

PRESENT AND FUTURE REGULATION OF CLOUD SEEDING ACTIVITIES IN CALIFORNIA

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1. INTRODUCTION

This paper outlines the broad legal framework governing cloud seeding activities in California. This legal framework has largely developed from other forms of water regulation. First, this paper describes cloud seeding and explains why entities use cloud seeding in California and why it is likely to increase. Second, this paper analyzes the role of the federal government and Native American Tribes in water law and, by extension, the law governing cloud seeding activities. Third, this paper examines the constitutionality of cloud seeding under both the United States and California Constitutions. Fourth, this paper examines the applicability of current California surface water and groundwater regulations to cloud seeding activities. Fifth, this paper examines potential interstate conflicts resulting from cloud seeding. Lastly, this paper examines the effects of Federal and State Environmental laws on cloud seeding activities.

2. BACKGROUND

Cloud seeding is a form of weather modification. Weather modification is defined by federal statute as an activity performed to produce artificial changes in the composition, behavior, or dynamics of the atmosphere.¹ Cloud seeding is the only known method for directing rainfall to specific locations and thereby increasing surface water availability at such locations.

It is well known that water has been a focal point for recurring tensions and conflicts throughout California for generations. The demand for water in the state, particularly in the south, has steadily increased while the supply of surface water from rain or snow, mostly from the north, has remained relatively constant. These fundamental facts, plus a variety of other man made factors, have contributed to intra-state water conflicts.

For instance, a major portion of California's water storage and distribution system needs improvement. Water diversions from the San Joaquin/

Sacramento River Delta have been limited, as courts have stepped in to reduce pumping to protect the natural environment in the estuary. Diversion of water from the Sacramento River watershed through the Delta to the south for the last fifty years has also increased pressure on aging and earthquake susceptible dams, levees and dredged channels—a risk that gained new attention after Hurricane Katrina caused catastrophic flooding.² It has become increasingly apparent that California's water system is already insufficient to meet the water demands of California's existing human population plus minimal environmental requirements for fish and wildlife, and that problem will only get worse. In the face of this predicament, weather modification technology offers a partial solution.³ California has looked, and may increasingly look, to cloud seeding as a tool to solve its perennial water shortage problems.

Currently, public and private entities, primarily Utilities, practice some cloud seeding near California mountain ranges, primarily the Sierra Nevada Range, to increase water supply for the dual purposes of increasing hydroelectric power generation and water supply. In the future, California has the potential to become an ever-increasing user of cloud seeding processes. California officials estimate that cloud seeding throughout the Sierra Nevada could easily produce another 300,000 to 400,000 acre-feet of water annually. An acre-foot is about enough water to supply a typical household for a year.⁴ This estimate is undoubtedly modest. Some foreign countries use cloud seeding far more extensively than California. For example, China spends an estimated \$100 million a year and employs 50,000 people for rainmaking.⁵ It is easily foreseeable that California may determine that cloud seeding is far more economical than other methods of increasing water supply, such as desalinization. Therefore, it is also easily foreseeable

¹ See definition from the Commerce and Trade section of the United States Code. 15 U.S.C. § 330 (2000).

² Mike Taugher, Biggest Delta issue remains unresolved, San Mateo County Times (CA), (Dec. 3, 2007).

³ See Tarek Majzoub, Fabienne Quilleré-Majzoub, Mohamed Abdel Raouf, Mira El-Majzoub, "Cloud Busters": Reflections on the Right to Water in Clouds and a Search for International Law Rules, 20 Colorado Journal of International Environmental Law and Policy, 321, 322 (2009).

⁴ Samantha Young, Cloud seeding aims to fight drought, Virginia Pilot and Ledger-Star (Norfolk, VA), (December 11, 2009).

⁵ Stephen Wade, Beijing Aims to Control Weather at Games, The Associated Press, (February 28, 2008).

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that California may dramatically increase its use of cloud seeding in the near future.

Cloud seeding is performed by releasing silver iodide into the atmosphere either from a plane or from a station on the ground.⁶ In simple terms, cloud seeding works as follows: silver iodide mixes with the moisture in clouds thus causing either an increase or decrease in the precipitation released from these "seeded" clouds. If silver iodide is released in small amounts into appropriate regions in cold clouds, it can stimulate the formation of ice particles which in turn accelerates precipitation formation. The effect is an increase in precipitation up to 150 miles downwind.⁷ Where silver iodide is released in large amounts, the opposite effect occurs. This causes a decrease in the amount of downwind precipitation from the seeded clouds. The process of decreasing the amount of precipitation from a cloud is termed "over seeding". In short, cloud seeding is a method of chemically altering precipitation patterns.

