Title
Treading Water: Resource and Legal Regulatory Scarcity in the Assessment of Groundwater Withdrawals in California

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Publication Date
2016

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

LOS ANGELES

Treading Water: Resource and Legal Regulatory Scarcity in the Assessment of Groundwater Withdrawals in California

A thesis submitted in partial satisfaction of the requirements for the degree of Master of Urban and Regional Planning

by

Seth Ryan Samuels

2016

ABSTRACT OF THE THESIS

Treading Water: Resource and Legal Regulatory
Scarcity in the Assessment of
Groundwater Withdrawals in California

by

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Master of Urban and Regional Planning
University of California, Los Angeles, 2016
Professor Susanna B. Hecht, Chair

What is the import of California's Sustainable Groundwater Management Act of 2014 ("SGMA")? It is acknowledgement that groundwater consumption is drastically outpacing aquifer replenishment and that new tools are necessary to resolve this issue. However, there is justifiable concern that the SGMA is ill-equipped to tackle sustainable groundwater management. Additionally, the timing of the SGMA's adoption raises questions as to the Legislature's motives, especially when it has remained silent for more than a century with respect to groundwater conservation. While the problem appears to be a tragedy of the groundwater commons (potentially remedied by market-based incentives and/or collective action), it is in fact much more complicated. As this paper argues, the problem is rooted in the interplay between the over-allocation of Constitutionally protected groundwater use rights, the American common law system and its independent regimes for surface water and groundwater resources (despite hydrogeological interconnectedness), the legislative process, severe climate-induced drought, and a significant lag between technological advancement and legal precedent. Only through state powers like eminent domain (by reacquiring and redistributing use rights) can the state prevent unbridled groundwater extraction.

The thesis of Seth Ryan Samuels is approved.

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2016

This Master Thesis is dedicated to:

Dr. Rana Lynn Samuels

A True Water Scholar

TREADING WATER: RESOURCE AND LEGAL REGULATORY SCARCITY IN THE ASSESSMENT OF GROUNDWATER WITHDRAWALS IN CALIFORNIA

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INTRODUCTION

A. ***RESEARCH QUESTION***

What is the import of the Sustainable Groundwater Management Act (known also as the "SGMA"), passed by the California Legislature and signed by the Governor into law in 2014? One might argue that the enactment of such legislation is recognition that the status quo on groundwater management is untenable; that some affirmative acts must be taken in order to preserve this finite natural resource. However, acknowledging the existence of a problem is only a necessary first step towards solving it. What must precede any viable solution is a clear understanding of the problem's etiology. Otherwise, we would find ourselves treating only observable symptoms, while leaving the underlying causes of the disease unaddressed. In this case, the disease is rapid groundwater depletion. A major cause of this disease, this paper argues, is legally entrenched, socially reinforced property rights governing ownership and extraction of groundwater.

B. ***MOTIVATING ASSUMPTION***

If we continue to pass legislation that does not uproot entrenched property norms, then we are doomed to exhaust our natural resources rather than preserve and manage them for the future.

C. ***ROADMAP***

In order to understand how more effectively to direct groundwater management strategy, we must first explore how California groundwater law developed into its present untenable state and how the Sustainable Groundwater Management Act of 2014 does not and will not meaningfully alter that state. To complete this task, this paper is divided into several chapters.

Chapter 1, and to a greater extent, Appendix B, examine the major points of the Sustainable Groundwater Management Act of 2014. Chapter 2 reviews scholarship pertaining to commons resources, the human right to common resources, the tragedy of the commons, and market and

collective action solutions to the commons tragedy. This chapter further explores the commoditization of water, the use of water in perpetuating the American ethos, and potential impacts of water scarcity on American society. Chapter 3 considers the impetus driving the passage of groundwater legislation in 2014 in California's legislative and executive branches. Chapter 4 lays the legal and historical foundations for understanding the trends in groundwater's conspicuous absence in California water management as discussed in Chapter 5. Chapter 6 provides some preliminary data that shows consistent groundwater extraction levels in Southern California and offers a hypothetical model for future regression analyses on groundwater extraction behavior due to resource scarcity and fear of resource scarcity. Chapter 6 concludes by offering several explicit reasons that the SGMA is and will continue to be ineffective at adequate groundwater management and offers three solutions to this ineffectiveness.

D. ***WATER WATER EVERYWHERE…***

Access to water is, and has been, crucial to Southern California's development, from its burgeoning agricultural stage in the late Nineteenth Century, to its transition to industrial agriculture in the early Twentieth Century, and ultimately to its peri-urban and suburban sprawl that characterizes much of the region to date. (Reichard *et al.*, 2003; Samuels, 2011). While the scientific disciplines of hydrology and hydrogeology, as well as conventional wisdom, inform us that all water on planet earth is connected—through such natural processes as precipitation, evaporation, transpiration, condensation, and/or saturation, operating over long time horizons that eclipse even the lengthiest of anthropo-temporal measures—the present socio-economic forces that govern water allocations on individual, communal, and regional scales and the legal structures that reinforce them do not recognize water's interconnectedness let alone its interdependence from one source of water to another. This paper seeks in part to integrate surface water and groundwater sources in the

political debate over water resource management. Without such reintegration, efforts towards sustainable management of water in California will continue to fall short.

California is unique, particularly amidst the drought-stricken regions in the American west, in its recent attempts to update its groundwater management system. While California obtains water from numerous locations, primarily from within the State of California, but also from without. One of its most significant sources—one that is so heavily relied upon and ironically so poorly managed—is groundwater. Indeed, groundwater is so critical to California's water supply that it is used to meet approximately thirty (30%) percent of the State's water demands in normal years and sixty percent (60%) or more during drier years. (Ostrom, 1990; Haugue *et al.*, 2014)

Ironically, up until September 2014, California had been the only state in United States without a comprehensive statewide groundwater management program. This new statewide legislative plan is an attempt to harmonize efforts in groundwater quality, quantity, use/withdrawal, and recharge in an efficient and effective manner. While the Sustainable Groundwater Management Act (about which a large portion of this paper is dedicated) is momentous—because groundwater legislation in California is virtually unprecedented (the last laws explicitly about groundwater management having been passed nearly one hundred years ago)—its task is monumental, and its anticipated effectiveness is questionable at best. Not only must it attempt to manage a rapidly depleting resource, it has the unenviable task of elevating legal treatment of groundwater management to the level of hydrology and hydrogeology's scientific certainty, all without upsetting existing groundwater pumping and use rights that have already been allocated (and, as stated above, which have been allocated separately from surface water use rights, thereby putting additional strain on an already limited resource). To date, these allocations total four hundred billion cubic meters of water, equivalent to five times California's mean annual runoff accounting for nearly one thousand

(1000%) percent of natural surface water supplies, with the greatest degree of appropriation observed in Sacramento River and San Joaquin River tributaries and in Southern California coastal streams. (Grantham and Viers, 2014).

This paper further shows that California policy makers lack the data and tools necessary to craft appropriate stratagems for managing fairly and intelligently rights to such a scarce and valuable resource as groundwater. The historical record of attempts by the California Legislature to manage water resources in general is notably lackluster due to the Legislature's inability and/or unwillingness to uproot existing water use rights. It is only through such state powers as eminent domain (justly compensating the rights holders so as not to violate Constitutionally protected property rights) that real change to water resource management can be achieved.

However, the unbridled use of eminent domain by the state to obtain ownership over water rights is not an end, but rather a means to achieving meaningful resource management. Today, with the benefit of sophisticated technologies and the application of those technologies to hydrogeology, the state can strategically determine which rights to inversely condemn[1] in order that policy-makers can craft better-informed laws and regulations to promote resource maximization and use-fairness.

The topic of water resource management, specifically with respect to groundwater, is especially important because California is experiencing one of the worst droughts in its recorded history.[2] And while many parts of the State are experiencing the adverse effects of extreme water rationing, Southern California has felt very few of them. (Caughey and Caughey, 1977; Keffer, 1934;

[1] Inverse condemnation is a legal term of art, often used instead of eminent domain. For the purpose of this paper, inverse condemnation and eminent domain are synonymous.

[2] Cautious optimism suggests that the recent emergence of El Nino may reduce some of the strain on California's clean water resources. However, the much needed rain and snow of late has done little to alter maps of drought conditions leaving nearly two-thirds of the state still in the worst two categories of drought. Experts project that this current drought, built up over several years due in part to hotter temperatures from global warming, will require many more rainstorms and more than a single winter to stabilize California's water situation.

Mayo, 1933).[3] As a result, use practices in places like Los Angeles are changing very slowly. Groundwater use has not declined to combat the drought. On the contrary, people are extracting groundwater at a much higher rate, putting even greater strain on the limited resource. No legislation, regulation or informal cajoling thus far has changed these behaviors fast enough to have any meaningful effect.

Beyond access to water, groundwater withdrawal brings a host of geological issues, not the least of which is land subsidence. As more water is removed from groundwater basins, air fills the negative space, reducing the land's ability to support any weight upon it. Subsidence has tremendous implications for the integrity of manmade structures built atop groundwater basins, especially in areas riddled with earthquakes and porosity of poorly compacted substrate that sits beneath foundations made of rebar reinforced concrete, for fear that the land undergirding the structures might subside.

Further, the impacts that groundwater pumping has on surface water ecosystems are generally under-recognized in California, yet they also generate significant conflict. For example, groundwater-dependent ecosystems and species—terrestrial, aquatic, and coastal ecosystems and species that require access to, replenishment or benefit from, or otherwise rely on subsurface stores

[3] The means by which Southern California acquired sufficient water were crucial first to enhance its industrial agricultural complex and later to support its rapidly growing suburban population. Appropriation of water rights from the Owens Valley in central California and the construction of its aqueduct served as Southern California's lifeblood, particularly in Los Angeles and its northern suburb known as the San Fernando Valley. William Mulholland, a skilled engineer, developer, land speculator, and chief of the Los Angeles Water Department under Mayor Fred Eaton, completed the aqueduct in 1910. "In 1905 Los Angeles made a start on the stupendous task of bringing water from the Owens [V]alley in the High Sierras over mountains and deserts in a great aqueduct, a distance of two hundred and fifty miles. Morrow Mayo, author of *Los Angeles* (1933) explains that, "all that is necessary to give Owens Valley twice as much water as it was getting [from the High Sierras], and Los Angeles twice as much as it has ever received from its aqueduct, was to build a storage reservoir [in Long Valley] above Owens Valley. But the San Fernando land-grabbers and the politicians of the Water Department, whom they controlled, had no time to waste on such a public project. The city…simply announced that it was going to stick an aqueduct into the Owens River and divert *all* that life-giving water to Los Angeles, two hundred and fifty miles away." Another equally controversial, albeit less publicized, water procurement endeavor included the appropriation of water from the Colorado River.

of water to function or persist—are suffering the consequences of reduced groundwater availability as well. Examples of several of these negative impacts of groundwater pumping are presented in Figure 1 below.

Additionally, impacts of pumping groundwater have given rise to conflicts (legal or otherwise) over groundwater use. These conflicts are exacerbated by the lack of meaningful data that can be analyzed to help resolve the conflicts.

Lastly, cities and dense urban centers are some of the primary purchasers of surface water because the operating common law doctrine of prior appropriation (discussed in greater detail below) allows them to lay claim to water that is not adjacent to the city boundaries. Groundwater hydrogeological connectivity to surface water, coupled with limited groundwater regulation and resource scarcity, incites groundwater pumpers to extract more water than they need, putting an even greater strain on the limited resource. As a result, urban centers will likely suffer the most from droughts and fear of drought.

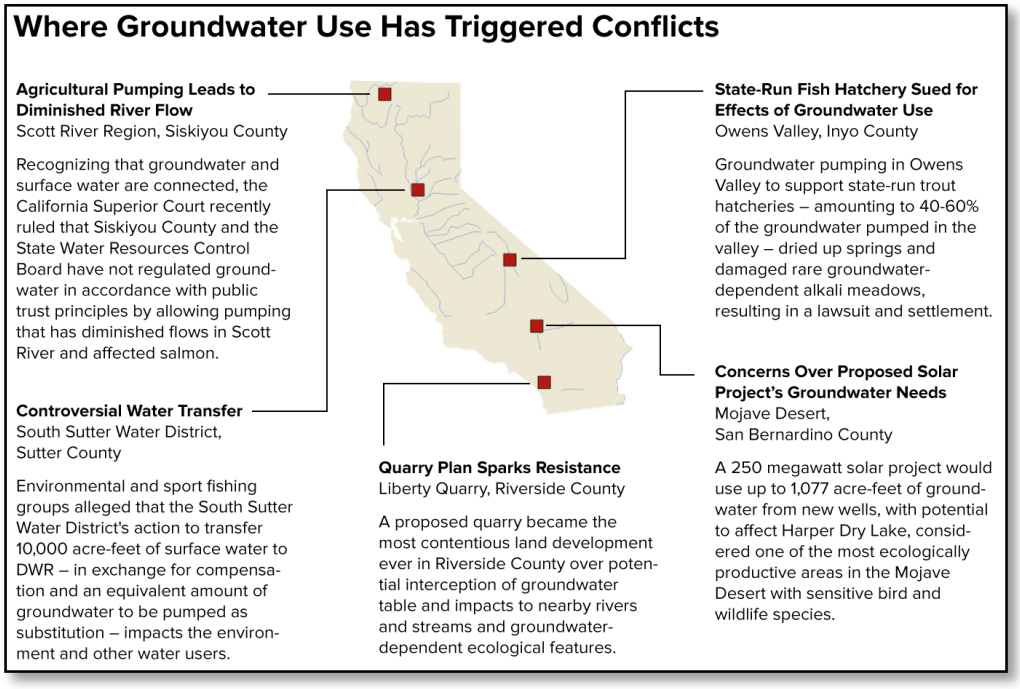

Figure 1: Map of Several Negative Impacts of Groundwater Pumping on Surface Waters, Ecosystems, and Surface Water Rights Holders. **Source:** Nelson. (2011). Groundwater Data: California's Missing Metrics. *Water in the West: Understanding California's Groundwater.* http://waterinthewest.stanford.edu/groundwater/conflicts/index.html.

CHAPTER 1: WHAT IS THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT?

On September 16, 2014, Governor Edmund G. "Jerry" Brown of California signed into law a three-bill legislative package: AB 1739 (Dickinson), SB 1168 (Pavley), and SB 1319 (Pavley).[4, 5] On January 1, 2015, that package, the building blocks of the Sustainable Groundwater Management Act, took effect, marking what appeared to be a milestone in California groundwater management. (CA.gov, 2015).[6] The SGMA purports to instigate "management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results." (California Water Code § 10721(u)). The SGMA lays out a process and a timeline for local authorities to achieve sustainable management of groundwater basins, by placing

[4] Opponents to the SGMA, including California State Senators Jean Fuller (R-Bakersfield) and Tom Berryhill (R-Stanislaus), said more time was needed to craft certain provisions of the bill, particularly those defining which basins would require greater oversight. Additionally, some opponents were fearful that the SGMA gave too much power to the state in overseeing management of basins and that a better program would devolve the responsibilities to local and regional agencies better versed in the idiosyncrasies of their water basins.

[5] The key provisions of the SGMA were based on extensive consultations and input from various relevant parties. The Association of California Water Agencies (ACWA), its member agencies, and other stakeholders provided extensive input on the legislation in April 2014. The three bills were largely based on recommendations by both the ACWA's Groundwater Task Force by the California Water Foundation. Senate Bill 1168 and Assembly Bill 1739—which were identical during an earlier iteration—were amended to distribute key provisions of the legislation between the two measures. However, the net result is the same because the two measures had to be enacted simultaneously. Specifically, Senate Bill 1168 included provisions related to establishing groundwater sustainability agencies (GSAs) and adopting groundwater sustainability plans, while Assembly Bill 1739 included complementary provisions related to implementation tools and enforcement authorities at the state and local levels. Senate Bill 1168 articulated the policy of the state's sustainable management of all groundwater basins for multiple economic, social and environmental benefits and that such management would be best achieved locally based on best available science. It also established phased requirements for high and medium priority basins to adopt groundwater sustainability plans, depending on whether a basin is in Critical Overdraft. It required adoption of groundwater sustainability plans by Jan. 31, 2020, for all high or medium priority basins in overdraft condition and by Jan. 31, 2022 for all other high and medium priority basins unless legally adjudicated or otherwise managed sustainably. Senate Bill 1168 also included language regarding basin boundary adjustments, requirements and authorities for establishing groundwater sustainability agencies, and required plan components. Assembly Bill 1739 included provisions related to coordination among local land use and groundwater management agencies, as well as provisions related to technical assistance from the Cal. Dept. of Water Resources ("DWR"), financial and enforcement authorities for groundwater sustainability agencies, and provisions related to the State's role. Senate Bill 1319 included amendments to address issues such as probationary basins and interim plans.

[6] In September 2015, Governor Brown signed Senate Bill 13 (Pavley), which made various technical, clarifying changes to the SGMA including requirements for groundwater sustainability agency formation, the process for State Water Board intervention if no responsible agency is specified for a basin, guidelines for high- and medium-priority basins, and participation of mutual water companies in a groundwater sustainability agency.

them into priority level categories and empowering agencies to act based on priority designation.[7] It also attempts to provide tools, endow authority, establish deadlines necessary to achieve sustainable groundwater management goals, and instill within the local public consciousness the importance of conserving those resources. The Act does this, however, without offering specific enforcement mechanisms and without the authority to alter existing groundwater or surface water rights.

While some proponents of the SGMA were, and continue to be, optimistic about its potential for local, coordinated, and meaningful sustainable groundwater management, other advocates are concerned that the law does too little to deter wasteful, uneconomical groundwater pumping practices, particularly in industrial agriculture, while others still—particularly farmers in the Central Valley—lambast the bill for undercutting how the lifeblood of California's politically, economically, and biologically fecund agricultural sector. (California Water Alliance). Whether condoned or condemned, the SGMA portends to offer new opportunities in the State for preserving a vital natural resource, especially in light of the current historic drought and unprecedented climate change. Unfortunately, the SGMA will likely fall short of its ambitious goals because, without the authority to upset exiting groundwater allocations, the status quo will not change.

For a full discussion of the SGMA and its specific provisions, refer to Appendix B.

CHAPTER 2: LITERATURE REVIEW

A. COMMONS PROPERTY AND THE TRAGEDY OF THE COMMONS

Just as water is a clear example of a common-pool resource, so too is the extraction of freshwater from groundwater aquifers without regard for replenishment a stark example of the commons tragedy—where consumers of natural resources consider only their immediate loss and/or gain, and not the accumulated effects of their actions borne by society, leading to an

[7] *Infra*, note 37.

inescapable exhaustion of resources. Before examining the tragedy of the commons as it pertains to groundwater, some context is necessary.

Nelson (1948), Demsetz (1967), and Block (2011) collectively distinguish among four specific types of property: (1) privately owned, (2) government owned, (3) state regulated and controlled ostensibly private property, and (4) commons. With respect to privately owned property, the exclusive right to control economic goods borne out of the property rests with an individual or a small group of individuals who possess ownership and control rights over the property. Government owned property is held and stewarded by the government for the use of all citizens. The more property is owned by the government, the closer the society in which it is situated resembles Marxist socialism. (Block, 2011). State regulation and control of ostensibly private property is the model that most closely resembles America's economic control over people's use of their property. Brought to its ultimate extreme, such a model would yield economic fascism.

The fourth type of property—common property—is unlike the previous three in that it is an economic object whose use is shared equally by all members of society, but whose responsibility to maintain it is not held by any member of society. Conceptually, a body that regulates use over an economic good in the commons, even if that body claims to equally represent all people equally, effectively limits individualized use of that property, making it inherently unequal. Therein lies the problem: commons property is difficult to maintain when everyone can take from it but none are obligated to put anything back into it.

Like private property, common property has played an important role in American social development. Until about 1890, Manifest Destiny and the lure of the western frontier fueled wilderness exploration for the sake of territorial expansion and the pursuit of personal wealth. This conception of environmental infinitude yielded natural resource exploitation and wastefulness.

(Nelson, 1948). Once the limits of the frontier were reached with the discovery of the Pacific Ocean, towns were quickly subdivided into private and public land tracts, leaving vast areas of countryside to be designated for equal use by all citizens. Despite the frontier's closure, however, the perception of endless resources persisted, particularly in the commons. Inevitably, as America's population has grown and mortality rates have dropped due to improvements in medicine and hygiene, the commons has rapidly shrunk, providing fewer resources for an increasing number of people.

Since Garret Hardin's seminal article in *Science* (1968), the expression "the tragedy of the commons" has come to symbolize the degradation of the environment whenever many individuals use a scarce resource in common. To illustrate this, Hardin describes a cattle-grazing pasture "open to all" herdsmen and then examines the structure of this situation from the perspective of an individually motivated, economically rational herder:

> "Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons…As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less conspicuously, he asks 'What is the utility *to me* of adding one more animal to my herd?' This utility has one negative and one positive component: (1) The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1; (2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of -1." (Hardin, 1968).

The tragedy of the commons is characterized both in the loss of commons land as well as the overexploitation of resources within those commons. As Hardin's hypothetical explains, each herder receives a *direct* benefit from his own animals and suffers *deferred* costs from the deterioration of the commons when his/her and others' cattle overgraze. Each herder is motivated to add more and more animals because he receives the direct benefit of his own animals and bears only a share of the costs resulting from overgrazing. Hardin concludes:

> "Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit — in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interests in a society that believes in the freedom of the commons." (Hardin, 1968: 1,244).

Hardin was not the first to sound the death knell for commons resources that lack private or governmental oversight. More than a decade before Hardin's article, H. Scott Gordon (1954) described the same dynamic:

> "There appears then, to be some truth in the conservative dictum that everybody's property is nobody's property. Wealth that is free for all is valued by no one because he who is foolhardy to wait for its proper time of use will find that it has been taken by another…The fish in the sea are valueless to the fisherman, because there is no assurance that they will be there for him tomorrow if they are left behind today." (Gordon, 1954: 124, *cited in* Ostrom, 1990).

Contemporaneously with Garrett Hardin, John H. Dales (1968: 62) noted similar phenomena:

> "Standard analyses in modern resource economics conclude that, where a number of users have access to a common-pool resource, the total of resource units withdrawn from the resource will be greater than the optimal economic level of withdrawal." (Clark, 1976; Clark 1980; Dasgupta and Heal, 1979).

While widely adaptable in some instances, Garrett Hardin's work and its progeny suggest that individuals will always act in their own rational, economic self-interest, and always at the expense of the collective, *i.e.* the optimal resource yield for the group rather than the individual.

