California Geothermal Law and its Impacts on Thermophile Biodiversity

*By Tiffany Grant**

I. Introduction

The growing need for efficient renewable energy in California has led to research into 'green' energy sources including geothermal energy production.[1] Federal and California state regulations have been designed to promote geothermal energy development. Although considered a 'green' resource, development of geothermal resources for energy production has not been without environmental opposition. "Plants . . . are facing the kind of obstacle environmentalists used to reserve for oil drilling."[2] Many environmental concerns stem from geothermal resource development;[3] this article focuses on the loss of thermophile biodiversity from utilization of geothermal resources.

Thermophiles are microbial organisms that have adapted over millions of years to the extreme temperature and chemical compositions of each specific geothermal resource. Their ability to withstand high temperatures makes them invaluable to scientific and medical research. The economic potential of thermophiles in scientific and medical research is well known, with the discovery and research of a species in Yellowstone resulting in a scientific process which reportedly generates approximately $100 million per year.[4] However, thermophiles and their environments remain largely unstudied.[5]

Although federal and state regulations applicable to California have some basic environmental protections[6] for geothermal resources, California lacks any regulations for the protection of thermophile biodiversity. In fact, current California law promotes the over utilization of geothermal resources thereby potentially promoting a significant loss of thermopile biodiversity.

II. Geothermal Resources & Energy Production

Through various technologies, the earth's heat, transferred through water, can be harnessed for energy production.[7] The higher temperature resources are utilized primarily for energy production, while the lower temperature resources are used for various domestic applications including mineral spas.[8]

The growing need for efficient renewable energy in California has led to research into what are considered 'green' energy sources such as wind, solar and geothermal energy production.[9] In 1999 alone, the Department of Energy spent a reported $28.5 million dollars on geothermal research and development.[10] The Geothermal Energy Association has reported, "In the next decade seventeen percent of the world's population could receive their electricity from a geothermal source."[11] Due to the demand for new energy sources, the development of geothermal resources has been promoted by the Department of Energy through research funding and Congress through the Geothermal Steam Act of 1970.[12]

III. Thermophiles & Environmental Concerns

The term 'green' to define geothermal energy production may be misleading. Although apparently less environmentally damaging than fossil fuel and nuclear energy production, geothermal energy, like any other energy resource, has adverse environmental impacts.[13] This article will focus only on the potential for loss of thermophile biodiversity.[14]

Geothermal resources contain extreme temperatures and mineral compositions making them toxic for most prokaryotic species, but certain species have adapted to live in these toxic ecosystems. These species are referred to as thermophiles, hyperthermophiles, and extremophiles. Norman Pace, a molecular biologist at the University of Colorado, has noted:

> It has become clear over the past few decades that substantial microbial diversity occurs at very high temperatures. Hyperthermophilic organisms promise a wealth of unknown biochemistry and biotechnological potential and challenge our comprehension of biomolecular structure. Nonetheless, relatively little is known about the diversity of life at high temperatures because of a traditional problem in microbial ecology: the inability to cultivate naturally occurring organisms.[15]

Cultures of some species are able to survive autoclaving,[16] making them significant to scientific research. The potential for scientific development of pharmaceutical and industrial products and applications[17] from bioprospecting is exemplified by the discovery and development of the "enzyme *Taq polymerase* . . . [which] was discovered through research on a thermally adapted microbe known as *Thermus aquaticus*" discovered during sampling of a hot spring in Yellowstone.[18] The enzyme and a resulting technique called the PCR process was subsequently sold for $300 million in 1991 and reportedly generates annual revenues around $100 million per year.[19] Acknowledging the importance of thermophiles, the National Park Service (NPS) has initiated a "Yellowstone Thermophiles Conservation Project."[20]

Due to thermophiles' temperature adaptation, a change in temperature of the geothermal resource through extraction, injection, or re-injection of non-heated water could cause species die-offs if the temperature change was great enough to cause the surrounding geothermal fluid to cool, even briefly, to a temperature below acceptable thermophile living conditions.[21] Many unknown conditions affect the sustainability and potential environmental impacts of geothermal resources. Research of replenishment rate and aquifer definition is primarily conducted in association with a proposed or currently utilized geothermal use. Although

research is being conducted into replenishment rates, aquifers and microbiological species of geothermal resources, the results are likely to be site/aquifer specific. The lack of scientific research and understanding into geothermal ecosystems is a key problem in the potential devastation of thermophile biodiversity.

IV. Current California Law

Geothermal Law in California can be broken down into the following steps: acquisition of the right to develop a geothermal resource, compliance with environmental requirements, and compliance with development and extraction requirements. Acquisition of rights to develop a geothermal resource is dependent upon whether the geothermal resource is federal, state, or private property.[22]

A. Federal Geothermal Acquisition and Siting Rights

The majority of geothermal resources are located on federal land[23] in the western United States. Prior to 1970, geothermal resource development had been limited to primarily private lands because the Department of the Interior (DOI) was reluctant to dispose of geothermal resources on lands within its jurisdiction without federal direction.[24] To reduce this restriction on geothermal resource development, President Nixon approved the Geothermal Steam Act.[25]

The Geothermal Steam Act (Act) of 1970 is the basis of all federal geothermal jurisprudence.[26] With two exceptions, the Act is the only means of acquiring rights to develop geothermal resources on U.S. public lands.[27] According to legislative history, the purpose of the Act was to "permit exploration and development of geothermal stream and associated geothermal resources. . ..[28] The Act gave the Secretary of the Interior the ability to issue leases for geothermal steam development[29] and utilization in public lands, national forest, and lands conveyed subject to a reservation to the United States of the geothermal steam and associated resources.[30] The Act sets forth guidelines for leasing and royalties[31] and exempts certain federal lands, including national recreational land and wildlife refuges, and tribally or individually owned Indian trust or restricted lands from the Act.[32] The Act also contains an exclusion for the development of geothermal resources within National Parks when a significant thermal feature will be significantly adversely affected.[33]

The primary question arising from the Geothermal Steam Act was: what are considered "lands conveyed by the United States subject to a [mineral] reservation to the United States of the geothermal steam and associated resources."[34] The leading Ninth Circuit case on point is *United States v. Union Oil Co.*,[35] which held that geothermal resources were minerals reserved to the United States under the Stock–Raising Homestead Act of 1916 (SRHA). In an effort to civilize the west, the federal government enacted the SRHA to transfer public lands to private ownership under patents subject to a reservation to the United States "of all the coal and other minerals."[36] The SRHA did not directly address the reservation of geothermal resources or have an intent to reserve them because congress "was not aware of geothermal power"[37] when it enacted the SRHA.

Union Oil, as owners of lands in the Geysers Field of California, argued that the term 'minerals' should be given the "meaning it had in the mining industry at the time the [SRHA] was adopted"[38] and that geothermal resources should not be considered a "mineral" under the SRHA. The court instead looked at whether it "would further Congress's purpose to interpret" geothermal resources as minerals[39] and held that the mineral reservation to the United States under the SRHA included geothermal resources.

It should be noted that "nothing prevents a contrary result in a case involving private rights arising in another state"[40] or under a statute other than the SRHA. In *Bedroc Limited, LLC v. United States*,[41] the Supreme Court distinguished a mineral reservation under the Pittman Act in *Bedroc Limited* from a previous holding in *Watt v. Western Nuclear* regarding a mineral reservation under the SRHA. In *Watt v. Western Nuclear*, the Supreme Court construed the SRHA to include a mineral reservation of gravel where the SRHA reserved to the United States "all the coal and other minerals."[42] In *Bedroc Limited,* however, the Pittman Act reserved to the United States "all the coal and other *valuable* minerals."[43] The Supreme Court in *Bedroc Limited* noted that at the time the Pittman Act was enacted, gravel was not a valuable mineral and therefore was not reserved to the United States. Such a different classification of geothermal resources could be found in a different state for private resources or under a different land grant act.

After rights to develop the resource are acquired, rights to construct a geothermal energy plant must be obtained. The Geothermal Steam Act provides that a geothermal lessee "shall be entitled to use so much of the surface of the land as may be found by the Secretary [of the Interior] for the production and conservation of geothermal resources."[44]

The primary California case on point is *Occidental v. Simmons* [45] decided in 1982 by the Northern District Court of California. Occidental, as the holder of a Department of Interior geothermal resources lease under the Geothermal Steam Act, filed suit against two owners of surface rights of land with mineral reservations to the United States patented under the SRHA. Occidental sought, "among other forms of relief," a declaration of its right to build and operate a geothermal plant without the consent of the surface owners.[46] The court held that power plant siting rights in lands under the SRHA were reserved to the United States and that the Geothermal Steam Act authorized such leases. The court noted that removal of geothermal resources is inextricably connected to their utilization[47] and to hold that geothermal lessees own the rights to geothermal resources and "yet do not have the right to exploit those resources without the consent of the owners of surface interests would reduce the holding of *Union Oil* to an empty theoretical exercise."[48]

B. Federal Environmental and Developmental Regulations

After acquiring a federal lease for rights to develop geothermal resources and siting rights, geothermal energy developers begin the actual development of the geothermal resource. According to the Department of the Interior, the "development and production of geothermal resources involves six phases: exploration, test drilling, production testing, field development, power plant and power line construction, and full-scale operations."[49]

Since the lease of federal geothermal resources requires the discretionary approval of a federal agency, geothermal resource development on federal land is subject to the National Environmental Policy Act (NEPA). NEPA was enacted to "ensure that all federal agencies consider the environmental impact of their actions" through the development of environmental impact statements (EIS). A question arises as to which stage of geothermal resource development triggers NEPA compliance and the drafting of an Environmental Impact Report (EIR).[50]

In 1974, Congress supplemented the 1970 Geothermal Steam Act with the Geothermal Energy Research, Development and Demonstration Act, which directed the federal government to "encourage and assist private industry through Federal assistance for the development and demonstration of practicable means to produce useful energy from geothermal resources with environmentally acceptable processes."[51] In 1973, the Department of the Interior (DOI) issued a programmatic EIS for the geothermal leasing program,[52] which noted that initial exploration operations involve only casual activities and "practices which do not ordinarily lead to any appreciable disturbance or damage to lands, resources, and improvements."[53]

The *Sierra Club* Court recognized that to undertake exploration other than casual use, the lessee must submit a detailed plan of operations to the United States Geologic Survey (USGS) which includes proposed measures for "protection of the environment."[54] Thus, geothermal energy developers are able to postpone the EIR NEPA process until a development plan is prepared. It should be noted that although NEPA requires an Environmental Impact Statement, it does not require that even significant environmental impacts be mitigated or avoided. In addition, it is difficult to measure the potential impacts on thermophile biodiversity because the majority of these species have not been identified, much less studied.

C. California State and Private Geothermal Acquisition

While Ninth Circuit case law has found that geothermal resources on federal land is a mineral, states differ on the classification and regulation of geothermal resources as a mineral, water, or sui generis, neither a water nor a mineral, resource.[55&56] In California, two cases hold that geothermal resources are minerals on state and private lands, analogous with *Union Oil*. *Pariani v. California*[57] addressed whether a state patent included rights to geothermal resources while *Geothermal Kinetics v. Union Oil*[58] addressed whether a geothermal resource is part of a mineral estate in a deed to private lands. Both cases regard rights to geothermal resources within The Geysers Field of Napa County, California.

In 1980, the California Court of Appeals decided *Pariani v. State of California,*[59] the state-law equivalent of the *Union Oil* case.[60] The plaintiffs were owners of land over geothermal resources in the Geysers Field area of Napa County. The lands had been granted by patent of the State of California between 1946 and 1956, with the reservation to the state of "all. . . mineral deposits."[61] As in *Union Oil*, the court noted "the fact that the presence of geothermal resources may not have been known to one or both parties to the. . .conveyance is of no consequence."[62] The court identified the interpretation as "[grants] for the sovereign should receive a strict construction—a construction which will support the claim of the government rather than that of the individual" and that "a grant is to be interpreted in favor of the grantee, except that a reservation in any grant, and every grant by a public officers or body, as such, to a private party is to be interpreted in favor of the grantor."[63]

Having stated the interpretation in favor of the state, the court then discussed the classification of a geothermal resource as a mineral. The court dismissed the idea that geothermal resources were heat or water, noting that the states' definition of geothermal resources does not limit geothermal resources to heat. The court also dismissed the claim that geothermal resources are water, noting that the toxic[64] condensate of the steam at the Geysers field is not the "life-sustaining water which the courts have felt impelled to exclude from mineral grants and reservations."[65] The court concluded that "either under a constructional approach of the general intent reservation. . .or the classification approach. . .geothermal resources are reserved to the patenting government."[66]

In *Geothermal Kinetics v. Union Oil*,[67] decided by the California Court of Appeals in 1977, the court considered whether a grant of minerals included geothermal resources. In agreement with *Union Oil* and *Pariani*, the court held that a geothermal resource is part of mineral estate in a deed to private lands. Geothermal Kinetics claimed title from a 1951 deed of conveyance for "all minerals in, on or under"[68] the land. Union Oil, holder of an assigned lease to the geothermal resources from the surface owners, claimed that the geothermal resources were not minerals, but heat. The court noted that a functional approach to interpreting the mineral grant was warranted instead of a mechanical approach. In addition, like *Union Oil* and *Pariani*, the court noted that the mineral does not need to be known to exist at the time of conveyance of a grant or reservation.[69]

The court recognized that the State of California placed the Geothermal Resources Act under the section for Oil and Gas in the Public Resources Code inferring that the legislature

view geothermal resources as minerals.[70] The court went on to distinguish the geothermal resources from water stating that unlike groundwater, the "origin of geothermal waters is not rainfall, but water present at the time of the formation of the geological structure. Because rainfall does not replenish geothermal water, it is a depletable deposit."[71] As in *Pariani*, the court also recognized that geothermal water was not a necessity of the surface estate and that the geysers' water was toxic and unusable for drinking or agricultural purposes. The court concluded that from examining both the broad purpose of the mineral conveyance and the expectations of the property interested, the rights to the geothermal resources are part of the mineral grant.[72]

Defining geothermal resources as water, mineral or a *sui generic* (unique and separate) resource, has resulting impacts on the ownership and regulatory oversight of geothermal resources. The Federal and California case law classifying geothermal resources as minerals provides for the best understanding of geothermal resources. Although most geothermal resources require water to function, classifying geothermal resources as minerals instead of water accurately portray the nature of geothermal resources as finite, where water is usually considered a replenishable resource.

D. California Environmental & Development Regulation

The Division of Oil and Gas (DOG) permitting process ensures developer compliance with applicable California Geothermal Laws. California enacted laws for geothermal resources conservation in the Public Resources Code[73] and regulations for the drilling and operations of geothermal resources are recorded in the California Code of Regulations Title 14.[74] The purpose of the Division of Oil and Gas permitting for development of geothermal wells is to: "prevent, as far as possible, damage to life, health, property, and natural resources; prevent damage and waste of underground geothermal deposits; prevent loss of geothermal reservoir energy; prevent damage to underground and surface waters suitable for irrigation or domestic use; prevent other surface environmental damage, including subsidence; and encourage the wise development of geothermal resources through good conservation and engineering practices."[75] Although the code specifically states its purpose is to prevent damage and waste of geothermal deposits, loss of geothermal energy, and damage to waters, the Public Resources Code does not however, make any mention of geothermal biodiversity or thermophile ecosystems.

The Division of Oil and Gas (DOG) oversees the drilling of wells and injection, including collecting monthly geothermal production and injection reports. The DOG ensures compliance with state casing, blow out prevention, plugging and abandonment, and production standards. In addition, the DOG collects well fees and is responsible for subsidence detection and abatement in geothermal areas in the State of California.[76] Development for low temperature geothermal resources require the same CEQA and DOG permitting procedures as high temperature wells, but differ in the amount of bond, fees, and drilling requirements.[77]

In addition to the NEPA and CEQA requirements discussed thus far, there is a vast number of other permitting agencies that may have jurisdiction over geothermal resource development within California.[78]

V. Conclusion

Science has only recently begun to understand the importance of thermophiles and other microorganisms in the ecosystem. However, their financial addition to biomedical and scientific research for industrial process has already been documented.[79] Currently, geothermal resources are being exploited and depleted at significant rates solely for energy production, low temperature heating, and health spas. In many cases, such as the Geysers Field in California, the user of the geothermal resources is aware that the resource is finite and will soon be exhausted and destroyed.

With the little scientific knowledge surrounding geothermal resources, California law should provide for the protection of thermal biodiversity in geothermal resources to ensure that valuable resources are not destroyed before they are understood and their economic potential recognized.

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Footnotes

[1] Kabeh Badiei, *Geothermal Energy: Is It Attractive Enough to Draw Investors for Construction of Geothermal Electric Plants?,* 7 Hastings W.-N.W.J. Env. L. & Pol'y 109, 109 (2001).

[2] Jake Wakeland, *Environmentalism's Big Lie: Renewable Energy,* The Intellectual Activist (October 2001), *available at* http://www.intellectualactivist.com/aboutEnvironmentalism.html.

[3] Some of the environmental concerns include the setting of energy plants in remote, natural areas and noise and air pollution, thermal and mineral stream pollution from plant discharge, subsidence, the seismic effects of injection and re-injection of water into the geothermal resource, and loss of geologic record and thermophilic biodiversity.

[4] Nancy S. Bryson, *The Integral Relationship Between the Federal Technology Transfer Act and Natural Resources,* 22 Energy & Min. L. Inst. 175, 182.

[5] Norman R. Pace, *Phylogenetic Analysis of Hyperthermophilic Natural Populations Using Ribosomal RNA Sequences*, DOE Microbial Genome Program Report Abstracts.

[6] Including stream pollution, subsidence, and tectonic effects of injection.

[7] It should be noted that many different geologic and tectonic processes cause heat production from within the earth, the detail of which is out of the scope and time constraints of this paper. For a more detailed discussion *see* Michael K. Lindsey & Paul Supton, Geothermal Energy: Legal Problems of Resource Development 3 (1975).

[8] The four energy producing applications are dry steam systems, hot water systems, hybrid geothermal brine systems, and hot dry rock systems. Low temperature resources are also utilized for direct heating into buildings, homes, and greenhouses.

[9] Badiei, *supra*, note 2.

[10] Badiei, *supra*, note 2.

[11] Badiei, *supra*, note 2.

[12] Badiei, *supra*, note 2.

[13] Badiei, *supra*, note 2.

[14] Some of the environmental impacts of geothermal resource use including noise and air pollution associated with the construction of geothermal plants in endangered species habitat, subsequent thermal and mineral stream pollution from plant discharge, loss of thermophile biodiversity and geologic record, unknown groundwater depletion and potential subsequent subsidence, and possible tectonic effects of injection and re-injection of water into geothermal reservoirs. In addition, it should be noted that plant construction may conflict with the Endangered Species Act due to plant construction proposal in endangered species habitat Thus, ecological degradation concerns and environmental opposition is perhaps greater due to required construction in remote and natural areas.

[15] Pace, *supra*, note 6.

[16] R. Hueber, H. Hueber and K.O. Setter, *Towards the ecology of Hyperthermophiles: biotopes, new isolation strategies and novel metabolic properties*, 24 Federation of European Microbiological Societies Microbiology Reviews Issue 5, 615 (2000) ("*Pyrolobus* and *Pyrodictium*").

[17] *Edmonds v. Babbit*, 93 F.Supp.2d 63, 64 n.1 (D.D.C. 2000).

[18] Bryson, *supra*, note 5.

[19] Bryson, *supra,* note 5.

[20] Yellowstone National Park Official Website, *Thermophiles*, *available at* http://www.nps.gov/yell/nature/thermophiles/biopro.html.

[21] Due to the isolation of each geothermal resource from another, each geothermal resource and even each hot spring has evolved its own thermophile species. Thermophile species are at a great risk for species die off due to geothermal resource utilization because they may only exist in one location. If that one location or geothermal resource is significantly altered or depleted, the species will become extinct.

[22] It should be noted that there are two parts to acquisition where the surface and mineral estates have been split: rights to the geothermal resource itself and 'siting' rights to construct a geothermal energy plant on land above the resource. Siting rights are particularly important on federal leases for geothermal resources where the United States has reserved mineral rights to land granted under land grants.

[23] Wakeland, *supra,* note 3.

[24] Michael K. Lindsey & Paul Supton, Geothermal Energy: Legal Problems of Resource Development 3 (1975).

[25] Lindsey, *supra* note 9, at 55.

[26] Badiei, *supra*, note 2, at 113.

[27] Ralph B. Konstant, *Summary of Geothermal Law*, *in* Natural Resources Law Manual 231 (Richard J. Fink ed., 1995) (citing 43 U.S.C. § 1331 and 1337 (1981)); The first exception is for offshore geothermal resources under the Outer Continental Shelf Lands Act. The other exception is for the Department of Defense (DOD) to develop geothermal resources on lands under the DOD. Under this exception, a geothermal plant was developed at the China Lake Naval Weapons Center in Coso, California.28 The Coso plant consists of two separate plants (Navy One and Two) utilizing a steam system to generate energy from steam at a temperature of 311°F driving 6 turbine engines. *See* Naval Air Warfare Center Weapons Division, *Geothermal Power Generation at Coso Hot Springs*, *at* http://www.nawcwpns.navy.mil/techtransfer/whitpaps/geo-therm.htm.

[28] Badiei, *supra*, note 2, at 113.

[29] 30 U.S.C. § 1002 (2004) The Act also provides that the Secretary of the Interior through the United States Geological Services (USGS), in consultation with the Secretary of Energy, shall establish a program for hot dry rock geothermal energy on public lands.

[30] *Id.*

[31] A lessee is "entitled to use so much of the surface of the land covered by his geothermal lease to be necessary for the production, utilization, and conservation of geothermal resources." U.S.C. § 1013 (2004).

[32] 30 U.S.C. § 1004 (2004).

[33] Section 1026 of the Act designates the monitoring and determination of adverse effects of proposed development within National Parks, which is subject to notice and public comment. Specifically the Act provides that the Secretary "shall determine on the basis of scientific evidence if exploration, development or utilization of the lands subject to the lease is reasonable likely to result in a significant adverse effect on a significant thermal feature within the National Park System." 30 U.S.C. § 1026 (2004). For projects that the Secretary determines are "reasonably likely to result in a significant adverse effect on a significant thermal feature within a unit of the National Park System, the Secretary shall not issue such lease." 30 U.S.C. § 1026 (2004).

[34] 30 U.S.C. § 1002 (2004).

[35] *United States v. Union Oil*, 549 F.2d 1271 (9th Cir. 1977).

[36] *Id.* at 1273-1274.

[37] *Id.* at 1273 ("The reason is evident. Although steam from underground sources was used to generate electricity at the Larderello Field in Italy as early as 1904, the commercial potential of this resource was not generally appreciated in this county for another half century. No geothermal power plants went into production in the United States until 1960.").

[38] *United States v. Union Oil*, 549 F.2d 1271, 1274 (9th Cir. 1977).

[39] *Id.*

[40] Kostant, *supra* note 28, at 231 ("The state of Oregon has declared as a matter of statute that geothermal resources are part of the surface estate."). However, the 10th Circuit has agreed with the *Union Oil* court and held in *Rosette v. United States* that "geothermal resources. . .were "minerals" with the reservations of the [SRHA] patents." *Rosette v. Use*, 277 F.3d 1222 (10th Cir. 2002).

[41] *Bedroc Limited, LLC v. United States*, 541 U.S. ____ 2004 (2004).

[42] *Id.*

[43] *Id.*

[44] *Occidental v. Simmons*, 543 F. Supp. 870, 877 (N.D. Ca. 1982).

[45] *Id.*

[46] *Id.*

[47] *Id*.

[48] *Id*.

[49] *Sierra Club v. Hathaway*, 579 F.2d 1162 (9th Cir. 1978)(citing Department of the Interior, Final Environmental Impact Statement for the Geothermal Leasing Program at III-2).

[50] The Ninth Circuit case to address this question is *Sierra Club v. Hathaway.52* Sierra Club brought suit to prevent the Secretary of the Interior from executing lease agreements for geothermal resources in the Alvord Desert Geothermal Area of southeastern Oregon based on the Interior's failure to draft an EIS as required by NEPA. The court, in holding for the Interior, noted that the lease in question was only in the exploration stage and that the DOI conducted a programmatic EIS for leasing under the Geothermal Steam Act, which found that exploration practices do not ordinarily cause appreciable environmental loss.

[51] *Sierra Club v. Hathaway*, 579 F.2d 1162 (9th Cir. 1978)(citing 30 U.S.C. § 1101).

[52] *Id*. (citing Department of the Interior, Final Environmental Impact Statement for the Geothermal Leasing Program at III-2.d) ("A programmatic EIS is one which addresses a specific long-term development program of national scope that will proceed in distinct phases. A programmatic EIS deals with the broad environmental ramifications of a program, whereas a regional or site-specific EIS catalogues the environmental implications for a local area.").

[53] *Id.*

[54] Including but not limited to, the prevention or control of (1) fires, (2) soil erosion, (3) pollution of the surface and groundwater, (4) damage to fish and wildlife or other natural resources, (5) air and noise pollution, and (6) hazards to public health and safety during lease activities. " *Sierra Club v. Hathaway*, 579 F.2d 1162 (9th Cir. 1978) citing 30 C.F.R. § 270.34 (h).

[55] Badiei, *supra*, note 2, at 116.

[56] Laura MacGregor Bettis, Comment, *In Hot Water: Can Idaho's Ground Water Laws Adequately Govern Low Temperature Geothermal Resources?,* 39 Idaho L. Rev. 113 (2002)(Noting that Idaho has classified geothermal resources as *sui generis* but "are declared to be closely related to and possibly affecting and affected by water and mineral resources in many instances. Washington attempted a more practical distinction by defining geothermal resource as only the 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. . ." While Hawaii and Texas use a mineral classification, Wyoming and Utah treat geothermal resources as groundwater.).

[57] *Pariani v. California*, 105 Cal. App. 3d 923 (Cal. Ct. App. 1980).

[58] *Geothermal Kinetics v. Union Oil*, 75 Cal. App. 3d 56 (Cal. Ct. App. 1977).

[59] *Pariani*, 105 Cal. App. 3d 923 (Cal. Ct. App. 1980).

[60] *Occidental v. Simmons*, 543 F. Supp. 870, 874 (N.D. Ca. 1982).

[61] *Pariani*, 105 Cal. App. 3d 923 (Cal. Ct. App. 1980).

[62] *Id.*

[63] *Id.*

[64] *Id.* ("The minerals arsenic, boron, and ammonia are present in the steam and its condensate in such amounts as to necessitate injection of the condensate into the ground through reinjection wells to avoid detrimental impact on the surrounding area.").

[65] *Id.*

[66] *Id.*

[67] *Geothermal Kinetics v. Union Oil*, 75 Cal. App. 3d 56 (Cal. Ct. App. 1977).

[68] *Id.* at 58.

[69] *Id.* at 61.

[70] *Id.* at 62.

[71] *Id.* at 63.

[72] *Id.* at 64.

[73] Cal. Pub. Res. Code § 3700 (2004).

[74] Cal. Code Regs. tit. 14, § 1900.

[75] Cal. Division of Oil and Gas, Drilling and Operating Geothermal Wells in California (1990).

[76] Cal. Code Regs. tit. 14, § 1970.

[77] Cal. Division of Oil and Gas, Drilling and Operating Geothermal Wells in California (1990).

[78] Secondary compliance laws include applicable state water law, Coastal Zone Management Act, Endangered Species Act, Wetland fill permits for construction of pipelines, waste discharge regulations for fluids and injection of water into geothermal resources under the National Pollution Discharge Elimination System (NPDES), local fish and game regulation for a pipeline crossing a stream bed and local building and planning departments.

[79] Nancy S. Bryson, *supra* note 5.