3. FEDERAL PREEMPTION AND NATIVE AMERICAN WATER RIGHTS

Clouds containing water droplets blow with the wind over national, state and Native American tribal borders with absolutely no regard to the sovereignty of the land beneath them. As discussed below, little law exists regarding the ownership, regulation and use of unprecipitated water droplets and ice particles in clouds. However, once the water particles precipitate and land on the ground as rain or snow, an extensive framework of law established by sometimes overlapping sovereign jurisdictions begins to apply to it. In California for instance, California Water Code section 106 states that, "All water within the State is the property of the people of the State, but the right to the use of water may be acquired by appropriation in the manner provided by law." No court has ever held that "water" under section 106 includes water droplets and ice particles in a cloud floating above the state, but it is certainly foreseeable that one could. Moreover, federal statutes and Native American water rights have the potential to affect the ownership and use of clouds.

By tradition, the federal government has confined the scope of many of its water related laws to navigable waters. For example, a federal program for the control of discharges of pollutants from point sources exists in the National Pollution Discharge

Elimination System which permits discharges of dredged or fill material into the navigable waters at specified disposal sites.⁸ However, while federal jurisdiction has enormously expanded in many areas during the last century, the federal government has not yet taken over the field of water rights and water quality. The United States Constitution grants the federal government the power, "To regulate Commerce with foreign Nations, and among the several States, and with the Indian Tribes."⁹ The federal government did attempt to extend the scope of its regulatory power when Congress passed the Clean Water Act (CWA). Under the CWA the term "navigable waters" is defined to include the waters of the United States, including the territorial seas.¹⁰ However, this definition was too broad to meet constitutional muster with the U.S. Supreme Court. The court found that the term "navigable waters," under the CWA, includes only relatively permanent, standing or flowing bodies of water, not intermittent or ephemeral flows of water.¹¹

The result of this constitutional limitation is that most water permitting and regulation is performed by the states under a hodge podge of different laws. For example, California reserves the authority to modify water appropriation permits and enforce water quality standards.¹² California uses the State Water Resources Control Board to enforce water rights and water quality standards.

At the present time it appears likely that federal courts would rule based upon existing precedent that federal regulation of cloud seeding is unconstitutional. After all, what form of water is more "intermittent or ephemeral" than a cloud? However, history shows that it is almost frivolous to attempt to predict how the United States Supreme Court will rule in any individual instance on the scope of federal power. To understand this issue, it is important to understand the history of federal preemption of state laws on a variety of issues. Arguably, Federal regulation of cloud seeding activities is constrained by the Commerce Clause of the United States Constitution. As with surface water regulation, regulation of cloud seeding activities at the federal level should be limited to regulations that affect interstate commerce. However, clouds pass over interstate borders at will. Moreover, the general trend in the United States over the last century has been to grant the federal government increasing powers. Beginning with the New Deal, Supreme Court Justices have been under intense political pressure

6 Note Parties may cloud seed by releasing a smoke of silver iodide from a plane or by forcing it into the air from a "seeding station" which is a mechanical assembly stationed on the ground.

7 Mark E. Solak, David P. Yorty, Don A. Griffith, *Estimations of Downwind Cloud Seeding Effects in Utah*, North American Weather Consultants, Inc., http://www.nawcinc.com/Downwind_Effects.doc.

8 33 U.S.C.A. § 1344 (West Supp. 2009).

9 U.S. Const. art. I, § 8.

10 33 U.S.C.A. § 1362(7) (West Supp. 2010).

11 *Rapanos v. U.S.*, 126 U.S. 2208 (2006)

12 *U.S. v. State water resources Control Board*, 182 Cal. App. 3d 82, (1st Dist. 1986).

to rule that expansive federal programs are constitutional. For example, in the 1930's and 1940's the U.S. Supreme Court authorized such sweeping federal legislation as federal minimum wage standards.¹³ Modernly, this trend appears to be slowing down. For example, the Supreme Court recently has recently struck down federal laws that provided a civil remedy for victims of gender-motivated violence.¹⁴ The current Supreme Court seems to be selectively choosing the laws to which the commerce clause applies. For example, the Supreme Court held that the application of Controlled Substances Act provisions criminalizing manufacture, distribution, or possession of marijuana to intrastate growers and users of marijuana for medical purposes, as otherwise authorized by California Compassionate Use Act, did not exceed Congress' authority under Commerce Clause.¹⁵ However, the membership of the Supreme Court constantly changes, and as evidenced by the Supreme Court's recent seemingly inconsistent rulings, predicting how the court will rule on the applicability of federal preemption to new issues remains difficult. Therefore, it is uncertain whether courts will allow federal regulation of cloud seeding activities, if Congress were to establish such regulations.

There is also uncertainty as to how the federal and state governments will deal with alteration to existing Indian Water rights. Native American tribes are considered independent nations and as such are entitled to certain water rights. For example, an Arizona court held that the federal government, in establishing Indian or other federal reservations, implied that it is necessary to reserve enough water to fulfill the purpose of each such reservation. In so doing, the United States reserved unappropriated water rights, which vested on the date the reservation was established, and those rights are superior to the rights of future appropriators.¹⁶ However, the rights of tribes to maintain existing natural precipitation patterns, if any, have never been litigated. Courts could decide that Native American tribes have no right to natural rainfall. Conversely, courts could decide that tribes do have a right to natural rainfall, and thus protection from cloud seeding activities. Recently, although not historically, federal courts have become highly protective of tribal sovereign rights. For instance, the Pit River Tribe in California recently halted construction of a geothermal plant on their land where a court ruled that the U.S. Forest Service, Bureau of Land Management and Department of Interior breached their fiduciary obligation to Native American Tribes. The

courts found an injury in fact, citing tribe testimony that it had used the lands in question for cultural and religious ceremonies.¹⁷ Similarly, tribes could declare that natural rainfall is part of their heritage and alteration of natural precipitation causes them injury. Therefore, cloud seeding activities may be limited or otherwise affected by the rights attached to Native American lands.