Related to the tragedy of the commons, the prisoner's dilemma and the logic of collective action have defined the accepted way of viewing many problems that individuals—rational, economic, self-interested individuals—face when attempting to achieve collective benefits. The prisoner's dilemma demonstrates how two completely rational individuals might not cooperate, even when it is in their best interests to do so. Formalized in the game with prison sentence rewards, the prisoner's dilemma is as follows:

> Two criminals are arrested and imprisoned. Each prisoner is held in solitary confinement and with no means of communicating with the other. The prosecutor lacks sufficient evidence to convict the pair on the principal, more severe, charge that carries a three-year

> sentence. In an attempt to get both criminals sentenced, the prosecutor offers each prisoner a bargain wherein each prisoner can either betray the other, by testifying that the other committed the principal crime, or not betray the other and instead remain silent. The prisoners will have no opportunity to reward or punish their partner other than the prison sentences they receive, and each prisoner's decision will not affect his/her reputation in the future. The outcomes of this dilemma are as follows:
>
> > (1) If A and B each betrays the other, each of them serves two years in prison;
> > (2) If A betrays B but B remains silent, A will be set free and B will serve three years in prison (and vice versa); or
> > (3) If A and B both remain silent, both of them will only serve one year in prison (on the lesser charge)

Because a purely rational, self-interested prisoner receives a greater reward (freedom) by betraying the other prisoner than he otherwise would by remaining silent, all rational, self-interested prisoners would betray the other. Thus, the only possible outcome for two purely rational, economic, self-interested prisoners is for them to betray each other. This result leads both of the prisoners to betray and get two years in prison apiece, even though each would fair better if they both kept silent, resulting in only one-year prison sentences for each spanning one year.

Early collective action theory similarly posited that unless the number of individuals is quite small, or unless there is coercion or some other special device to make individuals act in common interest, rational, self-interested individuals will not act to achieve their common or group interests. (Olson, 1965: 2, *cited in* Ostrom, 1990).

Collateral to the tragedy of the commons and the logic of early collective action are two main principles: (1) that *private* gain from consumption of commons resources is great while *public* costs to individuals therefrom are low, thereby creating a problem of inherently unequal distribution of cost and benefit; and (2) negative externalities. Of unequal distribution of public costs and individual gains, consumers of commons resources invariably do cost benefit analyses ("BCA") that focus on their individual financial inputs and outputs. As Hardin (1968) noted, when the positive utility to an individual of an additional unit of commons resource use is +1 and the negative utility

(or cost) to the individual of that same additional unit is -1 divided by the number of resource consumers, the benefit to the individual clearly outweighs the costs on individual ledgers. But the costs to the community, when added together, are much greater in the long term because the commons resources are consumed faster than they are replenished, resulting in eventual depletion.

Moreover, this paradigm, where an individual cannot be excluded from the benefit that others provide, each rational and economically self-interested person is motivated not to contribute to the joint effort and instead free-rides on the efforts of others. (Baumol, 1952). In other words, free riders do not agree to subordinate their individual use practices in favor of a resource management and allocation system that will yield greater collective benefits. The more participants who free-ride, the faster the collective benefit is exhausted. Thus, if the temptation to free-ride dominates, all will end up without any commons from which to exploit at a much faster rate. Alternatively, if some overcome the temptation to free-ride, the result will be a less than optimal level of provision for the collective benefit, *i.e.* creating an inequitable arrangement where the costs of production for all fall on the few.

Of negative externalities, rational, self-interested consumers exhaust resources, creating negative and positive consequences, the costs of which are borne by parties other than the people consuming the resources. The practice of externalizing costs from overharvesting finite resources shifts the burden of limited resources to those who lack the resource now and to future generations.

However, studies on game theory and collective action prove that people display a systemic bias towards cooperative behavior, much more so than predicted by simple models of rational, self-interested action championed by Hardin's formulation of the commons tragedy as well as by early iterations of the prisoner's dilemma and collective action. Indeed, more recent models that allow for the introduction of information from sources external to the game help individuals make resource-

optimizing forecasts and better predict the ways in which people make decisions, principally by forming coalitions, *i.e.* cooperatives where people share labor, knowledge, and protection. (Fehr and Fischbacher, 2003: 785–791; Ahn, Ostrom, and Walker, 2002: 3-4).

Bolstered in part by empirical studies of groundwater monitoring wells in the Los Angeles metropolitan area, Ostrom (1965, 1990), and later Blomquist (1987a), observes that neither the state nor the market is uniformly successful in enabling individuals to sustain long-term, productive use of natural resource systems. Instead, Ostrom argues that people, armed with information derived from sources external to their own capitalistic urges, act instead for the benefit of the collective and make decisions whose ramifications are expressed over longer time horizons than they would otherwise be without that external information. (Ostrom, 1990: xiv, 60, 104; Aladjem and Sunding, 2015: 29)). Indeed, collective action solutions in Ostrom's view are more easily implemented when resources are plentiful and more necessary when resources are scarce because, when resources are fallow, individual use behaviors become much more difficult to regulate.[8]

However, there are those who do not subscribe to Ostrom's belief in collective action as the superior method to alleviating the commons tragedy. Block (2011) criticizes Ostrom's inclination away from private property rights as the solution to the commons tragedy and towards collective action because Ostrom fails to account for market-based mechanisms of communal cooperation such as partnerships and legally binding contractual agreements. In Block's estimation, collective action and laissez faire capitalism need not be mutually exclusive because the latter embodies the

[8] The successful management of common-pool resources ("CPR"), according to Ostrom, share a number of characteristics: (1) clearly defined boundaries, both in area and in participants; (2) rules that are tailored to local circumstances; (3) local governance; (4) active monitoring for compliance with adopted rules; (5) graduated sanctions for violations of those rules; (6) conflict resolution mechanisms within the institution; and (7) support for local institutions by external governments. Although too soon to tell whether every Groundwater Sustainability Plan ("GSP") will include all of these characteristics, these characteristics serve as the model for GSP operation and are all integrated at varying levels into the text of the SGMA.

former. (Block, 2011: 1-11). However, even Block would agree that a successful private market-managed groundwater management program requires accurate monitoring measurements and well metering, which in turn require some collective agreement to integrate rights allocations into the system. (Aladjem and Sunding, 2015: 29).

Yet Block seems to miss the larger problem of private property rights as the lynchpin of commons resource allocation. As will be discussed below, the entrenched system of constitutionally guaranteed property rights and, in the case of California's groundwater, the Legislature's unwillingness to either purchase or upend these property rights are the reasons that past and present groundwater management legislation has been ineffective. This paper both continues this dialogue between Hardin, Ostrom, and Block and offers concrete solutions to the seemingly perpetual State of deliberation in the California Legislature about groundwater management that is at best political posturing and at worst meaningless.

*B. **HYDROLOGY AND HYDROGEOLOGY***

Geography and topography play pivotal roles in the location of surface water sources and groundwater aquifers, especially amidst the backdrop of dense-urban and rural-agricultural settings. Understanding groundwater requires a concomitant understanding of geo-location of these natural resources in the American landscape. Under what overlying lands do aquifers begin and end? How much water percolates from surface fresh-water sources—rivers, lakes, and streams—into groundwater to recharge aquifers? How frequently—days, months, or years—do aquifers recharge in various environments given the variation in topsoil and surface layer composition? These questions must all be answered before economic and social value can be ascribed to particular groundwater sources. Blomquist (1992) provides an in-depth review of eight groundwater basins in Southern California, many of which contribute to Los Angeles' diverse water sources. Specifically,

the West Coast Groundwater Basin and the San Fernando Groundwater Basin provide much of the water used for urban domestic purposes. While many critics argue that California lacks adequate groundwater management, Blomquist suggests instead that California groundwater management exists, albeit in forms that are haphazard and predominantly local. (Blomquist, 1992). Thus, it is clear that an evaluation of groundwater regulation will help us better understand how local agencies, courts, and citizens have applied (or disregarded) the law with respect to groundwater withdrawals.

Smith (1989) and Mount (1995) further this discussion, providing geographical context to water sources in California at state and local levels. They explore land use management and environmental conservation practices in the American West. Smith organizes his analysis state-by-state, focusing on nineteen states in all. His analysis is crucial to the overall understanding of groundwater sources because most sources traverse traditional political boundaries—states, regions, counties, cities—making the overall regulation and implementation of a single coherent regulatory system virtually impossible without cooperation among the various entities affected – a doubtful proposition at best. Mount offers greater insight into the particularities of hydrology and hydrogeology: How does water percolate? How does gravity affect surface water and groundwater flows in three dimensions? How does private land ownership affect fluvial processes? In answering these questions, Mount focuses primarily on the rivers and lakes of California, which are hydrogeologically connected to groundwater sources in a variety of ways.

Todd (1959) focuses on the technical aspects of groundwater hydrology. A civil engineer by training, Todd explores natural phenomena by analyzing data from the U.S. Geological Survey, as well as data collected from various state water resource agencies. Schumm ed. (1972) looks at the science of river morphology, examining from the propensity for surface water to percolate into the

surrounding soil and waterbeds into the bedrock. Together, these two scholars explicate the nature of water and how legal categorization does not accurately reflect the true nature of water's existence.

C. WATER AS PROPERTY RIGHT OR HUMAN RIGHT

The global debate over water access as a right to all humans has recently begun to incorporate the notion of water as a property right because granting of transferable water property rights to all individuals is touted as the best way to accomplish the material and political goals of satisfying the human right to water, especially in light of global resource scarcity. In general, the material goals of preserving the human right to water center on securing adequate water for the life and livelihoods of all, and especially for individuals either presently without, or on a trajectory to be deprived of, water. (Gleick, 1998). However, in view of large-scale uncertainties surrounding human impacts on the global water cycle, it is not clear how individual human rights should be scaled (if at all) to complex systems. (Vörösmarty *et al.*, 2004; Milly *et al.*, 2008). This is because granting rights to fixed amounts of water carries the risk that the total water claimed under human rights may exceed what is ecologically sustainable and/or actually available.

Advocates of the human right to water model frequently argue for collective action or governance under the paradigm of the commons tragedy (to be discussed in greater detail below) in order to counter the individualist tenets of property rights or variants of liberalism more broadly. Yet, as some scholars argue, articulating the human right to water in terms of the commons does not, of itself, eliminate the potential for privatization of water services. (Bakker, 2012). Some have questioned the strategy of linking human development, common resources, and environmental sustainability to broader structural processes and forces—political, economic, and cultural—because in many cases economic success is premised on "acceptable" tradeoffs with ecological destruction; tradeoffs that are typically ambiguous and often shuttered from contestation. (Johnston, 2013).

Nevertheless, advocates for the human right to water model gain considerable political and moral purchase from appeals to the commons. Such solutions are sometimes imposed through laws and/or regulations that determine, at least to some extent, how scarce resources are to be used and conserved. While true that such purchase is more easily achieved when commons resources are fecund, when fallow, the need for collective action to oppose privatization and reduce tradeoffs with economic forces is that much greater.

D. WATER USE FOR THE "AMENITY COMMODITY" OF SUBURBAN LAWN CARE

Urban and suburban lawn care, e.g. manicured lawns, flowering annuals and perennials, trimmed trees, sculpted bushes, etc., are vestiges of pastoral ideals championed by early American philosophers such as Thomas Jefferson (1782). In his writings, Jefferson envisions an idealized pastoral American lifestyle devoid of the seductive encroachment of technological advancements that would threaten the integrity of his idyllic concept.

Jefferson's vision, itself a reformulated model of European naturalism, was very popular and inspired land-owning males to till their land with the hopes that physical labor would translate into spiritual purification as well. (Jefferson, 1782). However, Jefferson's vision was doomed from its inception because it did not take into account the fact that most people even in his generation were not landed gentry, but rather slaves and indentured servants. At most, his vision was reserved for white privilege, an ultimately unattainable ideal for the incipient U.S. population.

As the Country's population grew, so too did its need for housing. This reduced the amount of land available for individual agricultural cultivation. Additionally, industrial agricultural practices over time reduced the need for individual farms and eroded the need for subsistence farming. These industrial agricultural complexes could and would supply enough food to urban dwellers who maintained specialized skillsets that they could exploit in exchange for foodstuffs.

In each generation, the thing that exists is supplanted by the thing people do not understand, and therefore fear. Just as American highways did unto railways what the latter had done unto waterways, modern construction technologies made tasks easier to complete, and thus, succeeded. The luxuries that these technologies afforded the burgeoning American middle class was cause for concern for those who cherished agrarian values of hard work, morality, and divine deference.

With little resistance, aggressive appropriation of natural resources for commercial purposes supplanted the desire to collect, preserve, catalogue, and display exotic natural specimens. (Hughes, 2004). Consequently, the American appreciation for the natural world was supplanted by commercialism, expediency, and mechanization. But the desire to maintain a pastoral area for one's own use and enjoyment endured in the American psyche. Indeed, the desire for immediately accessible green-spaces has in large part catalyzed a major land use demand in modern urban and suburban life. As such, houses, apartment buildings, businesses, and other structures display lawns (often by mandate) and other natural edifices in order to create observable and enjoyable green spaces. (Robbins, 2007).[9] In order to accommodate the high demand for these features, an industry of agricultural commodities developed. (Stoll, 1998). This industry's innovation came primarily from public investment in land-grant universities, including UCLA, that developed chemical fertilizers, insecticides, pesticides, and gardening tools. Ironically, modern lawn agriculture, the vestigial remnant of the Jeffersonian pastoral idyll, is not removed from the modern economy as Jefferson espoused, but rather intrinsically intertwined in it.

[9] Robbins's central concern is to understand how middle-class American "lawn people" do not act in compliance with their environmental awareness without portraying them as dupes or lemmings. To do this, he draws on Althusser's concept of interpellation, arguing that the private Ideological State Apparatuses (ISAs) and public Repressive State Apparatuses (RSAs) constitute and spread the dominant ideology of lawn care through the process of "hailing" at them in social interactions (the lawn hails the subject). This claim is bolstered by ethnographic interviews that show how all residents of Kingsbury Court felt compelled to keep their lawns up with the necessary chemicals for the collective, community good.

The implications of perpetuating the American ethos of lawn care by (over)harvesting groundwater resources cannot be overstated because cities, counties, and other regional governments rely heavily on groundwater for public supply,[10] and because much of the public supply is allocated to landscape maintenance.

E. ***PSYCHOLOGY OF SCARCITY***

Psychologist have recently begun to explore the psychological underpinnings of human decision-making amidst resource scarcity. These scholars espouse the notion that as people become limited in a particular resource, they tend to make unwise and inefficient decisions with respect to that resource. These bad decisions typically take the form of short-terms rewards with long-term detriments. The millennial generation's need for instant gratification due to technological innovations and other developments notwithstanding, Americans, when faced with impending or imminent loss, develop a scarcity mindset that consumes mental bandwidth—brainpower that would otherwise be devoted to fore-planning and problem-solving. (Mani *et al.*, 2013). This mental "tunneling" causes the brain to mis-allocate parts of the brain that are critical to improved problem-solving and analysis, thereby exacerbating the cognitive dissonance with respect to resource scarcity.

While there is a tremendous amount of literature showing that poor people do not perform as well in many of the common metrics that Americans use to quantitatively evaluate their lives and the successes or failures therein,[11] there is less literature on the effect of fear of scarcity. While there have been some important studies on survivors (and their offspring) of horrible atrocities, such as

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[10] *Supra,* page 6.

[11] These studies demonstrate that the poor are often less attentive parents than those who have more money, are worse at adhering to their medication regimens than the materially wealthy, and are less conscientious about efficient labor than their successful counterparts in similar fields, such as poor farmers who weed their fields less well than those who are less poor. Some of this is due to asymmetrical access to information on best practices. The rest, these studies argue, is due to the psychology of scarcity.

the Holocaust, concluding that those who survived were predisposed to neurotic, eccentric, and paranoid thinking, there have been fewer studies on those with resources who fear their loss.

Given this logic, it is not difficult to conclude that in drought-stricken California, water scarcity, and the fear of water scarcity, unduly increases groundwater pumping by those who depend upon it more. Holders of these rights act in their own self-interests in the pursuit of obtaining and storing the amount of water they deem necessary to satisfy their individual needs, whether it be for domestic use or small agriculture. This self-centered use adversely affects not only the amount of water available in the groundwater basins, but also the amount of water available in surface water sources because of the hydrological connectivity between the two.

After having examined the content of the SGMA itself and the seminal literature on resource scarcity with the particular emphasis on groundwater, we must now examine two primary questions surrounding the origins of the Act: (1) What motivated the California Legislature to take up the issue of groundwater management in 2014? and (2) Why has California not effectively addressed the issue of groundwater resource management prior to 2014? The subject of the first question will be explored in Chapter 3 of this paper. The subject of the second question will be explored in Chapter 5 of this paper, after an intermediary discussion of the legal and historical context surrounding groundwater rights in American jurisprudence.

CHAPTER 3: WHY NOW?

According to the legislative intent language in SB 1168, AB 1739 and SB 1319, these bills were placed on the respective Legislative House agendas in the 2014 calendar for five main reasons. First, California maintains a significant reliance on groundwater to meet its water needs, to a degree that is greater than any other state in the union, according to Governor Jerry Brown. (League of California Cities, 2014). Specifically, groundwater accounts for more than one-third (1/3) of the

water used by Californians in an average year and more than one-half (1/2) of the water used by Californians in a drought year when other sources, such as snow pack melt, are unavailable. (Sustainable Groundwater Management Act (Draft), 2014). The urgency of the matter was highlighted in both a UC Davis study from July 2014 and a UCLA Report from March 2015, noting that seventy-five (75%) percent of the shortfall in California's precipitation shortfall is being made up by groundwater withdrawals, which is far more than the entire State Water Project delivers in an average year. (Cal. Dept. of Water Resources, 2015; McCann, 2015; Howitt *et al.*, 2014).[12] To illustrate the severity of this problem, the State Water Project—which contains thirty-four (34) storage facilities, reservoirs and lakes; twenty (20) pumping plants; four pumping-generating plants; five (5) hydroelectric power plants; and nearly seven hundred (700) miles of open canals and pipelines—provides supplemental water to approximately twenty-five (25) million Californians and 750,000 acres of irrigated farmland. (Cal. Dept. of Water Resources, 2015). Nearly sixty-five (65%) percent of California's water supply has been estimated to come from underground sources, and well drilling has increased in all regions of the state over the past three years of drought. (Peel and Choy, 2014).

Second, Californians feel a sense of entitlement towards state and federally guaranteed rights to the domain and control over their individual property.[13] These protections have been interpreted

[12] On January 15, 2015, the Cal. Dept. of Water Resources ("DWR") announced to its contractors for the State Water Project ("SWP") that it would be increasing its water allocations from 418,520 acre-feet to 635,759 acre-feet, not only because of increased demand, but also because of late 2014 precipitation events (from light rain to flash flooding) that slightly increased the SWP reserves.

[13] The Founding Fathers and authors of the United States Constitution were extremely concerned about property rights. A man's home is his castle. The Federal Constitution and Bill of Rights protect individual property rights in many ways: First, at the inception of the nation, the Founders were concerned that Congress might use federal taxes to loot property in some states for the benefit and advantage of other states. Accordingly Article I, Section 2, Clause 3 and Article I, Section 9, Clause 4, require that direct taxes, most notably property and income taxes, be apportioned *among* the states. Second, the Constitution requires that indirect taxes, such as import duties, be levied uniformly. Most notably, the Constitution denies Congress the power to tax exports. Third, the Constitution empowers Congress to protect intellectual property by authorizing copyright and patent laws, as well as to punish piracy. Fourth, the Third Amendment, which largely prevents the government from quartering troops in private homes. Fifth, the Fourth

to include water rights. In order to respect and enforce the reasonable and economic use of both the overlying property rights as well as the surface and underground water rights, rights-holders are now required to submit to sustainable groundwater management planning, which will help mitigate and ultimately eliminate usurpation, theft, and waste.[14] However, as stated above and reiterated below, the mechanisms for enforcing these limitations on water rights are yet to be established.

Third, excessive groundwater extraction can cause overdraft, failing wells, deterioration of water quality, seawater intrusion, environmental damage, and irreversible land subsidence that damages *Infra*structure, reduces the availability and market value of land, and diminishes the capacity of aquifers to store water for future use.[15] For example, from 2007 to 2015, land subsidence that correlates to areas with large groundwater level declines has strongly increased in two large agricultural areas (U.S. Geological Survey, 2015).

Amendment protects persons, houses, papers, and effects from unreasonable search and seizure. Sixth, the Fifth Amendment of the Constitution (1) prevents any person from being deprived of property, without due process of law, and (2) requires that the government compensate property owners when property taken for public use. The definition of *public use* has been broadened in Supreme Court cases, to include allowable inverse condemnation (eminent domain) for private property used for the *public benefit* or the *public purpose*. The Supreme Court's decision in *Kelo v. City of New London*, 545 U.S. 469 (2005) exemplifies this broadened authority whereby it authorized the City of New London, Connecticut, to take non-blighted private property by eminent domain, and then transfer it for a dollar a year to a private developer solely for the purpose of increasing municipal revenues. In this case, the Court held that transfer of private property for municipal revenue was a sufficient *public purpose*, even though the revenue did not directly affect the public. Additional Constitutional protections on property can be seen in the Full Faith and Credit Clause, which partly requires state courts to honor property records in other states, as well as the Privileges and Immunities Clause, which protects the rights of citizens doing business and owning land in other states. The Founding Fathers also gave Congress an unlimited power to dispose of public land, but in practice this is a limited power to acquire or hold land, thereby preserving the right to transact and transfer land with the private sector.

[14] I use these terms, usurpation, theft, and waste in their legal sense. Usurpation means taking another's right or property by force. Theft refers to all crimes in which a person intentionally and fraudulently takes personal property of another without permission or consent and with the intent to convert it to the taker's use (including potential sale). Waste refers any damage to real property by a lawful or unlawful occupant which lessens its value to the landlord, owner or future owner. An owner can sue for damages for waste, terminate a lease of one committing waste and/or obtain an injunction against further waste.

[15] California's development of groundwater management through the first half of the twentieth century, highly unregulated and undermanaged, has caused significant declination in groundwater levels, which threatens seawater intrusion, land subsidence, loss of potable drinking water, and significant curtailment of water available for agriculture, among other things.

Fourth, population growth projections anticipate that the current water use practices will become even less sustainable in the coming years. (Public Policy Institute of California, 2015).[16] California's present course on water conservation is not keeping pace with population growth, according to state data. (Hanak *et al.*, 2011). The present state mandate for a twenty (20) percent savings by 2020 will likely be eclipsed a decade later, resulting in a sixteen (16) percent overall increase in water consumption due in large part to population growth. (Weiser and Reese, 2015).

Lastly, it is anticipated that integrated management and regulation of the state's water resources is essential to meeting both individual and state water management goals. Indeed, when properly managed, groundwater resources will most likely help protect communities, farms, and the environment against prolonged drought as well as the effects of climate change by preserving water supplies for existing, potential, and future use. Sustainable groundwater management in California depends upon creating more opportunities for extensive conjunctive surface and groundwater resource management both because of their inextricable hydrogeological connectivity and because of the confusion generated by conflicting and competing surface and groundwater rights. Moreover, climate change and its concomitant effects will intensify the need to recalibrate and reconcile surface water and groundwater management strategies.

These five reasons—by no means an exhaustive list—emphasize that severe drought conditions, whether caused by or operating in tandem with climate change (rising temperatures at higher altitudes, shorter and milder winters, etc.) are forcing those who hold water rights to hold

[16] According to 2013 U.S. Census Bureau California Department of Finance estimates, California had slightly more than 38 million people, and was the nation's most populous state (its population is almost one and a half times that of second-place Texas, with twenty-six (26) million. By 2050, California's population is projected to reach fifty (50) million people. However, while it is clear that California experienced tremendous population growth, especially at the latter part of the twentieth century, population growth has slowed in recent decades. Specifically, over the past twenty (20) years, California has experienced its slowest rates of growth recorded and an unprecedented out-migration of residents. From 2000 to 2013, California's population grew by thirteen percent (13%), which was low for the state and barely higher than the rest of the nation (12%).

them more tightly than they would otherwise in years of plenty. Over the past few decades, increased urban demands on water from *Infra*structural development designed to accommodate rapid population growth, exacerbation of a cultural phenomenological obsession with "health" foods (such as water-intensive almonds), implementation of widespread water-intensive industrial agriculture practices by an industry lobby entrenched in California's *politerati*, and significant new environmental restrictions on the availability of surface water have all resulted in much greater groundwater use. Thus, these explanations help to answer the first question of why the California Legislature took up the issue of groundwater management in 2014, though by all accounts, they should have started earlier.

As this paper explains, the legislative discussion in the SGMA, which is encapsulated in the SGMA's operative language and in its draft language (refer to Appendix B), continues to place the burden of managing groundwater resources at the local or regional level because it is believed that local and regional governments have better understandings of regional, topographical, geological, and hydrogeological idiosyncrasies that a central government and a central plan would not. Groundwater management will not be effective unless and until local actions to sustainably manage groundwater basins and subbasins are taken.[17] However, local and regional agencies need to have the necessary support and authority to manage groundwater sustainably, which comes from the constituent agencies in joint powers agreements,[18] or directly from the state.

It is important to note that, according to the legislation, in circumstances where local groundwater management agencies cannot or will not manage groundwater sustainably, the state will

[17] *Infra*, Appendix B. What the actions are that should be taken are outlined in the SGMA itself.

[18] In general, Joint Power Agreements ("JPAs") give rise to Joint Powers Authority ("JPAs"), which are governing entities comprised of constituent governing bodies or authorities that are endowed with all of the powers of the constituent bodies. By combining their commercial efforts, JPAs can achieve economies of scale or market power. § 6502 of the California State Government Code authorizes the use of JPAs.

intervene to protect the resource, unless and until a local groundwater management agency can sustainably manage the groundwater basin or subbasin. However, as stated above, the SGMA does not bestow on the GSAs a new overriding authority to restrict private groundwater use and extraction rights; they only have the powers of their constituent agencies. Instead, the Act creates responsibilities and it is incumbent on the local and regional agencies to coordinate the use of the powers they already have to meet them.

CHAPTER 4: LEGAL AND HISTORICAL CONTEXT

Before engaging in the Southern California groundwater dialectic, some context is necessary. From the inception of its national consciousness, the United States has treated water first and foremost as a property right. As such, water use rights allocations are sacrosanct in the eyes of the law at all levels of American government—federal, state, regional, and local. The American legal system segregates water resource management and water rights allocations based on the "source" of the water in question (*i.e.* water rights can be allocated separately from surface water sources and from groundwater sources, etc.). Had the notion of water source *independence* been correct, it would have allowed the current legal system governing water rights allocations to operate efficiently, effectively, and fairly. However, hydrogeological independence is incongruous with scientifically proven natural phenomena. Thus, a critical evaluation of individuated water rights in the United States in general, and in California in particular, necessitates a concomitant assessment of the interconnectedness of water sources. Additionally, such an evaluation demonstrates that legally enforceable water rights apportioned to an individual or entity can potentially and adversely affect water users and rights-holders everywhere. Similar risks of claiming water for particular purposes has the potential to exceed what is ecologically viable or hydrogeologically sustainable.

The discussion of American water rights allocations cannot be limited to an explication of

the latest iteration of laws that attempt to govern them. Rather, such a discussion must also include an evaluation of both the political processes and governance mechanisms at play in the formation, e.g. writing, editing, etc., of such laws as well as the preceding laws that attempted to manage groundwater up to the point before the SGMA's enactment. This next section does the latter. Chapter 5 will examine the former.

A. ***LEGAL PREDECESSORS TO THE SGMA***

The reasons for examining these predecessor laws are twofold: First, it is important to know if these laws—and the enforcement or non-enforcement thereof—have impacted groundwater extraction behaviors by groundwater rights holders and water rights usurpers; and second, the groundwater and surface water rights allocations created prior to the SGMA have been grandfathered in and cannot be altered in any way. The text of the SGMA states that the California Legislature did not intend to eliminate "overlying and other proprietary rights to groundwater, consistent with § 1200 of the Water Code," but rather sought to "preserve the security of water rights in the state to the greatest extent possible consistent with the sustainable management of groundwater." (AB 1739, § 1(b)(4)). Moreover, the SGMA states that "nothing in this part or in any groundwater management plan adopted pursuant to this part, determines or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights." (AB 1739, § 10720.1(b)). Assuredly, these provisions were concessions made to influential agriculturalists who had heretofore unrestricted groundwater pumping access. Nevertheless, the water rights that existed prior to the SGMA remain extremely relevant even under the SGMA and its attempts to manage such a vital and diminishing resource.

1. THE COMMON LAW

Prior to the SGMA, the extraction and use of groundwater in California was (and in large part remains) governed by a body of common law, augmented slightly by state legislation from the turn of the twentieth century. The majority of these laws were established by judicial rulings rather than by statutes, regulations, or ordinances, the implications of which may not be readily apparent without an understanding of the Constitutional Doctrine of Separation of Powers.

a. SEPARATION OF POWERS DOCTRINE

The Constitutional Doctrine of the Separation of Powers is a concept that guided the formation of three separate branches of federal and state government in the United States: The Executive Branch, the Legislature, and the Judiciary. Guided by this Doctrine, the Constitution codifies the allocation of responsibilities between these three branches both to separate and to balance power. Of separation, each branch is endowed with authority unique to its own branch. For example, the manner in which Congress can delegate some of its mandates (so long as it does not violate the Non-Delegation Doctrine) to agencies that in turn promulgate regulations consistent with those mandates is a feature unique to the Legislative Branch. Of balance, each branch is also given certain powers to govern the conduct of the other branches. With respect to making law, the Legislative Branch has the power to create new laws, the Executive Branch has the power to enforce and execute those laws created by the Legislature, and the Judicial Branch has the power to interpret the legality of the laws created by the Legislature as well as the enforceability of the laws by the Executive Branch. This system creates checks on law making, wherein one branch's efforts to impose oppressive or unconstitutional laws on the people would be thwarted by one or both of the other branches.

However, the Doctrine of Separation of Powers operates on the assumption that the Legislature has and will continue to make new laws to account for societal needs and technological change. It does not provide for a contingency where the Legislature lies dormant. In the case of California's groundwater management, the California Legislature did just that; it sat dormant, allowing over-allocation, mismanagement, and limited accountability to run rampant. For nearly a century, the most substantial legal changes came instead from the Judiciary, in the form of groundwater basin adjudications. Taken to its extreme, this judicial legislating could conceivably be viewed as a breach of the Doctrine of Separation of Powers. The Legislature's apparent nonchalance toward groundwater management is ironic given the State's robust arsenal of environmental laws, regulations, and ordinances.[19]

b. DEVOLUTION OF RESPONSIBILITY TO LOCAL AGENCIES

Additionally, California, unlike almost all other Western states in the United States,[20] lacked a comprehensive system for groundwater management. Instead, California's Pre-SGMA Groundwater management efforts placed the onus on local agencies to develop plans for preliminary information gathering,[21] requiring nothing beyond the tedious procedural requirement of collecting data, a task which both local agencies performed and state overseers enforced poorly.[22] Farmers, agriculturalists, and other groundwater users pumped groundwater virtually "at will"

[19] For example, since the Clean Air Act's inception in 1970, the U.S. EPA has approved more than fifty CAA waivers for California to implement more stringent vehicle emissions rules.

[20] *E.g.* Arizona was required to develop a comprehensive groundwater management plan before the federal government would authorize its participation in the State's water project.

[21] See Assembly Bill 3030, signed into law in 1992 and modified in 2002 by Senate Bill 1938.

[22] While some data sources exist, most data sources, if they exist at all, are spotty, inconsistent, and do not span more than thirty years of monitoring. In addition, the number of monitoring wells (approximately 1,200 active wells) from which to collect data is much greater than the number of groundwater wells in place to extract groundwater. Should these two efforts be harmonized, a mechanism would need to be installed at each well to monitor both the amount of water being pulled out by the well and to measure the declination of aquifer water depth from which the water is extracted.

without any governmental circumscription, approvals, or permitting requirements. In return, these agricultural interest groups have helped reelect many California State Senators and Assembly people.

c. LEGISLATING FROM THE BENCH: GROUNDWATER BASIN ADJUDICATIONS

California's historical groundwater use through the twentieth century caused significant groundwater level declination and threatened seawater intrusion. In the absence of comprehensive state and local groundwater management laws and in response to receding groundwater levels, many governing bodies began to assert their rights to the groundwater basins over which they sat and from which they pulled water at the exclusion of others in similar positions. In order to resolve these disputes, individuals and governing bodies turned to the judiciary for guidance. In the early 1960s, the Central and West Coast Groundwater Basins in Los Angeles County were adjudicated. (Reichard *et al.*, 2003).

The adjudications resulted in the creation of polycentric governance structures to oversee Basin management. For the West Basin in particular, major decisions were made by water users, courts, the Southern District office of the Cal. Dept. of Water Resources, the West Basin Water Replenishment District, the Municipal Water District, the Central Basin Water Association, the Los Angeles County Sanitation Districts, and the County Department of Public Works. The San Gabriel River Water Master governs the Central Basin in large part. (Blomquist, 1992).

As a result of these adjudications, water rights holders in Los Angeles County had to stipulate extreme curtailment of personal domestic water use of both surface water and groundwater sources. (Blomquist, 1992). While some local water agencies adopted groundwater management plans to promote good management practices, monitor groundwater levels, and implement voluntary programs to better manage their basins, (Haugue *et al.*, 2014), their efforts were thwarted by the lack of authorization in the California Water Code to manage groundwater in a holistic and

comprehensive manner. Instead, the California Legislature created nine groundwater management agencies to pass groundwater extraction ordinances (Cal. Dept. of Water Resources, 2011). While the Legislature's justification for establishing so many local agencies was to cater to the regional idiosyncrasies under their purview, the unintended consequence is comparable to the historical fallacy that regulates different water sources separately.[23] These agencies, controlled by court-appointed Water Masters, whose help determines how much water can be extracted by the parties [to each court decision, while extensive in some places, are not comprehensive enough to have a system-wide, meaningful effect on water source management. Moreover, these Water Masters and adjudications are limited by existing common law water doctrines operating in each jurisdiction and by the water allocations grandfathered into the system.

B. THROUGH HELL OR HIGH WATER: SOUTHERN CALIFORNIA'S POST-WAR SUBURBANIZATION

In a semiarid region such as Los Angeles, groundwater basins are extremely valuable when used in conjunction with surface supply systems. These freshwater sources are put under tremendous strain when viewed in light of social, political, and technological shifts occurring at the national and regional levels.

In the post-WWII period, the United States experienced a population surge and with it a growing appeal for suburban development. The early progression of American cities, uninhibited by governmental restriction or legislative prohibition, radically shifted to a system where federal, regional, and local governments actively facilitated the growth of American suburbs, primarily in the Sunbelt, through endorsement of automobiles as the dominant mode of transportation. This

[23] *Infra*, page 31.

financial and legislative support, which necessitated resource reallocation from the inner cities in the Rustbelt and hastened urban decline, continued into the 1970s and '80s.

In the 1950s, road, highway, and bridge construction began to accommodate exponentially increasing automobile ridership. However, as Dolores Hayden explains, this "massive program of road building…[was] orchestrated by both official and unofficial lobbyists for automobile interests who had worked towards these ends for years." (Hayden, 2003). The proliferation of automobiles combined with the relative affordability of building materials, and mass production methods for housing construction, led governmental bodies to endorse suburban expansion through legislation and regional planning. Most importantly, the Interstate Highway Defense Act of 1956 under President Eisenhower was the federal government's public sanction of automobiles as the primary mode of transportation over public transit and railroads. (Jackson, 1985).

Southern California as a whole benefited from the federal drive towards the Sunbelt. In particular, Los Angeles's suburban growth was stimulated by national defense contracts granted to engineering and aeronautical companies based in the Sunbelt. Through these contracts, the federal government funneled large sums of money for technological research and development. Additional incentives, including air conditioning, significant property tax abatements, and ample space for growth prompted business centers, manufacturing companies, and corporate headquarters to abandon their inner-city facilities and race to the Sunbelt. As such, engineering and managerial positions, jobs primarily reserved for well-educated middle and upper class Americans, became available. And while many in this elite workforce lived in close proximity to their places of employment, others moved into (or rather, out to), commuter suburbs with large housing lot subdivisions. FHA and VA loans were especially helpful in this regard because, not only did they

allow more Americans to take out loans with low interest rates and long amortization periods, Title 3 of the National Housing Act of 1947 also provided loan subsidies for defense housing.

C. *COMMON LAW WATER LEGAL REGULATORY FRAMEWORKS*

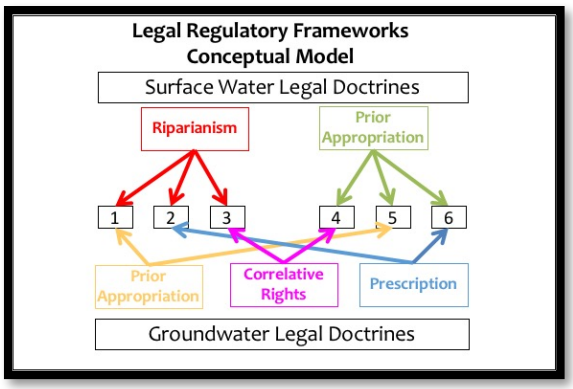

Figure 2: Common Law Regulatory Frameworks That Govern Groundwater and Surface Water Independently of Each Other.
Source: Author

Unfortunately, California water law has treated the regulation and management of groundwater and surface water separately, with independent rules for the allocation of each. The reason for this duality was a lack of knowledge about, and an inability to reconcile, the movement of water beneath the earth's surface. Today, this duality is perpetuated by the law's inability to incorporate scientific knowledge about hydrology and hydrogeology on a scale in a manner that does not upset the (over)allocation of water use rights. As a result, two legal systems grew independently of, and ultimately in conflict with, each other.

There are three common law groundwater doctrines operating in the California legal landscape—Correlative Rights, Prior Appropriation, and Prescription, as well as two operating surface water doctrines—Riparianism and Prior Appropriation. As such, a jurisdictional approach to water regulation will take one of six forms: (1) Riparian-Appropriative; (2) Riparian-Prescriptive; (3) Riparian-Correlative; (4) Appropriative-Correlative; (5) Appropriative-Appropriative; and (6) Appropriative-Prescriptive. These forms correspond to Figure 2.

Historically, California's surface water law favored Riparian landowners much like states east of the Mississippi River, effectively reducing surface water availability for land not immediately adjacent to surface water sources.

D. ***TRANSITION TO THE DOCTRINE OF PRIOR APPROPRIATION: CONFUSION ENSUES***

The boom in suburban development came with it a concommitant need for water. The California Supreme Court, recognizing the ineffectiveness of a purely Riparian system in an area replete with subdivisions, looked to its own judicial precedent and discovered the Prior Appropriation model developed in the mid-nineteenth century. The Prior Appropriation Doctrine originated during the California Gold Rush where industrious miners were looking to increase the amount of water available for their own mining operations. In 1855, the California Supreme Court, in *Irwin v. Phillips*, 5 Cal. 140 (1855), brought the problems of Prior Appropriation to the fore.

Prior Appropriation applies to surface water flowing in natural streams or lakes. A property right to use water (an appropriation) is obtained by applying the water of a natural stream to a "beneficial use" (the list of activities that constitutes "beneficial use" and the locations to which an assessment of "beneficial use" should apply are subjects of great legal debate). The often-used shorthand expression is "first in time, first in right," meaning that, in general, the oldest rights are the most valuable, although much controversy still turns on the validity and the status of rights acquired many years ago.

The consequences of transitioning from surface water Riparianism to Prior Appropriation were extreme. The value of land located immediately adjacent to and atop watercourses no longer came with assurances of user rights to the water. Some interest holder could appropriate that right away from the Riparian owner, so long as the appropriator applied the water to a beneficial use or purpose as defined by law. Additionally, the use of Prior Appropriation to develop water markets, while arguably a more efficient means of getting water to its optimal economic use than the Riparian model, the Prior Appropriation system fails to adequately adjust to society's evolving values. For example, the vast majority of water in the West is allocated to agricultural uses—especially water-

intensive crops like almonds and alfalfa—despite calls for additional water to be allocated to urbanized and urbanizing areas. Moreover, the high demand for water has caused over-allocations of water resources, thereby creating and attempting to satisfy more water rights for that particular water source than there is water actually available. (Daniels, 2008; Grantham and Viers, 2014).

However, the simultaneous existence of the doctrines of Correlative Rights and Prior Appropriation in the same state induced considerable uncertainty about the relative rights of one groundwater producer against others. (Ostrom, 1990: 108).

E. ***DISPARATE LEGAL TREATMENT FOR SURFACE WATER AND GROUNDWATER***

With respect to groundwater law development, California courts remained relatively silent, only delving into the subject when it pertained to dispute resolution between competing interests. These examples resulted in what are known as groundwater basin adjudications (explored in greater detail in the next chapter).[24] The result of judicial silence on groundwater law was stagnation in the development of responsible groundwater management from all three branches of government. The Legislature took no active role, the Judiciary did not discuss the matter, and as a result, the Executive branch (enforcement agencies) had no bases to enforce misuse. Groundwater continued to be governed by Riparianism, specifically through its doctrinal analog for groundwater known as the Correlative Rights Doctrine, complicated by a system of Prescription. Correlative rights apply only to land that overlies groundwater and require equitable sharing of the available groundwater between owners of overlying tracts. Off-tract users are subordinate to, and legally enjoinable by, pumpers

[24] Noteworthy is the fact the SGMA does not contain any provisions affecting the adjudicatory process; adjudicated basins are required to submit to the Cal. Dept. of Water Resources ("DWR") a copy of a governing final judgment, or other judicial order or decree and any amendments entered before April 1, 2016. After April 1, 2016, adjudicated basins are required to submit: (1) Any amendment made to the decree or final judgment of Groundwater elevation data unless submitted under § 10932; (2) Annual aggregate data identifying extraction for the preceding year; (3) Surface water supply used for or available for groundwater recharge or in-lieu use; (4) Total water use; (5) Change in groundwater storage; and (6) The annual report submitted to the court.

who use their owned overlying tracts if no 'surplus' groundwater is available. Prescription, on the other hand, applied to anyone who Adversely Possessed the groundwater rights of another, by satisfying a number of factors over the course of a defined statutory period. In fact, if the factors were satisfied, an Adverse Possessor could go to the county recorder and claim silent title to the groundwater rights.

The disunity between surface water and groundwater laws created a hybrid system replete with legal conflict. For example, suppose the City of Los Angeles seeks to divert water from the Colorado River, a surface water source, for the beneficial use of supplying urban residents with water for domestic use (traditionally all domestic water use is deemed beneficial by the courts). At the same time, a private farmer wishes to pump water from his personal groundwater well, located fifty (50) miles north of the City of Los Angeles, in order to irrigate his alfalfa crop. Both the City of Los Angeles and this private farmer have established legal rights to the water they intend to use. However, because the two water sources are hydrogeologically interconnected, the pumping of groundwater occurs at the expense of the downstream surface water user. This scenario is further complicated by the fact that in reality, there are more than just two potential users of surface water and groundwater vying for water rights.

Jurisdictions that have had the foresight to unify their regulation of ground and surface water—specifically by adopting a unified Prior Appropriation system—may also encounter conflicts if they do not unify the two lists of appropriators, resulting in similar problems to the one outlined above. For example, suppose, as in the scenario above, the City of Los Angeles seeks to divert water from a surface water source. Because surface water is governed by Prior Appropriation, the City of Los Angeles will own the right to divert that water based on seniority, meaning whoever lays claim to the water first has a superior right to that water. Now suppose that groundwater is also

governed by Prior Appropriation instead of correlative rights. In this case, a farmer, whose farm is fifty miles north of the City of Los Angeles, asserts his claim over water that lies beneath the surface water source being claimed by the City of Los Angeles. Because these two water sources are hydrogeologically connected, the pumping of groundwater in this case also occurs at the expense of the surface water user. However, both the City of Los Angeles and the farmer have appropriated water rights and are part of different lists of priority. The fact that these two lists of priority are not combined into a single list creates more problems.

Popular, as well as scientific, thinking in the late 1960s and early 1970s conceded that as a mere physical matter America possessed the technology to consummate the quest for a quality environment. A less unified consensus of opinion qualified this concession to technocracy by stating that matters of sheer economics could necessarily modify the attainment of a quality environment. Equally current, however, was the feeling that laws and institutional arrangements concerning the entire ecological continuum in general, and localized facets of the continuum, in particular, impeded, rather than enhanced, this quest (Ohrenschal and Imhoff, 1970). This notion is even more pronounced today given the fact that there is an even more tenuous consensus about technological capacities to mitigate environmental contamination, notwithstanding collateral assaults from deniers of anthropogenic climate change.

CHAPTER 5: WHY NOT PREVIOUSLY?

California has a rich history of environmental activism and consciousness, both as an independent state actor and as a conduit for federal implementation. (Brown n.d.). Indeed, there is a vast body of California and federal environmental law, principally, but not entirely, in the form of environmental protectionism. State and federal environmental laws provide for an array of obligations and responsibilities such as environmental review, protection of air and water resources,

regulation of the exposure of workers to environmental hazards, control of the storage of hazardous materials in underground tanks, control of the use, marketing, and manufacture of pesticides, and the warning of the risks of exposure to hazardous substances. In some cases, state environmental statutes merely implement recapitulated federal requirements. At other times, states go beyond federal requirements, most notably California's more stringent ambient air quality standards with respect to automobile emissions as compared to the federal National Ambient Air Quality Standards ("NAAQS") under the Clean Air Act ("CAA"). (Schultz and Hendrick, 2014). Federal environmental statutes and programs, many of which are overseen by U.S. EPA,[25] provide much of the framework used to develop, interpret, and enforce state environmental protection laws.

[25] *Federal Environmental Agencies.* There are numerous agencies of the federal government such as the Department of Transportation, Department of Agriculture, Food and Drug Administration, and the Occupational Safety and Health Administration that have tangential authority over the environment. But primary responsibility for the nation's environment rests with the Environmental Protection Agency ("U.S. EPA"). The U.S. EPA is the only major federal regulatory agency created not by an act of Congress, but rather by Presidential Executive Order. (President Nixon's Reorganization Plan No. 3 of 1970, 5 U.S.C. App. at 1132-1137 (1982)). As such, the U.S. EPA is not an independent regulatory agency, but is purely a creature of the Executive Branch. The U.S. EPA is among the most highly decentralized agencies in the federal government, operating through 10 regional offices. The regional office for the western states is in San Francisco. The regional offices pass on to the states the policies and requirements that are issued in Washington, D.C. The regional offices also enter formal agreements with each state that include criteria for enforcement and for other conditions of financial assistance. Each regional office has a great deal of autonomy, especially in enforcement and permitting decisions. Where state programs do not meet federal standards or where the states have chosen not to assume responsibility, U.S. EPA regional offices may assume enforcement authority. Where states have implemented their own programs (as in California), U.S. EPA enforcement activity (at least as to administrative and civil enforcement) is fairly limited.

U.S. EPA's Statutory Authority. U.S. EPA has responsibility under the following federal statutes: The Federal Insecticide, Fungicide and Rodenticide Act ("FIFRA"), 7 U.S.C. §§ 136-136y, which regulates sale and use of pesticides; The Marine Protection, Research and Sanctuaries Act ("MPSRA, the 'ocean-dumping' statute"), 33 U.S.C. §§ 1401-1445; The Safe Drinking Water Act (SDWA), 42 U.S.C. §§ 300f-300j; The Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. §§ 6901-6991i, which regulates hazardous waste from "cradle to grave;" The Clean Air Act ("CAA"), 42 U.S.C. §§ 7401-7671q, regulating all emissions into the air; The Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. §§ 9601-9627, for cleanup of sites where hazardous materials were located in the past; The Clean Water Act ("CWA"), 33 U.S.C. §§ 1251-1387, which requires permits for all discharges into "the waters of the United States;" The Toxic Substances Control Act ("TSCA"), 15 U.S.C. §§ 2601-2682, involves hazard assessment, labeling, and use restrictions relating to toxics; The National Environmental Policy Act ("NEPA"), 42 U.S.C. §§ 4321-4370f. While NEPA is administered by the Council on Environmental Quality, U.S. EPA reviews Environmental Impact Statements ("EISs") prepared by other federal agencies under NEPA; The Surface Mining Control and Reclamation Act ("SMCRA"), 30 U.S.C. §§ 1201-1328. While SMRCA is administered principally by the Department of the Interior, U.S. EPA also has some regulatory authority; under the Atomic Energy Act, 42 U.S.C. §§ 2014-2114, U.S. EPA has some authority to respond to radiation in the environment; The Uranium Mill Tailings Radiation Control Act, 42 U.S.C. §§ 7901-7942 and Exec. Order reprinted in 42 U.S.C. § 5201 at 837-839 (1982)

A. NO LEGAL TREATMENT OF GROUNDWATER

1. FEDERAL ENVIRONMENTAL LAW

While federal statutes have established national standards for the transportation, emissions, discharges, and the disposal of harmful substances, implementation and enforcement of many of the large programs has devolved to the states (whether as a result of strategy, limited resources, or a pure manifestation of federalist principles). In turn, the states apply national standards to sources within their borders through permit and allocation programs that control the release of pollutants into the environment. Nevertheless, while most implementation and enforcement occurs at state or local levels, the U.S. EPA maintains an overarching role by establishing federal standards and approvals of state programs. However, in a few notable exceptions, states can set stricter standards than those required by federal law. Examples of some of the programs that have been delegated by the U.S. EPA to the states include the emissions standards for hazardous air pollutants ("HAPs"), Prevention of Significant Deterioration ("PSD") Permits under the Clean Air Act ("CAA"), the Water Quality Standards and the National Pollution Discharge Elimination System ("NPDES") Programs under the Clean Water Act ("CWA"), the Hazardous Waste Program under the Resource Conservation and Recovery Act ("RCRA"), and the Drinking Water and Underground Injection Control ("UIC") Programs under the Safe Drinking Water Act ("SDWA"). Yet, despite the delegation of

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U.S. Department of Transportation. Under the Hazardous Materials Transportation Act ("HMTA") (49 U.S.C. §§s 5101-5127), the Department of Transportation ("DOT") has broad discretion to promulgate regulations regarding the packaging, labeling, and transportation of hazardous substances. (See 49 C.F.R. pts. 171-180.) DOT has issued those regulations in an extensive Table of Hazardous Materials published in the Code of Federal Regulations. (See 49 C.F.R. § 172.101.) The Table identifies hazardous substances subject to regulation by chemical name, states their classification, and outlines their basic transportation requirements. California statutes and regulations refer to the federal Table of Hazardous Materials in defining hazardous materials under California law. For example, the Table is expressly referenced in the California Highway Patrol regulations. (See Cal. Code Regs. tit. 13, § 1160.5.).

responsibility regarding water quality, air quality, and waste discharge, very little focus has been given to the preservation of surface water sources[26] and even less to groundwater sources.

2. *California Environmental Law*

a. Non-Groundwater Related Environmental Activity

California's record on environmental consciousness and foresightedness is evidenced by the number, scope, range, duration, and stringency of its environmental legislation. The following list exemplifies the tools in California's legal environmental arsenal:

(1) **The California Water Plan**. In 1957, in a special session of the California Legislature called by then Governor Goodwin Knight, developed the California Water Plan ("CWP"). The plan balanced the competing interests of fostering a growth economy that would serve both state and national interests and developing the *Infra*structure that would accommodate the anticipated population increases. The planning document for the CWP said:

> "Today, the future agricultural, urban and industrial growth of California hinges on a highly important decision, which is well within the power of the people to make. We can move forward with a thriving economy by pursuing a vigorous and progressive water development and planning construction program; or we can allow our economy to stagnate, perhaps even retrogress by adopting a complacent attitude…." (California Water Plan planning document, 1957).

The nation had built freeways, bridges and other physical structures essential to a modern post-war economy. But neither federal nor state governments had built the dams, canals and pumps to sustain arid California's continuing growth. The Water Plan, the culmination of the special session of the Legislature, became the foundation for the State Water Project, a massive system of dams, aqueducts and pumping stations that moves water from the northern part of the state to the southern part. (Greenhut, 2015). However, it was limited in that it did not incorporate any explicit

[26] The exception to this is the forthcoming article by Professor Dave Owen, "The Evolving Law of Headwater Streams."

management of groundwater, leaving a void in California's groundwater management until the SGMA's enactment.

(2) California law has preceded, and was the basis for, the development of most federal environmental laws, with the exception of the National Environmental Policy Act ("NEPA"), Endangered Species Act (ESA), and groundwater management.

(3) **The California Environmental Quality Act (CEQA)**, which is the California analog to the National Environmental Policy Act ("NEPA"), requires that prior to approval by a state or local agency of a development project of a certain size, an Environmental Impact Assessment ("EIA") and accompanying Report ("EIR") must be prepared to identify the significant effects of the project on the environment—the social, physical, and natural environments—any possible alternatives to the project, and the manner in which identified significant effects can be mitigated or avoided.

(4) **The California Air Resources Act** requires improvement and protection of the state's air quality, providing for enforcement of air quality standards and (vehicular and smokestack) emission limitations, as outlined in the federal Clean Air Act ("CAA") and state laws. The Act also directs the California Air Resources Board ("CARB") to divide the state into air basins of similar meteorological and geographical characteristics as well as to adopt ambient air-quality standards for each basin considering human health, aesthetics, interference with visibility and economic effects.

(5) **The Porter-Cologne Water Quality Control Act**, the state analog to the federal Clean Water Act (CWA), regulates effluent discharges that may affect the quality of the state's waters, *including groundwater*, through planning, permitting (via federal NPDES and state WDRs) and enforcement by either the State Water Resources Control Board ("SWRCB") or Regional Water Quality Control Boards ("RWQCBs").

(6) **Proposition 65**, codified at Health and Safety Code §§ 25249.5 *et seq.*, prohibits businesses from "knowingly" discharging listed carcinogens or mutagens (substances that cause genetic alteration) into water without first giving warning or notice to the appropriate affected persons and, when such notice is not given, assigns a monetary value of $2,500 per day per violation.

(7) **The Unified Hazardous Waste and Hazardous Materials Management Regulatory Program** ("Unified Program") provides for local implementation of the following six regulatory programs: (a) The Spill Prevention Control and Countermeasure Plan of the Aboveground Storage Tank program ("SPCC"); (b)The Hazardous Materials Release Response Plan and Inventory program ("HMRRP") (Business Plan); (c) The California Accidental Release Prevention program ("CalARP"); (d) The Uniform Fire Code Hazardous Materials Management Plan and Inventory Statement ("HMMP/HMIS"); (e) The Underground Storage Tank program ("UST"); and (f) The Hazardous Waste Generator and Onsite Hazardous Waste Treatment program.

(8) **The Aboveground Storage Tank Program** ("AST"), implemented by the SWRCB and the RWQCBs, requires owners or operators of aboveground petroleum storage tanks to file storage statements, pay fees, and implement measures to prevent spills.

(9) **Hazardous Materials Inventory and Reporting Requirements**, mandates that every "person" who "handles" more than a specified quantity of "hazardous material" or "hazardous materials" must prepare a business plan, which includes a chemical inventory (including a site map), an emergency response plan and procedures, and information on the business's hazardous materials training plan for employees. All terms in quotation marks are specifically defined by the statute and do not follow the vernacular meaning.

(10) **Underground Storage Tanks Monitoring Program**, concerns leakage from underground storage tanks containing hazardous material that has contaminated groundwater and drinking water supplies in the region.

(11) **The Hazardous Waste Control Act of 1972**, established standards for regulating the generation, handling, processing, storage, transportation, and disposal of hazardous wastes through what has been characterized as a "cradle to grave" method.

(12) **The California Fish and Game Code**, the State's analog to the federal Endangered Species Act ("ESA"), declares that no person shall import, export, or take, possess, purchase, or sell within this state any species, or any part or product thereof that has been determined to be an endangered or threatened species, or attempt any of those acts. The term "take" is defined as "hunt, pursue, catch, capture, or kill, or attempt to do the same." Courts have elaborated on the statute's and the U.S. EPA's guidance document definitions of pivotal terms such as "take." For example, the court in *Department of Fish & Game v. Cottonwood Irrigation Dist.* (1992) 8 Cal.App.4th 1554 held that intent to take a listed or endangered species is not a requirement in a case where an actual taking occurred when, water pumps activated during the course of otherwise lawful activity, endangered fish spawn, which were sucked into the pumps and killed.[27]

(13) **Pesticides Management**, under the auspices of the California Department of Pesticide Regulation ("DPR"), supervises county agriculture departments.

[27] *Department of Fish & Game v. Cottonwood Irrigation Dist.* (1992) 8 Cal.App.4th 1554; See also *Palila v. Hawaii Dep't of Land and Natural Resources* (1988) 852 F.2d 1106 (holding that habitat destruction that could drive endangered species to extinction constitutes "harm" and thus a "taking" within the meaning of the Federal Endangered Species Act, 16 U.S.C. §§ 1532, 1538); See generally *Babbitt v. Sweet Home Chapter of Communities for a Greater Oregon* (1995) 515 U.S. 687.

b. CALIFORNIA'S STATUTORY PRECURSORS TO THE SGMA AND FALSE-STARTS TO MEANINGFUL GROUNDWATER MANAGEMENT

In addition to the previous list of forceful environmental governance mechanisms in California, there have been numerous attempts by the Legislature to address groundwater at various levels of engagement. Some of the laws try to prevent contaminating the groundwater. Other laws require measurement and use accounting, but impose no substantive obligations based on data analyzed from those measurements. Further still, some laws call for voluntary monitoring and enforcement of groundwater withdrawal abuses, but do not make the duty mandatory. Through the following exploration of California's groundwater statutes prior to the SGMA, it will become evident how good intentions fall short of meaningful results:

Groundwater Management is outlined in the California Water Code, Division 6, Part 2.75, Chapters 1-5, §§ 10750 through 10755.4. There have been a number of previous legislative and administrative efforts that have laid the groundwork for development of a comprehensive bill such as the SGMA, and several of these are likely to be useful tools as implementation of the SGMA goes forward. These efforts include:

(1) **Assembly Bill 3030.** AB 3030, signed into law in 1992, provides systematic procedures for existing local agencies to develop Groundwater Management Plans ("GMPs"), specifically in order to account for seawater intrusion, wellhead protection, water table and aquifer recharge, groundwater contamination cleanup, issues of overdraft, conjunctive use, storage, conservation, recycling, and extraction projects. However, the GMPs authorized in this bill are strictly voluntary and, moreover, do not allow local agencies to control extractions from, or modify existing property rights associated with, groundwater basins. Thus, overdraft and land subsidence continued to be a problem in many areas, despite knowledge of the potential for such eventualities. Even with these

shortcomings, after AB 3030 was passed, approximately 149 groundwater management plans in California were developed.

(2) **Senate Bill 1938.** SB 1938, signed into law in 2002, modified the Groundwater Management Act by requiring any public agency seeking State funding from and through the Cal. Dept. of Water Resources ("DWR") for the construction of groundwater projects to prepare and implement Groundwater Management Plans ("GMPs") with specified required components. Effectively, this bill gave more teeth to the GMPs authorized in AB 3030. Moreover, the SB 1938 requirements applied not only to management areas that overlaid Bulletin 118 defined groundwater basins, but also to agencies with groundwater management outside of those basins.

(3) **Assembly Bill 359.** AB 359, signed into law in 2011, again modified the Groundwater Management Act by requiring public agencies to prepare and implement groundwater management plans ("GMPs") with an additional requirement focused on identifying groundwater recharge areas. In 1994, the State Water Resources Control Board ("SWRCB") emphasized that in order to use "water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers," the interaction between land use and surface water must be managed, such that porosity, permeability, and transmissivity are maintained through soil, vegetative, and sedimentary filtration to allow for sufficient, quality groundwater recharge rather than allow leachate to contaminate the aquifers. (Sutton, 2011). In addition to providing substantive mechanisms for effective aquifer recharge, AB 359 also included several plan adoption procedural changes.

(4) **California Statewide Groundwater Elevation Monitoring.** In 2009, the California Legislature amended the State Water Code with SB X7-6 (California's Comprehensive Water Package Legislation), which established a collaborative relationship between local monitoring parties

and the Cal. Dept. of Water Resources ("DWR") to track seasonal and long-term trends in groundwater elevations in California's groundwater basins and to provide that information to the public. SBX7-6 provided in particular that: (1) Local parties may assume responsibility for monitoring and reporting groundwater elevations; (2) DWR would work cooperatively with local Monitoring Entities to achieve monitoring programs that demonstrate seasonal and long-term trends in groundwater elevations; (3) DWR accept and review prospective Monitoring Entity submittals, notify the Monitoring Entity of the outcome, and make that information available to the public; (4) DWR perform groundwater elevation monitoring in basins where no local party has agreed to perform the monitoring functions; and (5) if local parties (for example, counties) would not volunteer to perform the groundwater monitoring functions, that DWR would assume those functions, thereby labeling those proposed Monitoring Entities ineligible for water grants or loans from the State.

(5) In accordance with this amendment to the Water Code, DWR developed the **California Statewide Groundwater Elevation Monitoring (CASGEM) program**. The intent of CASGEM was, and continues to be, to establish a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins. CASGEM builds on the many established local long-term groundwater monitoring and management programs. However, the established groundwater monitoring programs were too few and ill-equipped for the task. Nevertheless, DWR continues to coordinate CASGEM, work cooperatively with local entities, and maintain the collected elevation data in a readily and widely available public database.

(6) **Bulletin 118.** The Bulletin 118 series was California's Ground Water summary of available information from DWR, the U.S. Geological Survey, and other agencies for individual groundwater basins to "help those who must make decisions affecting the protection, additional use,

and management of the State's ground water resources." In 1975, Bulletin 118-75 included a summary of technical information for 248 of the 461 identified groundwater basins, sub-basins, and what were referred to as "areas of potential ground water storage" in California. The Bulletin 118-75 basin boundaries were based on geologic and hydrogeological conditions, except where basins were defined by adjudications. Bulletin 118-80 updated boundaries on thirty-six (36) groundwater basins, which resulted in the identification of 447 groundwater basins, sub-basins, and areas of potential groundwater storage. Additionally, Bulletin 118-80 identified 11 basins as subject to critical conditions of overdraft. The California Budget Act of 1999 authorized the update to Bulletin 118 and directed the Cal. Dept. of Water Resources ("DWR") to complete several tasks, including developing criteria for evaluating groundwater management plans and developing a model groundwater management ordinance. Bulletin 118-2003 was released to the public. The Update included guidance and tools that would attempt to assist local agencies in managing groundwater as a sustainable part of their water supplies. However, this does not include the ability to restrict individual pumping rights. Additionally, the update included web-based technical descriptions and GIS compatible maps of 515 groundwater basins and sub-basins.

(7) **California Water Action Plan.** In January 2014, Governor Brown's Office released the California Water Action Plan ("CWAP"), which formulated actions that focus on sustainable water resource management for California's people, environment, industry, and agriculture, with the overarching goals to improve reliability, restore key ecosystem functions, and establish resilient resources that can be relied upon for future generations. Ten key actions were identified in the CWAP: (a) Make conservation a California way of life; (b) Increase regional self-reliance and integrated water management across all levels of government; (c) Achieve the co-equal goals for the Delta; (d) Protect and restore important ecosystems; (e) Manage and prepare for dry periods; (f)

Expand water storage capacity and improve groundwater management; (g) Provide safe water for all communities; (h) Increase flood protection; (i) Increase operational and regulatory efficiency; and (j) Identify sustainable and integrated financing opportunities. The CWAP acknowledged that the State's water management system was currently unable to satisfactorily meet all ecological and human needs, was too vulnerable to wet and dry climate cycles and natural disasters, and was grossly inadequate to handle the additional pressures of future population growth and climate change. The true innovation of the CWAP was the emphasis on the hydrogeological linkage between surface water and groundwater and how crucial an approach to both in concert would be to achieving water management sustainability.

(8) **Local Groundwater Ordinances.** Another method of managing groundwater is through ordinances adopted by local governments. DWR's Bulletin 118-2003 update indicated that 27 counties had already adopted groundwater management ordinances related to the following activities: forming advisory committees; establishing basin management objectives; and controlling the export of groundwater by requiring permits for transferring groundwater out of the basin or county. The authority of counties to regulate groundwater has been challenged, as exemplified in the numerous groundwater adjudications in the State; as discussed below, many of these have yet to be resolved. (Cal. Dept. of Water Resources, 2011). A pivotal determination on this issue came with the California Supreme Court decision to decline certiorari to the appellate decision, *Baldwin v. County of Tehama* (9th Cir. 1994) (cert. denied 1995). The appellate court held that California State law does not occupy the field of groundwater management and does not prevent cities and counties from adopting ordinances to manage groundwater under their police powers. However, the precise nature and extent of the police power of cities and counties to regulate groundwater remains uncertain. Bulletin 118-2003 provided a model groundwater ordinance with recommended

components of a groundwater management plan to guide local agencies as they develop groundwater management ordinances. But without a Supreme Court determination, the issue remains unresolved definitively.

(9) **Local Enforcement of State and Federal Law.** Indeed, California state legislative and executive action does not cover the entire spectrum of environmental issues through governance. While these non-exhaustive lists identify forceful State authority to protect the environment and manage finite resources therein, much of the actual implementation of these laws occurs at the local level either though ordinances and zoning regulations or through mobilization of local law enforcement to compel adherence to laws at all levels to assign fee penalties and even impose heftier civil and criminal liability on infringers.

	Court Name	Filed / Final	Watermaster	County	No.	DWR Bulletin 118 Basin Name
1	Scott River Stream System	1970 1980	Department of Water Resources	Siskiyou	1-5	Scott River Valley
2	Santa Paula Basin	1991 1996	Three-person Technical Advisory Committee from United Water CD, City of Ventura, and Santa Paula Basin Pumpers Association www.unitedwater.org	Ventura	4-4.04	Santa Paula subbasin of the Santa Clara River basin
3	Central Basin	1962 1965	DWR, Southern District wwwdpla.water.ca.gov/sd/watermaster/watermaster.html	Los Angeles	4-11.04	Northeast part of Coastal Plain of Los Angeles County Basin
4	West Coast Basin	1946 1961	DWR, Southern District wwwdpla.water.ca.gov/sd/watermaster/watermaster.html	Los Angeles	4-11.04	Southwest part of Coastal Plain of Los Angeles County Basin
5	Upper Los Angeles River Area	1955 1979	Superior Court appointee	Los Angeles	4-12	San Fernando Valley Basin, entire watershed
6	Raymond Basin	1937 1944	Raymond Basin Management Board	Los Angeles	4-23	Northwest part of San Gabriel Valley Basin
7	Main San Gabriel Basin, Puente Narrows, Addendum to Main San Gabriel Basin decision	1968 1973 1972 1972	Water purveyors and water districts elect a nine-member board www.watermaster.org	Los Angeles	4-13	San Gabriel Valley Basin, excluding Raymond Basin
8	Puente Basin	1985 1985	Two consulting engineers	Los Angeles	4-13	San Gabriel Valley Basin, excluding Raymond Basin
9	Cummings Basin	1965 1972	Tehachapi-Cummings County Water District www.tccwd.com/gwm.htm	Kern	5-27	Cummings Valley Basin
10	Tehachapi Basin	1966 1973	Tehachapi-Cummings County Water District www.tccwd.com/gwm.htm	Kern	5-28, 6-45	Tehachapi Valley West Basin, Tehachapi Valley East Basin
11	Brite Basin	1966 1970	Tehachapi-Cummings County Water District www.tccwd.com/gwm.htm	Kern	5-80	Brite Valley
12	Mojave Basin Area Adjudication	1990 1996	Mojave Water Agency www.mojavewater.org/mwa700.htm	San Bernardino	6-40-43, 7-19	Lower, Middle & Upper Mojave River Valley Basins, El Mirage & Lucerne Valleys
13	Warren Valley Basin	1976 1977	Hi-Desert Water District www.mojavewater.org	San Bernardino	7-12, 8-2	Part of Warren Valley Basin, Northwest part of Upper Santa Ana Valley Basin
14	Chino Basin	1975 1978	Nine people, recommended by producers and appointed by the court. www.cbwm.org	San Bernardino Riverside	8-2	Northwest part of Upper Santa Ana Valley Basin
15	Cucamonga Basin	1958 1958	Adjudicated separately; watermaster appointed. Operated as part of Chino Basin.	San Bernardino	8-2	North central part of Upper Santa Ana Basin
16	San Bernardino Basin Area	1963 1969	One representative from: Western Municipal Water District of Riverside County San Bernardino Valley Municipal Water District	San Bernardino Riverside	8-2	Northeast part of Upper Santa Ana Basin
17	Six Basins	1998 1998	Nine-member board representing all parties to the judgement	Los Angeles San Bernardino	4-14, 8-2	Six sub-basins in northwest upper Santa Ana Valley, Upper & Lower Claremont Heights, Canyon, Pomona, Live Oak & Ganesha
18	Santa Margarita River Watershed	1961 1966	U.S. District Court appointee	San Diego Riverside	9-4, 9-5, 9-6	Three basins: Santa Margarita Valley, Temecula Valley and Cahuilla Valley Basins
19	Goleta	1973 1989	Goleta Water District	Santa Barbara	3-16	Goleta Central Basin, judgement includes North Basin
20	Beaumont Basin	2003 2004	Directors of Public Work for the Cities of Banning and Beaumont, the General Managers of Beaumont-Cherry Valley Water District, South Mesa Mutual Water Company, and Yucaipa Valley Water District		8-2.08, 8-2, 7-21.04, 7-21	Parts of the San Timoteo Subbasin of the Upper Santa Ana Valley Groundwater Basin, the San Gorgonio Pass Subbasin of the Coachella Valley Groundwater Basin

Table 1: List of DWR's 20 Adjudicated Groundwater Basins
Source: DWR
Source: Cal. Dept. of Water Resources. (2011). Adjudicated Groundwater Basins. *Notice*, California Department of Water Resources, Sacramento, CA: California State Water Project. https://assets.documentcloud.org/documents/1310075/groundwater-legislation.pdf.

(10) **Groundwater Basin Adjudication.** As the demand for groundwater exceeded the safe yield and caused overdraft in some California basins, landowners and other parties turned to the courts to determine how much groundwater could be extracted by each user. The courts studied available information on groundwater use and other factors to arrive at a fair distribution of the groundwater available each year, based on overlying use (Correlative Rights) and Prior Appropriation. Table 1 outlines the twenty (20) adjudicated groundwater basins as of 2004.

Groundwater basin adjudication, while an important step in groundwater management, is fraught with difficulty for several reasons: (1) the basins are over allocated (*i.e.* more rights are given

than there is water to be given); (2) the allocation of groundwater rights is largely in conflict with the allocation of surface water rights (*i.e.* Riparian surface water rights and Appropriative groundwater rights are not always synchronized); (3) there is no [accountability enforcement of sustainable and groundwater use by private citizens and businesses; (4) the process of adjudicating a groundwater basin is costly, tedious, and time-consuming, often leaving the basins in the interim open to unapproved exploitation (*i.e.* excessive pumping); (5) because of the hydrogeological connectivity of the groundwater, an adjudication in one basin may be undermined by excessive pumping in an adjacent unadjudicated or contradictorily adjudicated basin; and (6) not every basin can be adjudicated the same way because of local, idiosyncratic features.

Nevertheless, the intense technical focus on the groundwater yield and restrictions on groundwater extraction for all parties as well as the finality of the court rulings make basin adjudications one of the strongest forms of groundwater management in California. Many of these cases have been resolved with a court-approved negotiated settlement, called stipulated judgments.[28] The result of these adjudications is that the court decisions guarantee to each party a proportionate share of the groundwater that is available each year. It is important to note that the majority of adjudicated groundwater basins are located in Southern California and in the South Coast region. For each adjudicated groundwater basin, the court has generally appointed a water-master (a single individual) to oversee the court judgment. The majority of groundwater basin adjudications in California impose extraction limits and/or initiate management actions in the event of declining groundwater levels or water quality degradation.

From this previous section, we can see that California has a wide array of environmental legislation that exemplifies the legislature's (and the citizens') sentiment about environmental

[28] A stipulated judgment is an agreement between the parties to a case, which settles the case. Such agreement or settlement becomes a court judgment when the judge sanctions it. It is also known as an agreed or consent judgment.

protection, preservation, restoration, and management. Consistent with this sentiment, we also see some, albeit ineffectual, attempts to regulate groundwater, consistent with California's pervasive environmental consciousness. However, it is not until the adoption of the SGMA in 2014 that the beginnings of more meaningful legislation regarding groundwater management is seen (though some might say that this new legislation does not go far enough to protect groundwater).

B. DRIVERS OF LEGISLATIVE INTENT

With all of this attention directed at bettering the environment, the question remains: why did it take until 2014 for the California Legislature to develop a statute meaningfully strong enough to manage the State's groundwater resources? There are innumerable factors and circumstances that may have coalesced into what was California's ineffectual pre-SGMA groundwater management regime. In order to understand those factors, we must examine the thorough processes behind statutory development, namely the considerations that are part of socio-political common knowledge as well as the memorialized discussions in legislative history on this issue.

1. CANONS OF STATUTORY CONSTRUCTION

The use of legislative history to divine legislative intent is one of the canons of statutory construction (*i.e.* the processes by which judges, in the face of statutory ambiguity or vagueness, apply various tools and methods to interpret legislative purpose or the purpose behind statutorily delegated agency regulations). Box 1 below outlines some of those doctrines that can be used by courts to interpret legislative intent in statutes and/or agency intent in regulations.

Presumed Agency Deference
1. *Rule of deference* to agency interpretations, unless it is contrary to the plain meaning of statute or is unreasonable. 2. *Rule of extreme deference* when there is express delegation of law-making duties to the agency. 3. Presumption that agency interpretation of its own regulations is correct.
Presumed Internal Legislative Consistency and Continuity
1. *Rule of continuity* assumes that Congress does not create discontinuities in legal rights and obligations. 2. *Presumption of consistent usage* assumes that Congress uses same term consistently in different statutes. 3. *Super-strong presumption* assumes correctness for statutory precedents. 4. *Presumption that international agreements* do not displace federal law.

5. When Congress *borrows a statute*, it adopts interpretations placed on that statute, absent contrary statements.
6. When Congress *re-enacts a statute*, it incorporates settled interpretations of the re-enacted statute.
7. *Acquiescence rule* considers unbroken a line of lower courts interpreting statute, but do not give them decisive weight.

Consideration of Extrinsic Sources

1. Interpret provisions consistent with *subsequent statutory amendments*, but not subsequent legislative discussions.
2. Consider *legislative history* if the statute is ambiguous.
3. *Committee reports* are authoritative, but cannot trump a plain meaning, and should not be used if "imprecise."
4. *Committee report language* that cannot be tied to a specific statutory provision should not be credited. Reports inconsistent with one another should be discounted.
5. Presumption against interpretation considered and rejected by floor vote of a chamber of Congress or committee.
6. Floor statements can be used to confirm apparent meaning.
7. Contemporaneous and subsequent understandings of a statutory scheme (including understandings by President and Department of Justice) may sometimes be admissible.
8. The "dog didn't bark" canon is a presumption that a prior legal rule should be retained if no one in deliberations mentions the rule or discusses any changes in the rule.

Box 1: Canons of Statutory Construction re Legislative/Agency Intent
Source: "The Rehnquist Court's Canons of Statutory Construction," from the Appendix to "Foreword: Law as Equilibrium," William N. Eskridge, Jr., Philip P. Frickey, 108 Harv. L. Rev. 26, November, 1994.

For the purpose of this discussion, I focus on the canons governing the use of extrinsic sources. The general thrust of these canons is that if the language of the statute is clear, there is no need to look to extrinsic source material for fear of eisegesis, or the introduction of erroneous and anachronistic suppositions into statutory material. However, where there is ambiguity, the canons authorize the use of committee reports, Assembly and Senate floor statements, etc. as persuasive authority in statutory interpretation, but only to the extent that the extrinsic sources are consistent.

Hindsight does not always offer a clear glimpse into the explicit application of these doctrines during the deliberation process. In fact, some politicians may claim legitimacy of a particular position derived from a canon, when the true justification is based on preferential treatment to constituents or interested parties. Conversely, a legislator might claim an extra-canonical justification for a point or position, when the true reason was based on application of one or more canons. More research is needed at this point to discover the thought processes behind key legislators' intents in the building block bills that formed the foundations of the SGMA.

2. *Analytical Frameworks*

a. Risk-Reward Analytics

i. *Extrapolation*

When considering the motivations behind legislative intent, legislators and policy makers must grapple with multiple, often mutually exclusive, interests. Under a risk-based analytical approach, politicians use the results from quantitative risk assessments that employ inductive reasoning and extrapolate conclusions from small samples to larger cross-sections of people and environment. In the case of groundwater, politicians use information gained by extrapolating general conclusions that are gathered from sample populations, that describe the impacts of groundwater extraction at various rates and intensities, that estimate the extraction-response function, and then that generalize to larger impact levels. Extrapolation is critical for political governance because long-term, large-scale studies can be too costly, infeasible, and may not address the immediacy of certain problems.

ii. *Probability*

An additional risk-based method of analysis is that of assessment through categorical, fixed goals based on probability calculations. This type of assessment usually consists of statements about frequencies and the relative frequencies in repeated experiments. In this, there is an inherent shift away from the traditional common law analysis of proximate cause (*i.e.* where a plaintiff has the burden of proof to show more likely than not that the injury would have occurred as a result of the other party's negligence) to one of low probability (*i.e.* based on a potential showing of danger, where a small, unsubstantiated fear of what might occur if no action is taken is all that is required).

The classic 8th Circuit Appellate Case *Reserve Mining Co. v. EPA* (8th Cir. 1975) illustrates this point. In *Reserve Mining,* the Environmental Protection Agency ("EPA"), along with several states and environmental groups sued the Reserve Mining Company, seeking an injunction from

discharging iron ore waste into Lake Superior. The plaintiffs alleged that the waste contained asbestos-like fibers that, if ingested, created a greater likelihood of causing serious health problems, including cancer. The 8th Circuit Court of Appeal shifted its analysis from traditional proximate cause to one of a lower probability threshold. However, through an odd conflation of political and legal argumentation, the court stayed the injunction for a "reasonable time" until the defendant could find an alternative disposal method.[29] Despite the specific court ruling, the standard that *Reserve Mining* created endowed EPA with broad discretion to regulate corporate pollution. The new standard justified and authorized agency action where a "reasonable medical concern" exists, where "reasonable medical concern" could be measured extremely broadly. However, in the subsequent case *Industrial Union AFL-CI0 v. Am. Petroleum Inst.*, 448 U.S. 607 (1980), EPA's carte blanche was curtailed. In this case, a plurality for the Supreme Court of the United States upheld a Circuit Court ruling that rejected the EPA's change in the Benzene standard from 10ppm to 1ppm because it was not based on scientific data (notwithstanding the fact that there are no known safe levels of human exposure, meaning that any level of exposure creates a significant risk of harm). The analysis in this case turned on two statutory provisions in the OSHA statute: The first was section 6(b)(5) "…adequately assures, *to the extent feasible*...that no employee will suffer…" while the second was section 3(b) "…*reasonably necessary and appropriate* to provide safe and healthful employment...". The court held that unsubstantiated increases in the standard's rigor were not allowed without some justification. A third case, *American Textile Manufacturers v. Donovan*, (U.S. 1980), further curtailed *Reserve Mining*, by lowering the burden of proof to that of a 51% preponderance of the evidence standard from the higher clear and convincing standard of proof. Indeed, the court further stated

[29] Ironically, the court's assessment of the physiological harms caused by ingesting asbestos were wrong—it does not cause harms in the same manner as inhaling asbestos.

that something was safe not because it was entirely risk free, but rather because it posed an acceptable level of risk to human health and welfare.

iii. Limitations: Finances, Temporality, and Uncertainty

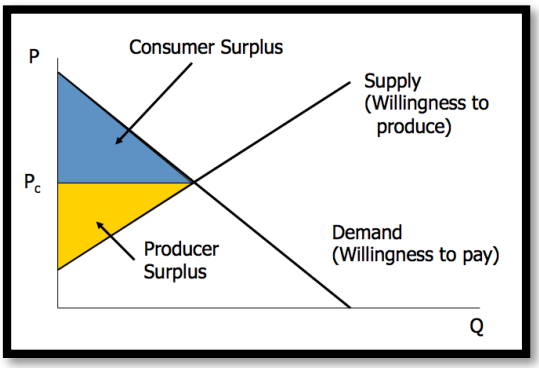

Figure 3: Perfect Market Equilibrium
Source: Author

And yet, while probability assessments are given a wide berth, they are constrained both by financial and temporal considerations. Financially, people may be willing to pay to reduce a certain amount of risk (or to get paid to accept an increase in risk). However, the willingness to pay is limited by ability to pay. Temporally, the difficulty of probability analysis is lack of causation; the further in time the harm occurs from the alleged event, the harder it becomes to establish but-for and proximate causal connections. Latent, long-term risks are disregarded because the harms intrinsic to them do not manifest until significant amounts of time have passed.

An additional inherent limitation to probability specifically, and risk-based analysis in general, is uncertainty. If uncertainty gives rise to the conclusion that action will yield greater negative consequences than inaction, then that conclusion might be the grounds for inaction. Thus, it follows that under-controlling for the harms created by overdrawing groundwater is far worse than over-controlling for non-harms. However, in practice we cannot wait for environmental problem analysis to manifest common law causation, in large part because waiting for absolute certainty will likely be too long a wait to fix the problem.

iv. Valuation Uncertainty in Public Governance

Many public decisions have uncertain consequences. The question arises whether government should be risk-neutral or risk-averse. The answer is not entirely one or the other.

Sometimes the government is risk-neutral, where outcomes are significant for individuals but small for society and where individual risks can be attenuated through insurance and risk-pooling (health, disaster response and compensation). Other times, the government is risk-averse, where outcomes are significant even on a societal scale and/or where resources that are at risk are unique, and non-substitutable. In either case, the implementers of law must consider the distribution of costs and risk. If the wealthy can pay more for safety, should public decisions place a higher value of life on them? The 1995 IPCC Assessment caused an uproar when it summed global impacts with value-of-life that was ten times lower in poorer countries than wealthier ones. (Campbell-Lendrum and Corvalan, 2007). Is efficiency a sufficient measure, especially when there are strong distributive forces at play? And how to value life? As a summation of experiences? In years accumulated? In years potentially remaining? Such practices are routine in medicine and insurance actuarial tabling. Lawmakers and politicians face similar issues when attempting to place a value on environmental issues. Such issues include whether the value of the environment is intrinsic or anthropogenically derived, and whether such assessments should also include aesthetics, utility, and aggregate effect on human health and welfare, and morality.

v. Application to Groundwater Legislation

So, what are the risks inherent to groundwater regulation? If an individual is an overlying landowner and pumps water for agricultural use, there are several key risks, none of which will subside with the new law. First, if there is an overdraft, all pumpers will be required to cutback on otherwise allocated water rights. Moreover, that cutback is Correlative; and just like its Riparian right cousin, every groundwater pumper shares the pain of pumping reductions. Second, if public agencies are pumping, they may have established Prescriptive Rights (similar to Adverse Possession), and as such, can impair the overlying right. Third, the water code's presumption in favor of

domestic use as the highest priority creates additional risk to overlying groundwater pumpers. And while this statutory favoritism has yet to be challenged in court, landowners and water rights holders are cautious of looming litigation on the horizon. Fourth, users by Prior Appropriation, usually cities and public agencies, harbor tremendous risk as well in that if they fail to establish prescription, they could be cut off, leaving the senior rights holders with an unabridged right to pump. Fifth, there is no accurate accounting of who is pumping and how much; we do not even know what people claim to have the rights to. The SGMA's requirement to develop Groundwater Sustainability Agencies ("GSAs") also does not then authorize these GSAs to determine water rights. The legislation merely requires GSAs to manage groundwater through a groundwater sustainability plan in CASGEM high and medium priority basins, but provides only minimal authority to enforce the plans as against individual water rights. Lastly, the risk is that in spite of all of these efforts, groundwater will become depleted, especially given that Californians pump fifteen (15) Million Acre Feet (MAF) of groundwater each year, supplying nearly eighty (80%) percent of Californians with potable water.

b. ECONOMIC-BASED ANALYTICS

i. Market Mechanisms: Competitive Equilibrium as Social Optimum Yielding Maximize Total Surplus

Under a neoclassical economic theory, market equilibrium is achieved when supply (the willingness to produce) equals demand (the willingness to pay). Such a model presumes several key features. First, it assumes no ethical considerations. Markets are not consequentialist, welfareist, fiscally liberal, libertarian, or conservative. Second, it assumes perfect competition between all actors. Third, it assumes equal ability to market entrance. Fourth, it assumes no externalities. Under these four assumptions, we can attempt to valuate both market-goods and non-market goods (although the latter is more difficult). With respect to non-market goods, neoclassical economists

look either to stated preferences, a valuation contingent on an appropriately chosen sample to explain a precise, well-posed choice whether to pay, or to revealed preferences, where estimations are made based on what people pay for related market goods (using Hedonic Pricing principles). At its core, costs are compared with the benefits of undergoing a particular activity or project, the larger of which determines whether the act or activity should be undertaken.

ii. Realism and Benefit Cost Analysis (BCA)

Discounting

- Generally, any quantity X occurring N years from now has present value $X/(1 + r)^N$

$$NPV = \sum_{t=0}^{N} \frac{B(t) - C(t)}{(1+r)^t}$$

Compound Interest **(Quantities increase by a constant factor per period)**

- Suppose the rate is r = 10% per year
- So $1,000 today is equivalent to:
  - $\$1,000 * (1.1) = \$1,100$ in one year
  - $\$1,000(1.1)^2 = \$1,210$ in two years
  - $\$1,000(1.1)^N$ in N years – or in general: $\$1,000 * (1 + r)^N$

Discounting **(Compound interest backwards)**

- Future quantities have a "Present Value" = amount invested today to get given amount in the future
- $1,100 in one year has a present value today of $\$1,100/(1.1) = \$1,000$
- $1,210 in two years has a present value today of $\$1,210/(1.1)^2 = \$1,000$

Terminology

- *Discount Rate* r: typical values ~ 1% (some say 0) – 10%
- *Discount Factor*: $1/(1 + r)^N$ – multiply this by FV to get PV

Figure 4: Formulae for Discounting to Present Value
Source: Author

However, markets are not perfect, ethical considerations must be accounted for, and valuation is subsumed by socio-political values, not just commercial values. Thus, politicians and decision-makers must include these in their calculus's behind legislation. Will this law have an adverse impact on the poor or impoverished? Will it single out historical minorities? Will it create externalities that cannot be internalized by private actors?

With respect to the environment, three main themes have emerged. The first issue is an inappropriate discounting of future harms to present value. Historically, low discount rates were used to favor wasteful public works projects. These projects also imposed huge environmental harms, but these were ignored. The famous Stern Review declared: "– 1.4% = 0.1% + 1.0 * 1.3%, 'now and forever' leveled costs over 300-year time horizon." (Stern, 2006). However, the Stern Review did not account for the fact that if future environmental harms become even worse, the

notion of discounting the harms to present value has the effect of eliminating inter-generational equity. Indeed, conventional risk management analyses understate "fat tails" of environmental harms, especially of catastrophic climate risk. (Samuelson and Nordhaus, 2005; Dasgupta, 2001). The second issue is that it is virtually impossible to prospectively include every variable in benefit cost analysis ("BCA").

1. The Tragedy of the Commons Revisited

The third and main environmental BCA issue is that of the tragedy of the commons.[30] Recall that the Founding Fathers valued individual land rights tantamount among the enumerated rights of men (they being life, liberty, property, and the pursuit of happiness). At its core, property ownership embodies the exclusive right to control the production of economic goods or products from that property. In essence, property rights dictate how humankind interacts with, and attempts to control, nature. In the realm of statutory construction, these absurd incentives and irrational results emerge mostly as unintended consequences that are externalized to others.

c. EQUITY-BASED APPROACHES

Often arguments for swift political action are framed in terms of social, distributive justice to rectify inequalities originating from and perpetuated by socio-political structures. These arguments are generally impassioned, but often lack foundational logic, or are based on flawed logic or faulty assumptions. Nevertheless, they can play a role in the legislative process, as constituents seeking greater social, economic, and environmental equity often take a more active role in civic participation in governance. (Phillips and Alyn, 2005).

[30] *Supra*, pages 8, 10-12.

d. TORT LIABILITY REGIMES

Politicians and decision makers also resort to common law principles of tort liability to remediate and rectify harms to others. However, scholars have demonstrated that tort law is inadequately equipped to address environmental harms for five main reasons. First, tort law is reactionary, based on the symptoms of the problem and not the underlying cause. Second, there are either too many or too few perpetrators from whom to seek remuneration. Third, tort liability is restrictive in that one must be within a proper class of individuals to bring suit. Many individuals, environmentally conscious and passionate about issues that occur even in areas that do not directly affect them, lack proper standing and as such are prevented from bringing suit. Fourth, it may be hard to find individuals with proper standing that are both willing and able to bring suit. Lastly, diffuse problems caused by particular environmental conditions create administrative and practicality difficulties that overburden the judicial system.

3. THEORIES OF POLITICAL ACTION

a. PUBLIC CHOICE THEORY

Public choice theory suggests that the policymaking process is a "battlefield where legislators, bureaucrats, interest groups, and individual voters compete to maximize their own private interests." (Dubinsky, 1992). This theory suggests a positive feedback loop wherein legislators behave in their own economic self-interests by crafting laws that benefit their constituencies, which in turn garners favor from their constituencies because of the perception that the law is in their best economic interest, thereby reinforcing the cycle through reelection. In addition to, or in lieu of, serving their constituents, the theory posits that legislators maintain popularity through political advertising and promotion, activities that come at a hefty price tag, thus compelling legislators to raise money for positive publicity while at the same time avoiding notoriety.

The root of this theory is that special interest groups can provide legislators with money and with publicity, and as such, public choice scholars ascribe great power to these groups. Furthermore, George Stigler and other scholars argue that bureaucrats build empires, maximize budgets, and take actions that protect their receipt of public funds as well as lucrative post-government employment. With the rise of the regulatory state, bureaucrats play an increasingly important role in developing and interpreting our public law. Professor Richard Epstein's argument is the public choice belief that government regulation cannot be presumed to further the public interest at all. (Dubinsky, 1992).

