramento and areas to the southeast; Reno-Carson City; Las Vegas and the area south to the Mexican border; two areas in central Arizona; Santa Fe-Albuquerque; Salt Lake City; Denver and areas to the north and south along the Front Range of the Rockies; and along the southern boundary of Texas.[16] The survey noted two central causes of the expected water shortages: decreased water storage in western snowpack and increased incidence and severity of droughts. The most dramatic effects are expected in southern mountain ranges and close to warming ocean water.[17]

Western governors have undertaken water planning initiatives, both within their own states and regionally, to address water supply challenges. Separately, the western governors, as well as the federal government, have been planning for renewable energy development. One product of the governors' efforts is *The Western Renewable Energy Zones Phase 1 Report*,[18] published by a joint imitative of the Western Governors' Association and the U.S. Department of Energy in June 2009. That report focuses mainly on a critical issue for future energy supplies: transmission. The locations of some known conventional geothermal resources are included in the report. However, the report does not adequately address the critical nexus of water and geothermal development, even for planning level purposes.[19]

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14. U.S. Dep't. of Energy, Types of Geothermal Heat Pump Systems, http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12650 (last visited Oct. 22, 2009).

15. Ben Dziegielewski, Presentation to the Council of State Governments Energy and Environment Task Force: U.S. Water Demand, Supply and Allocation: Trends and Outlook 9 (2007), *available at* http://www.csg.org/knowledgecenter/docs/Ben%20Dziegielewski-with%20notes-Puerto%20Rico.pdf.

16. *Id.*

17. *Id.* at 18 (citing a study by McCabe, G.J and D.M. Wolock (1999)).

18. WESTERN RENEWABLE ENERGY ZONES INITIATIVE, WESTERN RENEWABLE ENERGY ZONES – PHASE 1 REPORT 2-3 (2009), *available at* http://www.westgov.org/wga/publicat/WREZ09.pdf.

19. *See generally id.*

III. FEDERAL GEOTHERMAL LEASING AND ITS RELATION TO STATE LAWS

The primary federal law applicable to geothermal resource development is the Geothermal Steam Act of 1970 as amended in 1977, 1988 and 1993, codified at 30 U.S.C. § 1001-1027.[20] With respect to the definition of geothermal resources, the statute provides,

> "(c) 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 introduced* into geothermal formations; (iii) heat or other associated energy found in geothermal formations; and (iv) any byproduct derived from them."[21]
>
> "(d) "byproduct" means any mineral or minerals (exclusive of oil, hydrocarbon gas, and helium) which are found in solution or in association with geothermal steam and which have a value or less than 75 per centum of the value of the geothermal steam of are not, because of quantity, quality, or technical difficulties in extraction and production, of sufficient value to warrant extraction and production by themselves."[22]

The statute further provides that, subject to certain limitations:

> "[T]he Secretary of the Interior may issue leases for the development and utilization of the geothermal steam and associated geothermal resources (1) in lands administered by him, including public, withdrawn, and acquired lands, (2) in any national forest or other lands administered by the Department of Agriculture through the Forest Service, including public, withdrawn, and acquired lands, and (3) in lands which have been conveyed by the United States subject to a reservation to the United States of the geothermal steam and associated geothermal resources therein."[23]

The Mineral Leasing Act of 1920[24] as amended provides:

> As used in this chapter "mineral leasing laws" shall mean the Act of February 25, 1920 (41 Stat. 437); the Act of April 17, 1926 (44 Stat.

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20. 30 U.S.C.A. § 1001 (West 2009).

21. *Id.* (emphasis added). As written, the federal statute may be interpreted as providing that water appropriated subject to state water codes for use in geothermal projects may "become" a geothermal resource subject to federal law following its use for geothermal heat energy extraction, presenting a possible conflict between state and federal laws.

22. *Id.*

23. 30 U.S.C. § 1002 (2005).

24. 30 U.S.C. § 530 (2005).