4. CLOUD SEEDING: INVERSE CONDEMNATION & PUBLIC TRUST

4.1. Legality of Cloud Seeding under the California Constitution

California may hold that some cloud seeding activities performed by government entities violate the California Constitution. California's Constitution provides, "Private property may be taken or damaged for a public use and only when just compensation, ascertained by a jury unless waived, has first been paid to, or into court for, the owner."¹⁸ Generally, a public entity must compensate landowners for the physical damage it causes to private property.¹⁹ Private entities have successfully brought inverse condemnation claims for the taking of water by public entities. For example, a California court has ruled that a taking exists where a city pumped so much groundwater that it caused subsidence and resulted in damage to private property.²⁰

Similarly, cloud seeding by a public entity, such as a public utility, could result in a property taking where it causes less rainfall in a particular area and thus less water for use on a particular property. It is clear that California does not hold that new water users have statutory or constitutional rights to water. For example, California has previously ruled that a municipality may deny a water interconnection to a new homeowner.²¹ However, it is not clear whether California courts will find that cloud seeding activities alter existing water rights. For example, under normal rainfall conditions, a California property owner may receive, on average, 50 cubic feet per second (cfs) of water per year, but because of cloud seeding they may subsequently receive only 40 cfs. Are they entitled to compensation for the decrease? Cloud seeding activities could also result in a taking where the seeding causes an increase in rainfall, and corresponding increase in landslide or flood damage to private property. In short, the potential

13 *U.S. v. F W Darby Lumber Co.*, 60 S.Ct. 1105 (1940)

14 *U.S. v. Morrison*, 120 S.Ct. 1740 (2000).

15 *Gonzales v. Raich*, 125 S.Ct. 2195 (2005).

16 *In re General Adjudication of All Rights to Use Water in Gila River System and Source*, 201 Ariz. 307, (2001).

17 *Pit River Tribe v. U.S. Forest Service* 469 F.3d 768 (9th Cir. 2006).

18 Cal. Const. art. I, § 19.

19 *Albers v. County of Los Angeles*, 62 Cal.2d 250 (1965).

20 *Los Osos Valley Associates v. City of San Luis Obispo*, 30 Cal. App. 4th 1670, (2d Dist. 1994).

21 *Gilbert v. State of California*, 218 Cal. App. 3d 234, (1st Dist. 1990).

impact of cloud seeding activities under the inverse condemnation provisions of the California Constitution remains an open question.

Proponents of cloud seeding would argue that California law encourages the full use of water as a public resource. They would argue that public policy favors cloud seeding because it creates more precipitation in California as a whole, even though some water users or individuals may be adversely affected by changes in natural precipitation patterns. This argument may be persuasive because California values communal water rights and water access. For example, under California's Constitution "... the general welfare requires that the water resources of the State be put to beneficial use to the fullest extent of which they are capable".²² These proponents would argue that limiting cloud seeding activities would not be good stewardship of water resources because even if the use of cloud seeding by public entities constitutes a taking, such a taking is justified as a beneficial public use of water. The California Supreme Court has previously ruled that supplying of the inhabitants of an entire town with water is a "public use" to which the right of an individual to enjoy the flow of the water in its natural channel upon his land subservient.²³ Therefore, California courts may rule that cloud seeding activities represent a beneficial public use of a natural resource, and as such these activities are legal in California, although persons adversely affected may have some right to recourse by inverse condemnation.

Proponents may further argue that the public trust doctrine requires that cloud seeding activities be permitted. In general, the public trust doctrine posits that "the sovereign owns 'all of its navigable waterways and the lands lying beneath them 'as a trustee of a public trust for the benefit of the people.' " The State of California acquired title as trustee to such lands and waterways upon its admission to the union..."²⁴ The scope of the public trust doctrine has generally been limited to navigable streams and lakes.²⁵ Members of the public may generally assert the public trust doctrine in order to compel actions to protect the public trust. The California Water Board is required by statute to take public trust interests into account in undertaking planning and allocation of water resources. The uses it considers include using water use for domestic,

irrigation, municipal, industrial, preservation and enhancement of fish and wildlife, recreational, mining and power purposes, and any uses specified to be protected in any relevant water quality control plan.²⁶

There are several potential arguments that the public trust doctrine could be applied to cloud seeding activities, although there is currently no precedent for such an assertion. Under one line of reasoning, proponents would argue that the public trust doctrine should be applied to activities which alter precipitation patterns because cloud seeding increases the amount of water available to Californians. They would reason that the best public use of water as a California resource is to increase the overall amount of precipitation, even to the extent it may reduce rainfall to some existing water users. More simply, proponents could argue that cloud seeding increases the amount of water in the navigable waterways, which is a good for California, and that continuing to allow entities to do so is required, or at least permitted, under the public trust.

