MANAGING BASIN SECURITY: UNDERSTANDING THE KEY ORGANIZATIONAL AND ADMINISTRATIVE FACTORS THAT IMPACT SGMA IMPLEMENTATION

By

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Executive Summary:

California's surface and groundwater are inherently linked. Each year, municipal, environmental, and agricultural water users will use surface and groundwater to meet their various needs. During drought years, groundwater pumping increases to supplement surface water shortages. Despite this reality, before 2014, only surface water had comprehensive regulation, leading to significant groundwater overdrafting during dry periods.

Approved in 2014, the Sustainable Groundwater Management Act is California's first comprehensive law regulating groundwater. This regulation employs a unique system designed to maximize local control by authorizing Groundwater Sustainability Agencies (GSA) to develop their own Groundwater Sustainability Plans (GSP) that ensure the basin or subbasin becomes stable in 20 years. In meeting SGMA's requirements, GSAs have needed to move quickly in organizing stakeholders, securing financing, and implementing basin monitoring and recharge projects critical to basin security. These responsibilities have created unique challenges for the GSA administrators. This Culminating Project identifies and analyzes the key factors that impact SGMA implementation.

This culminating project employs a hybrid research methodology to explore this question, incorporating a literature review and interviews with groundwater professionals. My literature review compiles and analyzes academic literature from legal analyzes, surveys, and empirical case studies. This literature helps to identify challenges other scholars had identified when deconstructing SGMA's implementation. In conducting original research for this Culminating Project, I interviewed six groundwater professionals who bring unique perspectives into GSA

administration. In combining these research methods, I identified five factors that impact GSA administration. These include the. These factors impact administrators' ability to bring stakeholders together, develop consensus around GSPs, and design and implement groundwater projects to meet sustainability goals.

To ensure these factors are addressed, this culminating project presents several recommendations gleaned from interview participants. Participants recommended that GSA leaders continue improving stakeholder outreach methods, begin developing groundwater projects and work in collaboration to secure long-term financing. They also suggested that legislators make efforts to increase the level of financing and technical support available to GSA leaders, as well as clarify the Water Board takeover process if agencies cannot meet sustainability goals. Participants also suggested that peers in the Sacramento State MPPA program increasingly consider collaborative processes in developing programs and addressing large issues.

When California's legislature approved SGMA in 2014, it changed how California regulates groundwater and paradigms around the state's management of natural resources. By analyzing the key factors that impact program development and implementation, the state can better support leaders and improve the likelihood that they succeed in meeting long-term goals.

Introduction

California's water supply relies upon an intricate network of streams, canals, aqueducts, dams, and reservoirs that transport water from the Sierra Snowpack to businesses and consumers throughout the state. Annually, up to a third of California's water is stored in the Sierra snowpack, providing essential water to supply farms, businesses, and municipalities through the spring and summer months (Mount et al. 2019). However, as global temperatures rise, the reliability of the Sierra snowpack as a dependable reservoir is in question. According to the Scripps Institute of Oceanography and USGS, given the global projected temperature increase, Californians may expect a snow water equivalent reduction of the Sierra Nevada Snowpack by 29% by 2030, 55% reduction by 2060, and a 74% reduction by 2090 (Mount et al. 2019). This is not to say that California will lose the water that falls through the Sierra Nevada mountains entirely. Instead, water will fall in a liquid form, which California must be prepared to capture effectively.

California's water users have long used groundwater to supplement surface water allocations. When pumped at a sustainable rate, groundwater provides a useful source of vital water resources without affecting basin health. Conversely, when users over pump groundwater, the impacts can devastate the total basin storage, pump efficiency, water quality, and local infrastructure. In response to historical over pumping patterns in select basins, then Governor Jerry Brown signed the Sustainable Groundwater Act (SGMA) into law in 2014. This law requires water users in medium-priority and high-priority groundwater basins to form Groundwater Sustainability Agencies (GSA), responsible for creating and implementing Groundwater Sustainability Plans (GSP). Under SGMA regulations, these plans must guide the

development of contracts, agreements, and projects that will create groundwater-neutral subbasins within 20 years of implementing the plans.

Many leaders have faced organizational challenges related to GSA formation, stakeholder management, and regulatory compliance when implementing SGMA's requirements. These concerns may impact GSA's ability to meet SGMA's timelines and objectives. This Culminating Experience project explores the administrative and organizational challenges Groundwater Sustainability Agencies face in meeting the requirements set by SGMA. In doing so, I will explore challenges related to how agencies can balance the dueling responsibilities of maximizing public good through efficient resource allocation and allocating water equitably between stakeholders.

In developing this Culminating Experience project, I make efforts to direct my analysis toward specific institutional actors:

1) This paper should provide helpful information and antidotes to groundwater professionals working to support GSAs. In scanning this report, I hope they can compare their experience to that of their peers, identifying best practices and pitfalls impacting GSAs as they develop and implement plans.
2) This report should provide critical feedback to legislators, organizations, and associations familiar with SGMA policy language yet have little or no exposure to how GSAs and their leaders have managed to meet the timelines and requirements of the law. Reading this report, I hope they may identify key areas where new legislation or resources may support GSAs as they carry out GSPs.

3) This report should be accessible to my professors and peers at the Sacramento State Masters in Public Policy and Administration program. Outside of their association with me, many of these individuals may have little or no background in groundwater policy yet are intimately familiar with California's political institutions and the key factors that impact local governance. In reading this report, I hope my peers not only gain background on SGMA's and GSAs, but also a better understanding of the intimate relationship between legislation and program implementation.

In this report, I will attempt to make my language plain and approachable. In doing so, I hope my peers can better understand SGMA's legal writing and the technical elements of GSPs. To assist in explanations, I will also use visuals and graphs that help illustrate components of the report.

One key factor of groundwater is that it is largely invisible, as groundwater is stored in underground aquifers. As a result, it receives significantly less attention than surface water, despite being interconnected. Surface water is fundamental to supplying water for irrigating farms, maintaining habitat, and supplying urban centers. Historically, water users supplement surface water for groundwater when surface water is scarce. When surface water is plentiful, water users tend to pump less water. Inversely, in times of drought, where surface water is scarce, water users rely on groundwater to irrigate crops, develop habitats and supply drinking water. As once-periodic droughts increase in frequency and severity, sustaining groundwater supplies will become increasingly important to California's economic, environmental, and social well-being.

If GSAs cannot effectively develop and implement local plans, the State Water Board may step in with an interim plan that, among other interventions, directly manages groundwater extractions (Escriva-Bou et al. 2016). Interim plans both undermine local control of resources and may impact the economic productivity of basins, particularly in the central valley. For this reason, GSAs must be effective in convening stakeholders, drafting plans, and developing projects.

Section 2: History of Water Rights in California

While unorthodox, California's system governing surface water allocations is central to understanding the state's historical groundwater use. California's geography is the most diverse in the United States, incorporating mountain ranges, high and low deserts, coastal plains, and the central valley. Typically, the state receives most of its precipitation between November and April, followed by a period of drought between May and October (Hanak et al., 2011).

This cycle of temperate wet winters and dry, warmer summers created a unique ecosystem, supporting significant populations of migratory and perennial species. During the wet period, the central valley flooded with surface water creating the Sacramento Valley floodplain, providing food for migratory bird species, habitat for salmonid hatchlings, and filling underground aquifers through a process known as natural recharge (Katz, 2020). During the rainy season, the Sierra snowpack stores about 30% of the state's water reserves. Throughout the dry summer months, water from the snowpack filled streams and rivers, supporting migratory fish species with cold water (Hanak et al.,2011). Before developing the state's elaborate water

infrastructure system, this unique ecosystem, built around oscillating seasons of flood and drought, was the primary source of nutrition for the estimated 300,000 native Americans living in California (Hanak et al.,2011).

California's natural waterways changed irrevocably after the discovery of gold in Coloma, California, in 1848. In surveying gold prospects in the Sierra Nevada mountains and the lower foothills, miners soon realized the potential for extracting far more wealth using hydraulic mining techniques that diverts water from streams to erode ore-rich hillsides. (Hanak, et al.,2011).

In addition to causing significant environmental change, this process also created significant competition for water resources far from the sources. To adapt to this reality, the state developed a new system for allocating water and resolving disputes based on a "first-in-time, first-in-right" system (Hanak et al.,2011). Before this change, California used a riparian rights system mirroring the Eastern states. Under this system, the state assigned ownership to water resources based on proximity to a water source (Water Education Foundation). Since the gold rush, allocation of surface water rights increasingly uses an appropriative system where users' allocations are based on historical claims. During periods of drought, surface water is allocated based on the date and historic use of a claim (Water Education Foundation).

During the 1800s, adopting an appropriative system was key to fueling the industrial mining industry and its economic and social changes. The same system has been highly inequitable when superimposed onto a system based on agricultural, municipal, and

environmental users. In the agricultural sector especially, this water allocation system leaves some farmers with sufficient water to grow crops and some who do not.

Groundwater, tapped from ancient underground aquifers, has historically been a buffer for farms, cities, and environmental users when surface water supply is insufficient. California's farms and cities today rely on groundwater for about 40% of their water during nondroughted years and 60% during drought. Farmers initially pumped groundwater using windmills and steam engines (Hanak et al.,2011). With improved technology, they began pumping using gasoline-powered and electric pumps, increasing the amount of water extracted (Hanak et al.,2011). Because pumping is resource-intensive, water users often use it as a secondary water source if they have access to surface water. Unfortunately, increased pumping lowers water levels, creating a problem of users needing to dig perpetually deeper wells. While the California Supreme Court intended to scrap the groundwater rules permitting unchecked groundwater pumping and replace them with one that requires that groundwater levels stay consistent, it failed to assign a regulatory agency that would oversee groundwater drafting and identify lawbreakers (Hanak et al.,2011). As a result, groundwater over-drafting remained largely unchecked until 2014, when California's legislature approved the Sustainable Groundwater Management Act (SGMA).

SGMA was developed in reaction to a chronic problem of water users continually overdrafting basins. While the state did sponsor groundwater management projects and monitoring efforts through the 1990s, it retained little autonomy to control groundwater levels. This lack of control led to increased groundwater pumping, especially during the 2011-2016

drought when parts of the valley received only 60 centimeters annually. In seeing concerning levels of over-drafting throughout the state, lawmakers moved to develop a law requiring basins and subbasins to become organized and develop plans to meet groundwater sustainability markers. The result was a three-bill package (AB, 1739; SB 1319; SB 1168), with sustainable groundwater management by 2042. SGMA was signed into law by then Governor Jerry Brown in September 2014.

Section 3: Deconstructing SGMA's Goals and Requirements

When signed into law in September 2014, SGMA fundamentally changed how California regulates groundwater. SGMA is a collection of three bills, SB 1168, SB 1319, and AB 1739, amending the Water Code and Government Code (CALAFCO, 2016). SGMA's legislation develops a structure for managing groundwater supplies on a local level to achieve groundwater sustainability in high and medium-priority groundwater basins (CALAFCO, 2016). To meet this goal, SGMA requires high and medium-priority groundwater basins to form Groundwater Sustainability Agencies (GSAs) tasked with monitoring groundwater conditions and developing Groundwater Sustainability Plans (CALAFCO, 2016). As part of local governance, the statute granted GSAs the authority to manage groundwater by conducting investigations, imposing fees, and enforcing the terms and conditions outlined in GSPs (Water Education Foundation, 2015). SGMA's legislation also requires GSAs to develop and report data to support groundwater management. This data should help describe the basin's geology, water balance, and other measures of sustainability (Water Education Foundation, 2015). In collecting these figures, GSAs should be able to resolve disputes related to sustainable yield, beneficial use, and water rights (Water Education Foundation, 2015).

Finally, SGMA allows the state to develop and implement authority when GSAs fail to manage groundwater sustainability levels (Water Education Foundation, 2015). When GSAs cannot meet the objectives outlined in GSPs, SGMA grants the state the authority to develop and implement interim plans to guide the management of the basin until the GSA is ready to resume management (Water Education Foundation, 2015). The Department of Water Resources (DWR) and the State Water Resources Control Board (State Water Board) splits responsibility for GSA management and oversight (Water Education Foundation, 2015). Under SGMA, DWT is responsible for reviewing and overseeing Groundwater Sustainability Plans on an ongoing basis (Water Education Foundation, 2015). The State Water Board reserves an administrative role in enforcement, intervening when GSAs fail to meet obligations by the predetermined timeline (Water Education Foundation, 2015). When the State Water Board assumes administrative authority, leadership may recoup administrative costs by administering fees (Water Education Foundation, 2015). Appendix A includes a timeline for SGMA's obligations. SGMA is unique in the mechanisms it uses to meet key sustainability milestones on an accelerated timeline. By granting localized systems broad autonomy to meet sustainability objectives, the law diverts from long-held top-down models of natural resource governance. Understanding how SGMA changes California's groundwater governance is fundamental to understanding administrators' challenges in developing and overseeing GSAs.

Sections 4: Methodology

In developing this Culminating Project, I relied on two principal forms of data: academic literature and interview responses. I chose these research methods because they provide a

balance of perspectives and allow me to synthesize the most important elements that affect the success of SGMA's implementation.

Literature Review

I conducted a formal literature review to provide essential context and multiple perspectives into key elements impacting SGMA's rollout. I primarily used academic peer-reviewed literature in addition to one master's thesis in this literature review. I utilized peer-reviewed academic literature in the Literature Review section for three reasons:

1. Academic literature is a convenient source of essential background information. I leaned heavily on literature reviews conducted by other scholars to better orient myself and my readers to SGMA's complex history and developments.
2. The peer-review system provides an objective, independent review of scholars' data and methods, ensuring high confidence in the data quality.
3. The highly political nature of water politics in California may create an opportunity for skepticism. Using peer-reviewed academic literature ensured the data was vetted and reputable, protecting my conclusions from partisan critiques.

Using data pulled from scholarly articles, I preserved the independence of my research, analysis, and conclusions. Other areas of this Culminating Project contain information from non-scholarly sources, which were critical for establishing background and understanding different stakeholders' perspectives on SGMA's rollout. In these ways, academic research helped provide a comprehensive understanding of SGMA issues and relevant data while retaining the quality and independence needed for later analysis.

Compiling existing literature into a literature review allowed my analysis to synthesize research from multiple disciplines. In creating this Culminating Project's literature review, I used literature collected from legal scholars, policy and organizational scholars, sociologists, and data research experts. These scholars approached their research on SGMA and GSA administration from different perspectives and employed various tools in their analysis. Naturally, scholars' differing backgrounds, tools, and focus lead them to different and, at times, contradictory conclusions. My literature review takes steps to account for these differences of opinion when they arise.

In organizing my literature review, I grouped authors by their research method. In researching SGMA implementation, scholars primarily use three tools to execute their research. One group of scholars, principally legal scholars, focused on the relationship between the structure of the law and its implications on implementation. These scholars focused on the impacts of changing water regulation and where lack of clarity and state control within the legislation may lead to tensions between stakeholders. While few scholars have conducted large-scale surveys to study SGMA's implementation, the surveys helped to identify common concerns and frustrations stakeholders face going through the GSA and GSP process. Finally, I concluded the literature review by analyzing empirical-case studies. Because SGMA focuses heavily on localized groundwater control, these case studies helped provide site-specific context and nuance. Comparing these case studies, I better understood how organizational and environmental factors impact GSA administration. Additionally, case studies helped illuminate the process of GSP development, which is critical to understanding why leadership favored some strategies

over others. By categorizing my literature review by research methods, I analyzed using multiple lenses, which I will employ throughout my analysis.

Interviews

I used interviews with GSA leaders and stakeholders to collect critical data about the experience of going through the GSA administration and GSP formation process. This data was invaluable to this report as it helped contextualize or challenge academic's conclusions highlighted in the literature review. Additionally, interviews naturally allow for a more focused administrative lens that provides insight into GSA leaders' challenges when overseeing the SGMA process. These interviews allowed for a window into key factors impacting SGMA's implementation.

Participant selection was a crucial component of conducting an interview-centric research project. I selected participants using a snowball method, where individual participants recommend future participants after their interview. To begin this process, I contacted existing contacts that work professionally in water regulation and management. These contacts suggested leaders they felt could provide a unique perspective on my research question. As a result of this process, I interviewed six water leaders, each with a unique experience interacting with SGMA. Participants include:

James Mayer (Interviewed October 10, 2022) Mr. James Mayer is a McGeorge School of Law adjunct professor, a consultant for the Northern California Water Association (NCWA) Groundwater Taskforce and serves on Yolo County Flood Control's board. I

was introduced to Mr. Mayer through David Guy from NCWA, who felt Dr. Mayer would provide valuable insight into how GSAs approach administration and interpret the law. I interviewed Mr. Mayer over the Zoom communication platform. The interview lasted approximately one hour.

Lewis Bair (Interviewed October 25, 2022) Mr. Lewis Bair is the General Manager of Reclamation District 108, which serves rural communities and farmers in southern Colusa County and northern Yuba County. Mr. Bair was recommended to me through a contact who farms in Colusa County, who felt he could provide insight into how SGMA changes water management, GSA administration, and GSA stakeholder engagement. I interviewed Mr. Bair on the Zoom communication platform. The interview lasted approximately thirty minutes.

Bill Vanderwaal (Interviewed November 3, 2022) Mr. Vanderwaal is the Assistant General Manager of Reclamation District 108 and Dunnigan Water District, representing 10,000 acres in Colusa County. Mr. Vanderwaal was recommended by Mr. Bair, because of his high-level experience engaging in groundwater administration, stakeholder management, and project management. I interviewed Mr. Mayer on the Zoom communication platform. The interview lasted approximately one hour.

Kristin Sicke (Interviewed November 4, 2022) Ms. Sicke is the General Manager of Yolo County Flood Control & Water Conservation District and the Yolo Subbasin Groundwater Agency, a GSA representing stakeholders throughout Yolo County. Ms.

Sicke was recommended through Mr. Vanderwaal, because of her unique experience as a GSA leader who manages multiple subbasins through a single GSA. I interviewed Ms. Sicke over the Zoom communication platform. The interview lasted approximately one hour.

Dave Eggerton (Interviewed November 7, 2022) Dave Eggerton serves as the Executive Director of the Association of California Water Agencies, which represents 90% (450) of local public water agencies. I know Dave through previous research conducted through Sacramento State's MPPA program. I wanted to speak with Mr. Eggerton to understand how the experiences of GSA administrators may differ between geographic areas, demographics represented, and the environment. I interviewed Mr. Eggerton in person at a restaurant in Sacramento. The interview lasted approximately one hour.

Robert Thomas (Interviewed November 17, 2022) Robert Thomas is the owner and operator of Thomas & Associates, a consulting firm specializing in water issues, among other concerns. Previously, Mr. Thomas served as the Executive Director of the Water Forum, the City Manager of the City of Sacramento, and the County Executive for Sacramento County. I wanted to speak to Mr. Thomas because of his experience working with different GSA leaders and stakeholders and his administrative experiences at the highest level. Mr. Thomas and I met in person. The interview lasted approximately thirty minutes.

In conducting interviews, I asked each participant a series of questions selected from a list compiled in collaboration with my advisor Dr. Ted Lascher. The questions selected differed from interview to interview to accommodate time constraints and the participant's unique experiences. I have attached a copy of the questions I used in Appendix B.

Section 4: Literature Review of SGMA Implementation

The literature on examining SGMA employs three distinct research styles, and these include legal and historical analyses, larger survey-based research projects, and empirical case studies. This research provides the critical background to analyze the complexities behind SGMA's implementation.

Legal and Historical Context

One unique factor legal scholars point to when analyzing California's groundwater governance is its lack of regulation leading up to SGMA's passage in 2014 (Hubbard, 2020). Traditionally, California's law treated surface water and groundwater as separate resources, tightly controlling surface water resources while leaving groundwater largely unregulated. (Owens et al., 2019). Legal scholars point to SGMA as an attempt to reconcile legal structures governing water use with modern hydrologic reality (Owens et al., 2019).

Scholars analyzing how SGMA addresses groundwater rights have expressed concern over its inability to address legacy property rights (Dyble, 2017;Owens et al., 2019; Garner et al., 2020). Under California law, water rights are property that cannot be taken away without just compensation (Owens et al., 2019; Garner et al., 2020). In delegating the responsibility to

allocate water resources within a basin, SGMA pits GSAs mandates against users' water rights (Garner et al., 2020). Legal scholars warn that this underlying conflict may lead to a highly litigious environment as water users conflict with new legal and management systems to defend legacy rights to groundwater. (Owens et al., 2019; Dyble, 2017; Garner et al., 2020). In requiring GSAs to manage groundwater levels within their subbasin, some scholars argue that the state unfairly abdicated responsibility for limiting groundwater pumping that otherwise would be handled centrally by a public agency (Owen et al., 2019). As a result, SGMA creates legal vulnerabilities that may fuel legal challenges between groundwater users and GSAs (Owen et al., 2019).

When signed into law in 2014, SGMA deviated from the standard top-down model for natural resource management, developing a new stakeholder-based local control system (Kiparsky et al., 2017; Dyble, 2017). Lawmakers designed SGMA's bottom-up approach to match better physical and social characteristics with a hyperlocal management style that may be more appropriate to give basins or subbasins (Kiparsky et al., 2017). Several scholars have also expressed concern regarding how a GSA may be formed and governed. According to Dyble (2017), SGMA's guidelines for developing GSAs center decision-making power on a narrow group of stakeholders. This decision departs from the "one person, one vote" rule of representative government (Dyble, 2017). Without public representation, scholars have raised concerns over leadership's ability to garner the political needed to respond to SGMA's requirement and police groundwater effectively (Dyle, 2017; Milman & Kiparsky, 2020). This broad authority, combined with underlying water use trends, may undermine management and

impact decision-making in a way that undermines the effectiveness of the law (Hubbard, 2020;l Dyble, 2017).

Finally, several scholars point to the law's ambiguity as a major factor affecting GSP implementation. While the stature is specific and directive, the criteria for evaluating GSPs lack transparency. Identifying this ambiguity, several scholars expressed concern about how state agencies will interpret GSPs (Cantor et al., 2018; Milman & Kiparsky, 2020). Lacking tools, such as sample formulas or approved projects, GSAs risk allocating resources and time toward developing plans that may be rejected or challenged in the court system. (Cantor et al., 2018; Garner et al. 2020). In navigating these situations, GSAs may need to mitigate their level of risk, balancing preferred compliance options (lower-cost projects and enforcement tools) with the likelihood of state sanctions (Milman & Kiparsky, 2020). Increased ambiguity may invite assumptions about the regulatory process, undermining the effectiveness of the law (Milman & Kiparsky, 2020).

In pouring over SGMA's legislation, researchers identify three key areas that may lead to ongoing conflict. These include: unresolved property rights, local governance, and intentional ambiguity. In failing to alter property owners' historic rights to groundwater, SGMA limits the GSAs' agency to impose pumping restrictions. Because GSAs are not able to change landowners pumping allocations, administrators have limited options to meet groundwater sustainability goals. These challenges may force GSAs to prefer less efficient options in their GSPs and impact groundwater sustainability targets, such as paying for surface rechange or subsidizing farmland fallowing. SGMAs bottom-up approach to groundwater management also opts for a stakeholder-

based governance model over a representative-governance model. This decision provides water users, who may be interested in maintaining pumping levelpower to influence options considered in the GSP. Scholars warn that this model may undermine leadership's decision-making ability and limit more austere groundwater-saving options. Legal scholars also focus on the relationship between legal ambiguity and GSA governance. Researchers argue that SGMA's squishy language incentivizes risk-taking behavior, such as incentivizing lower-impact GSPs. This behavior may lead to lost time and resources and undermine sustainability goals. Legal analysis helps to provide expert predictions into GSA development and administration. Combined with other research forms, it helps illuminate key areas GSA administrations struggle with when implementing SGMA.

Surveys

Surveys are an essential tool for generating statistical data related to public opinion. Since 2014, two teams of researchers have conducted significant surveys centered around understanding SGMA's implementation.

The first study, "Implementing SGMA: Results from a stakeholder survey," was conducted in 2019 and overseen by the UC Davis Center for Environmental Policy and Behavior. This study surveyed SGMA participants, gathering data related to participants' perceptions of the SGMA process, levels of stakeholder engagement, and feelings related to collaboration (Méndez-Barrientos, 2019). The second survey, "Evaluating California's Sustainable Groundwater Management Act: The First Five Years of Governance and Planning,"

was conducted in 2021 by Leach et al. This study takes a narrower view, focusing on the perceptions of GSA managers and officials representing GSAs (Leach et al., 2021).
Both studies surveyed large groups of respondents to identify better where leaders are succeeding and challenged in SGMA's Implementation. In surveying participants about SGMA's implementation, the researchers received a wide range of answers suggesting that the process has played out differently between GSAs (Méndez-Barrientos, 2019; Leach et al., 2021). These studies identified five significant obstacles that negatively impact GSA administration. These obstacles include stakeholder engagement, inter-basin collaboration, climate change impacts, legislation challenges, and access to financial resources (Méndez-Barrientos, 2019; Leach et al., 2021). