Reconciling Institutional Levels of Water Governance and Management for the Monterey Peninsula Water Supply

A Thesis

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Abstract

Water managers in the West are faced with multiple and compounding challenges from climate change, spatial-administrative complexity, legal uncertainty and increasing demand from population, industry and environment needs. This article thus assesses the current state of water management in California by specifically looking at the fragmentation of governance and management and the variable management schemes proposed to solve the problems. As current management has resulted in delays and failures, new political factions and economic and environmental burdens have added new stresses for water managers. My study area is the Central Coast of California specifically the geographic region of the Monterey Bay, with a specific focus on the Monterey Peninsula (MP), Carmel Bay and South Monterey Bay Region. The methodology consists of a qualitative examination of water governance and management responses in the region through interviews, analysis of documents and materials, and direct observations of practices. The results demonstrate that decentralized management in CA has led to multiple dimensions of jurisdictional fragmentation and legal uncertainty relevant to all water managers in the state. Furthermore, the paradigm shift that is taking place in water management towards a more integrative and adaptive framework is hampered by these barriers and has been slow to take effect. Thus, further research is necessary to monitor this shift and to document ways to overcome current legal and political-administrative barriers.

Introduction

Water management in California (CA) is a complex and extensive system of agencies, infrastructure, and historical circumstance. The complexity is due to a water supply and demand dilemma, a decentralized system of governance and a complex state water code (Doremus & Hanemann 2008; Lund et al. 2009; Hedges 2011). Current management schemes have managed to deliver water yet, at a price, and have failed in a large part to protect the environment and as a result of a crisis in water management models a scarcity is present (Bakker 2010; Hanak et al. 2011). In addition, managers are challenged due to increasing pressures on the water supply from population and industrial growth, groundwater over-drafting leading to salt-water intrusion and decreased surface flows for ecosystems while laws continue to require larger in-stream flows. These challenges are also predicted to be compounded by the effects of climate change (deBuys 2011). Thus, it is recognized that broad holistic management that is adaptive and integrative is necessary to meet current and arising challenges.

Analyzing the multiple layers of governance and management and the barriers to effective management is necessary to address in order for changes to be made to allow for adaptation to the oncoming challenges. While many studies have examined the central system few have examined areas separate from the state water distribution system (Kallis et al. 2009; Hanemann & Dyckman 2009). The Central Coast of California has been largely left out of this discourse and presents a unique case due to the multiple and overlapping institutions involved and the complexity and longevity of the local issues. Thus, the driving question this research seeks to explore is what the challenges and possibilities are for reconciling the differential scales of water management and jurisdiction on the Central Coast, specifically the South Monterey Bay & Carmel Bay Area**.** I argue that due to a perverse and pervasive set of agencies & stakeholders involved there is fragmentation of water management jurisdictions which are complicated by legal uncertainties for these management projects under current California water statutes; resulting in delays, failures, political clout and economic and environmental burdens.

There are three principal dilemmas that water managers face, in California, which parallel the arguments made by Bakker (2010) for other regional contexts. The first is the competition between multiple users' common-pool resources. Second, tenuous relationships between users are due to the multiple scales at which water is managed (scaled governance). Lastly, responding to the mismatch between geopolitical and administrative boundaries, on the one hand, and hydrological boundaries on the other. Thus, this work addresses the literature on common pool resources (Hardin 1969; Ostrom 1990), governance & scale (Cash et al. 2006; Huitema et al. 2009; Termeer et al. 2010), and jurisdictional fragmentation (Doremus 2009; Hanak et al. 2011; Lubell & Lippert 2011). Furthermore, I also address the growing literature on legal uncertainty in CA (Foley-Gannon 2008; Hedges 2011).

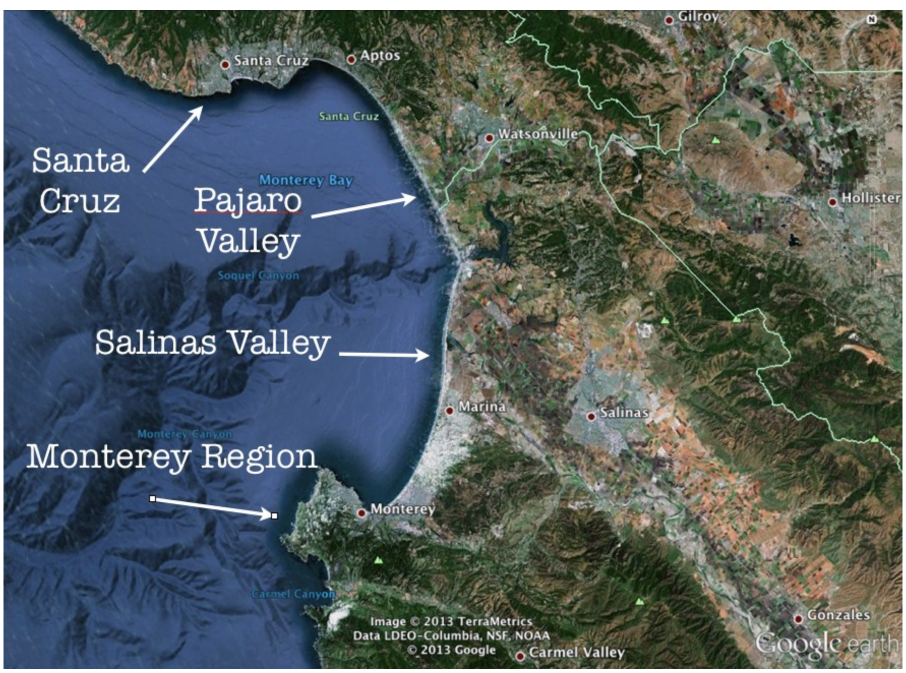
While literature has focused on the general larger scale management, the importance of analyzing small case studies is recognized to determine the empirical application and results of much of the theory (Huitema et al. 2009; Engle et al. 2011) Thus, the Monterey Region on the Central Coast presents the opportunity of a small case study where all three dilemmas are present as the area relies on two main water sources that have both been over used and over allocated to competing users with multiple scales of oversight that don't necessarily align with resource boundaries. Additionally, jurisdictional fragmentation is reflected in Monterey because of the many agencies competing to manage, govern, and allocate water in the basins. On the other, hand multiple informants cited “legal uncertainty” as one of the barriers that creates doubt in exploring further possibilities in conjunctive management. This latter point is especially novel, since most concerns over water in the American West have to do with the scientific uncertainty of forecasting water shortages in drought periods, although legal uncertainty is clearly evident in dealing with indigenous water rights and allocations (Reisner 1993; Bark et al. 2012). By “legal uncertainty,” however, I am not arguing that the law is necessarily unclear for the state. Rather, local administrative units, such as municipalities and counties, are constrained by their legal jurisdiction over questions of state-level water resources. Conjoined with legal uncertainty, however, this appraisal sheds light on how managers are faced with a political and legal atmosphere that hampers timely decision making leading to economic, environmental and political costs. Due to this history of complexity, this area shares much in common with other parts of the West. Only through increased transparency, collaboration, and legal and political support and resources will managers be able to overcome these challenges.

Methods

The methodology of this study entails a qualitative examination of water governance and management in California (Marshall & Rossman 1998; Creswell 2003). The region for this case study was chosen because it is representative of the changing dynamics of water management due to the complexity and history of the state of California. Both formal and informal interviews were conducted with a variety of stakeholders who are involved in the governance and management of water current water sources that include surface, ground, recycled and desalinated water. By investigating the roots of water management challenges though examining the various stakeholder positions, allows for an in-depth understanding of the scalar levels, managerial styles and competing legal understandings in California. Lastly, an examination of how adaptive management and integrated management are being proposed or used on the Central Coast is central in understanding how current decisions are influenced and how future decisions will be executed.

The case study took place in the geographic region of Monterey Bay, with a specific focus on the Monterey Peninsula (MP), Carmel Bay and South Monterey Bay region which will be referred to as the Monterey Region (MR). To diversify regional responses participants were contacted from various regions around the Monterey Bay including the regions of Santa Cruz, Pajaro Valley and the Salinas Valley, see Figure 1.

Figure 1. Map of the Monterey Bay with the cities of Santa Cruz, Watsonville and Monterey indicating the various regions of study (Google earth, 2012).



Local experts and stakeholders including local & private agencies, lawyers, & NGO's were contacted to participate in either semi-structured interviews or email questionnaires (Marshall & Rossman 1998; Creswell J 2003). A total of seven semi-structured interviews were conducted either in person or on the phone, and four email questionnaires were conducted via e-mail. This period of contact lasted from June 2012 to May 2013 and included five general managers (GMs) of water agencies, three attorneys working on water issues, and two non-governmental organizations (NGOs). Initial research was conducted during the months of November and December in 2009, and composed of eight semi-structured interviews from various NGO's, a general manager and an involved citizen that laid the groundwork for this study. Many other individuals were contacted however due to the timing of this study, many ongoing court and legal proceedings, many were unavailable for comment. While the total sample of respondents may appear small, these interviews were held with the principal experts involved and entrenched with water management in this California basin. Thus, they are representative of the majority of views on water in this region, and how the basin fits in with the larger mosaic of California water management and policies. This study does not pretend to capture all of the views or complexity of the issue. Lastly, questions were tailored towards different stakeholders to be relevant, yet a general specific set of questions was asked for analysis and validity across the spectrum, see Appendix.

Additional methods include analysis of documents & material, direct observation and triangulation (Marshall & Rossman 1998; Creswell J 2003) Direct observation occurred by attending a stakeholder meeting in Monterey concerning a water use fee for implementing certain alternative water projects, recording and notes were used.

Documents & materials from various institutions were gathered and analyzed, including reports, legal outcomes & proceedings, charts, newspaper articles, public opinions, etc. (Marshall & Rossman 1998; Creswell J 2003). Triangulation of the data was used to validate responses and formulate general outcomes across the data set (Marshall & Rossman 1998; Creswell J 2003).

The qualitative research methods as described were performed in order to contextualize the local case study into the broader theoretical knowledge of water governance & management. The research seeks to provide an example framework for local analysis in a politically turbulent and complex setting such as the Central Coast.

Background on Study Area

"Other than the Sacramento-San Joaquin River Delta, the Colorado River, and the Truckee-Tahoe water systems, the Carmel River water system is probably the most actively and complexly managed water system in California. This is a consequence of how little water there is to allocate, the attempts to avoid environmental harm, the endangered species present, and the multiple jurisdictions involved" (Kevan Urquhart as cited in March 2011)

The Monterey Peninsula is home to about 115,000 residents and is a semi-arid coastal region that is entirely dependent on local rainfall for its water supply as imported water is not an option (IRWMP, 2007). Due to its geography and rainfall patterns the region is prone to severe droughts and as a result has been through many periods of moratoriums and rationing (March 2012). The region depends on two sources of water, surface water from the Carmel River Watershed and groundwater from the Seaside Groundwater Basin, see Figure 2 (CPUC, 2012).

Figure 2. The two sources of water supply for the Monterey Region: The Carmel Watershed & the Seaside Groundwater Basin (MPWMD, 2013).

Due to overuse both sources currently legal restrictions applied to them and thus the region is seeking alternatives to augment its water supply (March 2012).

The Carmel River Watershed includes the Carmel River a 36 miles long coastal river and its tributaries and the Carmel Valley Alluvial Basin, which together drain a 255 square mile watershed, with an average participation of 20.33 inches per year and runoff of 78,190 AF (IRWMP, 2007; MPWMD, 2013). Historically the river was very healthy and was written about by local authors such as Robert Louis Stevenson, Roberson Jeffers and John Steinbeck who described the river in his novel Cannery Row as, "...a lovely little river. It isn't very long but in its course it has everything a river should have" (1945, 13). However, due to water development 3 dams and 21 wells used by the local water provider California American Water (CalAm) have strangled the river (March 2012).

This became relevant starting in the "...late 80's there was another extensive drought, 4 years long, that combined with minimal run off and increased pumping from the aquifer to meet the increased demand the river did not connect to the ocean for 4 years" (Frank Emerson, pers. comm., 23 November, 2009). As described by Mr. Emerson of the Carmel River Steelhead Association, the Carmel River "...is an unreliable supply of water, trying to use that, trying to turn it into a reliable supply has devastated the river and its wildlife" (2009). Thus, the watershed now has many species of status species, which have been listed as "threatened" or "endangered" by the State or Federal Government, and the two main "threatened" species of concern are the Steelhead Trout (*Oncorhynchus mykiss*) and the California Red Legged Frog (*Rana aurora draytonii*) (CPUC 2009). As a result of the damage being done to the river in 1999, the river appeared on "America's Top Ten Most Endangered Rivers" list by the national advocacy group American Rivers (American Rivers 2002).

The damage was also recognized in 1995 by the California State Water Resources Control Board (SWRCB) with its issuance of Order No. WR 95-10 which found that California American Water (CalAm), the local private water purveyor, did not have a legal right to 10,730 acre-feet a year (AFY) of the water it was pumping from the Carmel Valley River or a 70% reduction from what it was then withdrawing (SWRCB 1995a). At the same time of this decision SWRCB's issued Decision 1632, a dam permit for the expanding the capacity of the Los Padres Dam that would have legalized its diversions, furthermore "The dam permit that was issued by the SWRCB was the last on stream reservoir permit to be issued in the state of CA" (Marc Del Pierro, pers. comm., 8 Aug 2013). However, the dam permit for financing was shot down by voters like five other projects that had preceded it due to either political or legal reasons (SWRCB 2009a; MPWMD 2013).

While the region is heavily dependent on the Carmel River Watershed for water it has also, increasingly over the last 20 years, augmented its supply with water from the Seaside Groundwater Basin, and as a result of the groundwater production the basin was exceeding its 'Natural Safe Yield' and saltwater intrusion was present (CPUC, 2012). As a result the basin was adjudicated in 2006 and a 13-member group, called the Watermaster, was appointed by the Monterey Superior Court with the goal "to ultimately reduce the drawdown of the aquifer to the level of the Natural Safe Yield; to maximize the potential beneficial use of the Basin; and to provide a means to augment the water supply for the Monterey Peninsula" (California American Water v. City of Seaside et al. 2006; cited in California American Water v. City of Seaside 2010, 4) As a result CalAm's allowed take was reduced from 4,000 AFY to 1,474 AFY with a 10% yearly decrease to meet the 'Natural Safe Yield' (CPUC, 2012). Furthermore, two years later in 2009 the SWRCB finally cracked down on its Order 95-10 by issuing a cease and desist order (CDO), *ORDER WR 2009-0060* finding that CalAm failed to meet Order 95-10 and continued to divert 7,150 AFY without a valid right and subsequently mandated a yearly decrease in pumping to come into compliance with Order 95-10 by the start of 2017 (SWRCB 2009a).

In 2012 a project, which was proposed first in 2004, entitled the Coastal Water Project (CWP) also known as the Regional Project, was approved by the CPUC. However, the project failed due to conflict-of interests suit, litigation that resulted in the identification that water rights were not fully addressed in the final environmental impact report (FEIR), as well as various technical and political issues (CPUC 2012; Brennan 2013) Following this failure CalAM submitted a request during the summer of 2012 for a Certificate of Public Convenience and Necessity (CPCN) for the Monterey Peninsula Water Supply Project (MPWSP), A.12-04-019, before the California Public Utilities Commission (CPUC 2012). The current project proposes a three pronged portfolio approach including the use of desalination (desal), aquifer storage and recovery (ASR) and groundwater replenishment (GWR) to meet the supply gap as a result of the CDO and Seaside Basin Adjudication (CalAm 2013). The current proposed project is mainly the same project that was previously approved; yet, the seawater intake system and location of the desalination plant have been changed (CPUC 2012). However, numerous issues and tensions have flared in regards to the current project as they did with the last. There are also two other desal project vying for the spot. Thus, there is much contention over the legal rights of the source water, public vs. private ownership, governance and cost of the desal plant, the timeline for the permitting process, and representation in the decision making process (Brennan 2013). Furthermore, meeting the deadline of the CDO is problematic (Brennan 2013). Overall, at the time of writing this paper the current project is in hearings before the California Public Utilities Commission (CPUC) where thirteen organizations are presenting testimony before the Administrative Law Judge and a much anticipated decision is due later this year (Johnson 2013). Summarizing the water situation in the MR Mr. Stoldt, General Manager (GM) of the MPWMD explains, “Our district is disconnected from the state water project so we have to solve our supply needs locally. We have two sources of supply – the Carmel River and the Seaside groundwater basin. Both are over drafted and are under legal orders to reduce production. The shortfall will have to be made up from new projects, desalination and advanced treated wastewater that is expensive and politically charged" (pers. comm., 26 March 2013).