Conversely, courts may find that some types of cloud seeding activities must be restricted if they are "unreasonable." The California Constitution states, "The right to water...in this State is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water."²⁷ As applied to cloud seeding, one example of an "unreasonable" use might occur where a storm already threatens to overload water channels, and cloud seeding activities increase that risk. In an ideal situation where cloud seeding increases precipitation, creates more water for downstream users, and causes only minor adverse effects a court should not consider use of cloud seeding to be "unreasonable." However, it is not difficult to foresee situations where seeding could increase flooding or severely decrease precipitation, and in such situations the use may be considered "unreasonable."

One California case has specifically held that a property owner may sue a county in tort and for inverse condemnation claim when its cloud seeding activities during a storm allegedly contributed to a flood that destroyed property.²⁸ In that case, *First English Evangelical Lutheran Church v. County of Los Angeles*, the plaintiff, First English Lutheran Evangelical Church of Glendale, owned a camp on the banks of natural creek. A storm dropped a total

22 Cal Const. art. X, § 5.

23 *St. Helena Water Co. v. Forbes*, 62 Cal. 182 (1882).

24 See *National Audubon Society v. Superior Court*, 33 Cal. 3d 419, 434 (1983).

25 See *Golden Feather Community Association v. Thermalito Irrigation District*, 209 Cal. App. 3d 1276 (3d Dist. 1989).

26 Cal. Water Code Ann. § 1257 (West 2009).

27 Cal Const. art. X, § 2.

28 *First English Evangelical Lutheran Church v. County of Los Angeles*, 210 Cal. App. 3d 1353, (2d Dist. 1989).

of 11 inches of rain in the watershed area for the creek, and a flood destroyed the camp. The County of Los Angeles allegedly seeded the storm and contributed to the flood. The plaintiff landowner brought two causes of action relating to the cloud seeding: one for strictly liability for creating an unreasonably dangerous condition and one for inverse condemnation. The trial court dismissed both causes of action, but the Second District Court of Appeals reversed the trial court decision, holding that the plaintiff has stated a cause of action in both tort and inverse condemnation. The case was remanded for further proceedings.

5. COMPARISON OF CLOUD SEEDING ACTIVITY REGULATIONS TO SURFACE WATER REGULATIONS.

5.1. Cloud Seeding in the Context of Surface Water Regulations

California has not enacted any separate regulations over cloud seeding so the changes to precipitation patterns caused by cloud seeding are effectively ignored under California statutory law. Thus California law currently treats the water gained from cloud seeding the same as water from naturally occurring precipitation.²⁹ Natural rainfall is governed by the rule of capture as to precipitation on land where precipitation falls. When this water enters a stream or accumulates underground, rights to use the water are governed by surface and groundwater laws respectively. Water in its natural state, whether on or below the surface, is considered an interest in real property, either as part of, or appurtenant to, the land.³⁰

The right to use surface waters in California is governed by a system of water rights. There are three types of water rights. The first are "appropriative" rights. Under that doctrine the first person to use water from water source for a "beneficial use" has the right to continue to use that quantity of water for that purpose. Subsequent users can use the remaining water for their own beneficial uses provided they do not impinge on the use of prior users. The second are "riparian" rights, which are the right of a landowner to take water from a surface water source that abuts his or her land for use on that land. The third are "prescriptive" rights that are established by the use of water in the manner required to acquire a prescriptive easement.³¹

Conflicts are resolved in California through a hybrid system of riparian and appropriative rights. Where

two riparian users dispute the amount of water they may take from a stream, the court will resolve the dispute according to the American rule of reasonable use. This means the riparian users must use the water for what the courts decide is a reasonable use.³² If both the users are appropriators the court will resolve the dispute according to the prior appropriation doctrine.³³ If one user is riparian and the other is an appropriator, the court will award the water right to the party with the earlier priority by comparing the appropriative date of the appropriator versus the title to land for the riparian.³⁴ Because riparian rights are *usually* procured before the appropriation doctrine took effect, the rule of thumb is that riparian users usually get priority. These basic surface water right doctrines are likely to continue to govern water gained or lost as a result of cloud seeding activities because they have resulted in more than a century of water rights decisions.

In the future, however, water procured through cloud seeding may be given different legal status than natural rainfall. In California, a landowner does not have ownership of the physical corpus of the water but merely a right to use it.³⁵ California has not answered the question of whether the right to a natural amount of rainfall on land or water rights produced by natural rainfall are a property right. In other words, California has not answered the question, "Is water gained or lost due to cloud seeding activities a gain or loss of property?" The answer to this question will determine the rights of parties gaining and losing water as a result of these activities. Cloud seeding can cause precipitation to increase or decrease. Where there is an increase in water, California may grant a water right in the amount of the expected increase in water supply to the entity who "procured" the water through cloud seeding; to the exclusion of prior appropriators and riparians. California may pursue this policy because it would encourage cloud seeding activities. It is also possible, but unlikely, that California would award prescriptive water rights to entities that cloud seed, and thus adversely appropriate from other users. Therefore, water procured through cloud seeding activities may be governed differently under California state law than flow from natural rainfall in the future.

5.2. Interstate Surface Water Issues Caused by Cloud Seeding

Where states east of California perceive that California is taking precipitation at their expense, these states may request more surface water in return. According to one author:

29 See Department of Water Resources, *California Water Plan Update* 2005; vol. 2, ch. 14, available at <http://www.waterplan.water.ca.gov/docs/cwpu2005/vol2/v2ch14.pdf>.

30 Cal. Civ. Code § 662 (West 2007).

31 *Smith v. Hawkins*, 127 Cal. 119 (1899).

32 *Joslin v. Marin Municipal Water Dist.*, 67 Cal.2d 132 (1967).

33 Cal. Water Code Ann. § 1450 (West 2009).

34 *Lux v. Haggin*, 13 P. 654 (1887).

35 *Rancho Santa Margarita v. Vail*, 11 Cal.2d 501 (1938).

Some governments are planning cloud seeding projects to cause passing winter storms to deposit more of their moisture locally to help fill reservoirs with the supply western communities need to get through their long dry summers. The objections this time come from governments further inland who believe that if this seeding happens, their rain and snowfall would be reduced and their water supplies depleted. It will surely be a knock down fight if the central California farm areas attempt cloud seeding to increase rainfall, and likely reducing rainfall to Las Vegas which lies directly to the east. Legal action is sure to happen if any of these cloud seeding programs go forward, raising a host of interesting questions.³⁶

It is possible that cloud seeding activities in California are increasing, or will increase precipitation in California at the expense of the interest of states to the east such as Nevada, Utah and Arizona. This effect can be analogized to the natural effect the Sierra Nevada Mountains have on the precipitation in Nevada. Virtually the entire State of Nevada exists in a rain shadow created by the Sierras.

Various studies have been conducted to determine the effects of cloud seeding. These studies have generally determined that there is no substantial loss of precipitation to those areas down wind of cloud seeding activities.³⁷ A meteorologist would understand that the amount of water vapor in the air is not substantially depleted when clouds form and precipitation occurs. However, this seems counter-intuitive to the layman. Whatever the merit of these studies, it is possible that cloud seeding activities affect precipitation patterns in places other than those directly downwind of cloud seeding activities.

Changes in precipitation patterns could affect interstate water agreements. Surface water rights on rivers that flow through multiple states are, in some cases, dealt with through agreements which are negotiated between states. One example of such an agreement is the Truckee River Operating Agreement which allocated shares of water from the Truckee River between California and Nevada.³⁸ The jet stream, which drives most of California's and Nevada's precipitation patterns, blows west to east. If Nevada perceives that cloud seeding

activities are adversely affecting its water supplies, it could insist that this agreement be renegotiated. Another example of such an interstate surface water agreement is the Colorado River Compact of 1921. The States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming, entered into a compact to apportion waters from the Colorado River under the Act of the Congress of the United States of America approved August 19, 1921.³⁹ If states that are further east of California perceive they are receiving less water from the Colorado River than may occur naturally, they may request an amendment to the current Colorado River apportionment to the detriment of current California water users. Therefore, if there is substantial difference in rainfall caused by cloud seeding activities, California may be requested to renegotiate interstate water allocation agreements.

6. COMPARISON OF CLOUD SEEDING REGULATIONS IN CALIFORNIA TO GROUNDWATER REGULATIONS IN CALIFORNIA.

6.1. Use of Both Cloud Seeding and Groundwater are Subject to Few Regulations

Both cloud seeding and groundwater are regulated at the county level in California. Groundwater is regulated at the county level in California because California has not enacted comprehensive groundwater regulation at the state level. In *Baldwin v. County of Tehama* a California Appellate Court held that the water code of California is not sufficiently broad enough to occupy the field of groundwater regulation.⁴⁰ Specifically, the court held that California statutes allowing formation of local districts with limited powers over groundwater, statutes restricting export of water from basin, and statutes granting limited authority over groundwater to local agencies, did not imply occupation of the field of groundwater regulation, so as to preempt a county ordinance.⁴¹ Just as there is no statewide statutory remedy for loss of groundwater, there is no statewide statutory remedy for the loss of water or damage caused by activities which alter precipitation patterns. Since there are no statewide codes regulating cloud seeding activities, only municipalities and counties currently provide cloud seeding regulations. Just as most groundwater is governed by the rule of capture, so is water from cloud seeding. Therefore, groundwater and cloud seeding activities are both currently regulated only at the county

36 Will Taft, *The Next Water Debate – Cloud Seeding*, <http://willtaft.com/contemporary-issues/the-next-water-debate-cloud-seeding/>, January 18, 2010.

37 See Department of Water Resources, *California Water Plan Update 2005*; vol. 2, ch. 14, available at <http://www.waterplan.water.ca.gov/docs/cwpu2005/vol2/v2ch14.pdf>.

38 See United States Bureau of Reclamation, *Truckee River Operating Agreement and Related Documents*, <http://www.usbr.gov/mp/troa/>, (last updated January 4, 2010).

39 See United States Bureau of Reclamation, *Colorado River Compact 1922*, <http://www.usbr.gov/lc/region/g1000/pdfiles/crcompct.pdf>.

40 *Baldwin v. County of Tehama*, Cal. App. 4th 166 (3d Dist. 1994).

41 *Id.* at 171.

level in California.

California has taken minor steps at the state level to provide some continuity as to groundwater regulation. California has also encouraged local agencies to coordinate the development of groundwater management plans.⁴² One of the purported reasons California has not provided statewide laws for groundwater regulation is that groundwater basins are not well understood. They vary greatly in characteristics from basin to basin. For these reasons, California has allocated funds toward studying groundwater.⁴³ California has also provided for some groundwater monitoring at the state level.⁴⁴ However, California agricultural interests have vigorously and successfully opposed groundwater study or regulation for decades, and are likely to continue to oppose ground water study because it is perceived as a prerequisite to regulation.

California as a state has also not taken steps to comprehensively study cloud seeding, though other entities such as utilities are picking up the slack. In the northern Sierra Nevada, where Pacific Gas & Electric has sponsored cloud seeding operations since 1953, the utility says data going back four decades show the area has received 5 percent more snow on average than before.⁴⁵ Therefore, California is taking some actions at the state level to understand issues related to cloud seeding, although those entities that engage in seeding, primarily public utilities, appear well satisfied with the current non-regulated status quo.

6.2. Judicially Created Groundwater Rights in California

In many counties there are no governing state or county regulations of groundwater use. In these cases, groundwater rights can generally considered to be governed by the law of capture, due to the relatively sparse regulation of groundwater. As one author puts it:

California groundwater law as it currently exists is perhaps best summarized as the right to pump as much water as possible until one is sued. California groundwater is not regulated by a statewide management system, despite the severe overdraft of many basins. The California Legislature has not granted the State Water Resources Control Board jurisdiction over groundwater, even though it may be interconnected

with surface water resources, because groundwater is presumed to be percolating water. Most property owners with land overlying groundwater need only drill a well or construct other diversion works and extract the groundwater. Although some governmental controls do exist, they are often not enforced with any consistency. This has led to judicial management through court adjudications coupled with varying local controls."⁴⁶

In this absence of regulation, California courts have developed an elaborate system of underground water rights. Courts classify water rights in an underground basin as one of three different rights. First, overlying rights are analogous to that of the riparian owner in a surface stream. It is the owner's right to take water from the ground underneath the owner's property for use on his or her land within the basin or watershed; it is based on the ownership of the land and is appurtenant thereto. Second, appropriative rights are defined as follows. Any water not needed for the reasonable beneficial use of those having prior rights is excess or surplus water and may rightly be appropriated on privately owned land. Third, prescriptive rights accrue where the taking is wrongful.⁴⁷ A similar system of judicially created rights may develop into rights to precipitation from cloud seeding activities. Time will tell if precipitation alteration from cloud seeding activities receives the same judicial treatment as groundwater.

By contrast, some counties have adopted groundwater basin management plans. The California legislature has allocated much of the regulation of groundwater to local agencies and municipalities.⁴⁸ However, most counties have not enacted substantial groundwater regulation schemes. For example, water replenishment districts are given the power to do any act necessary to replenish the groundwater of the district, including, in particular, the power to buy and sell water; exchange water; distribute water to persons in exchange for ceasing or reducing groundwater extractions; spread, sink and inject water into the underground.⁴⁹ However, many counties and municipalities have adopted few groundwater regulations.

Similarly, California has allocated regulation of cloud seeding activities to local agencies and municipalities by default. There is currently no statewide

42 Cal. Water Code Ann. § 10750 (West Supp. 2010).

43 Cal. Water Code Ann. § 10780 (West Supp. 2010).

44 Cal. Water Code Ann. § 10780 (West Supp. 2010).

45 Associated Press, States study cloud seeding (12/11/2009), <http://www.santafenewmexican.com/HealthandScience/States-study-cloud-seeding>.

46 Symposium, *Environmental Restraints on Water Law: Institutional Reforms in California Groundwater Law*, Eric L. Garner, Michelle Ouellette Richard L. Sharff, Jr., 25, 1021 Pacific L.J. April, (1022-1023) (1994).

47 *City of Barstow v. Mojave Water Agency*, 23 Cal. 4th 1224 (2000).

48 Cal. Water Code Ann. § 10750(a) (West Supp. 2010).

49 Cal. Water Code Ann. § 60221 (West 2004).

regulation of cloud seeding activities. The result so far has been that many agencies and municipalities have chosen not to regulate cloud seeding activities. For example, officials at the National Oceanic and Atmospheric Administration, Environmental Protection Agency and the State Water Resources Control Board, as well as with both Siskiyou and Shasta counties, said they don't regulate cloud seeding if it is done on private property.⁵⁰ These agencies may not currently see a need to intervene because the public is mostly unaware of cloud seeding activities, and the entities engaged in cloud seeding activities benefit from cloud seeding. However, this may change in the future if third parties take an interest in cloud seeding.