> 301), the Act of February 7, 1927 (44 Stat. 1057); Geothermal Steam Act of 1970, and all Acts heretofore or hereafter enacted which are amendatory or of supplementary to any of the foregoing Acts; "Leasing Act minerals" shall mean all minerals which, upon [the effective date of this Act], are provided in the mineral leasing laws to be disposed of thereunder and all geothermal steam and associated geothermal resources which, upon the effective date of the Geothermal Steam Act of 1970, are provided in that Act to be disposed of thereunder.[25]

These statutes provide that geothermal resources fall within the category of "Leasing Act minerals" for purposes of federal leasing programs established for natural resource development.[26] However, with some limitations, the appropriation of water in the western states is subject to state water laws. The U.S. Supreme Court has stated, "[t]he effect of this [mining] statute (passage by Congress of the Act of July 26, 1866) was to recognize, so far as the United States is concerned, the validity of the local customs, laws, and decisions of courts in respect to the appropriation of water."[27]

This holding raises the question: which resources are subject to state water laws? At the federal level, the answer to this question is complicated by holdings in a line of cases including the Rosette case. [28] In that case, the Court held that for purposes of a patent issued under the Stock Raising Homestead Act of 1916, the use of warm water pumped from a well to heat greenhouses on the same property constituted use of geothermal resources subject to federal regulation.

Also notable for geothermal developers, the federal Geothermal Steam Act includes provisions relating to protection of water quality and other environmental qualities. Several provisions of the Act may conflict with some state laws. Federal-state geothermal law issues will be addressed in more detail in a future paper.

IV. GEOTHERMAL LAWS AND REGULATIONS AT THE STATE AND LOCAL LEVEL

The essential elements of geothermal energy development are the discovery, development and extraction of a resource – in this case, heat energy - from the earth. Those elements are similar to the elements of a mining enterprise, which involves discovery, development and extraction of mineral resources such as gold or silver. Water is the medium for transfer of heat energy, given current technology. State geothermal laws and regulations may or may not refer explicitly to the fluid that is used to extract heat energy; however, because of the presence of that fluid in the formation or introduced into the formation, state

25. *Id.*

26. *Id.*

27. United States v. Rio Grande Dam and Irrigation Co., 174 U.S. 690, 704 (1899).

28. Rosette, Inc. v. United States, 277 F.3d 1222, 1234-35 (10th Cir. 2002).

geothermal laws reflect to varying degrees the sometimes inconsistent of conflicting principles of water laws, regulating and limiting the use of a shared public resource, and mining laws, which encourage discovery and extraction of resources. In states where mining and oil and gas laws are well developed, geothermal laws and regulations may emphasize and support discovery, development and extraction of resources. In states with less experience in mineral development, or where there is greater competition for water resources, water law principles of beneficial use may be more dominant. Resulting risks include uncertainty regarding which regulatory agency is responsible for permitting, which laws and regulations apply to project development and operation, and who owns or controls the resource.

A. Definition of Geothermal Resources

The lack of a clear distinction between the heat energy being extracted and the water used for extraction is reflected in state definitions of geothermal resources.

Washington defines geothermal resources as, "*[O]nly 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 associated gas, but excluding oil, hydrocarbon gas and other hydrocarbon substances."[29]

Using technology as the criterion for defining geothermal resources has the benefit of recognizing the changing nature of technology and avoiding rigid temperature-based definitions. However, the technology-based definition creates an anomalous situation in which a low-temperature resource incapable of generating electricity (such as one developed for heating and cooling purposes) may be subject to one set of laws during the early stages of project development, but subject to different laws at a later stage. Washington law provides a partial but incomplete response to this concern.[30] With respect to water, Washington's geothermal definition does not clarify the relationship between "fluids" subject to water laws and "fluids" subject to Washington's geothermal statute.

Idaho defines geothermal resource as, "[T]he 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. *Ground water having a temperature of two hundred twelve (212) degrees*

29. WASH. REV. CODE § 78.60.030(1) (2009) (emphasis added).

30. WASH. REV. CODE § 78.60.100 (2009) (emphasis added).

Fahrenheit or more in the bottom of a well shall be classified as a geothermal resource."[31]

This definition attempts to distinguish extractable heat resources and associated fluids from water resources subject to the state water code. However, given recent technological developments that allow for the use of lower temperature water resources for power generation, the statute may result in exclusion of fluids that should be regulated under geothermal laws, and may cause confusion about applicable standards and requirements.

Nevada defines geothermal resource as "*[T]he natural heat of the earth and the energy* associated with that natural heat, pressure *and all dissolved or entrained minerals that may be obtained from the medium* used to transfer that heat, but excluding hydrocarbons and helium."[32] This definition is the most purely "extraction-oriented" of the three examples provided here; that is, it focuses on the extraction of energy and minerals from the earth. The definition itself does not provide guidance as to whether water resources associated with the geothermal project are subject to state water laws.

B. Overlapping Water Laws and Geothermal Laws

Some states legislatures have adopted statutes specifically attempting to distinguish geothermal resources from water resources subject to state water laws. Nevada's geothermal statute, for example, starts with the assumption that the state's water code *does* apply, and then selectively excludes certain categories of water use in geothermal projects. The statute states:

> A consumptive use of water brought to the surface outside of a geothermal well is subject to the appropriation procedures of chapters 533 and 534 of NRS [state water code], except for . . . water that is removed from an aquifer or geothermal reservoir to develop and obtain geothermal resources if the water is returned to or reinjected into the same aquifer or reservoir . . . .[33]

Arizona law also distinguishes geothermal resources from water resources, but starts with the assumption that the state water code does not apply, and then identifies the circumstances in which it does. An Arizona statute entitled Relationship of Geothermal Resources to Water Laws provides, "[g]eothermal resources and their development shall be exempt from the water laws of this state unless either (1) such resources are commingled with surface waters or groundwaters of this state; (2) such development causes impairment of or damage to the groundwater supply; (3) in the development of geothermal

31. IDAHO CODE ANN. § 42-4002(c) (2009) (emphasis added).

32. NEV. REV. STAT. § 534A.010 (2009) (emphasis added).

33. NEV. REV. STAT. ANN. § 534A.040(1) (West 2007).

resources, any well drilled to obtain and use groundwater..., shall be subject to the water laws of this state."[34]

C. Ownership and Control of the Resource

The lack of clarity in distinguishing geothermal resources from water resources is also evident in statutes establishing ownership interests in geothermal resources. State laws reflect different views of ownership and control, consistent with mining law or water law principles. Mining law vests ownership interests and control of resources in the owner of interests in land. A lease is provided to the mine operator, to provide a level of certainty, encouraging investment and providing an incentive to develop the resource. Royalties and other payments are made to the landowner to compensate for the depletion of the value of the land as the resource is removed and to reward the landowner for the value of the resource extracted from the land.[35] Since the extraction of mineral resources has historically been important to the development of civilization, the discovery and removal of resources is encouraged and rewarded under mining law principles. Western water laws, in contrast, circumscribe ownership interests to reflect the public's continuing interest in, and substantial control over, the resource.[36] These two sources of law are reflected in western geothermal laws, and are often in apparent conflict. Interests in land and resources should be carefully evaluated as part of project planning, and when drafting leases and agreements.

Washington law establishes private ownership interests in geothermal resources, providing, "Notwithstanding any other provision of law, geothermal resources are found and hereby determined to be *sui generis, being neither a mineral resource nor a water resource and as such are hereby declared to be the private property of the holder of the title to the surface land above the resource*."[37] This is in contrast and possible conflict with the State Water Code, which provides; "[s]ubject to existing rights all waters within the state belong to the public, and any right thereto, or to the use thereof, shall be hereafter acquired only by appropriation for a beneficial use and in the manner provided and not otherwise; and, as between appropriations, the first in time shall be the first in right."[38]

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34. ARIZ. REV. STAT. ANN. § 27-667(A)-(B) (2009).

35. *See generally* John C. Lacy, *Going with the Current: The Genesis of the Mineral Laws of the United States*, 41 ROCKY MTN. MIN. L. INST. 10 (1995).

36. *See, e.g.*, CHRISTINE O. GREGOIRE ET AL., OFFICE OF ATT'Y GEN., AN INTRODUCTION TO WASHINGTON WATER LAW 1-2 (2000), *available at* http://www.ecy.wa.gov/pubs/0011012.pdf ("Like most other states, Washington has declared, both in Constitution and in statute, that water is a public resource held in trust for the people.").

37. WASH. REV. CODE ANN. § 78.60.040 (West 2009) (emphasis added).

38. WASH. REV. CODE ANN. § 90.03.010 (West 2009) (emphasis added).

Some states create a property interest that is nevertheless limited by the operation of state water laws. For example, Idaho law provides; "[g]eothermal 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."[39] This statute acknowledges the potential interaction between water resources (subject to the water code) and geothermal resources. However, it fails to clarify the relationship between property interests in geothermal resources and property interests in water rights.[40]

State statutes purporting to grant or vest a right to geothermal resources in the surface landowner, or in his or her successor(s) in interest, if interests in geothermal resources have been severed from the surface estate, may be in conflict with federally reserved rights.

D. Local Ordinances and Private Agreements

Where there are multiple geothermal resource users in a defined area, local governments and developers may wish to manage the resource through agreements or ordinances.[41] The federal government and some states provide for unitization - enforced or agreed arrangements for the joint management of the geothermal reservoir by multiple developers. Conflicts may arise where local governments assert authority over geothermal resources, or where private parties wish to enter into contracts relating to interests in geothermal resources. State laws should be carefully evaluated to determine under what circumstances local control or private agreements might be allowed.

For example, the citizens of the City of Klamath Falls, Oregon, passed an ordinance relating to reservoir management for a district heating system. The ordinance was adopted on June 30, 1981, with the purpose of regulating the use of geothermal water, and specifically requiring that any geothermal water pumped from a well be returned to the same well.[42] On July 17, 1981, the state of Oregon filed suit, naming the city as defendant. The ordinance was declared valid and enforceable.[43] The Oregon Court of Appeals noted that the state has "clearly [expressed] an overall public policy and interest in controlling the appropriation of ground water and [setting] forth a uniform system to effectuate that policy."[44] The fact the state created such a comprehensive regulatory framework does not

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39. IDAHO CODE Ann. § 42-4002(c) (2009) (emphasis added).

40. *See generally Id.*

41. For information on Western water law principles and specific state statutory and regulatory requirements, the reader is referred to publications such as WELLS A. HUTCHINS, U.S. DEP'T OF AGRIC., WATER RIGHTS LAWS IN THE NINETEEN WESTERN STATES (1971).

42. PAUL J. LIENAU, GEOTHERMAL DISTRICT HEATING INSTITUTIONAL FACTORS: THE KLAMATH FALLS EXPERIENCE, *available at* http://www.osti.gov/geothermal/servlets/purl/894596-2sarTY/894596.pdf.

43. *Id.*

44. Water Res. Dep't v. City of Klamath Falls, 682 P.2d 779, 785 (Or. Ct. App. 1984).

"expressly prohibit local bodies from engaging in regulatory activity of their own that is not inconsistent with that statute or agency relations."[45] The court held that the state has not preempted the field"[46] and noted that Oregon law specifically permitted concurrent regulation by local authorities consistent with state laws.[47]

V. ISSUES IN WESTERN WATER LAW AND OTHER WATER-RELATED LAWS

Where state water laws or state water-related requirements may apply to geothermal projects, the developer should carefully consider how those laws affect project planning and development.

A. *Western Water Law Principles in Geothermal Development*

Western water laws were developed in the mid-nineteenth century to meet the water needs of western mining enterprises. Extraction of gold and other metals required the use of scarce water resources. To meet the demand, rules of use were established requiring miners - and others who wanted to divert water for beneficial use - to post their intent to use water, and to take diligent actions to build the necessary infrastructure and put water to beneficial use. Those early principles were subsequently adopted in statutory and regulatory schemes in the western states. Western water laws, with some exceptions, retain ownership of water resources in the people of the state, while vesting the right to use water in persons who put water to beneficial use, consistent with the principle, "first in time is first in right." These "prior appropriation" laws authorize usufruct rights in the resource, requiring diligent project development and continuous beneficial use to maintain the rights in good standing.[48]

State water codes and the modern permit systems adopting "prior appropriation" principles generally require findings that: (1) water is available; (2) water will be put to beneficial use; (3) the use of water is in the public interest (or not detrimental to the public interest); and (4) the use of water will not be detrimental to senior water right holders.[49]

1. Availability

Some states establish specific regulatory structures quantifying available supplies and establishing priority systems for allocating water. This may be done on a formal basis through adjudication, or via administrative schemes. To illustrate, the state of Oregon has conducted water availability analyses for

45. *Id.*
46. *Id.*
47. *Id.* at 782.
48. HUTCHINS, *supra* note 41.
49. *See, e.g,* WASH. REV. CODE ANN. § 90.03.290(3) (West2009).

various regions as a baseline for allocation decisions,[50] while Colorado quantifies and allocates available supplies through a system of special courts.[51]

Instream flow regulations, as well as water rights held by individuals and others may impact findings of availability.[52] The physical connections between nonpotable geothermal resources and water supplies subject to state water codes are generally not well understood.

Availability may also be limited by geographic and financial constraints. For example, if a geothermal project is proposed to be developed at a remote location, especially at higher elevations, water may not be available in sufficient quantities, or may require development of substantial storage or conveyance facilities.

2. *Beneficial Use*

Some states list beneficial uses in their water code, and many states simply state without elaboration that water must be used for a beneficial purpose.[53] Whether beneficial uses are listed in the state water code or not, use of water for power generation purposes is generally considered a beneficial use.[54]

3. *Public Interest*

Public interest considerations are the most elastic of the criteria for water rights approval, representing changing social goals and values relating to water use. Public interest benefits may include preservation of fish and wildlife, instream flow protection for aesthetic and recreational use, and other social and environmental benefits.

Some state water codes prioritize public interest considerations or list them.[55]

> Alaska law provides one instructive example, listing public interest considerations as follows:
>
> In determining the public interest, the commissioner shall consider:
>
> (1) the benefit to the applicant resulting from the proposed appropriation;
>
> (2) the effect of the economic activity resulting from the proposed

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50. *See e.g.*, Don Price, *Records of Wells, Water Levels And Chemical Quality of Ground Water in the French Prairie-Mission Bottom Area, Northern Willamette Valley, Or.*, 1 OR. GROUND WATER REPORTS 2, 8, 10 (1961).

51. *See* COLO. REV. STAT. § 37-92-203 (2009).

52. *See* HUTCHINS, *supra* note 41, at vii-viii.

53. HUTCHINS, *supra* note 41, at 523.

54. *Id.* at 539-541.

55. *See id.* at 524.

> appropriation;
>
> (3) the effect on fish and game resources and on public recreational opportunities;
>
> (4) the effect on public health;
>
> (5) the effect of loss of alternative uses of water that might be made within a reasonable time if not precluded or hindered by the proposed appropriation;
>
> (6) harm to other persons resulting from the proposed appropriation;
>
> (7) the intent and ability of the applicant to complete the appropriation; and
>
> (8) The effect upon access to navigable or public water.[56]

The public interest in geothermal and renewable energy development is currently not well represented in statutes or case law. Social values of carbon reduction, reduced energy importation, and reduced use of fossil fuels will likely be reflected in future cases testing the limits of the public interest test. In the near term, limited guidance will be available to support the public interest in geothermal energy development, as against other public interest values, potentially putting geothermal projects at a disadvantage in securing water in the competitive western water market.

4. *Senior Water Rights*

Senior water rights may include instream flows set by the state, federally reserved rights, Tribal treaty rights, and water rights held by individuals and others.[57] Specific challenges for geothermal projects may include the following:

a. Senior water right holders may assert that geothermal projects detrimentally impact their property interests. Given current regulatory and technical guidance, both the geothermal developer and the water rights holder claiming impairment may have limited substantive guidance or procedural means to evaluate and address claims of detrimental impacts and protect their respective rights.

b. If water secured for a geothermal project is junior in priority, water supplies for the geothermal project may be subject to cutoff during times of shortage. Since one of the attractive aspects of geothermal

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56. ALASKA STAT. § 46.15.080(b) (2009).

57. *See* HUTCHINS, *supra* note 41.

energy development is the ability to provide baseload power 24/7, this is an important consideration in evaluating project viability.

B. Resources May Not be Available for Appropriation

Some water may not be available for appropriation. In Arizona, for instance, so-called "percolating groundwater" is not subject to appropriation, but is considered to be an attribute of the overlying land.[58]

C. Water Resource Planning

State and watershed-level planning processes have been established on an informal basis, such as the Copper River Watershed Project in Alaska,[59] and on a formal basis, pursuant to litigation settlements, adjudications, interstate compacts and other special circumstances.[60] Stakeholders who participate in these processes have substantial influence in managing local water resources. Their decisions and actions can affect the ability of geothermal developers to secure and use water resources.

Regional water planning efforts, such as those undertaken by the Western States Governors' Association, may also have significant impacts on the ability to secure water supplies. These regional planning efforts will be especially important to the geothermal developer if they include consideration of major infrastructure improvements requiring political will and substantial financial commitments. Representatives of the geothermal industry have not been well represented to date in these planning discussions, putting them at a disadvantage as plans are developed and allocation schemes are implemented.

D. Laws Relating to Injection

Injection of resources into the source reservoir following use is an important element of many geothermal projects. The federal Safe Drinking Water Act ("SDWA") authorizes the U.S. Environmental Protection Agency ("EPA") to establish regulations for Underground Injection Control ("UIC").[61] States are authorized to implement and administer UIC programs consistent with federal requirements.[62] The health-related origin of the UIC program (to protect drinking water sources) may result in oversight by state health or environmental agencies

58. *See* Davis v. Aqua Sierra Res., L.L.C., 174 P.3d 298, 303 (Ariz. Ct. App. 2008).

59. *See* Copper River Watershed Project, Accomplishments, http://www.copperriver.org/about-us/accomplishments (last visited Nov. 14, 2009).

60. *See id.*

61. *See* 42 U.S.C.A § 300(h) (West 2009).

62. *See id.*; *see also* 40 C.F.R §144.1 (2002) (citing each State must meet requirements in order to obtain primary enforcement authority for the UIC program in that State, and UIC program for States are to be administered directly by EPA).

with little experience or expertise in natural resource development. Oversight by multiple agencies, as well as adoption of rules for well development and injection that are not appropriate for geothermal purposes, may present challenges for the developer. Also, the author has encountered different interpretations as to acceptable chemical and physical characteristics of injection water.

E. Drilling and Well Development Regulations

Drilling regulations may present challenges to the developer in several ways. In some states, geothermal drilling regulations are modeled on oil and gas drilling requirement, which may not be suited to geothermal development. In the case of UIC wells, drilling regulations designed to meet the requirements of the Safe Drinking Water Act may not be consistent with the requirements of state natural resources agencies.

To address inefficient or overlapping regulatory requirements, Nevada has taken steps to integrate and streamline the UIC approval process and has established timelines for UIC review.[63] For geothermal power projects requiring a permit from the Nevada Division of Minerals (NDOM) or BLM, the State provides that the permit also satisfies the UIC requirements of the Nevada Division of Environmental Protection.[64]

Idaho law allows conversion of existing wells and authorizes exemption from permitting for "specific categories of wells or injection wells . . . upon a finding that the purposes of this chapter do not require that such wells be subject to the permit requirement . . . ."[65]

F. Discharges to Groundwater or Surface Water

If discharge will be to a surface water body, disposal may require a National Pollutant Discharge Elimination System (NPDES) permit under the federal Clean Water Act[66] and associated state statutes and rules. For discharges to groundwater, disposal may be regulated under state groundwater protection laws and rules.

These regulatory programs may not be well suited to discharges of geothermal resources. For example, discharges of highly mineralized water to a groundwater body may be infeasible under current laws, if water quality standards that must be met at the point of discharge or at the boundary of a mixing zone are higher than the quality of the receiving aquifer.

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63. *See* Nevada Division of Environmental Protection—Bureau of Air Pollution Control, NDEP Streamlined Permitting Process for Renewable Energy Resources in Nevada, http://www.ndep.nv.gov/admin/renewenergy_bapc07.htm (last visited Dec. 18th, 2009).

64. *See id.*

65. IDAHO CODE ANN. § 42-4003(d) (2009).

66. 33 U.S.C. § 1342 (a) (2008).

VI. POTENTIAL SOLUTIONS ADDRESSING BARRIERS TO WATER USE IN GEOTHERMAL PROJECTS

The discussion above outlines inconsistencies and potential conflicts in geothermal laws and regulations, as well as other barriers to geothermal energy development in the Western U.S. In this section, potential solutions to expedite and support geothermal development are identified.

A. *Water Resources Planning Should Incorporate Geothermal Needs*

In the last several decades, intensive population growth in the western United States has resulted in state legislatures, courts and administrative agencies taking significant proactive steps to clarify water laws and establish new programs for water management. Legal issues that have been at least partially addressed in many states include: clarifying what constitutes beneficial use, defining and regulating interactions between groundwater withdrawals and surface water impacts, updating public interest criteria and establishing conservation programs and watershed-based management solutions. States have undertaken adjudications and pursued litigation to identify water rights associated with specific water bodies.[67]

Consideration of the water needs of geothermal development has not generally been part of the planning mix. This is understandable, given the relatively recent growth in interest in renewable energy generally, and geothermal energy in particular. Geothermal energy advocates should identify opportunities to participate in watershed-level, statewide and multi-state planning efforts, in order to secure water supplies in the context of a constrained and competitive water future.

B. *A Model Geothermal Code is needed to Clarify Geothermal Regulations and Minimize Potential Conflicts*

Professional organizations focusing on geothermal energy development, in cooperation with state and national bar associations, should undertake a legal analysis of the appropriate use of mining, oil, gas and water law principles in geothermal laws and regulations. The results of that study should be used as the basis for a Model Geothermal Code which would (1) establish a consistent regulatory framework for geothermal laws at the state level; (2) attempt to distinguish and harmonize state and federal authorities and jurisdiction; (3) support and encourage development and extraction of heat and mineral resources, consistent with mining law or oil and gas law principles; (4) regulate fluid resources in a way that protects surface waters, potable aquifers and senior water

67. *See generally*, HUTCHINS, *supra* note 41.

right holders; (5) meet the special technical requirements of geothermal projects (such as drilling requirements); and (6) provide certainty and flexibility with respect to use of non-potable geothermal fluids, as well as water resources subject to state water codes.

C. Use of Reclaimed or Recycled Water and Other Non-potable Water Supplies Should be Encouraged

Because of the scarcity of water in the West, states should proactively support and encourage the use of nonpotable water sources such as reclaimed water through regulatory streamlining and other incentives. Some state codes lay the predicate for reclaimed water as a preferred source for geothermal projects. For example, California law states that use of potable water for non-potable purposes constitutes waste.[68] In 2001, a report to the governor of Nevada by the Nevada Energy Policy Committee acknowledged concern about competition for scarce water resources, and advised that preference should be given to air-cooled power plants, and projects proposed at locations with abundant water resources.[69]

One example of the use of reclaimed water in geothermal development is the Santa Rosa Geysers Recharge Project, which provides up to 11 million gallons per day of reclaimed water through a forty-mile pipeline to extend the commercial life of Calpine Geyser's geothermal resource.[70] Geothermal advocates should identify opportunities to participate more fully in reclaimed water planning efforts, including policy discussions and opportunities for financial assistance for recycled water development and use.

D. Co-location of Water Storage and Combined Uses of Geothermal Resources Should be Prioritized

Geothermal developers should look for opportunities to cooperate with planning entities, utilities and others to develop water storage facilities as well as co-locating energy facilities with direct uses in residential and commercial applications. Given projections of decreasing water storage in the western snowpack, several western states are planning for new water storage facilities. Some projects, such as the Black Rock Project evaluated by the Bureau of Reclamation in Washington State, have been found to be infeasible due to high cost.[71] If the benefits of water storage for geothermal energy are added to storage for other purposes, large-scale storage projects might "pencil out." Similarly, co-

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68. CAL. WATER CODE §§ 13550-13557 (West 2009).

69. NEV. ELEC. ENERGY POLICY COMM., REPORT TO THE GOVERNOR OF THE STATE OF NEV. (2001), *available at* http://pucweb1.state.nv.us/PUCN/energy/NeePC%20Final%20report.pdf.

70. Calpine, *History – The Geysers*, http://www.geysers.com/history.htm (last visited Dec. 18, 2009).

71. John Trumbo, *Study: Black Rock Reservoir Project Too Costly*, TRI-CITY HERALD, Dec. 20, 2008, *available at* http://www.tri-cityherald.com/kennewick_pasco_richland/v-print/story/422145.html.

location of geothermal energy projects with residential or commercial operations, for combined heat and power benefits, can add value and enhance the likelihood that projects will be economically feasible.

VII. CONCLUSION

Geothermal resources are abundantly available in the western United States, and should be developed to provide baseload power and direct use benefits. Securing water to realize the full potential of geothermal energy development in the arid West, however, presents significant challenges. Development of a Model Geothermal Code would identify and help reduce potential conflicts of laws relating to geothermal and water resources, and would support and encourage extraction of heat, consistent with principles of mining law, while protecting valuable water resources, consistent with water laws. To the extent possible, model statutory and regulatory provisions would clarify and distinguish federal and state roles and responsibilities. In addition, given the convergence of water shortages and increasing competition for water in the West, geothermal energy advocates should identify and pursue opportunities to participate in planning efforts for water, reclaimed water, water storage, and co-location of facilities. Taking these steps would reduce risks associated with conflicting and inconsistent laws, would encourage and facilitate cost-effective development of geothermal resources in the western United States, and would help western states meet their renewable energy goals.

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