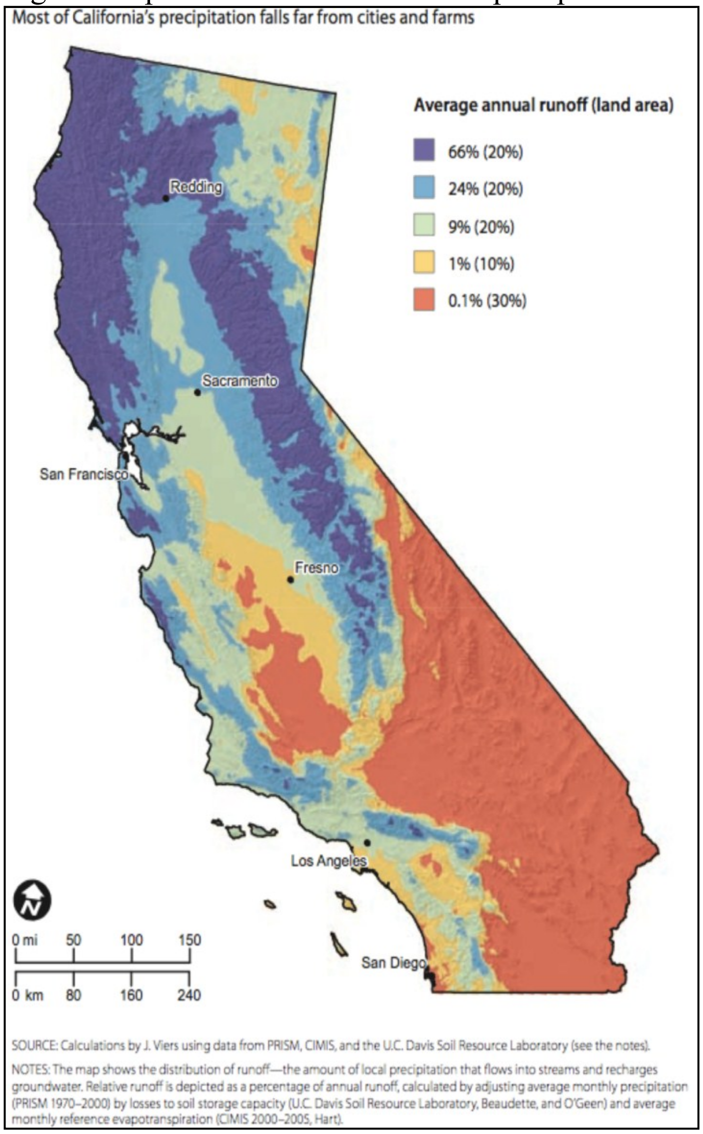
The problems faced by the MR are a small example of many problems that are common across the West. Analyzing these issues in this small setting can provide insights into the general themes across the West and the possibility for reconciling differential scales of water management and jurisdiction that are largely fragmented and uncertain. In the next section a background of the larger scale issues present in the West is addressed along with some of the reasons that lie behind these issues.

A Review of Water Challenges in the West

Water in the West: Variable and Extreme

A general theme across the arid-Southwest and especially in California is that water supply and demand do not match in space or time. The spatial component is due to the majority of its population & agriculture being based in the South, a semi-arid to semi-desert region where the least amount of precipitation falls as some areas receive less than 4 inches per year, while the majority of precipitation falls in the North with areas receiving upwards of 140 inches per year (DWR 2006, p. 2-1). In fact two-thirds of all precipitation falls to the north of Sacramento, while two-thirds of the water demand is in the South, see Figure 2. (Doremus & Hanemann 2008).

Figure 2. Spatial distribution of water precipitation on California (Hanak et al 2011, 4).



Adding to the spatial complexity most of the precipitation falls on the interior mountains, while the majority of the population is located along the coastal regions. In a spatially diverse state, this spatial aspect of water posed and continues to pose a challenge for water managers.

The temporal aspect comes from a Mediterranean Climate that makes it the only state in the US that has a truly seasonal rainfall pattern, stone-dry for a good part of the year and wet during the rest as described by one stakeholder “California has a drought every year, that's the weather pattern, it's not a mystery it only rains for a few months out of the year" (Frank Emerson, pers. comm., 23 November, 2009; Reisner 1993; Doremus & Hanemann 2008) Furthermore, temporal variability includes cyclical drought cycles due to quasi-periodic climatic forcings from weather phenomenon's such as El Niño/Southern Oscillation (ENSO) & Pacific Decadal Oscillation (Gurdak Hanson & Green, 2009). Yet, this temporal variation is not visible to inhabitants of these arid regions as John Steinbeck described in his book *East of Eden*, "And it never failed that during the dry years the people forgot about the rich years, and during the wet years they lost all memory of the dry years. It was always that way" (1952).

These temporal and spatial elements to water supply and demand are prevalent to various extents throughout the West, and as a result every major river basin has been clogged full of water projects in the past century to try to deal with this dilemma, halting some of the world's major rivers, building some of the biggest projects in history. As a result like many other states across the West it is said that water flows uphill toward money and power (Glennon 2002; Reisner 1993; deBuys 2011).

California Institutions of Water Governance & Management

While just like the temporal and spatial elements of the water supply, the institutions that oversee water management have varying temporal and spatial elements. Water governance in terms of management and policy is implemented from a decentralized system of around 3,000 water districts and agencies in California (Lund, et al. 2009). The institutions that play a role in this governance are highly scalar ranging from federal agencies such as the US Bureau of Reclamation to state agencies such as the State Water Resources Control Board (SWRCB) to regional water agencies such as the

Metropolitan Water District of Southern California to even local agencies such as the Monterey Peninsula Water Management District (MPWMD). This institutional diversity is often advocated as it is considered to allow for a flexible resource base, innovation, local expertise, localized accountability, and a sounder financial base (Dinar et al 2007). Yet, there are consequential challenges to effective coordination as government support can be slow and often suffers from jurisdictional fragmentation and an absence of sustained leadership (Hanak & Lund 2012). Thus, political-administrative boundaries in some circumstances may pose a challenge to effective management. While political and jurisdictional fragmentation is common due to the decentralized management system, jurisdictional uncertainty from law, policy and regulatory compliance also pose a challenge to effective water management (Foley-Gannon 2008; Hedges 2011)

Aspects of Water Law in California

This governance complexity is not lessened by California's complex water code. This code stems from the evolution of western water law that is predicated on mining and western agriculture practices stemming from the Homestead and Mining acts of the 1800's (Reisner, 1993; Glennon 2002). Yet, the goal of this work is not to recant the history of water law in the West (Reisner, 1993; Wilkinson 1992; Shaw 1992; Pisani 1996; Sax 2002; Andreen 2006) as California has a long, fascinating, yet sometime perplexing history of water law. This history has led to the formation of current water law in the West and has been a large influence on the governance and management schemes that are present today.

Hybrid System

" We are hindered by our mining heritage, in terms of use it or lose it and decertification of wasting water in order to bolster the right" (Aengus Jeffers 2012, pers.comm., 13 Jul 2013)

California and some other states use a hybrid system of riparian and appropriative rights. These hybrid states originally recognized riparian rights, yet preserved these rights while converting to a system of appropriation (Getches, 2009). Yet, overlying, prescriptive & pueblo, rights are also acknowledged (Getches 2009). Riparian rights are inherent to land that borders a waterway, and do not need to be exercised to be kept alive. A 'reasonable' amount of water can be used as long as the 'natural flow' is not hampered; if there is overuse all users decrease their use (Gretches 2009). Lastly, these rights cannot be lost like prior appropriation rights unless someone obtains a "prescriptive right" by diverting for five or more years without an explicit challenge (Gretches 2009).

Prior Appropriation stems from the early settlement of the American west, specifically the early miners in California, whom sought out water for their operations on public land, thus they did not have ownership and consequently no riparian rights. Thus, reverting back to the rules for minerals, 'first in time, first in right', as a result a water law developed in western states known as 'beneficial use' where usage of the water determined the right (Gretches 2009). Yet, this type of allocation system creates enormous inefficiencies by ignoring the economic value of the activity, thus treating low and high value uses alike (Glennon, 2002). Compared to a system of pueblo water rights where the allocation is according to need not priority, a stark contrast to appropriation, yet it is the basis for water rights in the West (Glennon 2002).

As prior appropriation developed ground water was largely unacknowledged and as a result law followed suit. Surface water and groundwater are interconnected in the hydrologic cycle, yet the legal system treats them separately thus at odds with hydrologic reality (Glennon 2002). There are three recognized categories of water in CA, surface streams, groundwater referred to as ‘percolating groundwater’ and subterranean streams, treated the same as surface streams. Surface water is extensively regulated by the state through a permit system, yet groundwater has remained effectively unregulated (Foley-Gannon 2008).

Groundwater Law

Though the regulation of groundwater has been considered on several occasions, the California Legislature has repeatedly held that groundwater management should remain a local responsibility (Sax 2002)

California has little legal authority over groundwater; as groundwater management still remains in its infancy in most areas (Glennon 2002). Surface and groundwater law are separate in the California Water Code and California is not authorized to manage groundwater in the Water Code. Thus, California is only one of two states, the other being Texas, that does not have statewide regulation of groundwater allocation or management (Foley-Gannon 2008). Furthermore, California was the first state to adopt a system of “correlative rights” that provides groundwater to be shared by all property owners above an aquifer (Glennon 2002). As a result of the legal code and a lack of state wide legislation groundwater is managed by a patch work quilt of local regulatory bodies with varying control, yet in many areas there are no restrictions or management whatsoever.

The state has developed three indirect basic methods to allow for local groundwater management: local ordinances, special act districts and adjudicated basins. The local ordinances come from local city and county governments’ authority, due to their inherent police powers, to implement groundwater ordinances. Currently 28 out of the 56 counties in the state having some kind of ordnance, yet most only require a permit to export extracted groundwater (Hedges 2011). Special Act districts can be created by voters for a variety of purposes from waste management to irrigation districts that have varying authority over groundwater rights. The legislature can also create water districts with specific regulatory authority as it did to create the Monterey Peninsula Water Management District, in 1977, with the goal to “To Manage, Augment, and Protect Water Resources for the Benefit of the Community and the Environment” (MPWMD 2013). These special-act districts usually have broader authority then voter created water districts (Hedges 2011). The last method and probably most effective is court adjudication. There are currently 22 adjudicated groundwater basins in California; the Seaside Groundwater Basin is one of these (DWR 2013). In these basins all rights have been determined by a judge and all parties pay fees to a water master who is in charge of managing the basin, usually with the goal of bringing it out of overdraft and into the region of sustainable yield. These are usually the most rigorous groundwater management systems in the state (Foley-Glannon 2008; Hedges 2011).

Water’s Economic Importance

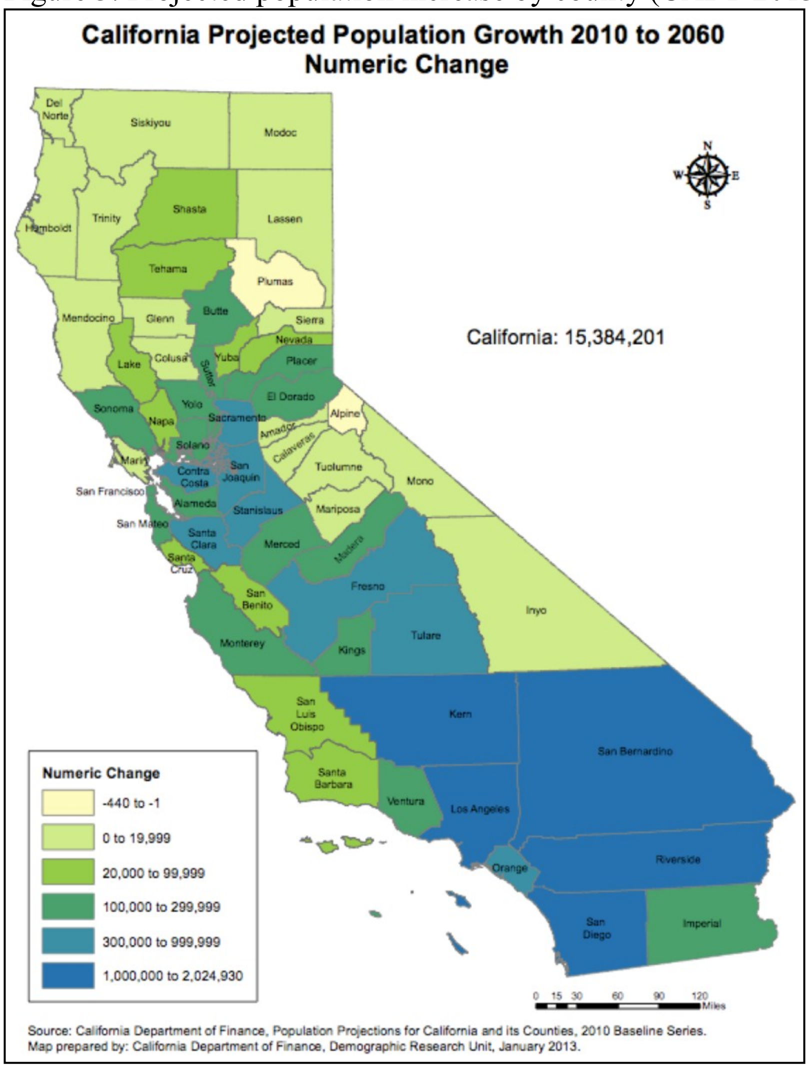
While water managers deal with spatial, temporal, legal & political complexities they have been able to provide water throughout California's rapid growth. As a result, water is an integral part of California’s economy and has led to its impressive development. California has the 9th largest economy in the world, which is very dependent on water (CCSECE, 2012). A major part of this dependence comes from agriculture, since California is home to the San Joaquin Valley, the most productive and richest agricultural region in the world. Overall there are 25.4 million acres of farm land in production leading to a $43.5 billion agricultural industry that is the most productive in the country and is a significant water user, 80% of supply, and thus a major influence in water politics (Reisner 1993; DOA 2012; Canessa Gree & Zoldoske 2011) The Monterey region alone supports a $3.85 billion agriculture industry, the number one vegetable producing region in the nation and boasts over a $2 billion tourism industry (FBM 2011).

Water management is also an important part of the state's economy with public and private agencies ranging from small business to federal programs. Just looking at the local, state, & federal agencies in the water management system there is an estimated direct input of $34 billion with $14-23 billion in value added and the direct employment fifty-three thousand people with indirect employment of many thousands more through consulting, law, engineering and construction (Hanak et al. 2012). With the projected need for sustainable water strategies to meet the needs of the 21st century water challenges, a recent study has found that there are substantial opportunities for job growth in the sector within 136 proposed occupations and a range of 5-72 jobs per million invested in various areas such as alternative water sources, stormwater management, urban and agriculture efficiency, and restoration and remediation and other areas (Moore et al. 2013). The drivers of these sustainable water management strategies come from federal, state, and local levels and are a range of regulatory, financial, and educational drivers.

Growth & Environmental Pressures

There are many pressures on the future of water supply in California that need to be considered by managers. Population and economic growth continue to add new demands for water in competition with other uses such as environmental needs. California is the most populous state with 38.0 million people and is expected to gain another 15 million people by 2060 (Census Bureau 2012; CADF 2013). The Central Coast region in particular Monterey County is expected to gain 100,000-300,000 people by 2060 as seen in Figure 3 (CADF 2013).

Figure 3. Projected population increase by county (CADF 2013, 7).