The crux of the issue is "Arrow's Paradox," a term coined by Kenneth Arrow to demonstrate that majority voting patterns lead to "cycling majorities" that cannot choose among three or more mutually exclusive alternatives. (Arrow, 1963). Indeed, Arrow's Paradox suggests that political outcomes may not reflect dominant political preferences at all. Rather, political outcomes are distorted by strategic behavior and the filtering of combinations of voter preferences through agenda-setting rules. Where cycling is present, therefore, maneuvers such as agenda manipulation or "strategic voting" may become decisive. (Farber and Frickey, 1998).

Public Choice scholars have surmised that numerous factors have corrupted the purity of statutory interpretation. These factors include: a breakdown of political consensus; enhancement of interest groups on both sides of the political aisle; criticisms of public disinterest, ignorance, and apathy towards the democratic process endemic to Generation X; continued efforts by conservatives to espouse deregulation and devolution of government; public ridicule of the canons of statutory construction; and attacks on objective interpretation.

Opponents of the dominant strain of Public Choice Theory, namely Farber and Frickey, believe that interest groups' exertion of power yield inefficient political outcomes that do not jibe

with public interests. Additionally, Farber and Frickey argue that facilitating economic efficiency is not the only legitimate goal of government; government may also promote societal values such as "environmentalism, racial equality, and income redistribution, to boot." (Farber and Frickey, 1998).

b. PUBLIC INTEREST THEORY

In stark contract to Public Choice Theory, Public Interest Theory posits that law is made in response to public demand for the correction of inefficient or inequitable market practices. (Dubinsky, 1992). Unlike the Public Choice Theory, Public Interest Theory does not assume that statutes have legal meaning separate from and precedential to the process of statutory interpretation. Indeed, one who ignores the elected drafter's intent, in the words of Farber and Frickey, "strains the chain of legitimacy from the electorate to the drafter and then to the implementor." (Farber and Frickey, 1998). Similarly, when a court ignores legislative intent in implementing a statute, it weakens the legitimacy of the statute by detaching the implementation from the actual purposes of the electorate's representatives.

> "The law recognizes that statutory meaning is influenced by statutory context, of which legislative history is a large part. Indeed, some aspects of it, such as committee reports, frequently represents the most intelligent exposition of what the statute is about. After all, legislative history is merely extrinsic evidence of intent. That it may not be perfectly reliable is no reason to exclude it from consideration entirely. Even if legislative history were systemically biased, that would not justify ignoring it, because a decision-maker can always compensate for known bias in assessing evidence." (Farber and Frickey, 1998).

The Public Choice Theory's unwavering deference and adherence to "unambiguous" language presupposes that statutory language will always have an unambiguous interpretation. But, empirics will demonstrate that this is far from the case. Statutes often are completely ambiguous in that they are vague, or, at the other end of the spectrum, are susceptible to multiple, rational interpretations, both types claiming to be unambiguous. Such preferential treatment to plain sense meaning does not undercut the primacy or legitimacy of legislative intent. Indeed, unambiguous

language is very strong evidence of intent and should be used when weighed against the probative nature of extra-linguistic sources, such as legislative history. Moreover, subsequent legislative history can help courts and interpreters of statutory language determine application and relevance in light of current societal norms and mores. By its very nature, then, legislative intent is an amorphous term, describing interpretation, induction, deduction, logical reasoning in its context rather than an "inexorable outcome of some pre-established formula." (Farber and Frickey, 1998).

c. THE UNPREDICTABILITY AND INACCURACY OF LEGISLATIVE HISTORY

There is another school of thought, unlike Public Choice Theory, suggesting courts' adherence to legislative history and extra-judicial material improperly elevates "counterfeit legislative history above the duly enacted language of the law itself." (Farber and Frickey, 1998). Judge Frank Easterbrook for the 9th Circuit Court of Appeals, and Justice Antonin Scalia of the Supreme Court of the United States are two proponents of this line of thinking. Indeed, these two officers of the court, with others, advocate rejection, or at least significant curtailment, of courts' reliance on legislative history, consideration of congressional actions, or interpretations post enactment.

The description above of these thought processes and methodologies demonstrate that the burden on the shoulders of legislators to consider all of the pertinent variables is immense. Moreover, the use of some methodologies are inconsistent with and mutually exclusive to other methodologies.

Now that we have explored many of the legislative considerations, we can now look at the SGMA itself in order to determine: who is impacted and how; who is responsible and for how much; what are the benefits from compliance; and what are the consequences for non-compliance.

4. *SQUARE PEGS IN ROUND HOLES: THE LAW-LAG PHENOMENON*

Scientific progression generally outpaces the development of American jurisprudence.

(Moses, 2007).[31] In the United States, this phenomenon is especially fraught because of two compounding features of American government: (1) the democratic republic model of governance, where ultimate authority is derived from citizens, but where the government itself is run by elected officials; and (2) the common law legal system inherited from America's English forebears, wherein the judiciary assiduously, even to its own detriment, relies on case precedent and seldom deviates to accommodate shifting attitudes and social norms. These two features impede the law's ability to catch up to scientific and technological progress. As a result, the state of the world that the law seeks to regulate is a distant memory of the world as it currently exists due to rapid scientific discovery and progress. Just as the stars that illuminate the Earth's night sky are not portraying the stars as they currently are but rather as they once were because of limits on the speed of light,[32] so too is the common law a portrayal of the state of society that has already passed, supplanted by innovation and discovery. The common law, like starlight, is curtailed by the speed of the democratic process and has yet to catch up with modernity.

While it is true there are some examples of court cases where judges give some weight to relevant scientific information (*Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 579 (1993); *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999)), there is no requirement that judges include scientific evidence in the court cases they oversee, especially when case precedent in that particular jurisdiction is on

[31] Three poignant examples of the recurring phenomenon where the law lags far behind technological and scientific progress include technological innovations in: (1) contraception, with quantifiable benefits to women's hormonal health and unwanted pregnancies that would otherwise place financial burdens on the welfare state; (2) abortion, which is scrutinized and persecuted by those who believe that the Constitutionally guaranteed rights to the fetus trump those Constitutionally implied rights to self-determination held by the mother; (3) privacy, wherein the ability to monitor and collect data on individuals through such mechanisms as wire-tapping, video-surveillance, satellite global positioning, low-jacking, bugging, etc. have become more complex, more discreet, and more ubiquitous. All of these examples have led to enumerable lawsuits challenging the legality of their very use. It is within these lawsuits that the law-lag phenomenon can be observed, where legal precedent must attempt to regulate conduct that may not have even been conceived of at the time the law/regulation was enacted.

[32] Light travels rapidly—as far as we know, it's the fastest thing in the Universe—but it's not *infinitely* fast. At 300,000 kilometers per second (186,000 miles per second), it takes light more than eight minutes to get from the closest star to Earth; one can think of it as seeing the Sun as it was eight minutes ago.

point, but even when case precedent is not so clear. Indeed, the mechanism by which experts in a field or discipline may give expert testimony in courts is outlined in the Federal Rules of Evidence (the rules that govern the gathering and presentation of evidence in all federal court proceedings) and/or in its analogous set of rules in California. The California Rules of Evidence does in theory allow for the introduction of information that is otherwise absent from case precedent. However, some judges exclude expert testimony from the evidentiary record for want of proper evidentiary foundation, an insufficient establishment of the expert's *bona fides*, and/or the inability of the new information to withstand proper scrutiny.[33] Or, judges might allow evidence to come in on one

[33] According to the Federal Rules of Evidence, expert testimony should be admitted if it (1) is necessary; (2) would assist the trier of fact; and (3) meets the four following criteria:

(1) *Proper Qualifications*: scientific, technical, specialized knowledge, skill, education (not necessarily formal), background, experience, and/or training that matches the proposed testimony (Burden of Proof is on the proponent of the evidence to prove expert qualifications, typically out of jury's hearing; opponent may require a voir dire exam)

(2) A *Proper Topic* that is helpful to the factfinder such as: (1) Information that goes *beyond the ken* of the juror's common knowledge (so as not to abdicate their role as critical thinkers); (2) Information that *adds depth to common knowledge*; (3) Information that, using broad generalizations rather than specific instances, *disabuses the jurors of misconceptions*, e.g. mafia, race relations, spousal abuse, Hmong stereotypes, *etc.*

(3) A *Proper Basis* for her opinion on facts/data in that the expert: (1) has been made aware of through hypothetical questions during trial; (2) has personally observed/has first-hand knowledge of; or (3) has been presented with the facts/data out of court, but not perceived by her personally.

(4) A *Proper Methodology* (must prove each by a preponderance of the evidence under Fed. R. Evid. 104(a)): (1) *Relevant*—(a) Does expert's *knowledge "fit" the issue*? (b) Is there *valid connection to pertinent inquiry* that *assists* the jury?; (2) *Reliable and/or Scientifically Valid*—(a) uses *scientific method* (b) applies to any body of knowledge on *good grounds*

   a. *Factor Test* (extremely fact-specific, reviewed on an Abuse of Discretion Standard): (1) Has the theory been tested?—(a) Can it be *tested*? (b) Is it *falsifiable*?; (2)—Has theory been *subjected to peer review and publication*? (relevant but not dispositive); (3) What is the *known or potential rate of error*?; (4) What are the *standards of controlling the technique's operation*? (*i.e.*, will we get valid and reliable results?); (5) Is there *"general acceptance"* of the technique in the relevant community?; (6) Is it *new science* (*i.e.* not yet subject to peer-review)?; (7) *Is probative value substantially outweighed by risk of unfair prejudice* (Fed. R. Evid. 403)? (which is greater in the realm of expert witnesses, who can mislead more); (8) was testimony based on preparation done independent of litigation?; (9) Is methodology *logically deficient* (*Kumho*) such that there are *analytical gaps* between data and opinion?; (10) What is expert's experience?; (11) Do alternative explanations account for result?; (12) Did expert use appropriate professional care?; (13) Does the field reach reliable results?

An ideal expert post-*Daubert* is one that is: (1) published, (2) whose information is gathered on a non-litigation based, and (3) whose methods for data collection and falsifiability are generally accepted in the field or relevant expert community. Experts, once established as such at the current proceeding, have tremendous latitude with respect to the information they can offer as part of their expert testimony. For example, they can testify about inadmissible hearsay (*i.e.* evidence that would otherwise be inadmissible because it was an out-of-court statement made by someone other than the current declarant offered for the truth of the matter asserted without an exemption or exception enumerated in the evidentiary rules). Additionally, experts can offer ultimate conclusions of their offered evidence if the court deems that it would help the jury in its task; the ability to render conclusions based on presented evidence is highly restricted in American courts and is almost always reserved for the judge and/or jury. Because of the latitude afforded to experts and

ground, but exclude it as overly prejudicial and/or inflammatory to a jury. (Fed. R. Evidence 403). Thus, it is clear that the judicial system is unequipped to properly assess scientific information and apply it to the case at hand.

Indeed, the point at which the law catches up to science is when, after much deliberation, adjudication, and consternation, the burden shifts from the judicial branch of government to the legislative branch, where legislators use their numerous tools and procedures to craft laws stating their expectations and their objectives, and assigning the responsibilities of enforcing and regulating their mandates (ideally with adequate financial and political means to do so).

But this is not always inevitable. Legislators, after all, are politicians, concerned with satisfying their constituents in addition to pursuing their agendas. Often, the constituents to whom the legislators are beholden are a select few influential individuals or groups interested in maintaining the status quo. Weighing the costs of disappointing these constituents against the costs of being unseated might incline a politician to enter into an agreement to stay in office. Many would rationalize such deal-making by the fact that a politician who is out of office has far less power to effect change than a politician who is in office, albeit constrained to act in accordance with the special interests that got him/her elected.

The law-lag phenomenon is abundantly clear in the context of water resource management, especially with respect to resource rights allocations. Recent droughts and increasing hydroclimatic volatility, especially in the western United States, continue to test the ability of water managers to meet diverse and growing demands for supply reliability, improved water quality, and healthy ecosystems. (Gleick and Chalecki, 1999; Christensen *et al.*, 2004; Wilhite *et al.*, 2007).

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testimony offered as such, courts have broad discretion regarding the admission or exclusion of expert testimony. The evidence itself is evaluated under a greater level of judicial scrutiny than evidence presented by a lay witness.

Understanding the legal structures governing groundwater is crucial for a critical evaluation of groundwater management in Southern California. Moreover, exploring the five competing groundwater doctrines currently operating in the American West, especially when juxtaposed to the three doctrines in California, paints a vivid picture of water regulation and implementation variety. (Thompson *et al.*, 2013). Analyses of state and regional adjudications regarding the enforcement and modification of these doctrines raise critical questions about externalities and responsibility (*i.e.* whether users of groundwater can be held responsible for some negative effect of which they cannot by any possibility have legal notice, etc.) (following *Sipriano v. Great Spring Waters of America*, 1. S.W.3d 75 (Tex. 1999)). In an era without a feasible means of determining the availability of potable water from an aquifer, does limiting water use on overlying land and by overlying landowners provide a readily enforceable method of resource sharing? (following *Martin v. City of Linden*, 667 So.2d 732 (Ala. 1995)). While these questions and many others go unanswered, they do evoke a critical understanding of the shortcoming of American groundwater management.

CHAPTER 6: DATA

Numerical data collection suitable for the statistical modeling of groundwater well extraction practices proved exceptionally difficult to gather for a study focused on California groundwater management practices (or the lack thereof). California is noted for lagging behind other Western states in groundwater data collection and sharing, a chilling statistic given that California pumps more groundwater annually than any other state in the U.S. (Nelson, 2011). Indeed, a fundamental challenge in proposing specific policy suggestions regarding the successful undertaking of a groundwater resource management system in California is that no extant system includes data from publicly maintained groundwater wells[34] and from the more ubiquitous category of privately held

[34] In 2009, SBX7 6 authorized the Cal. Dept. of Water Resources ("DWR") to establish and gather data from the California Statewide Groundwater Elevation Program ("CASGEM").

wells. Additional complications to data collection and sharing emerges with respect to data quality when there is no guarantee that privately reporting wells share the same physical dimensions or that their data gathering methodologies are uniformity. As millions of acre-feet of groundwater are pumped from wells statewide each year, many heavily used basins continue not to have any comprehensive record of the quantity of groundwater withdrawn, the basin from which a quantity of groundwater originated, nor the amount of water remaining in the aquifers. Many prominent figures, including California state Senator Fran Pavley (D), have argued further that data sharing is frustrated by California state law that prohibits public access to the well logs compiled by private corporate users of groundwater, even after the enactment of the SGMA.

Whether due to state law actively prohibiting data proliferation or passively frustrating it by not providing for the means by which to enforce proper and adequate data collection, in either case data is not present and accessible to the public and public oversight at a time when drought and related cutbacks on surface water supplies are motivating groundwater users to drill new and/or deeper wells in increasing numbers.

Groundwater data are the critical foundation for water managers both to prevent problems and formulate solutions. In California, where groundwater makes up between thirty (30%) and forty (40%) percent of the State's water supply system, everyone benefits from good groundwater management, whether through direct use, or indirectly from the social, economic and environmental contributions associated with groundwater use. (Freeman, 2008).

A. HYPOTHETICAL LINEAR REGRESSION GIVEN IDEAL DATA

The study of groundwater management as a sub-part of a variable comprised of all water sources would benefit from a statistical analysis of, at the very least, the factors that contribute to loss of water as well as the fear of loss of water. There are a number of important factors that

contribute to people's resource consumption behaviors. People are likely to vary the amount of water they use based on the perceived and potential impacts of natural and man-made disasters, population increases, global climate change and concomitant climatological events, and drought. Diminished access to potable water as well as the fear of said diminishment, in theory, leads to increased freshwater harvesting and/or purification, which in turn strains water resources.

However, as explained above, a statistical analysis of Californians' groundwater use behaviors would be difficult if not impossible because there is no study, as of the time of publication of this paper, that measures the impact of social, economic, and political pressures on people's groundwater pumping behaviors (*i.e.* by conducting a survey of a representative sample, assigning a numerical value to each pressure category, and running a linear regression).

While it is possible to approximate per capita groundwater use (by taking the population of a particular area and dividing it by the thirty (30%) to forty (40%) percent of California's annual water supply made up of groundwater resources), the result would be misleading because it would not accurately reflect the actual well locations from which the water was being withdrawn. In other words, the average taken from the sample would not reflect the geological, topographical, subterranean, demographic, seasonal, etc. variations that lead either to more or less groundwater extraction. This is because we do not know the locations of all of the private wells currently in operation at any one time. Thus, much of the required funding and planning behind a comprehensive data collection and sharing system will necessarily be allocated to visual identification of all active groundwater wells. This is not to say that a per capita groundwater use figure would be entirely useless. Future research projects could do preliminary, low cost assessments for regional governments on how to strategically manage groundwater resources.

A hypothetical statistical model based on ideal data regarding triggers that affect groundwater extraction behaviors was contemplated by the author and is summarized in Box 2.

Ideally, groundwater well data should include five key pieces: (1) well drilling logs (information on location, depth and subsurface geology, collected at the time a well is dug or deepened); (2) groundwater elevations (information on changes over time in aquifer water level, including the preponderance of land subsidence); (3) production metering (information on how much water is pumped from a basin); (4) water quality (information that captures fluctuations in temperature, salinity and contaminants); and (5) groundwater models (representations of geology and geography, water supply and demand, and climate for groundwater planning and forecasting).

In lieu of a statistical analysis of groundwater due to the lack of adequate groundwater well monitoring data, the author of this paper constructed a model based on disaggregated data from groundwater monitor wells managed by the Los Angeles County Department of Public Works and from corresponding GRACE (Gravity Recovery and Climate Experiment) Satellite data.

Legal Regulatory Framework Linear Regression Statistical Analysis Model (Hypothetical)

1. Overarching Research Question:

Are there differences in average annual groundwater well extraction rates between Correlative groundwater rights holders and Appropriative groundwater rights holders, and if so, what variables might explain these differences?

A. The following sub-questions will guide this research project:

(1) What are the determinants of the amount of water people extract from groundwater?

(2) What is the role of legal regulatory frameworks, as one of the above determinants?

i. De Jure: How has the California Legislature formally codified these legal regulatory frameworks?

ii. De Facto: How does the execution of these legal frameworks differ from their codification?

(3) What is the relationship between the legal regulatory frameworks and the other major determinants of groundwater extraction behavior?

2. Defining the Population of Interest:

Before testing hypotheses related to this question, the population of interest must be defined. In this case, we would want to test data for groundwater rights holders, and not for those whose claims of resource ownership are legally questionable nor for those whose resource ownership claims are connected to non-groundwater resource extraction. Additionally, the population would need to be divided between those whose rights were based on the Correlative Rights doctrine and those based on the Prior Prior Appropriation doctrine. Such a division would provide additional context because it would inform when the rights were acquired, by whom, and for how long.

3. Using a T-Test to Assess a Difference in Means:

Before analyzing the variables that may explain differences in groundwater rights holders' average annual extraction rate, we must first find out whether an extraction level difference exists between these groups at all.

a. Research Question #1: *Is there a significant difference in Correlative and Appropriative rights holder's average groundwater extraction rates?*

H0: There is no difference in average groundwater extraction rates between Correlative and Appropriative rights holders ($\sigma^2_1 = \sigma^2_1$).

H1: There is a difference in average groundwater extraction rates between Correlative and Appropriative rights holders ($\sigma^2_1 \neq \sigma^2_1$).

Once the research question and the hypotheses pertaining to that question are established, we can conduct an Independent Samples T-Test.

a. Test Variable: EXTRACTION RATE

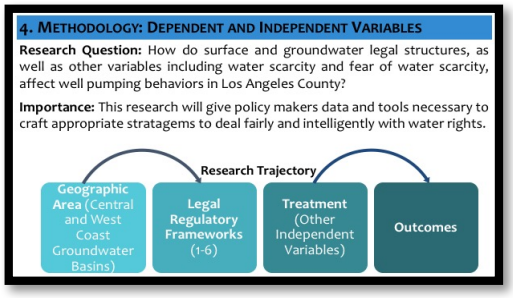
b. Grouping Variable: RIGHTS (Rights Holder's Designations as either Correlative or Appropriative)

After running the T-Test through SPSS, we look to the Equality of Variances Model.

An *F*-test is used to test if the variances of two populations are equal. Depending upon the research question, this test can be either a two-tailed test or a one-tailed test. The two-tail tests against the alternative that the variances are not equal. The one-tail tests only in one direction, *i.e.* that is the variance from the first population is either greater than or less than (but not both greater and less than) the second population variance. In this case, the test is two-tailed.

Using the *Equal Variances Assumed* model in conjunction with the F-test, we would be able to determine whether the value of |t| is > or < the 1.96 cutoff value at a two-tailed 5% significance level. If the t-value is greater than 1.96, then we reject the null hypothesis and conclude that there is a significant difference between the two groups of our population.

4. Further Analysis of Data:



This analysis could be extended in a number of ways. We could test for differences in proportions rather than differences in means (averages). This study could control for customary groundwater use practices and look for significant differences in the average groundwater extraction levels within each region at bar. If we see differences within each region, then we could say that some other variable besides regional groundwater extraction custom is influencing extraction behaviors. Additionally, this study could control for proximity to the agricultural sector, the predominant users of groundwater in the State of California, in order to observe potential differences between Correlative and Appropriative groundwater rights holders who extract from groundwater wells more heavily and less heavily relied upon by the agricultural sector for similar periods of time. If we see differences within each group, we know some other factor besides proximity to agriculture-dependent groundwater wells is influencing extraction behaviors. And, as the statistical *coup de grace*, this study would control for the legal regulatory frameworks that govern surface water and groundwater use within each region at bar. While there are five active groundwater doctrines in the United States, only two, Correlative Rights and Prior Appropriation, are deployed in California. In contrast, California's surface water sources are governed by three doctrines, Prior Appropriation, Riparianism, and Prescription. If we do not observe any difference within each region, then we would know with relative certainty that legal regulatory frameworks—the interplay between surface and groundwater doctrines in a particular jurisdiction—are primarily at play in determining rights holders' extraction behaviors.

Population increases and demographic changes would be based on census data from 1980, 1990, 2000, and 2010. Precipitation, weather fluctuations, and climate change factors will be measured based on the United States National Climate Assessment Report and other relevant resources. Groundwater basin adjudication impacts will primarily come from Blomquist (1992) seminal work on basin adjudication and management in Southern California.

Box 2: Hypothetical Linear Regression Model Given Ideal Data
Source: Author

*B. **DATA IN LIEU AND ANALYSIS***

1. RESEARCH DESIGN AND COLLECTION METHODOLOGY

a. GROUNDWATER WELL DATA FROM THE LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

The primary data source for this project came from disaggregated groundwater well data maintained by the Los Angeles County (LAC) Department of Public Works ("DPW"). Through a Google Maps powered CSV interface (Microsoft Excel compatible), the DPW identified 9,145 groundwater monitoring wells throughout the County on its map. Of the total number of wells present, only 1,097 wells remain currently active.[35] Each well is demarcated on the map by location

[35] This is due in part to aquifer water levels receding due to over-harvesting the water without giving the aquifers enough time to naturally (or artificially) recharge.

markers at their approximate locations. The location markers are also linked to a pop-up snapshot of that well's data: the well number, whether the well is active, the date of the well's last taken measurement, the figures from the date of the well's last taken measurement, and a hyperlink to a Microsoft Excel-Compatible CSV report with coded data for each well's groundwater fluctuations for its use-life.

b. Groundwater Level CSV Reports—Codes and Abbreviations

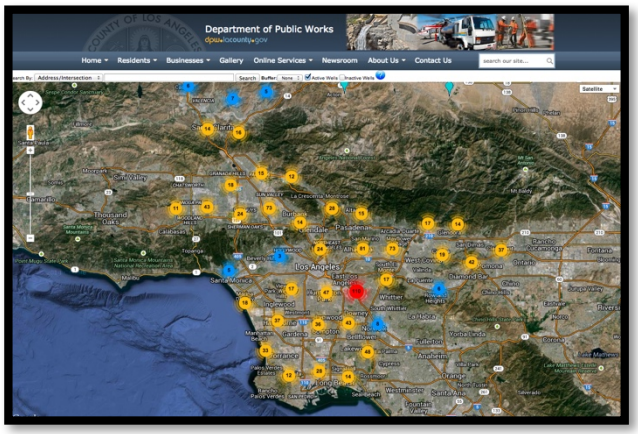


Figure 5: Map of Groundwater Wells in Los Angeles County
Source: Los Angeles County Department of Public Works

Each of the CSV reports are divided into eleven columns with a separate heading at the crest of each column. The first column included the State Well Number, which is an identification number assigned to each monitoring site. The State Well Numbers are based on the public land grid, and include the township, range, and section in which each well is located. The second column contained the measurement dates, which are the dates when the groundwater level reading was taken from that well. The third column denotes the Reference Point Elevation (listed on some reports as R.P. Elev.), which is the elevation of the point from which the groundwater level readings were taken. The reference point for a well is selected for its permanence, such as the top of casing, or the edge of a concrete pad. Some reference points are below ground surface, for example, when the well is located in a cellar. Occasionally, due to activity at the well, the reference point is changed to a more accessible point on the well. The fourth column denotes the Ground Surface Elevation (listed on some reports as (G.S. Elev.), which is the average elevation of the ground surface in the vicinity of the well. In a few cases, the ground surface elevation is determined by surveying methods. More

often, however, the ground surface elevation is determined by interpolation from a U.S. Geological Survey 7.5-minute topographic map. Thus, the accuracy of the reported ground surface elevation is a function of the contour interval of the topographic map. Most wells are located in areas where the contour interval of the topographic maps is five feet; however, some maps are accurate to only twenty or forty feet. Depth of the groundwater is listed in the fifth and sixth columns. The fifth**,** Reference Point to Water Surface (RPWS), is the measured distance between the reference point and the water level in the well. The sixth, Ground Surface to Water Surface (GSWS), is the measured distance from the ground surface to the water level in the well. The water surface elevation, listed as WSE, is the elevation of the measured groundwater level relative to mean sea level. It is calculated by subtracting the depth to water below reference point measurement from the elevation of the reference point. On some of the CSV reports is the phrase No Measurement Code (NMC). When it is not possible to measure the water level in a well, a code is entered in this field to explain the missed measurement. The valid codes used to explain NMC coding are shown in the following table. On other CSV reports is the phrase Questionable Measurement Code (QMC). When conditions at a well effect the quality of a measurement, a code is entered in this field to explain the questionable measurement. The valid codes used to explain QMC coding are shown in the following table.

Valid Codes Following NMC	**Valid Codes Following QMC**
Discontinued	Caved or deepened
Pumping	Pumping
Pump house locked	Nearby pump operating
Tape hung up	Casing leaking or wet
Can't get tape in casing	Pumped recently
Unable to locate well	Air or pressure gauge measurement
Well destroyed	Other
Special	Recharge operation at nearby well
Casing leaking or wet	Oil in casing
Temporarily inaccessible	Acoustical sounder measurement
Dry well	
Flowing well	

Table 2: Key to Groundwater Level Report Codes and Abbreviations
Source: Los Angeles County Department of Public Works. http://dpw.lacounty.gov/general/wells/

c. AGGREGATION OF SPREADSHEETS; 2013-2014 HYDROLOGIC REPORT

Once all of the CSV files were downloaded, it was necessary to aggregate the information into a single excel file from which comparisons could be made in statistical modeling software and/or other measurement software such as Matlab. In order to do this, the author first created a new Excel file and created enough tabs for the nearly 9,000 wells for which there were data. The author then copied the data from each individual CSV file into its corresponding tab in the newly created Excel file. From there, the author had to find a method of copying the data from each tab into one consolidated tab in the Excel file. To do this, the author wrote a specific macro that would consolidate all of the data from the specified range of cells in each CSV file into a summary Excel tab designated by the author. The resulting document was then compared with the Los Angeles County Department of Public Works Hydrology Report Appendix figures for 2013-2014 that measured many (but not all) of these same wells, albeit in a more abbreviated manner.

d. X AND Y AXES—MATLAB INCORPORATION OF LATITUDES AND LONGITUDES

In order to track more accurately groundwater basin level fluctuations, the author needed to ascertain the exact locations of all of the wells in the Los Angeles County Department of Public Works groundwater well network. Looking at a two-dimensional map on a computer screen of an otherwise three-dimensional landscape obfuscates the presentation of data by ignoring contours, natural land formations, natural and artificial barriers and structures, elevation changes, etc. Southern California is replete with these three-dimensional topographical features. To illustrate, groundwater in Los Angeles County is stored in basins underlying five major geographic areas, separated by geologic features that neither conform to underground water percolation routes nor

correspond to jurisdictional boundaries above ground.[36] Moreover, using the elevation measurements solely from the CSV reports from each well without more information would erroneously assume that all of the wells were placed on an even plane. Thus, it was prudent to find the latitudes and longitudes for each well and also to identify the proper coordinate reference system to use.

There are two coordinate references systems in common usage. The first of the coordinate reference systems is the World Geodetic System ("WGS"), a standard geodetic datum[37] used in cartography, geodesy (the study of the Earth's geometric shape, its orientation in space, its gravity field, as well as the changes of these properties with time), and navigation, including that used in Global Positioning Systems ("GPS"). NPS comprises a standard coordinate system for the Earth, a standard spheroidal reference surface (the datum or reference ellipsoid) for raw altitude data, and a gravitational equipotential surface (surfaces of constant scalar potential, aka the geoid) that defines the nominal sea level. The latest revision is WGS 84 (aka WGS 1984, EPSG:4326), established in 1984 and last revised in 2004.

The second coordinate reference system is the North American Datum ("NAD"), the geodetic datum coordinate system now used to define the geodetic network in North America. In surveying, cartography, and land-use planning, two North American Datums are in use: the North American Datum of 1927 (NAD27) and the North American Datum of 1983 (NAD83).

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[36] The Los Angeles County Department of Public Works operates 2,436 acres of spreading grounds and soft-bottom channel spreading areas for replenishment of local groundwater supplies. The Department of Public Works has also assisted in the operation and maintenance of 269 acres of spreading grounds owned by others. An additional 656 acres of spreading grounds are controlled maintained and operated by other agencies. Groundwater replenishment consists of storm runoff, imported water, and recycled water.

[37] A datum is a formal description of the shape of the Earth along with an "anchor" point for the coordinate system.

The WGS 84, the NAD 27 and the NAD 83 are all geodetic coordinate reference systems, but are all based on slightly different assumptions and measurements (the complexity of which is beyond the scope of this paper). Thus, in order for the data gathered to be properly observed, the author needed to determine the coordinate reference system used in establishing the longitudes and latitudes for the LAC DPW groundwater monitoring wells. The one used by the Los Angeles County Department of Public Works is the NAD 83.

Once the latitudes and longitudes were matched with the corresponding groundwater wells, it was possible to then graphically represent the change in all of the measurements over time in each of the wells. Those figures in each well were averaged together and used to create graphical representations of the average aquifer level fluctuations. Figures 6 and 7 are the result of that endeavor.

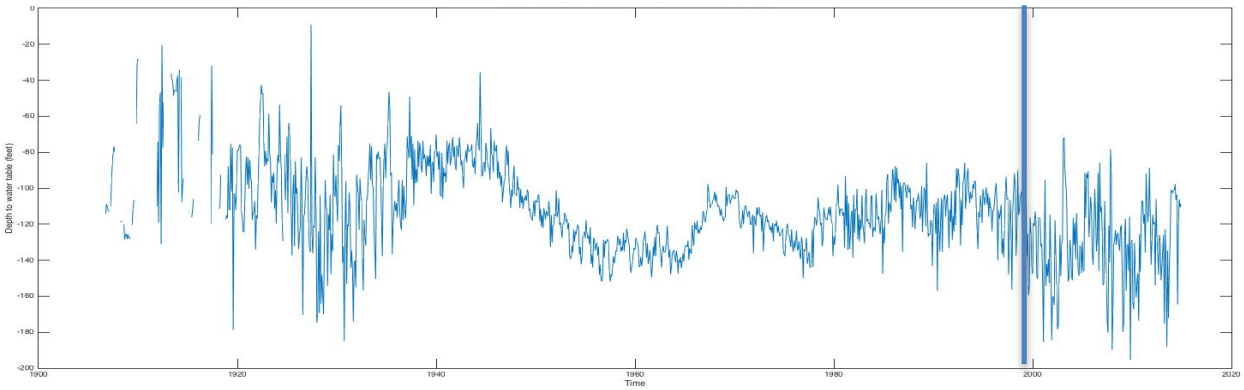

Figure 6: Los Angeles County Average Monthly Depth to Water Table, 1900-2014.
Source: Author's graphical representation of data collected from the Los Angeles County Department of Public Works Groundwater Monitoring Wells.

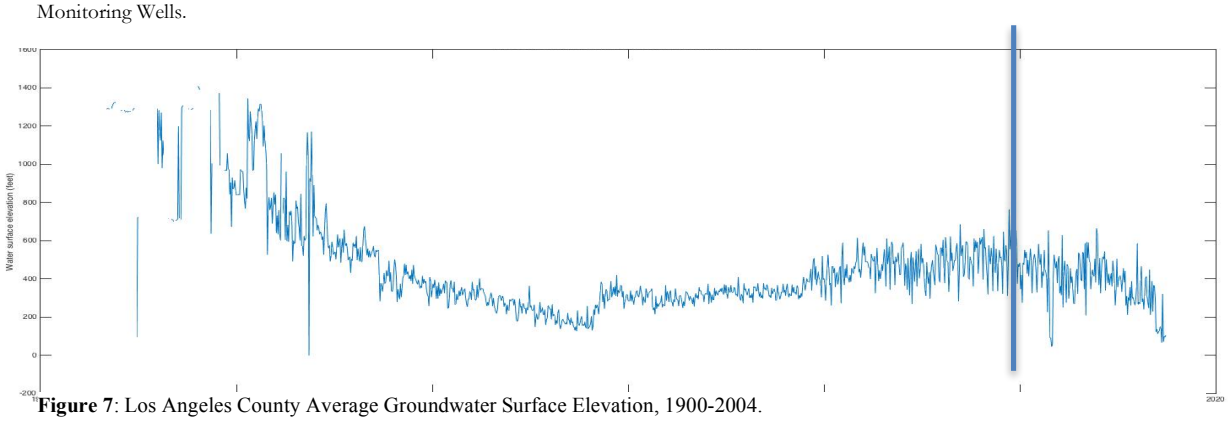

Figure 7: Los Angeles County Average Groundwater Surface Elevation, 1900-2004.
Source: Author's graphical representation of data collected from the Los Angeles County Department of Public Works Groundwater Monitoring Wells.

e. Z AXIS—GRACE SATELLITE DATA

In order to check the accuracy of the groundwater monitoring wells, these graphs of average were compared to a novel approach to quantify groundwater use based on remote sensing observations from the Gravity Recovery and Climate Experiment (GRACE) satellite mission. This research, undertaken by scientist, including Jay Famiglietti of Jet Propulsion Laboratories and the University of Irvine, assesses groundwater stress in order to quantify the relationship between groundwater use and availability (where stress is defined as a ratio of groundwater use to availability). (Richey et al., 2015; Bernstein, 2016). In a manner similar to the way Famiglietti's research compares nationally reported groundwater withdrawal statistics GRACE measurements, this research compares data from the Los Angeles County Department of Public Works groundwater well data to GRACE measurements of Los Angeles. Similarly, just as Famiglietti recognizes groundwater withdrawal statistics are unable to capture aquifer stress, so to does this research note the lack of adequate data for comparison.

The juxtaposition of the data in Graph 8 with the data in Graphs 6 and 7 beyond the dividing lines at the year 2000 show that these two measurement systems are relatively consistent with each other. This means that the measurements from the Los Angeles County Department of Public Works, while restricted in scope, are accurate and can be used in further study.

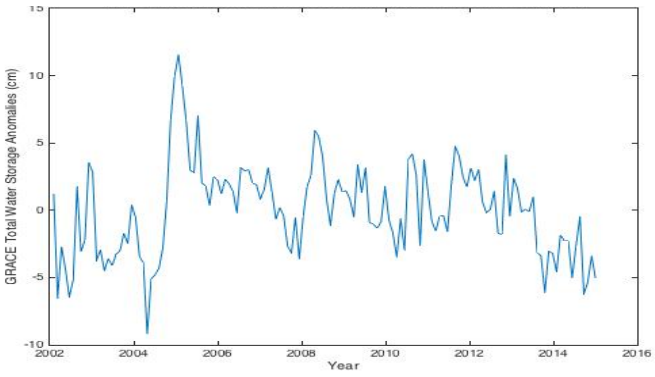

Figure 8: GRACE Changes in Total Water Storage Over Central Los Angeles, 2002-2014.
Source: Michelle Miro, UCLA Doctoral Candidate in the Hydrology and Water Resources Department and Advisee to Jay Famiglietti.

EPILOGUE: MORE OF THE SAME?

The SGMA gives localities a tremendous amount of work to do, particularly with regard to the implementation of its monitoring and data collection obligations, within a short period of time. The interrelated issues of fragmented governance and the challenges of cutting back on existing pumping present extraordinary challenges for localities. What remains clear is that in order for the SGMA to produce any qualitative benefit, the Legislature must do the following: (1) discontinue its practice of grandfathering existing groundwater use rights allocations that are the cause of much of the excessive extraction of groundwater; (2) harmonize surface and groundwater legal regulatory schemes either by legislative or judicial action that has binding precedential force; (3) imbue the relevant executory agencies (GSAs in the case of the SGMA) with the powers of eminent domain and the financial means to activate it with regard to privately held groundwater use rights holders; (4) provide the relevant executory agencies with adequate and comprehensive data gathering systems that encompass all public and private use wells; (5) hold the relevant executory agencies accountable for the quality and quantity of their monitoring of groundwater aquifers and users; and (6) authorize these agencies to use police powers to effectively enforce groundwater use and meaningfully penalize those who violate imposed groundwater use restrictions in order to deter abuse in the future. Without these six essential components, any legislation passed that purports to manage groundwater in a sustainable way merely pay lip service to a critical and timely issue.

A. OTHER LIMITATIONS AND UNINTENDED CONSEQUENCES OF THE SGMA

The SGMA has other limitations. Developed over short period in a hurried and chaotic manner, the SGMA has produced a confusedly organized document full of ambiguous provisions (Sawyers, 2014). Combined, the three bills contained in the SGMA are over 100 pages in length,

laden with excruciating detail in some places and lacking specificity in others. A substantial amount of litigation is expected despite clarifying documents from the DWR. [38]

Additionally, an unintended consequence of the SGMA is its limited ability to coordinate fragmented authority over groundwater management. While the SGMA requires some degree of central, basin-level management, it does not require a single governing body or management plan in each basin, and instead places the responsibility of coordinating the development of groundwater sustainability agencies ("GSA") and groundwater sustainability plans ("GSP") on multiple local and regional agencies within each basin.[39] As stated above, one of the SGMA's major concessions was maintaining local control, where the State would provide oversight from a distance, and would intervene to provide technical and financial assistance in reviewing GSPs, to monitor implementation of those GSPs, and to take the helm only in the event of non-action by local agencies in formation of adequate GSAs and/or GSPs.[40]

Another unforeseen consequence of the SGMA is that by labeling basins as low- or very low-priority, the Act has left approximately three hundred and eighty-eight (388) groundwater basins

[38] Groundwater overdraft often leads to conflicts between groundwater users seeking to protect their groundwater rights. While the actual number of conflicts between groundwater users is difficult to determine, a study by Nelson (2014) documented fifty-five (55) groundwater-surface water conflicts across the state between 2008-2012, demonstrating that the majority of conflicts result from reduced surface water flows and impacts to groundwater-dependent flora and fauna caused by groundwater pumping. The study represented a diverse community of disputants, including local and national nongovernmental organizations, and surface water-dependent water utilities

[39] The SGMA offers three potential methodologies for GSA formation. First, it offers the centralized GSA model, characterized by a single functioning agency responsible for formation and implementation of the GSP. This will likely take the form of joint powers authority ("JPA"), a special district, a county, or a water district. The second proposal is that of the distributed GSA model, which implies the creation of multiple GSAs within a single basin that are coordinated by, and given specific tasks through, an MOU agreement. The third model is a combination model, where a centralized GSA assumes some responsibilities while other GSAs within the same basin assume the remaining responsibilities. The form of the GSA will likely determine its function as well as the appropriate distribution of authority between participating agencies.

[40] For example, the Act does not affect land use decisions—although the Act requires that existing and future water supplies meet GSA land use plan requirements, it does not explain how such changes should be incorporated into GSPs, nor does it authorize GSAs to limit land use developments based on anticipated water shortages.

outside the scope of the Act. Assuredly, these basins are encouraged to develop GSAs and GSPs voluntarily. However, there is no mechanism to force compliance. Although, as discussed below, these low- and very low-priority basins constitute less than four (4%) percent of California's annual groundwater use, if left unconstrained, groundwater pumping in these basins could yield future adverse impacts.

A third unintended consequence of the SGMA is the legal uncertainty it generates by leaving crucial terms undefined. For example, "Undesirable Results" and "Significant and Unreasonable" both lack clear criteria or explication, and as such, may require lengthy adjudication to resolve.

Fourth, the legal effect and force of the SGMA is not yet known. Prior to the enactment of the SGMA, groundwater management planning was voluntarily undertaken. In order for the SGMA's mandates to be successful:

> "A credible threat of State intervention will be critical…If groundwater agencies do not believe that the State is willing to step in and take over management of the basin if deadlines or objectives are not being met, then in certain basins there will be limited motivation or long-term commitment to take the difficult actions required to achieve sustainable management goals." (Gould, 2015).

B. ***SILVER LININGS OF THE SGMA***

While the SGMA may have flaws and can be scrutinized ex-post facto with the benefit of twenty-twenty hindsight, the Act does have some benefits. Enactment of the Act makes it significantly easier to initiate an action to adjudicate all claims of a right to extract groundwater from a basin. It also requires relatively quick disclosure of evidence supporting a party's right to extract groundwater, potentially streamlining what had previously been a lengthy and expensive adjudication process. Thus, landowners may soon find themselves involved in a global adjudication of groundwater rights, and will need to gather quickly and provide to other parties documentation and evidence required to support their claimed rights. Indeed, landowners located in affected basins

have already begun gathering information and engaging the consultants and counsel needed to establish their claims.

Additionally, the SGMA allows courts to impose on objecting parties proposed stipulated judgments supported by only some of the parties to the adjudication. Because these new procedures may make comprehensive groundwater adjudication more viable—an attractive option for efficiently determining parties' water rights and priorities—the number of actions filed may significantly increase in the short term, but in the long term result in greater permanence and legitimacy in rights allocations. Moreover, final court rulings will also be able to resolve the issue of over-allocated groundwater basins by redefining rights based on current water levels rather than based on water levels at the times the rights were originally allotted.

C. WHAT REMAINS TO BE DONE?

While there are many proposed suggestions for further mitigation of groundwater depletion during the SGMA implementation period, two main ones have come to the fore: (1) accelerating implementation of the SGMA, and (2) placing a de facto moratorium on new groundwater extraction wells. Of the former, attempts to accelerate SGMA implementation are unrealistic and will place an undo burden on already resource-limited local and State agencies.

Of the latter, the authority granted to GSAs to curtail groundwater well extraction directly by groundwater rights-holders is undermined by the sacrosanctity of individual property rights. The SGMA makes clear that it does not undue existing water rights, whether grandfathered or adjudicated (Water Education Foundation 2015). Indeed, GSPs that include any reductions in groundwater pumping must respect California's groundwater priority rights, which could constrain GSAs' abilities to effectively manage groundwater. Moreover, the lack of clarity with respect to the

property rights system itself means that groundwater users could assert that measures in a GSP violate their property rights, again requiring resolution from lengthy adjudications.

Efforts to limit new wells would require either (1) appeals to the common good rather than punishment for a violation of the Act—carrot rather than stick—or (2) indirect infringement on groundwater use-rights by imposing arduous administrative and procedural requirements in reporting to GSAs such that continued drilling and extracting becomes inefficient and uneconomical to continue. Perhaps the most viable short-term solution is that of state government playing a larger, more aggressive role. However, doing this would require abrogating a central tenet of the SGMA—arguably a facet of the law that was necessary to garner enough political support in the legislature—that of devolution to local government.

The SGMA, while opening the door for litigious action in many different areas that may take years to resolve, is unprecedented and may be the touchstone for future, meaningful groundwater resource conservation efforts by the State of California. One can only hope that momentum builds up from here rather than evaporates.

APPENDICES

A. ***DEFINITIONS***

1. **Common Law**— the body of law constituting the basis of the legal systems in all states of the United States except Louisiana. The common law tradition of case-by-case judicial rulings based on custom and case-law precedent among other things is derived from the English legal tradition, in contradistinction to civil law, statutory law, ecclesiastical law, or Roman law.
2. **Groundwater**—water that collects and/or flows beneath the soil surface, filling porous spaces in sediment and rock. Groundwater originates from rain and mountain snowpack melt that percolates through the surface substrate and settles underground in either slow-moving subterraneous rivers or collection caverns. The upper surface of groundwater is called the **Water Table**.
3. **Legal Regulatory Framework**—the operationalization of both a surface water and a groundwater doctrine in a particular jurisdiction. The following are the common law doctrines governing water in the United States.
    i. **Correlative Rights**—a groundwater doctrine that provides each landowner with a right as a **Tenant-in-Common** with other landowners to use water from a common source (typically an aquifer) situated beneath a parcel of property for a beneficial purpose. The amount of water each landowner is entitled to use is commensurate with the amount of land owned by each landowner on the surface above. However, landowners are not given the prerogative to seriously deplete a neighbor's water supply. In the event of water shortage, courts may apportion an underground supply among

landowners. Many states facing acute or chronic shortages have adopted the Correlative Rights Doctrine of under-ground water rights.

4. **Critical Overdraft**—As defined in the SGMA, "A basin is subject to critical overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts."
5. **Groundwater Sustainability Plans (GSPs)**—must include a physical description of the basin, including groundwater levels, groundwater quality, subsidence, information on groundwater-surface water interaction, data on historical and projected water demands and supplies, monitoring and management provisions, and a description of how the plan will affect other plans, including city and county general plans. GSPs can build upon existing groundwater plans.
6. **Prescription**—a method of acquiring a non-possessory interest in land through the open, continuous, exclusive use of land belonging to another under a claim of right for the statutorily determined period of time. It differs from **Adverse Possession** in two ways: First, Prescription refers to the use of the property of another whereas Adverse Possession refers to the acquisition of title to the property of another (usually through quiet title). Second, Prescription requires the possession to be open, exclusive, and continuous for the statutory period, whereas Adverse Possession requires the possession to be open, notorious, hostile, exclusive, and continuous for the statutory period.
7. **Prior Appropriation (aka Appropriative Rights)**— the legal doctrine that the first person to take a quantity of water from a water source for "beneficial use" has the right to continue to use that quantity of water for that purpose. There are four essential elements to the Doctrine: intent, diversion, beneficial use, and priority. Each water right

has a yearly quantity and an appropriation date. Each year, the user with the earliest appropriation date (known as the "senior appropriator") may use up to their full allocation (provided the water source can supply it). Then the user with the next earliest appropriation date may use their full allocation and so on. In times of drought, users with junior appropriation dates might not receive their full allocations, if at all. When a water right is sold, it retains its original appropriation date. Only the amount of water historically consumed can be transferred if a water right is sold. Subsequent users can use the remaining water for their own beneficial purposes provided that they do not impinge on the rights of previous users; this is the priority element of the doctrine. In addition, a user may not change the intent in which he is appropriating water such that the change hinders the use by another. In general, water rights are unconnected to land ownership, and can be sold or mortgaged like other property. These rights can be lost over time if non-use of the water source is demonstrated or if the water has not been used for a certain number of years (in other words, if a water right is not used for a beneficial purpose for a period of time it may lapse under the doctrine of abandonment). "Beneficial use" is commonly defined as agricultural, industrial or domestic/household use. Ecological purposes, such as maintaining a natural body of water and the wildlife that depends on it, were not initially deemed as beneficial uses in some Western states but have subsequently been incorporated into the definition in some jurisdictions. The extent to which private parties may own such rights varies among the states. For water sources with many users, a government or quasi-government agency is usually charged with overseeing allocations.

8. **Riparianism**— a system for allocating water among those who possess land along its path. All landowners whose properties adjoin a body of water have the right to make reasonable use of it as it flows through or over their properties. If there is not enough water to satisfy all users, allotments are generally fixed in proportion to frontage on the water source and/or augmented based on priority (a Riparian/Prior Appropriation hybrid model). These rights cannot be sold or transferred in any instrument other than with the adjoining land and only in reasonable quantities associated with that land. Neither can the water be transferred out of the watershed without due consideration as to the rights of the downstream Riparian landowners. The reasonable use of the water by a Riparian owner is subject to the downstream riparian owners "riparian right" to receive waters undiminished in flow and quality. However, since all surface waters eventually flow to the public ocean, federal regulatory authority under the Clean Waters Act, like the Clean Air Act, extends beyond only public (navigable) waters to prevent downstream pollution. Any Riparian right is subordinate to the public right to travel on the river, but any public right is subject to nuisance laws and the police power of the state. Because a finding of navigability establishes state versus federal property, navigability for purposes of riverbed title establishes federal question subject matter jurisdiction pursuant to the Federal Rules of Civil Procedure ("Fed. R. Civ. P."); the states retain residual power to define navigability for the purposes of defining the "public trust" over water within their borders (*i.e.* lands or resources that the sovereign holds in trust for public use such as the shoreline between the high and low tide lines, regardless of private property ownership). The states could divest themselves of title to the streambed, but the water remains under federal control subject to the Commerce Clause of the Constitution which by holds an

easement or equitable servitude (property law concepts), benefiting the federal government for the purpose of regulating commerce on navigable bodies of water. In determining the contours of Riparian rights, there is a clear distinction between navigable (public) waters and non-navigable waters. The land below navigable waters is the property of the state, subject to all the public land laws. Navigable waters are treated as public highways with any exclusive Riparian right ending at the "ordinary high water mark." The Pennsylvania State Supreme Court defined the "ordinary high water mark" as the "ordinary low water mark, unaffected by drought; that is, the height of the water at ordinary stages." *Appeal of York Haven Water & Power Co.*, 212 Pa. 622 (1905). Land beyond the low water mark belongs to the state government in the case of the 13 original states (and upon ratification of the U.S. Constitution, title to these lands remained vested in "the several states"), while lands between the high and low water marks are subject to the police powers of the states. As new lands were acquired by the United States, either by purchase or treaty, title to the highways and the beds of all navigable or tidal lakes, or rivers became vested in the United States unless they had been validly conveyed into private ownership by the former sovereign. During the territorial period, the United States held these "in trust" for the benefit of the future states that would be carved out of the territory. Each of the states were to come into the Union on an "equal footing" with the original thirteen (13) states, thereby vesting these new states with the same sovereign title rights to wetlands as the original thirteen (13) states. Ownership of the submerged lands was resolved by Congress passing the Submerged Lands Act, which affirmed state title to the beds of all tidal and navigable bodies of water. While the Act conveyed title to lands below tidal and navigable waters to the states, non-navigable

streambeds were treated like dry lands and are part of the adjoining estates. Waters subject to the ebb and flow of the tides, even if non-navigable, also passed to the states, but the ownership and public use of these tidal lands is based on state laws.

9. **Hydrology**—the study of the movement, distribution, and quality of water (generally of surface water) on Earth and other planets, including the hydrologic cycle, water resources and environmental watershed sustainability.
10. **Hydrogeology**—the area of geology that deals with the distribution and movement of groundwater in the soil and rocks of the Earth's crust.
11. **Sustainable Groundwater Management**—The management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results. Undesirable results include any of the following effects caused by groundwater conditions occurring throughout the basin: (a) chronic lowering of groundwater levels, but excluding levels during droughts if years of fecundity are offset by years of fallowness; (b) significant and unreasonable reductions in groundwater storage; (c) significant and unreasonable seawater intrusion; (d) significant and unreasonable degradation of water quality; (e) significant and unreasonable land subsidence; and (f) surface water depletions that have significant and unreasonable adverse impacts on beneficial uses.
12. **Sustainable Groundwater Management Act**—AB 1739 (Dickinson), SB 1168 (Pavley), and SB 1319 (Pavley).
13. **The Tragedy of the Commons**—an economic theory involving shared-resources where individual users acting rationally according to their own self-interests behave contrary to the common good of all users by depleting a resource.

B. *THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT OF 2014*

1. *OVERVIEW*

On September 16, 2014, the Governor signed into law a three-bill legislative package: AB 1739 (Dickinson), SB 1168 (Pavley), and SB 1319 (Pavley). These laws, collectively known as the Sustainable Groundwater Management Act ("SGMA"), purport to instigate "management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results," (California Water Code § 10721(u)). The SGMA outlines a process and a timeline for local authorities to achieve sustainable management of groundwater basins, by placing them into priority level categories and empowering them to act on the bases of those priority designations. It also establishes benchmark deadlines, displayed in Table 3 below.[41]

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[41] Full Timeline as Presented in the SGMA:

Deadlines That Have Passed:

Sept, 16, 2014: Groundwater management legislation becomes law. Gov. Brown signs Senate Bill 1168, Assembly Bill 1739, and Senate Bill 1319, which made up the groundwater management legislation package.

Jan. 1, 2015: Legislation goes into effect. The Sustainable Groundwater Management Act becomes effective.

Jan. 31, 2015: DWR must establish initial groundwater basin priority. Cal. Dept. of Water Resources ("DWR") establishes the initial priority – high, medium, low or very low – for each groundwater basin in the state by the end of January 2015 (Water Code § 10722.4).

Jan. 1, 2016: DWR must set emergency regulations for basin boundary revisions. DWR adopts emergency regulations for groundwater basin boundary revisions by Jan. 1, 2016. The regulations must include the methodology and criteria used to evaluate proposed boundary revisions, including the establishment of new subbasins (Water Code § 10722.2).

June 1, 2016: DWR must establish emergency regulations for evaluating plans. DWR adopts emergency regulations for evaluating Groundwater Sustainability Plans ("GSPs"), their implementation and coordination agreements among local agencies for sustainability planning. The regulations must identify GSP components and information to assist plan and coordination agreement development and implementation (Water Code § 10733.2).

Deadlines Still to Come:

Dec. 31, 2016: DWR estimate of water available for groundwater replenishment due. DWR publishes its estimate of the water available for groundwater replenishment on its website (Water Code § 10729(c)).

Jan. 1, 2017: Basin deadline to submit alternative to a GSP. Medium- and high-priority basins choosing to meet sustainability objectives by ways other than groundwater sustainability planning (which includes not forming a Groundwater Sustainability Agency ("GSA")) must submit their alternatives to DWR (and then again every five years). (Water Code § 10733.6).

Jan. 1, 2017: DWR will establish best management practices for sustainable management. DWR publishes best management practices for the sustainable management of groundwater on its website (Water Code § 10729(d)).

June 30, 2017: Deadline to form a GSA. A local agency or agencies in each high- or medium-priority groundwater basin must have officially formed one or more ("GSAs") for the entire basin (Water Code §§ 10724, 10735.2(a)(1)).
Sustainable Groundwater Management Act Timeline Page 1

June 30, 2017: State Water Board can begin to put basins on probation. The State Water Resources Control Board (State Water Board) can initiate probationary status to a medium- or high-priority basin if the basin lacks one or more GSA(s) that covers the entire basin or no alternative has been approved (Water Code § 10735.2(a)(1)).

Time	Action
6/30/2017	Formation of GSAs
1/31/2020	Completion of GSPs in Critically Overdrafted basins
1/31/2022	Completion of GSPs in all other basins
1/31/2025	Intervention delayed 2 years in areas with significant impacts to surface waters
20-year implementation period	Implementation of local GSPs to achieve sustainability

Table 3: Major Deadlines Outlined in the SGMA
Source: Williams, K. (2015). *Regional Groundwater Workshop*. California Water Foundation.

The Cal. Dept. of Water Resources ("DWR") evaluated California's 515 groundwater basins identified in Bulletin 118-2003 (discussed above) and categorized them into four priorities: (1) high priority; (2) medium priority; (3) low priority; and (4) very low priority. The CASGEM basin prioritization identified forty-three groundwater basins as high priority, eighty-four basins as medium priority, twenty-seven basins as low priority, and the remaining three hundred and sixty-one (361) groundwater basins or sub-basins as very low priority. The 127 groundwater basins designated as high or medium priority include ninety-six (96%) percent of the annual groundwater use and eighty-eight (88%) percent of the population overlying the groundwater basin area. (U.S. Dep't of

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July 1, 2017: Those pumping in a probationary basin must report extractions. Pumping groundwater in a basin that either has been designated as a probationary basin or lies outside a GSA's management area must be reported to the State Water Board. These reporting requirements do not apply to those extracting for domestic purposes 2 acre-feet per year or less, and some others (Water Code §§ 5202, 10724).

Jan. 31, 2020: GSPs required for Critically Overdrafted basins. Basins designated as high- or medium-priority and subject to critical conditions of overdraft must be managed under a GSP or GSPs. The State Water Board can initiate probationary status for all or part of a basin if there is no GSP, if the GSP is inadequate, or the GSP implementation will not likely achieve sustainability (Water Code § 10720.7(a)(1), 10735.2(a)(2), 10735.2(a)(3)).

Jan. 31, 2022: GSPs required for all remaining high- and medium- priority groundwater basins. All remaining basins designated as high- or medium-priority must be managed under a GSP or GSPs. The State Water Board can initiate probationary status in 2022 for all or part of a basin if there is no GSP, if the GSP is inadequate, or the GSP implementation will not likely achieve sustainability except for basins where groundwater extractions result in significant depletion of interconnected surface waters (Water Code § 10720.7(a)(2), 10735.2(a)(4), and 10735.2(a)(5)(A)).

Jan 31, 2025: State Water Board actions where extractions impact surface waters. The State Water Board can initiate probationary status for those medium- or high-priority basin where the GSP is inadequate or implementation is not likely to achieve sustainability AND the basin is in a condition where groundwater extractions result in significant depletion of interconnected surface waters (Water Code § 10735(a)(5)(B).

Jan. 31, 2022 -2024: DWR completes evaluation of all GSPs. DWR must evaluate and issue an assessment of a GSP within two years of submission by a GSA. DWR may include recommendations for addressing any deficiencies in the GSP (Water Code § 10733.4(d)).

Jan. 31, 2040 - 2042: Basins must achieve sustainability. A GSP must include measurable objectives and milestones in increments of five years to achieve sustainability within 20 years of GSP adoption (Water Code § 10727.2(b)(1)).

Ag., 2015)[42] Under the Act, high and medium priority basins that are subject to critical conditions of overdraft must be managed by a groundwater sustainability plan ("GSP") by January 31, 2020 (California Water Code § 10720.7(a)(1)) and requires all other groundwater basins designated as high or medium priority be managed under GSPs by January 31, 2022 (California Water Code § 10720.7(a)(2)).

2. GSAs AND GSPs

The legislation provides for financial and enforcement tools to carry out effective local sustainable groundwater management through formation of Groundwater Sustainability Agencies (GSAs). As explained above, GSAs made up of one or more local agencies overlying a groundwater basin will be required to develop Groundwater Sustainability Plans (GSPs).[43] The legislation provides options for local agencies to develop the required GSPs. Agencies may opt to create a single plan covering the entire basin, or knit together multiple plans created by multiple agencies. A plan must include measurable objectives and interim milestones to achieve the sustainability goal for the basin within a 20-year time frame. The plan also must include a physical description of the basin, including information on groundwater levels, groundwater quality, subsidence and groundwater-surface water

[42] USGS data divides groundwater uses into eight (8) use-categories: (1) Public Supply; (2) Domestic; (3) Irrigation, (4) Livestock; (5) Aquaculture; (6) Industrial; (7) Mining; and (8) Thermoelectric. These use-categories do not adequately reflect the proportion of water used in urban and suburban agriculture for lawn maintenance or productive crop land. While the largest use-category is thermoelectric power generation, there should be a category that disaggregates the Public Supply category between domestic uses for human consumption (ingestion, waste, etc.) and landscape maintenance. Those sub-categories should then be aggregated into the Irrigation use-category.

Of total fresh groundwater withdrawals (76,000 Mgal/d), irrigation accounts for sixty-five (65%) percent, primarily in California, Arkansas, Texas, and Nebraska. Fresh groundwater irrigation withdrawals in these four States cumulatively accounts for forty-two (42%) percent of the national total fresh groundwater withdrawals. Nearly all groundwater withdrawals—ninety-six (96%) percent—were from freshwater, and irrigation used greater than three times more fresh groundwater than public supply, which was the next largest use of groundwater in the Nation.

In December 2014, DWR confirmed that the classifications it announced in June 2014 through the California Statewide Groundwater Elevation Monitoring System ("CASGEM") would be used in conjunction with the law.

[43] For more information, refer to Appendix A.

interaction; historical and projected data on water demands and supplies; monitoring and management provisions; and a description of how it will affect other plans, including county and city general plans.

GSAs responsible for high and medium priority basins must adopt GSPs within five to seven years, depending on whether the basin is in Critical Overdraft.[44] Agencies may adopt a single plan covering an entire basin or combine a number of plans created by multiple agencies. Preparation of GSPs is exempt from the California Environmental Quality Act ("CEQA").

a. NEWS TOOLS FOR LOCAL AGENCIES

The legislation gives local agencies new tools to manage groundwater sustainably. For example, groundwater sustainability agencies may: (1) Require registration of wells and measurement of extractions; (2) Require annual extraction reports; (3) Assess fees to implement local groundwater management plans; and (4) Request a revision of basin boundaries, including establishing new sub-basins, etc. However, as explained briefly above, these tools do not include the ability to restrict individual Riparian, Appropriative, Prescriptive, or Correlative groundwater extraction rights.

3. PROBATIONARY STATUS

In general, the State Water Resources Control Board may designate a basin as "probationary" if, after consulting with DWR, it is found that a groundwater sustainability plan has not been created, the plan is inadequate, or the plan is not being implemented in a way that will lead to sustainability. Specifically, the State Board may designate a basin as probationary if: (1) No local agency has formed a groundwater sustainability agency for the basin by the June 30, 2017, deadline; (2) No groundwater sustainability plan has been adopted for a high- or medium-priority basin in Critical Overdraft by the Jan. 31, 2020, deadline; (3) No groundwater sustainability plan has been adopted for a high- or medium-priority basin not currently in Critical Overdraft by the Jan. 31, 2022,

[44] For more information on Critical Overdraft, refer to Appendix A.

deadline; (4) After Jan. 31, 2020, the groundwater sustainability plan for a basin in Critical Overdraft is found to be inadequate or is not being implemented to achieve sustainability; (5) After Jan. 31, 2022, the groundwater sustainability plan for any other high- or medium-priority basin is found to be inadequate, or is not being implemented to achieve sustainability, and the State Board determines the basin is in a condition of long-term overdraft; or (6) After Jan. 31, 2025, a groundwater sustainability plan is found to be inadequate, or is not being implemented to achieve sustainability, and the State Board determines that groundwater extractions are resulting in significant depletions of interconnected surface waters. If a local agency fails to respond to a deficiency within 180 days, the State Board is authorized to create and develop an interim plan that would remain in place until a local groundwater sustainability agency is able to take over and manage the basin sustainably.

4. ROLE OF THE DWR

The Groundwater Sustainability Program Strategic Plan (Strategic Plan) describes the Cal. Dept. of Water Resources' ("DWR") roles and responsibilities under the SGMA and outlines related actions from the California Water Action Plan ("CWAP"). This Strategic Plan aims to document DWR strategy in helping to implement groundwater sustainability; share information with those who have interests in or management responsibilities for groundwater; and describe the structure through which DWR implements specific actions in coordination with stakeholders and partners. DWR and the State Water Resources Control Board ("SWRCB") are the two State agencies charged with helping to implement recent groundwater legislation. DWR's principal role is to provide guidance and support to local agencies across California to help them achieve a more sustainable future in water management.

DWR's SGM Program will implement the new and expanded responsibilities identified in the SGMA. Some of these expanded responsibilities include: (1) developing regulations to revise

groundwater basin boundaries; (2) adopting regulations for evaluating and implementing GSPs and coordination agreements; (3) identifying basins subject to critical conditions of overdraft; (4) identifying water available for groundwater replenishment; and (5) publishing best management practices for the sustainable management of groundwater.

To these ends, DWR has published several published the Batch 2 GSP Discussion Papers on the following topics:

- Topic 1 - Pre-SGMA Conditions and Undesirable Results (June 16, 2015)
- Topic 2 - Measureable Objectives and Interim Milestones (June 16, 2015)
- Topic 3 - Land Use and County Involvement (June 16, 2015)
- Topic 4 - Alternative GSP Submittals (August 3, 2015)
- Topic 5 - Boundaries – Overlapping and Unmonitored Areas (August 3, 2015)
- Topic 6 - Intra-Basin Coordination Agreements (August 3, 2015)
- Topic 7 - Water Budgets and Coordination (forthcoming)
- Topic 8 - State Agency Coordination forthcoming)
- Topic 9 - Data Collection, Management, and Reporting (forthcoming)
- Topic 10 - Adaptive Management and Focus Areas (forthcoming)

a. TOPIC 4-ALTERNATIVE GSP SUBMITTALS

The topic of Alternative GSP Submittals, and what constitutes an alternative approach to a GSP (Alternative GSP), are identified in California Water Code (Water Code) § 10733.6. Select provisions of the Water Code related to this topic are provided in this document. Should a local agency elect to submit an Alternative GSP, rather than prepare a GSP in accordance with Water Code §10727 *et seq*., the Alternative GSP must be submitted to DWR no later than January 1, 2017, and every five years thereafter.

1. Code Sections related to § 10733.6:

a. 10750.1. Limitation on Authority to Adopt New Plans.

(a) Beginning January 1, 2015, a new plan shall not be adopted and an existing plan shall not be renewed pursuant to this part, except as provided in subdivision (b). A plan adopted before January

1, 2015, shall remain in effect until a groundwater sustainability plan is adopted pursuant to Part 2.74 (commencing with § 10720).

(b) This section does not apply to a low- or very low priority basin as categorized for the purposes of Part 2.74 (commencing with § 10720).

(c) This section does not apply to a plan submitted as an alternative pursuant to § 10733.6, unless the department has not determined that the alternative satisfies the objectives of Part 2.74 (commencing with § 10720) on or before January 31, 2020, or the department later determines that the plan does not satisfy the objectives of that part.

b. 10733. Department Review of Plans.

(c) The department shall evaluate whether a groundwater sustainability plan adversely affects the ability of an adjacent basin to implement their groundwater sustainability plan or impedes achievement of sustainability goals in an adjacent basin.

c. 10733.6. Alternative Submittals.

(a) If a local agency believes that an alternative described in subdivision (b) satisfies the objectives of this part, the local agency may submit the alternative to the department for evaluation and assessment of whether the alternative satisfies the objectives of this part for the basin.

(b) An alternative is any of the following:

(1) A plan developed pursuant to Part 2.75 (commencing with § 10750) or other law authorizing groundwater management.

(2) Management pursuant to an adjudication action.

(3) An analysis of basin conditions that demonstrates that the basin has operated within its sustainable yield over a period of at least 10 years. The submission of an alternative described by this paragraph shall include a report prepared by a registered

professional engineer or geologist who is licensed by the state and submitted under that engineer's or geologist's seal.

(c) A local agency shall submit an alternative pursuant to this section no later than January 1, 2017, and every five years thereafter.

C. (d) The assessment required by subdivision (a) shall include an assessment of whether the alternative is within a basin that is in compliance with Part 2.11 (commencing with §10920). If the alternative is within a basin that is not in compliance with Part 2.11 (commencing with § 10920), the department shall find the alternative does not satisfy the objectives of this part.

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