6.3. Reclassifying Extra Water Procured by Cloud Seeding Activities as Captured Water

California may choose not to follow the current surface rights and groundwater rights with respect to water procured through cloud seeding activities. It may decide that cloud seeding is not only legal, but that water procured through cloud seeding belongs to the entity who seeded the clouds to the exclusion of other water appropriators. California may thus choose to award ownership of additional water procured by cloud seeding activities to the entity employing cloud seeding. California has granted a similar type of ownership to water districts who store water underground. California courts have held that water districts may fill underground basins with water and could own the rights to that water, even where the water storage floods and affects an adjacent property owner.⁵¹ In *Niles Sand* a water district conducted an underground water replenishment program to prevent salt-water intrusion from the San Francisco Bay. Because this program resulted in the flooding of plaintiffs' sand and gravel pits, plaintiffs pumped out and discharged the water into the Bay causing substantial amounts of fresh water to be wasted, which could have been used for domestic use. The court ruled that the groundwater belonged to the city, and the private entity, Niles Sand, must cease its pumping activities. In this case, California made an exception to its abstention from regulating groundwater to allow for the municipal storage of water underground. Therefore, California courts may make similar exceptions for water procured by cloud seeding.

One example of such an exception would be for California to allow municipalities the right to any greater than natural amounts of precipitation they procure through cloud seeding activities. Currently,

water obtained through cloud seeding is regulated by local agencies. Water obtained through cloud seeding is considered natural supply. This extra water is governed by existing surface water rights and groundwater regulations. However, in the case of cloud seeding, the courts could rule that cloud seeding causes additional precipitation and that municipalities or entities engaging in this beneficial activity should be rewarded. For example, one could imagine a situation in which a municipality seeds clouds which cause increased snowfall in an adjacent mountain range. Then that municipality could claim rights to a portion of the additional valuable springtime runoff water. It would be difficult to define what fraction of total precipitation is increased water resulting from cloud seeding, but some system based on this concept is possible. Therefore, a California court could rule that a portion of the increased water resulting from cloud seeding activities belongs to the cloud seeding entity, even to the exclusion of riparian and appropriative rights of others.

7. ENVIRONMENTAL REGULATIONS OF SURFACE AND GROUNDWATER AS RELATED TO CLOUD SEEDING ACTIVITIES

7.1. Regulation of Pollution from Cloud Seeding Activities

Current environmental laws are probably sufficient to regulate cloud seeding. There currently exist many state and federal laws that deal with surface water pollution and ultimately cloud seeding activities. For example, the Federal Clean Water Act regulates most surface waters in California⁵² as well as the issuance of federal licenses for hydroelectric facilities.⁵³ California law states that any person who has discharged or discharges waste into the waters of this state in violation of any waste discharge requirement is required to clean up the waste or abate the effects of waste.⁵⁴ Private causes of action can also be brought to prevent water pollution. Cloud seeding operates by an entity shooting chemicals into clouds. These chemicals eventually make their way back into surface water and possibly groundwater; and consequently fall under current environmental laws. Therefore, existing environmental laws are relevant to deal with cloud seeding activities.

If any environmental damages result from cloud seeding they are likely caused by increased amounts of silver in the environment. This is because silver iodide is the most common chemical

50 Dylan Darling, *Cloud seeding plan in California sparks debate*, (Dec. 24, 2008), Scripps Howard News Service, <http://www.scrippsnews.com/node/39447>

51 *Niles Sand & Gravel Co. v. Alameda County Water Dist.*, 37 Cal. App. 3d 924, (1st Dist. 1974).

52 *Environmental Protection Agency v. California ex rel. State Water Resources Control Bd.*, 96 S. Ct. 2022 (1976).

53 *In S.D. Warren Co. v. Maine Bd. of Environmental Protection*, 126 S. Ct. 1843 (2006).

54 Cal. Water Code Ann. § 13304 (West Supp. 2010).

used for cloud seeding. Silver iodide may break down and add concentrations of silver to the environment. There is debate as to the extent to which silver iodide breaks down into silver. Some debate also exists as to the extent that silver affects humans and aquatic habitat. In California, there is a fear that additional silver can harm aquatic habitats, especially in the Bay Area. According to Samuel Luoma, a senior research scientist at the U.S. Geological Survey, silver is a powerful environmental toxin. It kills microorganisms indiscriminately and can wipe out the beneficial ones as well as the pathogenic ones. In addition, it has a direct effect on the reproductive capabilities of certain aquatic invertebrates, and possibly fish as well.⁵⁵ As for humans, the Environmental Protection Agency has published materials which classify silver as a "nuisance chemical" in drinking water. The EPA states that in concentrations of 0.1 mg/L silver can cause skin discoloration and a graying of the white part of the eye.⁵⁶ To be fair, silver isn't considered to be an extremely dangerous chemical like mercury, lead or arsenic. It is currently the opinion of this author that cloud seeding does not substantially impair drinking water or habitat. However, there is certainly room for scientific and political debate as to the amount of silver which should be artificially released into the environment.

Currently there are no California-wide state laws dealing directly with silver contamination. Some cities and counties may take initiative to prevent silver contamination. For example, the City of Livermore has cited Lawrence Livermore Laboratory for discharging water with excessive amounts of silver in it.⁵⁷ However, this incident involved releases of silver used for processing of photographs.

It presently appears unlikely that cloud seeding activities will violate existing groundwater contamination or soil contamination laws and regulations. The California Regional Water Quality Control Board has previously stated that the maximum Concentration Limit of silver in soil is 5 mg/l when using proper testing methods.⁵⁸ Under the current methods

of cloud seeding it is unlikely that this amount of concentrated silver would ever occur in soils. The silver iodide is released over a wide area and is unlikely to accumulate in concentrations which would be dangerous to humans. It is possible that undispersed capsules containing silver iodide could produce such concentrations if silver iodide is leaked or negligently dropped from a plane as has occurred in Russia.⁵⁹ However, these types of incidents are likely to be isolated and easily remedied. Therefore, groundwater and soil environmental regulations are unlikely to affect cloud seeding activities.

7.2. Violation of Endangered Species Acts

A different question is whether cloud seeding and weather modification activities fall within the scope of either the Federal Endangered Species Act⁶⁰ or California Endangered Species Act.⁶¹ Both of these acts establish a scheme under which any species which is deemed "endangered" or "threatened" is protected from various private and governmental activities which will or may jeopardize its continued existence. Consequently, these acts protect species which may be harmed by activities involved with surface water and groundwater. The activities are highly regulated if the activity is deemed to adversely affect the habitat and reproduction of endangered species such as frogs, birds, or fish. As discussed above, silver contamination at levels not harmful to humans may nonetheless adversely affect the breeding and habitat of endangered species such as salmon by contaminating waterways. Cloud seeding also alters natural weather patterns and which could adversely affect wildlife, including endangered species. Therefore, the endangered species act may prohibit cloud seeding activities in some areas.

8. CONCLUSION

This paper defined the broad legal framework governing cloud seeding activities in California. California is increasing its water supply through cloud seeding and will probably increase its use of cloud seeding. The federal government has not significantly intervened into cloud seeding activities because it has confined to regulation of water to navigable waters. Additionally, federal regulation may be slow to develop because courts may rule that federal regulation of cloud seeding is unconstitutional.

55 Robin Marantz, *Our silver-coated future: nanotechnology, fast becoming a three-trillion-dollar industry, is about to revolutionize our world. Unfortunately, hardly anyone is stopping to ask whether it's safe*, 29 OnEarth 1 (2007).

56 Environmental Protection Agency, *Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals*, <http://www.epa.gov/safewater/consumer/2ndstandards.html>, (Last updated Nov. 28th, 2006).

57 Peter Weiss, *Livermore Cites Lab for Sewer Discharge*, San Ramon Valley Times (Cal.) A03, (May 10, 1997).

58 California Regional Water Quality Control Board San Diego Region, *Addendum No. 1 to Order No. 93-86: Maximum Concentration Limits for Soils Containing Nonhazardous Concentrations of Petroleum Hydrocarbons, Organic and Inorganic Compounds, Metals, and Pesticides for MSW*

Landfills with Subtitle D Liners, <http://www.sandiego.gov/environmental-services/ep/pdf/93-86add1.wdr.pdf>.

59 Ian O'Neill, *When Cloud Seeding Goes Wrong: Cement Chunk Falls From the Sky*, <http://www.universetoday.com/2008/06/19/when-cloud-seeding-goes-wrong-cement-chunk-falls-from-the-sky/>, (June 19th, 2008)

60 See 16 U.S.C.A. § 1531 (Westlaw online).

61 West's Ann. Cal. Fish & G. Code § 2050 (West Supp. 2010).

Currently, water procured from cloud seeding activities is governed by the same surface water rights that already exist under state laws. Current environmental laws are probably sufficient to regulate cloud seeding. Environmental regulatory actions concerning cloud seeding are likely to focus on the silver used to cloud seed which may adversely affect endangered species by contaminating waterways. California may hold that some cloud seeding activities performed by government entities violate the California Constitution. Conversely, California may hold that cloud seeding activities are not only constitutional, but that the California public trust doctrine requires that cloud seeding activities be permitted. In the absence of state and federal regulation, cloud seeding is regulated at the county level

in California. A system of judicial rights or alternate water rights for cloud seeding activities may soon develop. Alternatively, California may choose not to follow the current surface rights and groundwater rights with respect to water procured through cloud seeding activities. Where states east of California perceive that California is taking precipitation at their expense, these states may request more surface water in return.

California has an increasing population and limited water supplies. Cloud seeding will likely play a larger role in California to increase water supplies. The future focus of the law on cloud seeding activities in California will probably increase at the same pace the cloud seeding itself increases.