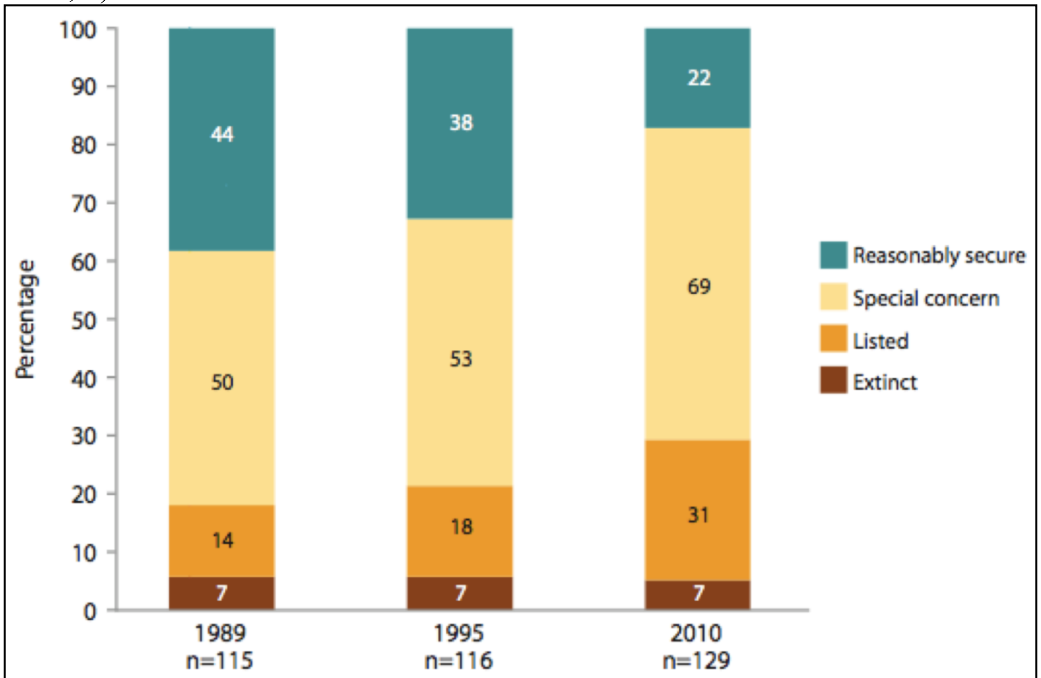


While growth is increasing, as we are moving through the 21st century we are reaching the limits on take of water from water systems, like the Colorado, Sacramento-

San Joaquin River and Carmel River systems. The majority of the large scale water infrastructure was designed and built during the 20th century through federal and state investments and as water infrastructure networks have the longest turnover rate time of any utility (Bakker 2019). Thus, managers are faced with constraints of old system infrastructure and now any new project faces many hurdles from environmental regulation, to the lack of good sites, to cost effectiveness. Furthermore, environmental water demands are increasing thus even the current diversions have been limited (Hanak et al. 2011).

The full demand for environmental water has been hard to represent, since there has been no comprehensive studies or measurements (Hanak et al. 2012). Yet, societal demand for healthy watersheds is reflected in environmental laws passed such as National Environmental Policy Act (NEPA), the Clean Water Act (CWA), and the Endangered Species Act (ESA), as well as state similar state laws beginning in the late 1960s and 1970s. This sentiment is also relevant in voters' approval of over $30 billion in state water bonds since 1970, much of which has been spent on water quality and environmentally related water issues (Hanak et al. 2011). Due to strains on native fish, of which a quarter are listed as threatened or endangered under federal and state laws, while more than half are still in decline despite increased awareness in the policy and science fields (Figure 4), environmental requirements will increase (Hanak et al. 2011, 2012).

Figure 4. Visualization of California's native fish species in sharp decline (Hanak et al 2011, 6).



SOURCE: Moyle, Katz, and Quiñones (2010).

NOTES: Extinct = extirpated from California; listed = listed as threatened or endangered under state or federal Endangered Species Acts; special concern = species in decline that could qualify for listing in the future; reasonably secure = widespread, abundant species according to current knowledge.

Fortunately, despite these challenges, water managers have a good record of adapting to supply challenges and stresses such as major droughts, 1976-77 and 1988-92, population growth and increased protection for aquatic ecosystems, and as a result have brought much innovation into the field through non-traditional water management techniques (Hanak & Lund 2012). However, while they have been good at adapting to supply challenges the environment has not improved as seen by the increase in number of species now listed or of special concern (Hanak & Lund 2012). As a result many regions are facing scarcities as environmental and groundwater restrictions come into play (Hanak et al. 2011; March 2012).

Climate Change: Changes in Water Availability and the Freshwater System

The spatial-administrative complexity, population and industrial growth, as well as aquatic ecosystem needs may all be potentially exacerbated by the anticipated effects of climate change (DWR 2009; Hanak et al. 2011). Climate change projections from across the board for the Western states indicate decreased snow pack, changing runoff patters, more intense storms and higher air temperatures (Bates et al.et al. 2008, Barnett 2008). Studies pertaining specifically to California point to changes in discharge rates, runoff patterns and time periods while having a higher impact on dammed drainages vs. free-flowing basins; sea-level rise, and increased evapotranspiration rates, leading to some projections predicting water shortages of more then 20% statewide by 2050 & indicate the agriculture sector as the most vulnerable (Anderson et al. 2008; Palmer et al. 2008; Connell-Buck et al. 2009; DWR 2009a; deBuys 2011; Hanson et al. 2012).

The full effects of climate change are not fully understood, yet recent research on extreme weather events between 1948 and 2011 points to an emerging trend of larger and more frequent storms. The research found a dichotomy, a North-South split, in the pattern of extreme precipitation events centered on the San Francisco Bay with a 26% decrease in frequency to the North and a 35% increase to the South (Madsen & Willcox 2012; Miller 2012). This pattern has been predicted in climate models as well (Georgakakos et al. 2012). This could pose yet another problem to water managers as the current water infrastructure has most of its storage and distribution based in the North. Overall, climate change adds much uncertainty for management, policy and planning on top of already uncertain hydrology, water demands and institutions in California (deBuys 2011; Lund & Hanak 2012).

Looking locally at the Central Coast, a study looking at a watershed basins in the

Santa Cruz region found reduced early and late wet season runoff, thus an extended dry season regardless of the direction precipitation changes, more or less. Hence, there is an overall projected increase in water deficit (Flint & Flint, 2012). Furthermore, sea level rise is projected to be in the range of 1.0-1.4 meters then today's levels by the year 2100 under medium greenhouse gas emission scenarios. This will increase saltwater intrusion into coastal aquifers especially for over-drafted aquifers, thus threatening water security for groundwater basins such as the Seaside, Pajaro and the Salinas Valley (Barlo & Reichard 2009; Heberger et al. 2011). In the seaside basin one in-depth study found groundwater extraction to be the dominant factor in inducing sea water intrusion into the sub-basin, yet sea-level rise did increase intrusion as well (Loaiciga Pingel & Garcia 2012). Hence, regional studies are necessary to determine the impacts of sea-level rise and managers need to plan accordingly.

California is taking steps to limit Climate Change that will affect water management. In 2006 Assembly Bill (AB) 32, the Global Warming Solutions Act of 2006, was signed into law. The act requires the state to reduce GHG emissions back to 1990 levels by 2020; this correlates to roughly a third decrease as compared to business as usual. Additionally, Executive Order S-3-05 calls for emissions to be reduced to 80 percent below 1990 levels by 2050 while accommodating projected growth in its economy and population, which when factored in correlates to a 90% reduction from baseline (AB 32, 2006; Executive Order S-3-05, 2005; Greenblatt et al. 2012). As a result of the executive order in 2005 the state is requiring reports on the effects of climate change in several areas of governance, one being water resources. As a result the California Department of Water Resources (DWR) in 2006 issued the first report to incorporating climate change predictions into the scope of management of water resources throughout the state and has since included these uncertainties (DWR 2006; DWR 2009a).

These steps could help limit the effects of climate change; however, these new emission targets will also pose a challenge for water management. Water related energy use consumes nearly a fifth of the state's electricity, 30 percent of the non-power plant natural gas and 88 billion gallons of diesel a year (CEC, 2009). Current water supply projects to augment water supply such as desalination and water reuse can be energy intensive (Cooley et al. 2006; SWRCB 2009b). Consequently, water managers will also need to consider the power consumption and the types of energy sources that are part of the supply portfolio.

Increased stress on water resources due to a variety of compounding affects ranging from growth to climate change indicate a strong need for holistic**,** adaptive & integrated water management to build a resilient system in California as threats span across complex hydrological, managerial & legal scales and boundaries. If management strategies that increase the resilience & flexibility of the water supply through choosing water innovative management options are effectively implemented, studies point to their impact on reducing the compounding impacts of climate change and growth on the California's water supply (Tanaka et al. 2006; Medellin-Azuara et al. 2007; Hanak & Lund 2012; Georgakakos 2012). For example, many experts predict that management adaption's such as conjunctive use will play a significant role in California's water supply, particularly in a warmer and dryer climate (Medellin-Azuara et al. 2007; Connell-Buck et al. 2009) Therefore, examining the current efforts, challenges and possibilities in a local context and in-turn applying alternative management styles can provide great insights into what barriers and opportunities exist for local managers.

Literature Review: Dilemmas Faced by Water Managers

As mentioned in the introduction, the literature on water management is vast and includes many topics such as: the intricacies of common pool resources, scalar levels of governance in management, private and public debate, specific types of management, jurisdictional fragmentation and legal uncertainty. Given this vast base of literature on water governance, I have limited my treatment to the works that pertain to the main barriers faced by managers as described by Bakker (2010) with an emphasis on my specific regional context.

Governance

A Common Pool Resource: The Need for Water Institutions

Management of surface and groundwater, with the interconnected nature of the hydraulic cycle, is difficult due to the inherent nature of common pool resources (CPRs), the difficulty to exclude users and the possible effects on third parties (Ostrom et al. 1999; Dietz Ostrom & Stern 2003; Heikkila 2004). This difficulty is apparent around the world and especially in California where a history of environmental damage is well known due to over use of surface water and groundwater (Ostrom et al. 1999; Ostrom 2009; Hanak et al. 2011)

Common property theory has been evolving since Hardin's controversial work entitled "Tragedy of the Commons", in which he argued that the commons are finite and when rational, independent, free-enterprisers interact with the commons, it can lead to ruin for all (1968). He proposed two possible solutions: first, mutual coercion in the form of what many took to mean central government, and second, that of privatization (private property rights). Hardin's conception of the commons has been criticized for being oversimplified (Hardin 1969; McCay & Acheson 1987; Ostrom et al. 1999). It is now held that the dichotomous "private and government management" options are neither the only solutions to managing CPRs nor the most flexible, as group management and property rights are another viable alternative with the involvement of nested institutions in larger settings (Ostrom et al. 1999). A combination of the three types of coercion in the form of either governance or property rights (Table 1) poses the basis for general institutional arrangements regarding the management of CPRs (Ostrom et al. 1999).

Table 1. The main types of property-rights systems that can be used to regulate common-pool resources (Ostrom et al. 1999, 279).

Property rights	Characteristics
Open access	Absence of enforced property rights
Group property	Resource rights held by a group of users who can exclude others
Individual property	Resource rights held by individuals (or firms) who can exclude others
Government property	Resource rights held by a government that can regulate or subsidize use

Yet, 40 years later scholars point towards the difficulty of governing CPRs, such as groundwater, due to resource system diversity. As resources differ both temporally and spatially, given the diversity of social economic settings, it is recognized that no single 'ideal' solution fits all circumstances as commons are diverse and the socio-ecological systems (SESs) are complex (Ostrom 2010). As a result, many empirical studies and theoretical analysis of governance have been performed to seek out principles for sustainable governance of CPRs (Ostrom 1990; Dietz Ostrom & Stern 2003; Pahl-Wostl 2009; Ostrom 2009). These general principles for the sustainable governance of CRPs, as seen in Figure 5, have emerged from studies of long-enduring institutions that governed sustainable resources.

Figure 5. The eight design principles for sustainable governance of CPRs (Source: Anderies Janssen & Ostrom 2004, 8; Adapted from Ostrom 1990).

1. *Clearly Defined Boundaries*
The boundaries of the resource system (e.g., irrigation system or fishery) and the individuals or households with rights to harvest resource units are clearly defined.

2. *Proportional Equivalence between Benefits and Costs*
Rules specifying the amount of resource products that a user is allocated are related to local conditions and to rules requiring labor, materials, and/or money inputs.

3. *Collective-Choice Arrangements*
Most individuals affected by harvesting and protection rules are included in the group who can modify these rules.

4. *Monitoring*
Monitors, who actively audit biophysical conditions and user behavior, are at least partially accountable to the users or are the users themselves.

5. *Graduated Sanctions*
Users who violate rules-in-use are likely to receive graduated sanctions (depending on the seriousness and context of the offense) from other users, from officials accountable to these users, or from both.

6. *Conflict-Resolution Mechanisms*
Users and their officials have rapid access to low-cost, local arenas to resolve conflict among users or between users and officials.

7. *Minimal Recognition of Rights to Organize*
The rights of users to devise their own institutions are not challenged by external governmental authorities, and users have long-term tenure rights to the resource.

For resources that are parts of larger systems:

8. *Nested Enterprises*
Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Source: Based on Ostrom (1990).

These principles have formed the basis for much of the theory of governance.

Scale & Governance of the Commons: Water Resource

"Few areas of American political and economic experience offer a richer variety of organizational patterns and institutional arrangements than the water resource arena" (Ostrom 1962, 450)

The logics of governance on how to sustainably manage CPRs at varying scales and among different government structures is perverse. Scholars have looked at the interplay of scale, governance and management to determine how best to manage resources (Cash et al. 2006; Huitema et al. 2009; Termeer et al. 2010; Ostrom 2010). It is recognized that today the management systems addressing the scale of issues and the dynamic linkages across levels, are more successful at understanding problems and coming up with solutions, which are more sustainable both politically and ecologically (Cash et al. 2006).

In water resource management and governance, the proffering of panaceas has been common, and has included public, collective or private (market) institutional changes to solve water issues (Meinzen-Dick 2007). There has been a traditional emphasis that focuses on reducing uncertainties by designing systems that can be predicted and controlled. Historically, these have been in the form of monocentric governance, known as top-down or 'classical modernist' governance where there are limited hierarchal levels that don't overlap tasks, and hence seem efficient (Huietma et al. 2009) However, Skelcher points out that many of these state centric models have never been completely 'monocentric' (2005). Consequently in the 1950's, due to a high number of governmental units operating in metropolitan areas, advocates of the monocentric theory argued that governance had become chaotic due to the high number of water management institutions, causing overlapping jurisdictions (Gulick 1957; Friesema 1966). In response to this criticism Vincent Ostrom found in his analysis of the metropolitan institutions that a rich variety of both public and private agencies is valued in the political economy of water development and consequently introduced the concept of the 'polycentricity', a state of 'organized chaos' (1961, 831; 1962). Other studies have since acknowledged that fragmentation and duplication of authority may actually lead to increased collaboration, thereby adding value to governance systems as effectively as centralized coordination mechanisms (Imperial 1999, 2005). Consequently, polycentric institutional arrangements that nest multiple centers of decision making to allow for integration of roles and activities between state and non-state actors have been advocated by many scholars (Dietz et al. 2003; Pahl-Wostl 2007; Minzen-Dick 2007; Ostrom 2010). These are important distinctions to point out for this study because California has developed a decentralized system of governance for water systems. Therefore, examining the attributes and effectiveness of polycentric governance is of particular importance.

Polycentric governance concerns multiple governing authorities of varying scales that use local knowledge and have independence to make norms and rules within its specific domain (Ostrom 2010). Literature cites polycentric governance system's advantages as including resilience, ability to cope with change and uncertainty, encouragement of experimentation across scales and institutions, and comparisons of benefits and costs in different settings (Huitema et al.2009; Ostrom 2010). Other studies focusing on decentralized governance find that the conditions that improve decentralized performance have good resolution mechanisms, put financial responsibility on the users, and government financial support (often important and needed) (Dinar et al. 2007). Furthermore, success is dependent on the social and ecological conditions, the biophysical scale in which problems are framed, as well as the type of change sought by governance (Dinar et al. 2007; Bakker 2010). Overall it has been found that a higher degree of complexity and diversity in governance regimes (in otherwords polycentric systems) can lead to higher adaptive capacity and a better ability to deal with multi-scalar problems (Pahl-Wostl 2009; Termeer et al. 2010).

Yet polycentric governance just like monocentric governance has its limitations and problems. For example, the loss of democratic accountability from the outcome of the collaborative process as common in intergovernmental committees (Huitema et al. 2009).

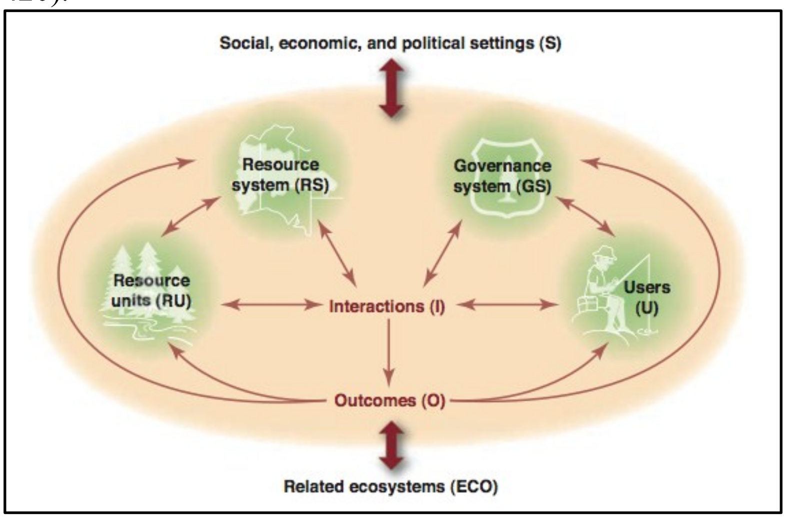
Additionally, while coordination might be effective on smaller spatial scales, state institutions can handle larger spatial scales (Minzen-Dick 2007). More over, while fragmentation and duplication of authority might be seen as beneficial, they can also be detrimental when trust is not developed between parties since the inherent fragmentation results in conflict and struggle as seen in California (Hanak et al. 2013). Recent studies have described the challenges of political gridlock in areas of California like the Sacramento-San Joaquin Delta, where narrowly focused, self-interested stakeholders' "reluctance to compromise leads to parties holding out" Hanak et al. 2013, 7). Furthermore, some argue that this creates a game of 'chicken', where "policy change is feared and only self-interest is king", thereby leading to no management outcomes and compounding issues with the water supply and environment! (Madani & Lund 2011; Hanak et al. 2013, 7).

As these limitations suggest there is no single characterization of scale or applicable level that applies to a whole system, yet it is also argued that there is no best governance form either (Cash et al. 2006; Termer et al. 2010). Governance regimes emerge under varying historical, political, cultural, economic and environmental conditions and face many uncertainties (Pahl-Wostl 2009). In a study examining scale approaches in monocentric, multilevel and adaptive governance, Termeer et al. (2010) found that multiple theories are needed while multilevel arrangements and adaptive networks are formed. Hence, various governance and scalar processes applied in an integrated nature seem necessary to meet the multidimensionality of the current governance landscape.

While various governance structures might be needed, these structures need to also be analyzed for their effectiveness in local settings to determine necessity (Anderies

Janssen & Ostrom 2004; Ostrom 2009; Termeer et al. 2010). Analytical tools are available on how to analyze the outcomes achieved in management structures for SESs and can be applied to a broader range of systems, as they emerged to try to disentangle the intricacies of these complex systems. Literature indicates there are two main levels of SESs. First level as seen in Figure 6, calls for analysis of the connection between the social, economic and political settings with the ecosystem through the imbedded resource management and governance subsystem.

Figure 6. The relationships between the first level subsystems of an SES (Ostrom 2009, 420).



The second-level, see Table 2, examines the intricacies of each subsystem, the two combined in this framework allow for analysis of robustness in SESs (Anderies Janssen & Ostrom 2004; Ostrom 2009).

Table 2. The second-level variables of each first-level cores subsystems used as a framework for analyzing social-ecological systems, not listed in order of importance (Ostrom 2009, 421).

Social, economic, and political settings (S)	
S1 Economic development. S2 Demographic trends. S3 Political stability. S4 Government resource policies. S5 Market incentives. S6 Media organization.	
Resource systems (RS)	*Governance systems (GS)*
RS1 Sector (e.g., water, forests, pasture, fish)	GS1 Government organizations
RS2 Clarity of system boundaries	GS2 Nongovernment organizations
RS3 Size of resource system*	GS3 Network structure
RS4 Human-constructed facilities	GS4 Property-rights systems
RS5 Productivity of system*	GS5 Operational rules
RS6 Equilibrium properties	GS6 Collective-choice rules*
RS7 Predictability of system dynamics*	GS7 Constitutional rules
RS8 Storage characteristics	GS8 Monitoring and sanctioning processes
RS9 Location	
Resource units (RU)	*Users (U)*
RU1 Resource unit mobility*	U1 Number of users*
RU2 Growth or replacement rate	U2 Socioeconomic attributes of users
RU3 Interaction among resource units	U3 History of use
RU4 Economic value	U4 Location
RU5 Number of units	U5 Leadership/entrepreneurship*
RU6 Distinctive markings	U6 Norms/social capital*
RU7 Spatial and temporal distribution	U7 Knowledge of SES/mental models*
	U8 Importance of resource*
	U9 Technology used
Interactions (I) → outcomes (O)	
I1 Harvesting levels of diverse users	O1 Social performance measures (e.g., efficiency, equity, accountability, sustainability)
I2 Information sharing among users	
I3 Deliberation processes	
I4 Conflicts among users	O2 Ecological performance measures (e.g., overharvested, resilience, bio-diversity, sustainability)
I5 Investment activities	
I6 Lobbying activities	
I7 Self-organizing activities	O3 Externalities to other SESs
I8 Networking activities	
Related ecosystems (ECO)	
ECO1 Climate patterns. ECO2 Pollution patterns. ECO3 Flows into and out of focal SES.	

*Subset of variables found to be associated with self-organization.

Recognizing the intricacies of SESs, the management techniques that have evolved largely acknowledge the interconnectedness of ecosystems and social systems and as a result this framework for analysis can be used to determine robustness of various management systems as well. Regarding this subject, it is critically important for managers to analyze these varying systems to look for areas of weakness and strength in order to improve by learning from the past to offer functional systems now and in the changing environment moving forward (Anderies Janssen & Ostrom 2004; Ostrom 2009).

Management

Alternative Styles for Water Resource Management

Like monocentric & polycentric governance, the norm of water management used to be top-down management and over the past couple decades a paradigm shift has taken place from command and control style to a decentralized, integrated and adaptive style of management (Kundell & Hatcher 1985; Folke et al. 2005; Engle et al. 2011) This shift started with conjunctive management, which advocates managing ground and surface waters together. Heikkila (2004) when analyzing the relationship between scale of governance institutions and conjunctive management she found that effective water resource management programs are associated with institutional boundaries that coincide with natural resources, and for areas that don't the coordination among jurisdictions is crucial. In California the shift towards conjunctive management has been advocated by the legislature and was introduced as a major resource management strategy in Update 2005 and was further refined in 2009 (DWR, 2013). Furthermore, a hydro-economic optimization model on the water management in California called CALVIN developed by the University of California at Davis (UCD) found expanded conjunctive use to be economically beneficial throughout the state, especially over inter-annual or drought periods and on a regional scale. Additionally, local and regional changes while being economically advantageous also reduce the need for imported water (Lund, et al. 2009). Overall, the end of cheap water across the state is predicted by the mode, not a scarcity of water, but of cheap water (Lund, et al. 2009). Thus, the state is pushing for conjunctive use.

Conjunctive management is now a part of most management styles and more recent empirical studies have advocated holistic approaches to water resource management with interconnection and cooperation being key elements (Chanan & Woods 2006; Colebatch 2006; Ostrom 2009) Colebatch (2006, 26) suggested that 'there is no quick fix in institutional change', and that what is needed is multi-dimensional change as 'institutional change is always a work in progress'. Thus, good governance, coordination and a holistic approach are necessary for a strong alternative style to water management in which conjunctive management plays a strong role. The two most influential management styles to emerge have been integrated water resource management (IWRM) and adaptive management (AM). These management formats are listed and defined in Table 3.

Table 3. Current working definitions of IRWM and AM (Engle et al. 2011, 3).

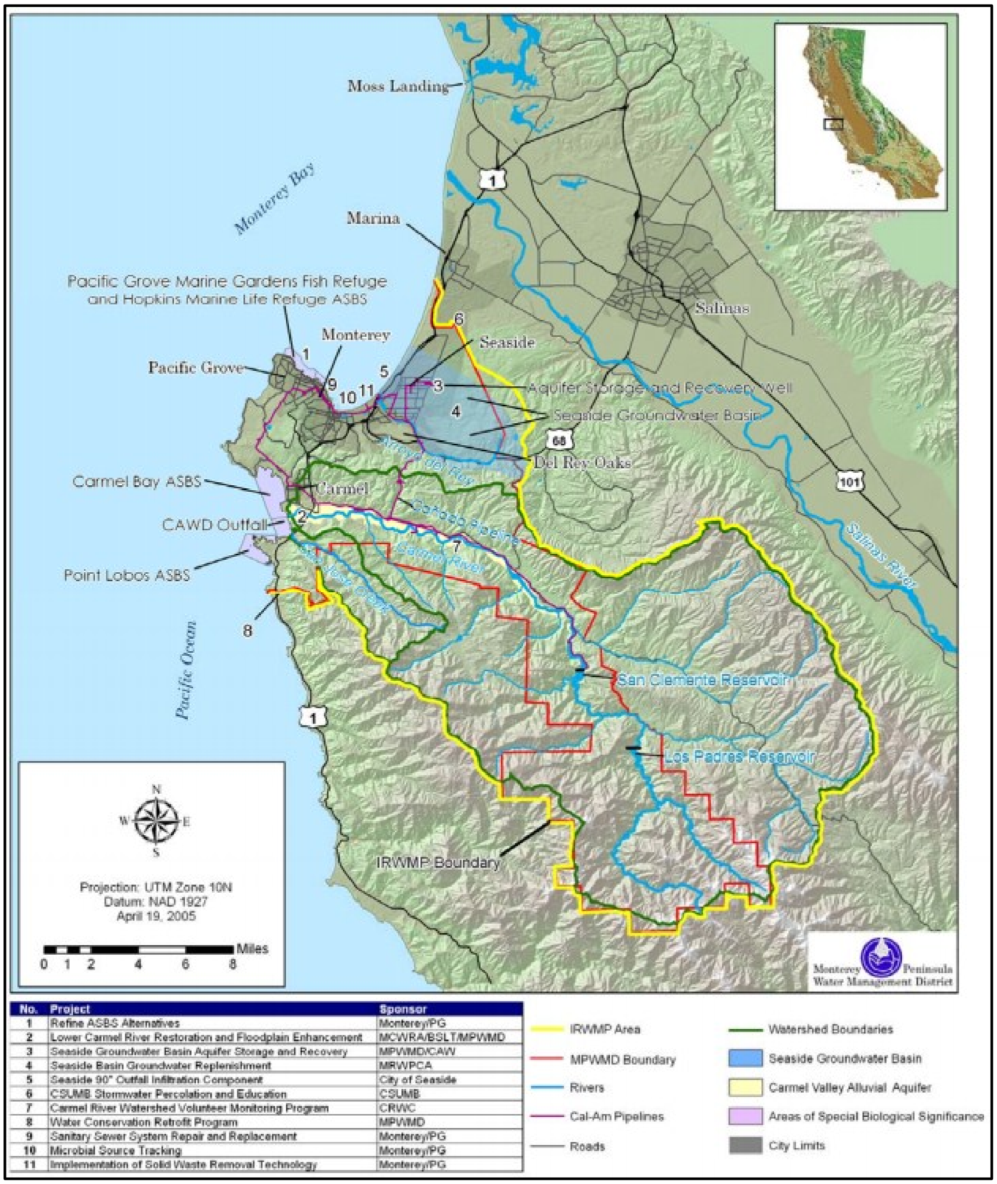
	Working Definitions
IWRM	"A process which promotes the coordinated development and management of water, land, and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." Global Water Partnership, www.gwp.org/en/The-Challenge/What-is-IWRM/ It is based on the Dublin Principles, stating that: "1) freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment; 2) water development and management should be based on a participatory approach involving users, planners and policy makers at all levels; 3) women play a central part in the provision, management and safeguarding of water; 4) water is a public good and has a social and economic value in all its competing uses; and 5) integrated water resources management is based on the equitable and efficient management and sustainable use of water." Global Water Partnership, http://www.gwp.org/en/The-Challenge/What-is-IWRM/Dublin-Rio-Principles/
AM	"Seeks to aggressively use management intervention as a tool to strategically probe the functioning of [a system]. Interventions are designed to test key hypotheses about the functioning of the [system]...[it] identifies uncertainties, and then establishes methodologies to test hypotheses concerning those uncertainties. It uses management as a tool not only to change the system, but as a tool to learn about the system...The achievement of these objectives requires an open management process which seeks to include past, present, and future stakeholders. Adaptive management needs to at least maintain political openness, but usually it needs to create it. Consequently, adaptive management must be a social as well as scientific process..." Resilience Alliance, http://www.resalliance.org/600.php

Adaptive Management has its roots in ecosystem management and focuses on a systems approach with adaptability and acknowledges the linkages and feedbacks in ecosystem and social systems (Holing 1978; Walters 1986; Huitema et al. 2009). It is a systematic, integrated and multidisciplinary approach that confronts complexity and uncertainty by striving to continually learn from past outcomes of management practices and policies (Folke et al. 2005; Pahl-Wostl 2006). Thus its goal is to learn and adapt in the face of the inevitable uncertainty (Folke et al. 2005). AM is leading a paradigm shift as managers are 'learning to manage by managing to learn' Pahl-Wostl 2006, 49). In this study I mainly focus on the role of IRWM, yet AM a basis of many innovative water management schemes and increasingly becoming more present in management.

Integrated Regional Water Management has become prevalent in the past 20 years and focuses on integrating all aspects of a water resource and other socioeconomic aspects that affect the resource while striving to integrate across scales while incorporating a range of stakeholders (Biswas 2004; Mitchell 2005; Engle et al. 2011). Many articles recognize a need for integration & flexibility in the water management system (Folk et al. 2005; Lund, et al. 2009; Ostrom 2009; Engle et al. 2011). Thus, IRWM has been proposed as a solution to the fragmentation and lack of cooperation that is characteristically a result of decisions from multiple political and administrative boundaries in a regional setting (Pahl-Wostl & Hare 2004; Mitchell 2005; Rahaman and Varis 2005). Furthermore, the theoretical perspective is that IRWM can reduce the transaction costs of monitoring, bargaining, and enforcing cooperative agreements, associated with decentralized governance (North 1990; Dinar et al. 2007). Yet, its effectiveness is up for debate, as it is not a panacea for policy fragmentation and is mainly dependent on regional settings in CA; however, in some regions incremental change is taking shape (Biswas 2004; Lubell 2011).

The State of California has tried to push its hand on the many agencies of the decentralized system to adopt IRWMPs through an incentive system that started in 2002 with passage of Senate Bill 1672 with the purpose to "encourage integrated regional strategies for management of water resources and to provide funding, through competitive grants, for projects that protect communities from drought, protect and improve water quality, and improve local water security by reducing dependence on imported water" (DWR 2011). These plans seek to promote resiliency and to accommodate the changing conditions of climate change, environmental needs, flood or drought events, financing capabilities and regional settings (DWR 2011). Funding has been provided by voter approved propositions 50 and 84 allocating some $1.5 billion in funds (DWR 2011). An IRWMP plan has been developed for the Monterey Peninsula, Carmel Bay and South Monterey Bay Region, hereby referred to as the MR IRWMP (MP 2013). It's boundaries, see Figure 7., were defined based off geographic, hydrologic, and existing management's legal responsibilities (MP 2013).

Figure 7. The boundaries of the MP IRWMP, MPWMD, Carmel Valley Watershed & Seaside Groundwater Basin.



No.	Project	Sponsor
1	Refine ASBS Alternatives	Monterey/PG
2	Lower Carmel River Restoration and Floodplain Enhancement	MCWRA/BSLT/MPWMD
3	Seaside Groundwater Basin Aquifer Storage and Recovery	MPWMD/CAW
4	Seaside Basin Groundwater Replenishment	MRWPCA
5	Seaside 90" Outfall Infiltration Component	City of Seaside
6	CSUMB Stormwater Percolation and Education	CSUMB
7	Carmel River Watershed Volunteer Monitoring Program	CRWC
8	Water Conservation Retrofit Program	MPWMD
9	Sanitary Sewer System Repair and Replacement	Monterey/PG
10	Microbial Source Tracking	Monterey/PG
11	Implementation of Solid Waste Removal Technology	Monterey/PG

IRWM is thus being developed across the state in order to try to overcome the jurisdictional and political barriers that many managers face, to help coordinate improvements in supply, water quality and the integration of land use into water management (Biswas 2004; Mitchell 2005; Engle et al. 2011; DWR 2011).

Overall, these management forms discussed seek to overcome the challenges of CPRs like water and approach management from a more holistic, integrated and evolving standpoint. These approaches seek to conserve and expand the use of freshwater through space and time to meet the pressing challenges of the 21st century (Biswas 2004; Folke et al. 2005; Pahl-Wootl 2006). Yet, like governance schemes limitations are present.

Limitations to Adaptive and Integrated Management

As in governance, there has been criticism of IWRM and AM and other panaceas to water management (Pahl-Wostl et al. 2007; Engle et al. 2011). Engle et al. 2011 found that IWRM may be at odds with the experimental, flexible and self-organizing nature of AM. Another study, looking at how the principles of AM might improve IWRM, found that major transformation processes are needed in many cases due to the structural requirements such as adaptive institutions and a flexible technical infrastructure, would be necessary for adaptive management yet are not available (Pahl-Wostl et al. 2007). Huitema et al. (2009) assessed the idea of adaptive water management from the perspective of the governance literature and found that the complexities of participation and collaboration, the difficulty of experimenting in a real-world setting, and the politicized nature of discussion on governance at the bioregional scale all need to be addressed. There is very little empirical research of these models integrating (IWRM, AM, SES) through decentralized participatory governance and many questions remain on how these theoretical models work in practice, especially to help lessen the issues associated with jurisdictional fragmentation (Engle et al. 2011). Thus, further research is necessary to examine the barriers, the adaptability and the effectiveness of these applications.

Before presenting results from my study that examines these aspects of IWRM and AM I focus on two key challenges for future water management: jurisdictional fragmentation over water governance and projects, and the legal uncertainties presented with the new pathways for management under current California water statutes.

Jurisdictional Fragmentation

Water policy and law is fragmented across the nation, vertical fragmentation with respect to institutional levels and horizontally in respect to the multitude of agencies and political entities that have responsibilities within the same subject area (Hanak et al. 2011; Lubell & Lippert 2011). Andreen (2006) warns, that United States legislators are creating separate legal systems to govern land use, water use and water pollution, and thus it will take considerable effort to demonstrate to voters, economic interests, and decision-makers at all levels of government precisely how land use and water are inextricably connected throughout the whole of a watershed.

It is commonly acknowledge that decentralized systems experience fragmentation that takes place in multiple dimensions (Lubell & Lippert 2011). There are a couple different ways of explaining the different types of fragmentation involved in these decentralized systems. Lubell & Lippert break down the fragmentation into four types, geographic, institutional, ideological and technical (2011). Geographic (horizontal) fragmentation is the ‘inability of local actors to realize regional goals’ (80). Institutional (vertical) fragmentation occurs when multiple levels of a system fail to coordinate policies, due to conflict and overlap of agencies at the local, state and federal level. Ideological fragmentation occurs when stakeholders holding varying social and political values and preferences, hence unable to find common ground. This can lead to uneven political power and the formation of status quo due to a skew in water management towards agencies that have an organized economic interest. Lastly, technical fragmentation happens when projects cannot connect inputs and outputs to maximize efficiency and benefits. Overall they explain that "Collective-action problems and interdependence are at the heart of all dimensions of fragmentation – actors fail to make decisions that take advantage of opportunities for mutual gains, and avoid the risk of mutual costs" (Lubell & Lippert, 81).

Perhaps a simpler breakdown of geographic and functional fragmentation is described by Hanak et al. (2011) which he explains hinder California's decentralized system of water and land management. Geographic fragmentation comes from the numerous agencies separately making decisions within the same basin or watershed, and functional fragmentation comes from numerous agencies acting on only one piece the pie i.e. supply, quality, or land use etc (Hanak et al. 2011). Either description points to the multilayered fragmentation currently present in management systems especially in California.

Jurisdictional fragmentation is built into these systems, thus trying find systems that work within the means of fragmentation to coordinate and effectively manage resources is a challenge all levels of society and governance and is a large project that all levels need to address and work towards decreasing. Furthermore, the uncertainty caused by jurisdictional fragmentation is also present in the fragmented legal code in California.

Legal Uncertainty

A high degree of uncertainty exists in water resources management in California due to its unique hydrologic conditions and pressing challenges of the 21st century (Hanak et al. 2011; Foley-Gannon 2008). The patchwork management of groundwater due to legislative and legal arrangements is frustrating to managers and provides much uncertainty in terms of the legal code and legislative patchwork (Hanak et al. 2011; Hedges 2011) This multi-layered complex system is a source of frustration for managers and as part of this emerging literature on 'legal uncertainty' (Foley-Gannon 2008; Hedges 2011; Bark et al. 2012), many of this study's informants mentioned the legal barriers they face and the uncertainty of water rights that cause difficulties in management, "You can get three different attorneys and get four different opinions" (Brad Hagemann, pers. comm., 12 March 2013). While much legal uncertainty exists in regards to the state water code, there is a growing body of research indicating that this uncertainty will hamper conjunctive use efforts (Foley-Gannon 2008; Hedges 2011). The main uncertainties that have been identified for conjunctive use projects are the rights of users to interconnected surface and groundwater, the priority of rights to storage space, agency authority to managed rights of import and export, and protection of water quality (Foley-Gannon 2008; Hedges 2011). There are steps the California legislature and voters could take to decrease this legal uncertainty and pave the way for innovate techniques and management in the field of water resources.

Legal uncertainties unnecessarily increase the cost of implementing conjunctive use projects and discourage innovative techniques. Thus, Foley-Glannon suggests a series of fixes to keep and increase power at the local level. First, she suggests that the state amend AB3030 to require local agencies to adopt groundwater management plans, thus these agencies would develop a better understanding of the intricacies of their basin that are essential to implementing conjunctive management and to catch overdraft. Second, the legal authority of agencies to include assigning priorities to the storage space in a basin and the ability to compel participation in a conjunctive use program should be clarified. Third, specific criteria should be provided to agencies to follow and consider not just the needs and uses in the basin but those of surrounding areas and the state, in order to avoid the 'balkanization' of the state's resources policy. Lastly, she would compel the state to make sure that anti export laws are not applicable to imported water. (Foley-Glannon 2008).While these changes have not come to fruition the state is actively backing conjunctive use and passing streamlined regulations (SWRCB 2012). Voters and managers need to push politicians and the California legislature to implement some changes so water can be more managed without the uncertainty that is currently present.

Alternatives to Traditional Water Resource Management

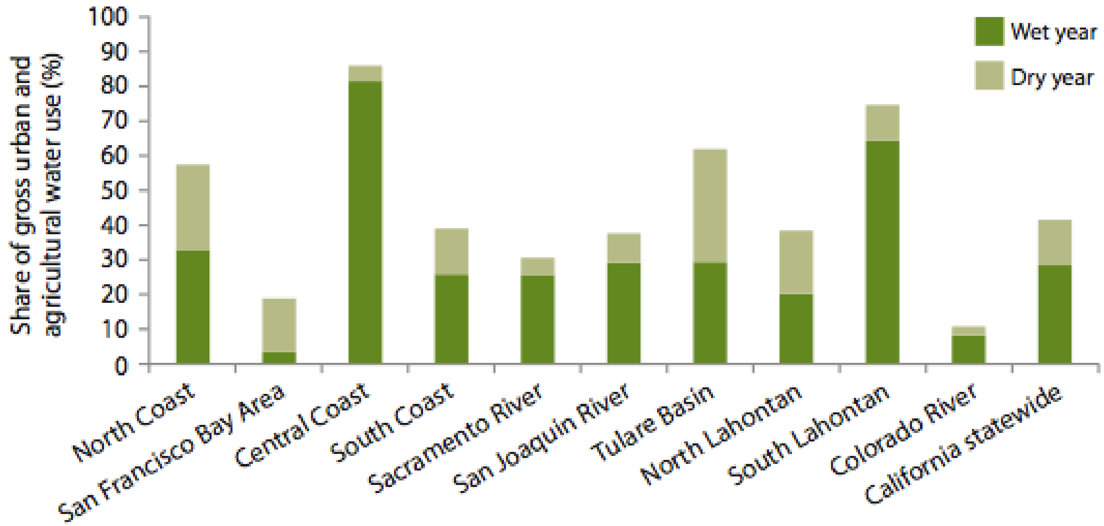
The various pieces of an alternative water supply portfolio can include conjunctive use of ground and surface waters, conservation goals, or alternative supplies: such as rainwater, storm water, desal & wastewater all of which are being implemented at various scales across the world and especially in California. The implementation of these alternatives is important in the US especially since the united states ranks last out of 147 countries for water efficiency with inefficiencies at times reaching 50 percent (NCSE, 2004). Hence, increasing efficiency and using various means to augment a water supply are important to meet the growing demands of the various social and environmental needs as surface water and groundwater sources are strained (Glennon 2002).

Groundwater & Surface Water

Only .8 percent of all water on earth is potable and easily accessible from surface water sources such as lakes, marshes, and rivers or through pumping groundwater (Glennon 2002). Historically surface water was the main source of water for society until the technology developed to allow for access to a seemingly unlimited supply of groundwater, estimated at thirty times more than surface water (Reisner 1993; Glennon 2002). Thus, there has been an increasing shift from surface water to groundwater as surface water has become largely over appropriated, polluted, or legally protected due to harm of the environmental resources (Glennon 2002; Hanak et al. 2011). Furthermore, as explained the groundwater use is can come with just owning the land, no permits necessary; yet, if they are, they are much more easily obtained due to current legal schemes in the West (Glennon 2002).

Groundwater consequently is becoming one of the most important natural resources in the nation in terms of economic output, as it provides 40% of the nation's public water supply (Gurdak Hanson & Green 2009) California is the largest extractor of groundwater in the nation, 11 billion gal/day, and depends on groundwater to meet 40% of the fresh water demand during 'normal' years, while many regions rely on groundwater for 60% of their supply and some regions are entirely dependent on groundwater (DWR 2003; Kenny et al. 2005; Hanak et al. 2011). This dependence is very high for the Central Coast region since the majority of the region is not connected to the state water project, and thus many areas rely on groundwater for more than 80% of local needs as seen in Figure 8 and a few are even completely reliant on groundwater like the Pajaro Valley (Hanak et al. 2011; Mary Banister, pers. comm., 21 March 2013).

Figure 8. Illustration of Central Coast's dependency on groundwater. Source: Hanak (2011, 79) adapted from DWR (2009a).



SOURCE: California Department of Water Resources (2009).

NOTES: The figure shows total groundwater withdrawals as a share of total gross water use in the urban and agricultural sectors in the period 1998–2005. The dry and wet year shares refer to 2001 and 1998, respectively.

As a result of this dependency many groundwater reserves are shrinking due to unsustainable use, putting many aquifers in overdraft and as a result many economic, environmental consequences have developed (Glennon 2002). Groundwater overdraft is a result of long-term groundwater extraction that exceeds aquifer recharge, the amount of water that percolates naturally into the aquifer (Glennon 2002; Zektser et al. 2004) While overdraft is reversible, groundwater 'mining', taking water from aquifers that don't recharge on a human timescale, is not and is an unsustainable resource that some regions have come to depend on (Glennon 2002).

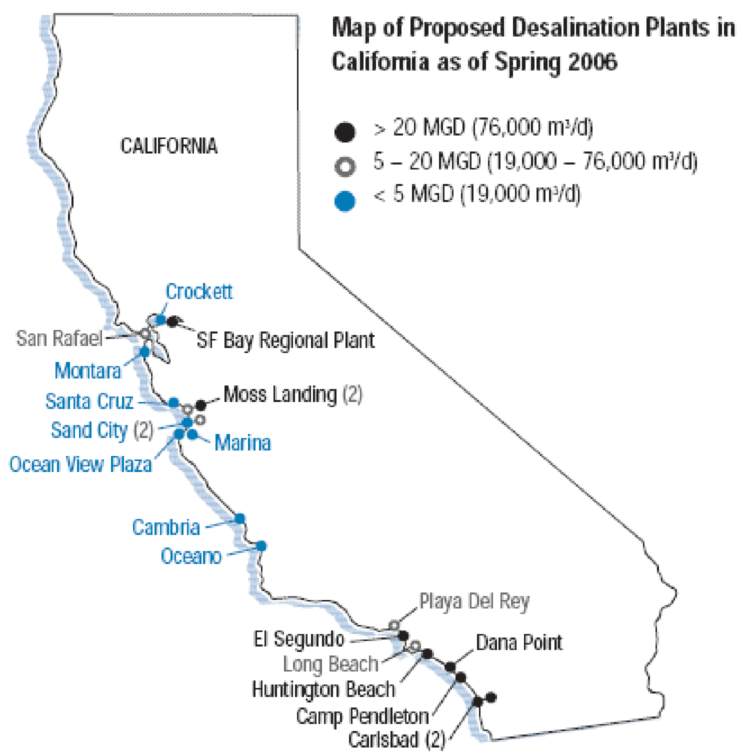
Currently, many groundwater basins in California are over drafted, yet there are varying estimates of the extent since no formal monitoring program has existed statewide (Harou & Lund 2008). Yet, the DWR in their latest groundwater survey Bulletin 118 estimates an overdraft withdrawal of 1-2 million AF/yr and a more recent study based off of NASA's Gravity Recovery and Climate Experiment (GRACE) satellite estimates an even higher withdrawal of 2.5 million AF/yr in just the Central Valley (DWR 2003; Famigliett et al. 2011). It is recognized that overdraft is an inherent problem throughout the state (Harou & Lund 2008).

Overdrafting has some serious environmental & economic consequences. As overdraft continues and the aquifer level drops, deeper wells are need to reach the water, hence more energy, thus money, is required to extract the water. Environmental issues include issues with reduction of stream flow or lake levels, reduction or elimination of vegetation, water quality, seawater intrusion into coastal aquifers, land subsidence and actual loss of storage due to damage that can occur in an aquifer that is not full (Glennon 2002; Zekster et al. 2005; Hanak et al. 2011). To combat overdraft various methods are used including decreasing demand, water reuse projects, surface water substitution or conjunctive-use through natural or artificial methods of recharge (Glennon 2002; Harou & Lund 2008; Racz et al. 2012). In the Monterey Region all of these techniques have been advocated expect for surface water substitution as the region is isolated from the State Water Project and no other surface sources are available. The main components of the current MPWSP entail conservation, a desalination component, conjunctive use through Aquifer Storage and Recovery (ASR) and various water reuse projects (Cal-Am, 2013). Conservation on the peninsula is already high with per capita water use close to 50 gallons per day and the conservation programs have been implemented and are thus not a major contender to solving the MR water supply dilemma; however, many participants recognized there still could be some low hanging fruit (Janet Brennan, pers. comm., 1 December, 2009; Aengus Jeffers, pers. comm., 13 July 2013).

Desalination

Seawater desalination is currently receiving attention worldwide in areas that face water scarcity as a drought proof solution and is growing globally over 15% a year partly due to decreasing cost over the last 20 years that now ranges between $1,900 to more then $3,000 per AF (Cooley et al. 2006; Cooley & Ajami 2012; Craze 2013). In California desal is being considered in many regions along the coast with 21 proposed projects of varying sizes in 2006, see Figure 9. (Cooley et al. 2006).

Figure 9. Proposed Desalination Plants along the coast of California as of 2006 (Cooley et al. 2006, 2).



Since this initial estimate of 21 active desal proposals only a small plant in Sand City was built while a plant in Carlsbad has been permitted since 2009 it has been unable to secure financing. As of 2012 there are currently 17 projects proposed and an additional two in Mexico to augment California's water supply (Cooley& Donnelly 2012). The Monterey region currently has 3 of the total 9 operational desal plants in California, pointing towards the lack of usable supply in the region (Cooley& Donnelly 2012). Furthermore, of the nine operational plants three are idol and combined with the decrease in proposals these signs could be indicative of changing circumstances. In regions like Santa Barbara, California and in Tampa Bay, Florida desal plants have been built but due to changes in water demand, cost and availability of alternatives have remained largely in-operational (Cooley et al. 2006). These white elephants hint at the uncertainty in these costly and energy intensive endeavors (Cooley & Ajami 2012). Thus, there are many uncertainties and barriers to successfully building and running a desal plants in the State.

Some issues associated with desal include the cost and energy associated with plants, environmental impacts, permitting and legal issues (Cooley et al. 2006; Lewis 2010). The cost and energy associated with desal plants is enormous and as one stakeholder described, “Desal is expensive to build, but operationally it is just pure energy. If both situations cost the same amount, but if desal is $420 and ASR is the same. But desal is subject to energy inflation” (Aengus Jeffers, pers. comm., 13 Jul 2013). The energy of seawater desal is roughly 8-10 times that of groundwater or reclaimed wastewater, while only 2-3 times more for brackish water desalination (Cooley et al. 2006). Furthermore, these high energy uses lead to GHG’s, which the CA is trying to cut back to 1990 levels by 2020 as mentioned earlier, and thus there is uncertainty in the planning stages as restrictions could come up limiting what power sources they could use (Greenblatt et al. 2012).

The other main environmental issues include entrainment and entrapment form open ocean intake and the impacts of discharging highly concentrated salty brine (Lewis 2010). In the Monterey region there are three proposed desalination projects, CalAM WSP, DeepWater Desal (DWD) and the Regional Desalination Project at Moss Landing Commercial Park (formerly known as the Peoples Moss Landing Project) (Brennan 2013). DWD and the Regional Desalination Project (RDP) both propose open water intakes while CalAm's WSP proposes brackish water intake with slant wells. One reason CalAm's WSP project has the most support is federal and state environmental regulations are trying to phase out open ocean intake to avoid entrainment and entrapment to protect coastal ecosystems (Lewis 2010; Brennan 2013). In California the SWRCB is developing regulations for desalination plants and California Coastal Commission already requires looking for projects that rule out all alternatives before using open ocean intake (CCC 2004; Foster et al. 2012). Thus, the legal uncertainty in terms of upcoming regulations and how the CCC would rule on intake options present main barriers to desal projects.

There is not just legal uncertainty due to regulatory permits, there is also high legal uncertainty for CalAm's current proposed desal plant that uses slant wells which take feed water from the edge of the Salinas groundwater basin, of which it is estimated that 97% will be seawater in the form of brackish water, yet some fresh water could be taken. This calls into question the legalities if water can be transferred inter basin and whether it will harm other users. Thus it comes down to an issue of water law in regards to property rights to groundwater. One lawyer expressed his concern for the project as, "Cal Ams approval. I can virtually guarantee you there will be property owners that will file for adjudication of the basin, for no other reason than to cut CalAm off at the knees"

(Marc Del Pierro, pers. comm., 8 Aug 2013). Hence, the water rights of the feed water for this plant present a major legal uncertainty that will most likely not be flushed out until the project is being built, as litigation follows harm.

Besides these uncertainties projects such as CalAm's WSP face upwards of 30 permits including permits from CPUC, SWRCB, Regional Water Quality Control Board (RWQCB), CCC, State Lands Commission and others. One stakeholder pointed out these barriers cause the price of projects to increase increase the length of time until implementation, "If you are trying to do something in CA multiple everything times two, because of these regulatory hurdles that you don't have to worry about to the same extent elsewhere. It causes the price of the project to go up up and up" (Brad Hagemann, pers. comm., 12 March 2013). Overall, desal proposals face many barriers to implementation, yet they do provide a great tool to help augment supply when no others exist and the SWRCB is currently looking at streamlining desal approval (SWRCB 2013). As desal has lagged due to the many barriers aquifer storage and recovery and water reuse techniques are quickly gaining ground and have many benefits (Glennon 2002; Lewis 2010).

Conjunctive Management: Aquifer Storage and Recovery

"We have the water it just all comes in the winter time and we just don't have the place to store it" (Aengus Jeffers 2012, pers. comm., 13 Jul 2013)

As mentioned the goal of conjunctive management is to provide water supply reliability and availability by coordinating the timing of the use of ground and surface water supplies (Glennon 2002). There are many considerations to take into account in order to know if conjunctive management is feasible. There are certain physical factors necessary such as appropriate hydrology, geology, a water supply (lake, river or water reuse), and distribution system capability. Furthermore, institutional coordination and legalities need to be examined and water rights obtained that protect and promote conjunctive use programs and the coordination of agencies & users to manage the system (Glennon 2002; Sheng 2005; Foley-Gannon 2008). Aquifer Storage and Recovery (ASR) is a tool used to conjunctively manage water resources to augment supply (Pyne 1995). ASR systems have been in operation since the late 1960's in the US utilizing artificial recharge (Pyne 1995). Artificial recharge comprises a series of techniques (direct injection, bank filtration in streams, or infiltration ponds) to increase flow of water into an aquifer by using excess flows from surface sources or return flows from agriculture, storm water, or wastewater (Racz et al. 2012). While natural percolation is slow especially in urban landscapes as the hydrologic connection is broken, artificial recharge is advocated as an efficient and safe way to efficiently recharge aquifers (Pyne 1995, Sheng 2005; Racz et al. 2012).

Conjunctive use with artificial recharge is gaining popularity as a management tool in order to halt overdraft and use the vast amount of available storage space in aquifers to augment supply (Glennon 2002). This storage space is estimated to be 143 million AF due with current overdraft and natural storage, which is over three times the total capacity of surface reservoirs in California, only 42 million AF (Robie & Donovan 1979). There are also a variety of benefits to storing water in the ground that include decreasing demand for expensive surface storage facilities, water is not lost to evaporation, natural treatment and purification of water, emergency supply in case of disruptions in surface water systems, and mitigation of the effects of overdraft (Glennon

2002; Foley-Gannon 2008). Furthermore, Harou & Lund found that effective conjunctive-use infrastructure annuls the economic cost of not over drafting and is effective in sustainable management (2008). Overall research points to conjunctive use programs as the least expensive and environmentally safest way for stretching available water supplies (Glennon 2002; Harou & Lund 2008; Hanak et al. 2011) California has recognized the potential of ASR and in 2012 the SWRCB released General Order 2012-0010 that provides for streamlined permitting and consistent requirements for ASR projects across the state and recognizes their benefits and need due to the current dependence on the groundwater table that has resulted in overdraft and the growing limitations on surface water across the state (SWRCB 2012).

In the Monterey Region the second part of the MPWSP is ASR using a technique of direct injection, where water is forced down a well into an aquifer (MPWMD 2013). It is recognized that conjunctive use works better in adjudicated basins since the hydrologic knowledge and water rights are flushed out and monitoring is in place (Foley-Gannon 2008). This is the case for the Seaside Basin which has been adjudicated since 2006 and thus ASR has been fairly easy to implement (DWR, 2009). MPMD has been testing ASR for the past 10 years by taking extra water in the winter from the Carmel River and storing it through direct injection into the Seaside Basin. Then during summer months they rely on this water for supply to avoid pumping from the river. The system can be expanded, yet is dependent on storage capacity of aquifer and infrastructure, "Yes, but the existing supply wells and treatment capacity on the Carmel River is constrained. To expand adds cost and requires an EIR. We believe that capacity maxes out at 3,000 to 3,500 AF without larger scale improvements to supply facilities." (Dave Stoldt, pers.

comm., 26 March 2013). Thus, while the current project is only proposing to meet about a third of the total supply gap the peninsula faces, the possibility of expansion should be examined as desal is a costly, unstable and environmental damaging proposal.

While the MR is having success with ASR with few barriers, many regions across the state face an array of legal and institutional uncertainties as previously mentioned, which may limit conjunctive use within the state (Folly-Gannon 2009; Hedges 2011). Thus, further research is needed to examine these barriers and to help coordinate conjunctive management across the state (Hanak et al. 2011). The technology of ASR is also implemented in projects that reuse various sources of wastewater.

Water Reuse

"...we really can tell where we are at with water when we are arguing now about who owns the waste water, 20 years ago it was like flush it make it go away I don't want to see it anymore"
(Brad Hageman, pers. comm., 12 March 2013).

Water reuse is expanding globally and growing at a rate of 15% in the US (Miller 2005). This increasing trend among water managers to repurpose waste water is mainly through the implementation of non-potable reuse (NPR) projects for irrigation of golf courses & landscapes, agriculture, industry, and indirect potable reuse (IPR), also known as groundwater recovery (GWR), projects to augment local potable water supplies (Miller 2005; Meehan et al. 2013) It is currently recognized that there is an important future for potential reclaimed treatment of effluent and other waste water sources to augment water supplies not just in semi-arid regions but also worldwide (Miller 2005; NRC 2012).

Currently IPR is the most technologically advanced and is considered as a great tool for water managers to augment metropolitan water supplies (Meehan et al. 2013).

This technique involves treating wastewater to a tertiary or advanced stage that is then mixed with drinking water supplies via an environmental buffer (i.e. retention in a river, aquifer or reservoir), which later is extracted retreated to meet drinking water standards before use (NRC 1998). The discourse on wastewater and public perception is changing, see Table 3, and today these techniques are now considered as safe as or safer than normal drinking water supplies in terms of chemicals and microbial agents (NRC 2012).

Table 3. A summary of the changing discourse on wastewater (Meehan et al. 2013, 70).

From	To	Example
Risky	Safe	"The [recycled effluent] is safe. We have very stringent water quality standards. This is not [Los Angeles Department of Water and Power] saying the water is safe, this is the [California] Department of Health, which throws you in jail if you're violating health standards" (Sheppard, 2000).
Polluted	Purified	"As pure as distilled water" (general manager of the Orange County Water District Michael Marcus quoted in Glennon, 2009: 166); It is "about as pure as [water] can possibly be" (California State Assemblyman Michael Duvall quoted in Athavaley, 2008); "Reuse? The result is as pure as distilled water" (Michael Marcus quoted in Archibold, 2007).
Linear	Sustainable	"Authorities used to pump partially cleaned wastewater into the ocean, but now water goes through a three-step purification process to make it fit for human consumption" (PBS NewsHour, 2008).
Externality	Commodity	"The days are over when we can consider wastewater a liability. It's an asset. And that means figuring out how best to use it" (Peter Gleick quoted in Royte, 2008).

This change in perception and acknowledgment of reuse has opened the doors to managers to implement projects around the world (Meehan et al. 2013).

Water reuse has been identified as an important part of current water management techniques. Miller (2005), identified that the value created from the inclusion of water reuse in integrated water resource planning, water policy and its implementation in water projects, provides long term sustainability, which is considered its most valuable assets.

Durham et al. advocates for a holistic long term approach to IRWMP, which is supported by legislation, agreed quality standards, financial backing, and a participatory approach, and augmented by the responsibility of one water management agency for all water resource issues that seeks to maximize efficiency to solve shortage problems (2002). Yet, in practice a study by Meehan, Ormerod & Moore regarding the governance of recycled effluent found through analysis of various IPR projects that successful projects were usually characterized by extending existing modernistic water governance with 'large-scale, centralized infrastructure, state and techno-scientific control, and a political economy of water marked by supply augmentation and unchecked expansion' (2013, 67). Thus, the future of water reuse should be highly regulated & controlled and will require financial and infrastructure backing (Durham et al. 2002; Miller 2005; Meehan et al. 2013).

Water managers have identified many of the empirical benefits and barriers to implementing water reuse techniques. The benefits include but are not limited to: reduced effluent outflow to oceans, support of tourism and agriculture in the form of cheap reuse water, aquifer recharge, slowing or stopping seawater intrusion, drought proof water supply, water supply augmentation, and increased knowledge of local resources (a necessary byproduct of implementation) (Durham et al. 2002; Anderson 2003). There are also numerous barriers that many projects experience including the difficulty of public acceptance (thus need for public education), the need for more innovative technology, funding, and support by regulators and politicians (Miller 2005). As a result of its safety, cost effectiveness and various benefits sewage is now a sought-after resource in water strapped areas as new methods and technology allow for reuse.

California has a long history of water reuse, NPR projects for agriculture have been around for a half a century and the first IPR projects started in 1962 in the Los Angles in the form of groundwater recharge of potable aquifers (Crook 2010). Sense then California has developed regulations specific to water reuse and is advocating its use throughout the state (Crook 2010; NRC 2012). The largest and most successful IPR project to be completed in California, the Orange County Groundwater Replenishment System (GWRS), has been a model for projects all over the world (Meehan et al. 2013). The project managers anticipated the political challenges and implemented a large public outreach campaign resulting in virtually no opposition when the plant came into operation (Meehan et al. 2013). While many ‘poster child’s’ of water reuse have done wondrously many projects have also failed to make it off the ground (Bischel et al. 2012).

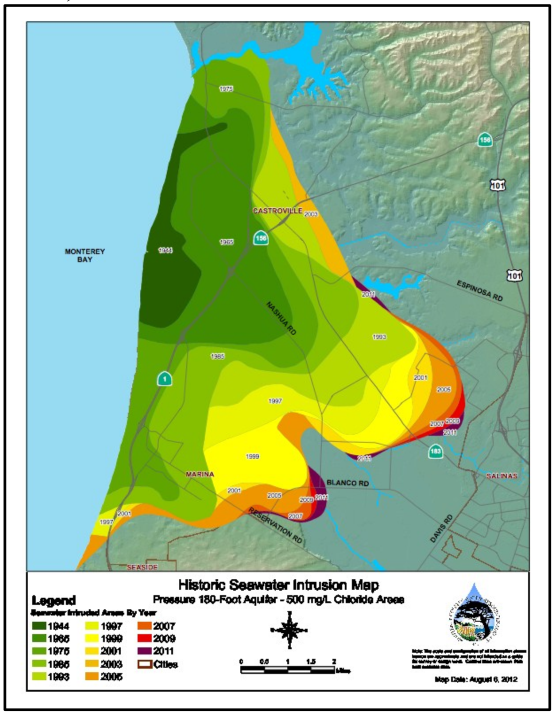
California is leading the way in recycled water use. Since 1970, the reuse of municipal wastewater has more than doubled. California currently has a goal to double its use of recycled water for beneficial use from 2002 levels by 2020 (SWRCB 2009b). Yet a recent study (Bischel et al. 2012) found that only 20% of increases in reuse between 2001 and 2009 occurred in Northern California and in general the state is failing to meet its goals. The study examined mangers in Northern California and found that the regulatory requirements limiting discharge were the main drivers for project implementation, yet more recently scarcity of supplies and need for system reliability were cited as the most important drivers. The main barrier cited by the study’s respondents was the economic challenges especially the cost of distribution systems, while the negative perceptions of water reuse was only cited by 26% of respondents (Biscehl et al. 2012, 1). Lastly, the State’s goals & mandates for recycled water were only listed as a top three driver by 14% indicating the lack of authority of statewide regulations (183). Thus, despite the progress California has made, there are still areas for significant improvement.

Water Reuse in the Monterey Region

"The least we can discharge the better at least from an environmental standpoint and a resource management standpoint" (Brad Hagemann, pers. comm., 12 March 2013)

Water reuse in the Monterey Region is significant in terms of NPR projects across the region. The Carmel Area Waste Water District (CAWD) in conjunction with Pebble Beach Community Service District (PBCSD) has been providing non-potable (NP) water for golf courses and opens spaces since 1994. They currently upgraded their facility and other infrastructure components in 2009 to be able to provide 100% of the water needs for golf courses in Pebble Beach to help alleviate the strain on the Carmel Valley River by an average of 950AF a yr (CAWD 2011). Furthermore, the region has led the way in producing highly treated water for agriculture reuse. This project came about as a result of overdraft from agriculture users of the Salinas Valley Basin (SVB), that led seawater intrusion that has been documented in the area since 1930 and has since traveled over 5 miles inland (Fig 10.), thus threatening a multi-billion dollar agricultural economy (DWR 2003).

Figure 10. Historic Seawater Intrusion for the Salinas Valley & Seaside Basin (MCWRA, 2013)



As a result the community examined the possibility of using recycled water leading to a study to determine if recycled water could be safe for uncooked food crops (MRWPCA 2012). This historic study determined it was safe and as a result a partnership between the Monterey Region Regional Water Pollution Control Agency (MRWPCA), the Monterey County Water Resources Agency (WCWRA) and the local agricultural interests to implement a reclamation project. The project has been online since 1992 and recycles 60% of the wastewater it receives to provide recycled water to 12,000 acres of prime agricultural land making it the largest supplier of recycled water for food crop irrigation in the U.S (Dobrowolski et al. 2008; MRWPCA 2012). With the success of this project and of the Orange County GWRS, the agency is considering expanding their recycled water operation and building its own GWR project in conjunction with MPWMD & Cal-Am as part of the three pronged planned to meet the Peninsula's water supply.

The current project entitled Monterey Peninsula Groundwater Replenishment Project (GWR) plans to artificially the recharge Seaside groundwater basin with a proposed 3,500 AF a year of highly purified treated water (Israel 2012). Yet the current source for wastewater is up for debate, while the current testimony before the CPUC indicates this to be wastewater, the agricultural interests want to make sure they get their supposed entitlement of 19,500 AF since they helped fund the initial reuse project. Thus, no one is quite sure who has rights to what water, “The primary issue is who owns that water, who has rights to it. That has been a big bone of contention” (Brad Hagemann, pers. comm., 12 March 2013). Beside the uncertainty of who the water belongs to, as the cities ramp up conservation efforts and the price of water has risen, the inputs into the plant have decreased as much as 10% in the past 5-6 years (Brad Hagemann, pers. comm., 12 March 2013). Hence, they have less wastewater input to work with. Due to the decrease in available water to recycle combined with the legal uncertainties and a deadline of 2017 the agency is no now examining other options like industrial waste water and stormwater (Brad Hagemann, pers. comm., 12 March 2013).

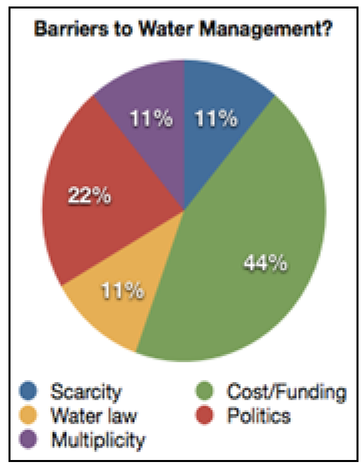
Stormwater is currently starting to be used and considered to help augment water supply with an estimated annual runoff of 2,400 AF (IRWMP, 2007). A main reason for its consideration is to avoid costly monitoring programs required by the Regional Water Quality Control Board (RWQCB) since the runoff goes into the Monterey Bay National Marine Sanctuary and some municipalities are located next to Areas of Special Biological Significance. Mr. Hagemen thinks these facts will drive the use of stormwater, “...those municipalities are looking at the option of diverting the stormwater discharge into the sanitary sewer system. … they can then sign off or discontinue a very expensive and aggressive monitoring project that the state has required them to participate in. I think we will see in the next 5 years some kind of either 1st flush or dry weather diversion" (Brad Hagemann, pers. comm., 12 March 2013). All other coastal managers (n=3) agreed that stormwater is being considered and the major barrier cited was storage. Thus the region will most likely develop a first flush or dry weather diversion system due to its practicality.

Overall water reuse is a viable and highly beneficial way to augment water in the region. The benefits previously mentioned in the literature were all confirmed by the stakeholders while the barriers identified included the declining input source, cost, legal, political and public perception barriers (Bischel et al. 2012). Mr. Hageman like other managers in Northern California identified cost as a big barrier "….pretty significant transmission costs. That's what starts to drive the numbers up ($2,000-$3,000 AF) desal in same range" (pers. comm., 12 March 2013). In other regions where the demand is mostly agricultural cost can be prohibitive, "We could percolate additional recycled water but the state requirements make it cost prohibitive (RO level of treatment) and the restrictions limit where the water could be put" (Mary Banister, pers. comm., 21 March 2013). A general view point is that it will increase as the demand, tech and political perceptions shift, "So I think recycled water is one of those where there is going to be more opportunity as both the tech and political perceptions evolve regarding the reuse of water" (John Ricker, pers. comm., 7 Mar 2013). Thus, as the discourse on water reuse changes and as strong education programs are implemented water reuse stands to be a useful tool for water augmentation (Meehan et al. 2013).

Results & Discussion: Reconciling Water, Water Law, and Water Rights in California

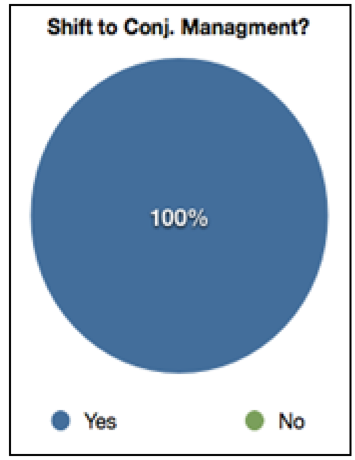
In this qualitative analysis the results and discussion are combined in order to facilitate fluidity as each subject is addressed. Overall in the study five general managers (GMs), two attorneys (Attys.) and two NGOs participated in the research. I paraphrase the questions asked in this section, for the full question please see Appendix.

Barriers to Water Management: Economic, Political, Legal, and Hydrological?

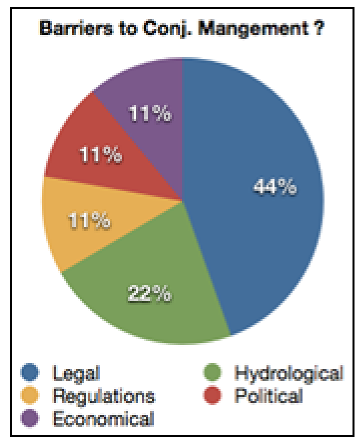


The first part of the survey poised a question in regards to what the main barriers participants experienced during their time working in the field of water management. Cost & funding were cited the most by participants (n=5) followed by politics (n=2). Yet, these relative numbers may not present the whole story, as many respondents explained the underlying problems. The funding issue seems to stem from legislation hurtles as, "Water laws in California give some landowners an overblown sense of their 'ownership' of the resource. Rate setting law (Prop 218, etc.) makes it difficult to implement rates adequate to address water resources management" (Mary Banister, pers. comm., 21 March 2013). Here two issues are identified: the manner of CA water law that grants much power to water rights holders and the political hurdles due to the necessity of a vote by the public for any rate increase from the legislative. Thus, political reasons could be the main difficulty faced by managers trying to implement projects given the political clout to any rate hikes, "I think a lot of it is political, in that the various factions have equal footing. So that inhibits, you know, projects from moving along, you got political clout among three or four different groups. Mayor JPA, when 1st formed going to be a group to push through Cal Am's project, they have morphed into another alternatives analysis, better cheaper way" (Brad Hagemann, pers. comm., 12 March 2013). One general manager pointed towards the failure of governance to educate that results in the political clout that often hampers projects, "Funding is always the most problematic, getting enough money to do what needs to be done, and I think part of that is ultimately the voters have to approve these sorts of things. So they need to be brought along and maybe we haven't done such a good job of that, certainly as we head towards a vote on desal there has to be a pretty high level of organization, get in and not vote their guts" (John Ricker, pers. comm, 7 Mar 2013). Furthermore, even the regulatory hurdles seem to be politically charged, "I think there certainly are some regulatory hurdles to get through, but when you have politicians implementing those regulations certainly from the political side, certainly the Coastal Commission is a political body" (Brad Hagemann, pers. comm., 12 March 2013). These quotes paint a picture of the political fragmentation that underlies much of the funding issues, which creates high tension and is prohibitive of passing effective plans to manage water as we will see as one of the common trends that emerge.

Innovative water management: Conjunctive Use



When asked if they saw a shift towards conjunctive use across the state there was unanimous consensus. Yet one participant made the point that "...the cost of water and community values is what will drive shifts in management of water**,** so if either or both of those factors are pushing toward more efficient management of water resources..." (Sarah Damron, pers. comm., 15 March 2013). While all recognize the shift the cost and values in a local region do play a role in the direction of the shift, again the political motivations could be underlying this shift. When discussing the barriers to implementing innovative management, such as conjunctive use, answers were not as concise. The majority of respondents (n=4) cited legal barriers with some also citing geological (n=2). One manager found these to be connected, "I think that is still one of the dangers with dealing with a coastal basin, where you've got both the threat of sea water intrusion and the fact that there really isn't that much empty storage. So there are certainly hydrologic issues and the legal issues just in terms of getting the water rights….10-20 years, to get the water right and be able to move it to another area" (John Ricker, pers. comm, 7 Mar 2013). Getting the right to move water between basins is difficult as many districts have passed laws prohibiting inter-basin transfers and is a main barrier and legal uncertainty to conjunctive use (Foley-Gannon 2008; Hedges 2011). The

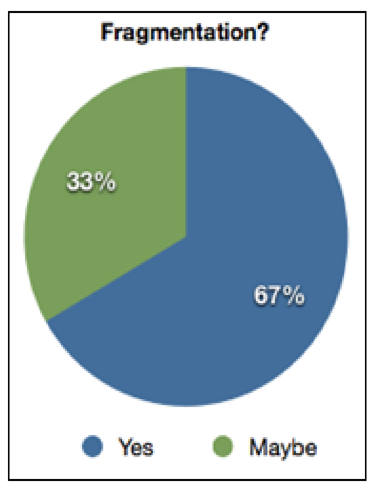


hydrologic barriers very by region and some areas are better suited then others for conjunctive management.

One NGO representative outlined a possible solution to the current issues, “To the extent that integrated management requires more communication and a larger vision, and possibly sharing water between water basins, the creation of a larger oversight agency or Memorandum of Understanding between agencies might be very helpful” (Sarah Damron, pers. comm., 15 March 2013). Many participants recognized this need in one way or another of better communication and some overarching institution to force agencies to work together and to provide guidance. Overall participants seem to recognize the need for more innovative management, “We have to be more creative, more holistic, more integrative whatever the right words are” (Brad Hagemann, pers. comm., 12 March 2013). Thus, stakeholders in the region recognize the need for more integrated and holistic management and the possibility of an oversight agency to help in order to help improved collaboration, communication across the region as the legal barriers are hard to overcome.

Jurisdictional Fragmentation & Decentralized Management

“It’s just an alphabet soup when you come down to it”
(Aengus Jeffers 2012, pers.comm., 13 Jul 2013)



One question poised towards participants was if they thought there are too many institutional layers to water management and if there were fragmented administrative management styles as a result. The majority of respondents agreed (n=4) that there was fragmentation or cited maybe (n=2). The two GMs that cited maybe agreed that fragmentation was an issue, yet that the extent depended on the decision makers, “While I believe in decentralized management, some regions cannot attract good people and you get bad decision making” (Dave Stoldt, pers. comm., 26 March 2013), and collaboration, “It depends on how well agencies work together. If you get pretty good collaboration and everyone is on the same page the fact that you have multiple agencies doesn't seem to be a problem. But I think it would make it easier if there were fewer agencies. Right now we have to negotiate and discuss to get everyone on the same page (John Ricker, pers. comm, 7 Mar 2013). These two opinions point toward the unique situation of place and scale of each governance setting as main determinants of fragmentation that is not often cited in the literature, yet the collaboration and governance do play crucial roles in limiting fragmentation (Lubell & Lippert 2011).

As mentioned the decentralized management system in CA has caused much jurisdictional fragmentation (Hanak et al. 2011). This jurisdictional fragmentation in the decentralized governance system has caused an extremely slow process that poses economic, environmental and political repercussions as the Carmel River and Seaside Basin that continue to be overused furthering environmental damage, possible economic sanctions if the state ordered cutback is not met and political turmoil from the large contingency of voters that are fed up with the the lack of action (Marc Del Pierro, pers. comm., 8 Aug 2013). The evidence of this jurisdiction fragmentation is evident in Figure 11 due to the plethora of institutions involved at varying level that all have interests in the Peninsula’s water supply.

Figure 11. A diagram of the multiple institutions involved in water issues at varying levels in the Monterey Region

This fragmentation has led to a ridiculous timescale at which projects are implemented as described by one GM, “The fattest commentary, they can’t get out of their own way. This county is notorious for having projects on the books for 20 years, rebuilding the dam, doing different things. I think the various political factions the enviros [environmentalists], the development guys, maybe the no growth...they are so equally balanced in terms of their influence or strength that you can never get anything done it seems like” (Brad Hagemann, pers. comm., 12 March 2013). This is a common sentiment that is also expressed in the local newspaper regarding the jurisdictional mess that has ensued in the past decade as the region has the weight of an oncoming deadline to find a solution:

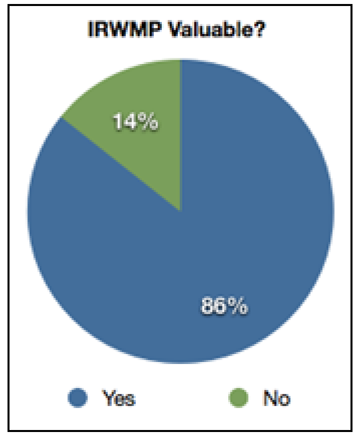
> “To understand how water policy is made on the Monterey Peninsula, do what you can to fill a colander with water and then watch it run out all the holes. You'll be left with water flowing in every direction, and an empty container. **The Peninsula's water issues have grown over the years even as more and more entities have taken on some role in the search for a solution but without plugging any of the holes.** Some of the entities may even have created some new ones. What we are left with is a lot of people and

> organizations involved, but no one with the authority to do much of anything, and no one to take responsibility for the way things are....As it stands, **Peninsula water politics are an insider's game almost indecipherable to anyone not directly involved**" (Herald, 2009)

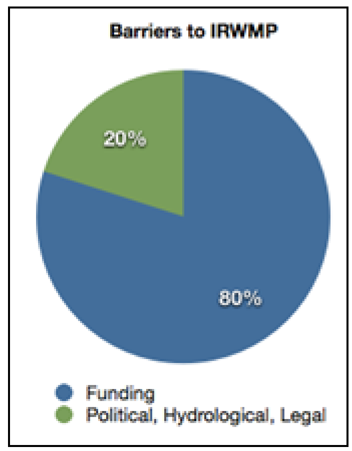
The political and jurisdictional fragmentation circumstances in the region have only gotten worse since 2009 as political scandals, corruption and a host of constituencies battle it out on how to solve the Peninsula's water dilemma.

Looking for a solution to this fragmentation one participant proposed that, "...it would be much easier for the public to engage if there was one agency in charge of managing the County's diverse water resources with sub-agencies in charge of specific tasks and/or regions" (Anonymous 2013). While there is one agency that handles water at a regional level, the Monterey County Water Resources Agency (MCWRA), they have limited power and focus more on flood control. Overall, this is a common theme across the state where management is highly decentralized as many agencies manage different parts of the water resource system (Lubell & Lippert 2011). Yet with the SWRCB now proposing IRWMP based of a financial incentive, there is recognition of the problem as the State tries to force its hand. One general manager describes the states push for regional solutions, "That is certainly what the state level is pushing. With the IRWP plans, they are sort of forcing the issue. They are saying look if you guys want a piece of this pie you have to go do that. You are not going to get any funding unless you are showing you are looking at this from a higher elevation a more regional approach" (Brad Hagemann, pers. comm., 12 March 2013). Thus, the movement towards regional management is happening yet jurisdictional fragmentation, political clout, and legal barriers together pose a large obstacle to overcome.

Integrated Regional Water Management Plans



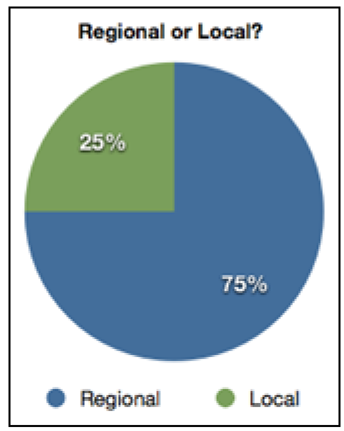
Participants when asked if the IRWMP would be a valuable resource to them, all the general managers agreed it would. Mr. Rosa explained that IRWMP will have a positive effect while it lasts, "...there is a grant in place for the IRWMP that pays for a grant writer that writes the grants up and works with that individual agency! So that is of no charge since it is under the grant. That will run out, they always run out, expire. But, that is the most important thing going for us" (Don Rosa, pers. comm., 3 July 2013).



Yet, others expressed that there are some barriers to this value due to the amount of effort and time it takes to get a grant, and the limited amount of money available, "The grants are limited and short term (John Ricker, pers. comm., 7 Mar 2013). When asked what the main barriers were to IRWMP for creating real change, funding was cited as the main barrier followed by the normal political, hydrological and legal barriers faced by managers. The general sentiment was expressed as "Funding is always the most problematic, getting enough money to do what needs to be done" (John Ricker, pers. comm., 7 Mar 2013). Furthermore, there is much uncertainty in whether the funds will continue to be available, when talking about running out of funds one participant commented, "That's a good point, that's the end of this bond cycle prop 84 or prop 50, are the voters going to be willing to shell out some more dough, that's a great question. I am always surprised how this last round got approved" (Brad Hagemann, pers. comm., 12 March 2013). Overall, the IRWMPs are a relatively new resource for the region and further research is necessary to gauge the long-term effectiveness, yet as it stands funding is currently limiting its performance (Lubell & Lucas 2011).

Regional or Local Solutions in Water Management

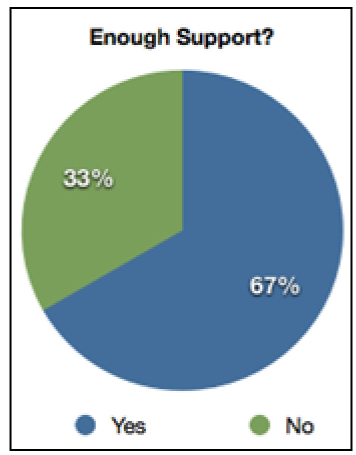
As the state seems to be pushing for IRWMP participants were asked if they thought regional or local approaches to water management were most effective. The majority expressed regional management as being more effective due reasons such as economy of scale, more water sources, and general funding from the state through IRWMP. One general manager for regional solutions stated, "Definitely regional – due to economy of scale for most projects if nothing else. Similarly for environmental enhancement, a unified, regional approach can be much more comprehensive and multi-objectives can be met more easily" (Mary Banister, pers. comm., 21 March 2013). This multi dimensionality is a key part to protecting common pool resources like groundwater and environmental assets like rivers that span multiple jurisdictions and thus are subject to a varying patchwork of local laws and regulations (Ostrom 1990).



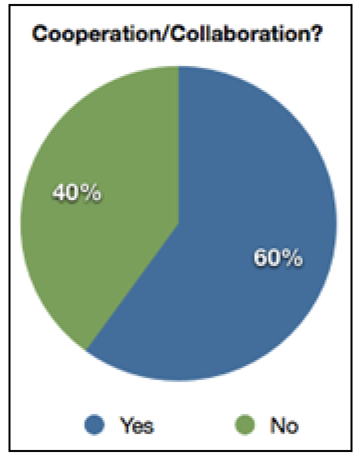
Other participants cited the difficulties of a regional approach due to the fact that your supply and demand is usually local. One NGO described that, "Regional solutions require extensive collaboration and cooperation, and sometimes compromise of interests. It also requires meeting the need of multiple constituencies, which can be challenging" (Sarah Damron, pers. comm., 15 March 2013). Additionally, a general manager stated that, "Local is still better because supply and demand are typically localized" (Dave Stoldt, pers. comm., 26 March 2013). Thus, the issue is not white and black, and while the general consensus is that regional is the most effective, as mentioned before there are various associated barriers to implementing effective management at this scale.

Support & Collaboration

In order to gauge how stakeholders interact and the efficacy of support mechanisms in place with current governance and managerial practices, participants were asked if they felt there was enough support from government or private institutions and collaboration to find a sustainable source of water in their local area. The majority of respondents usually GMs stated they had enough support (from institutions). One small districts general manager expressed, "You think you are out there all alone, but you realize that people have gone through this and there are answers out there, you just have to tap the right people" (Don Rosa, pers. comm., 3 July 2012). Another GM also commented on the help of IRWM, "Pretty good support both locally and at the state level. The state has its whole IRWM program that has been set up to support a lot of local approaches to water management." (John Ricker, pers. comm, 7 Mar 2013). In fact all the GMs indicated they felt supported.

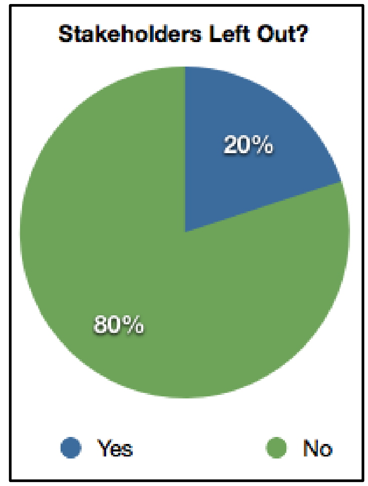


On the collaboration side others point towards the impact of IRWM, "I think IRWM has forced neighbors to collaborate. Also, with aggressive pursuit of funding (Pajaro) and an involved agricultural community (Monterey, and more recently Pajaro) projects are getting built. I think the community has taken ownership of the problem" (Mary Banister, pers. comm., 21 March 2013). Yet, while some regions like Santa Cruz and Pajaro have good collaboration, some regions are known for having more issues, "Yes – local agencies have collaborated. Those who chose to go it alone (or in an exclusionary fashion) seem to have imploded locally (Monterey Regional)" (Mary Banister, pers. comm., 21 March 2013). While public officials didn't cite a lack of collaboration the NGO's in the region did. One respondent stated that "I don't think that all the parties involved are willing to do what it takes, or rather put their own interests aside, to solve the Carmel River and Seaside Basin overdraft problems" (Anonymous, pers. comm., 2013). Another explains, "The public is not being represented right now. It clearly needs to be represented in the process" (Janet Brennan, pers. comm., 11 March 2013). These two quotes represent the general sentiment that political issues have hampered collaboration and support networks seem to be lacking in the region. The multi-level fragmentation clearly present, hinders the management of a resource as seen in the past history and current drawn out process of finding a project to solve the regions supply issue (Hanak et al. 2011; Lubell & Lucas 2011).



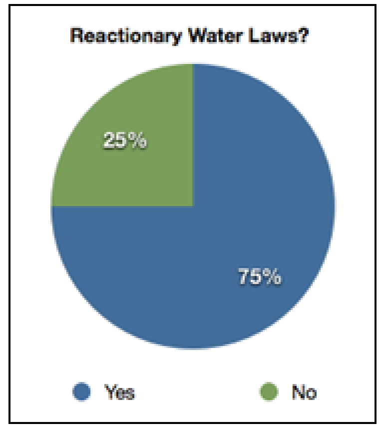
Stakeholders Left Out?

The inclusion of stakeholders is an important part of participatory governance and leads to a more thorough analysis of projects and decisions as well as adding new ideas. In this study region the majority of participants felt that stakeholders were by no means left, Mr. Stoldt explained that, “this place loves to talk” as stakeholders have plenty of opportunities to comment and be involved. Yet some NGO’s made the point that while there are a lot of organizations represented, there are still likely many people left out, “Probably anyone without the time or expertise to understand the complexities of the problem, solutions, and players. This could potentially be a lot of people” (Sarah Damron, pers. comm., 15 March 2013). Furthermore, the general public might not be fully represented, “The public is not being represented right now. It clearly needs to be represented in the process” with the sentiment that many decisions happen behind closed doors (Janet Brennan, pers. comm., 11 March 2013). Similar sentiments were also expressed by a GM who stated that, “What’s interesting to me, you know it is always the same six, you don't hear from the average ratepayer. You hear from special interests or people interested in it. That’s the case with anything but it is kind of frustrating sometime!” (Brad Hagemann, pers. comm., 12 March 2013). The same contingency groups do hold a political clout over most meetings and proceedings as they represent a set of specific interests and the general public often does not show up from my observations.



Reactionary Water Law?

While California does provide local agencies and users with a variety of tools to manage groundwater, these tools are mostly used retroactively to manage overdraft, thus many basins continue to be in overdraft (DWR 2012; Nelson 2011). As in the literature many of the respondents recognized that water laws are reactionary, “In large part, the applications for adjudication have followed the determination that the basin has been in overdraft" (Marc Del Pierro, pers. comm., 8 Aug 2013). Most respondents indicated that no one would file for adjudication or for local management unless they experience a loss, usually when their well runs dry. Furthermore, as mentioned



while many times property rights are ill defined water rights are often not even quantified and California is notorious for doing a poor job of measuring water use and rights (Hanak et al. 2011).

Public vs. Private

The public vs. private debate in water management has plagued the local area for the past decade. Currently there is a high degree of political fragmentation as to what level of public involvement is appropriate. Some advocate for a public buyout, some for partial public funding, while others a so locked up with the timeframe that they just want the project to move forward no matter the cost. One manager pointed out in his opinion that:

> "Cal AM is your water purveyor, your not going to buy them out. While you want them to be as efficient and cost effective as possible. I think there is a lot of time and energy wasted talking about getting rid of them or doing something different or we will buy them out which is just not practical. As opposed to working within the confines of kind of the cards that you have been dealt to some extent when you have a water purveyor that is very much entrenched within your local community, it is very difficult to kick them out and turn it over to government, being a non-profit" (Brad Hagemann, pers. comm., 12 March 2013).

A manager from Santa Cruz on the other hand was happy to have public ownership and management, "CalAM did own the Felton plant here and we were pretty happy to get them out of the picture. They are decision makers they are not ultimately bound to the electorate like they are with an electorate system" (John Ricker, pers. comm, 7 Mar 2013). Yet, the difficulty of changing entrenched systems is highly relevant as Colebatch (2006, 26) stated 'there is no quick fix in institutional change', the change needs to be holistic and incremental. The region will most likely not get rid of the private purveyor, yet through incremental changes as we can see it is diversifying its options and pushing for public oversight and finance.

Only through increased transparency, collaboration and legal and political backing will managers be able to overcome these challenges.

Conclusion

In conclusion some main points can be drawn from this analysis and discussion. First, the decentralization of water management in California has led to multiple dimensions of jurisdictional fragmentation (Hanak et al. 2011; Lubell & Lippert 2011). A common problem that is slowly changing across the West is that we still treat resources in isolation rather than embedded in ecosystems. This is relevant to jurisdictional fragmentation where boundaries do not align with the resource boundaries (Glennon 2002; Bakker 2010). Combined with the uncertainty of water law and the current focus on conjunctive, integrated and adaptive management that has been proposed, these two factors limit sound and holistic management styles that protect the environment and secure water for future uses. Second, while there is a paradigm shift in water management, from prediction and control to management as an integrated and learning process, to overcome these current barriers, this shift cannot be fully evaluated until the outcomes are clear (Ostrom 1990; Ostrom 1999; Biswas 2004; Mitchell 2005; Engle et al. 2011). Even so, this shift is subject to the political gridlock and legal uncertainty inherent in California's current legal framework and could be the reason why this shift is still not significantly integrated into water management across the State.

Here, I have demonstrated that due to a perverse and pervasive set of agencies and stakeholders involved there is fragmentation of water management jurisdictions. These are complicated by legal uncertainties for management projects under current California water statutes, resulting in delays, failures, political factions in resource disputes, and economic and environmental burdens. The high amount of uncertainty and fragmentation present throughout the water resource system and management is a significant obstacle. This research concludes that the present obstacles can be overcome and reconciling the varying institutional levels of water management and governance in the region is possible through increased cooperation and effective implementation of integrated and adaptive management techniques. Working towards these goals will lessen the fragmentation present by aligning management with the ecosystem. Additionally, through increased cooperation some of the constraints and uncertainty imposed by law can be mitigated. Even so, stakeholders and managers need to cooperate and push for changes in the CA water code, by all means necessary, to decrease uncertainty and to become more in line with more contemporary management practices. A common theme across the state is that the current complexity faced by water managers has led to “solutions” that seem dated, sluggish, or not innovative enough to keep up with changes taking place across the West.

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Appendix

General Formal Interview Questions:

- Water managers in CA face a daunting future from a trifecta of pressing issues: Climate Change, Growth (Pop. Ind. & Ag), and increasing environmental constraints due to surface water protection. There is thus a need for strong multifaceted diverse water management in California.
  - What are the main barriers (political, legal, economical, hydrological) to water management that you have come across during your time working in the field?
- Conjunctive Use: Conjunctive use is a relatively new form of water management, do you see a shift from surface based water projects to integrated ones in California?
  - What are the major barriers to innovative water management such as conjunctive use (CA state water law, CA decentralized approach to water management, political, economical)?
  - What changes need to be made for better conjunctive use?
  - Do you think changing a management system to incorporate these integrated and adaptive management approaches requires more levels of governance?
- In 1992 AB3030 was passed and allows a wide variety of groundwater management activities by local agencies either through granted authority or groundwater ordinances, it also calls for management through court adjudication.
  - Do you think the decentralized approach to water management, is working in CA?
  - Has much been accomplished in the last two decades or is this process too slow?
  - Water laws seem to be reactionary, is there a way for managers to be preventive? For example managing a basin before it becomes in overdraft, and possibly damaged?
- The state has mandated that Integrated Regional Water Managment Plans (IRWMP) be formed to help ‘manage all aspects of water resources in the region’ and ‘involve multiple agencies, stakeholders, individuals and groups’. This legislation encourages regional strategies of water management.
  - Will this be a valuable resource for the peninsula?
  - Will collaboration be an issue? Have local agencies collaborated in the past?
  - Do you think real change will occur? If not, what are the main barriers (economical, political, hydrological, legal...)?
  - Will the IRWMP for the Great Monterey County help integrate management of water in the region? Could funds be allocated for more alternative water supply projects to help keep down energy costs associated with desal plants and less associated environmental impact?

- It seems that state funding is pushing for regional solutions. Do you think local or regional solutions or a combination of both are most effective for water management? Why?
- Do you think there are too many institutional layers to water management? If so, do you think there is fragmented administrative management styles due to this alphabet soup of agencies involved or for other reasons?
- Do you feel like there is enough support(gov, private) and collaboration to find a sustainable source of water in the local area? Why?
- Recycled Water: The SWRCB has mandated statewide increases in use of recycled water by two million AFY & stormwater by one million AFY by 2030 over 2002 levels.
    - Do you think these goals are on track to being met?
    - Would you say this legislation helps more to streamline recycled water projects or is it a hinderance due to added administrative layers?
    - What are the main obstacles to implementing recycled water projects?
- The California Coastal Commission is a very powerful agency.
    - How do you think their decision will impact the projects?
    - Have they had any affect on projects in ______?
- Which set of stakeholders do you think is being left out of discussions on water management in this basin? Why do you think that is?
- Overall the Central Coast seems to have progressive management of resources.
    - Where are some areas in which it could be improved?
    - What are some of its strengths?

Specific Questions on Water Projects on the Monterey Peninsula:

Monterey Peninsula:

- Conservation: The Monterey Peninsula is leading the way state wide in terms of water conservation since use is at 58 gal per person. The state requirement of a 20% reduction in urban per capita water use by 2020, has a goal for region 3 at 123 g per person by 2020.
    - Do you think these conservation options have been maximized? Are there any low hanging fruit or further actions you think need to be taken? Australia, Spain and Israel have per capita water demand in the 30-50 range.
    - What are the main barriers to implementing a successful conservation program?
    - Do you think conservation is being pursed as intensively as it should be?
- Groundwater Banking/Storage:
    - What is the current storage capacity of the Santa Margarita Aquifer? I have heard this to be around 48,000 AF… Is there room for an expanded or other Aquifer Recharge projects or GWR?
    - ASR 1 & ASR 2 when completed are estimated to average a 1,920AFY yield through use of the Santa Margarita Aquifer. Can ASR be expanded beyond this? If not, what are the barriers (water rights, hydrological, structural(size of conveyance pipes), economical, political)?

    - MRWPCA's GWR is expected to yield 3,500 AFY, with the use of 4,400AFY of secondary water. Yet, MRWPCA has an average of 10.500AFY of unused water that is discharged out to sea.
        - Is this correct?
        - Can this project be expanded, what are the barriers (hydrological, economical, political, legal)?
        - What are the main challenges for the current project? Do you think it will be online by the 1st quarter of 2017 to trigger a smaller desal plant?
- Desalination: With three projects on the table, and Cal Am's formally backed.
    - Out of the three proposed projects, which do you think is best to meet the water needs of the peninsula?
    - Desalination seems to be getting all the attention compared to ASR, GWR and alternatives, is this due to political and economic reasons?
    - The State Water Resources Control Board is also developing new seawater desalination regulations that could force desalination plants like Carlsbad Poseidon's to change its intake and discharge systems. Do you think this will have an impact on the proposed local plant?
    - Currently desalination proposals are slow due to a lack of streamline review. Do you think water agencies will be quicker to call on desal once this process is streamlined?
    - With AB32 and Executive Order S-3-05 California needs to reduce GHG emissions to 80% below 1990 levels by 2050. The energy requirement of desalination is 10-13x that of alternatives. Additionally, CalAm just proposed a 700afy larger plant due to lots of record, 'tourism bounce-back' and due to the requirement for increase input into the Seaside Basin to bring it back into a sustainable yield. Should the energy use of water be more heavily considered?
    - Santa Cruz and Salinas are looking at the possibility of augmenting their local water supply with desal, would a regional project be more cost efficient and practical in light of these developments?

Additional Questions for NGO's:

- What has been your organizations involvement in the water issues on the peninsula? Are you still involved now that the regional project fell through? If so, do you feel adequately represented?
- How has collaboration been through the process of deciding a new water supply for the Monterey Peninsula? Has your organization had direct or indirect involvement?
- Finding an alternative water supply source for the Monterey Peninsula has been a long drawn out process. Four years have passed since I last researched the issues and have been filled with corruption, not well thought out plans and what seems like a lack of good governance and cooperation.
    - What are the major problems you see?

    - Do you think there are too many institutional layers to water management? Do you think there are fragmented administrative management styles due to this alphabet soup of agencies involved or for other reasons? If so, what could be done to fix it?
- Now that the MPRWA and MPWMD are more involved do you think there continues to be problems with governance/collaboration of water management in the area?
- Groundwater Banking/Storage:
    - GWR (MRWPCA) and ASR (Calam & MPWMD) are two options that are being pursued as part of the water supply portfolio. Do you think these projects are being pursued as intensively as they could be? Should they be expanded if possible?
- Is their a real threat of water shortage if the 2017 Deadline for the cease and desist is not met?
- The privatization of water is becoming a theme worldwide, what do you think are the advantages or disadvantages of CalAm's role? Does a public solution make more sense? The MPWRA is requiring a public governance committee, will this make the project more secure for ratepayers and the publics interest?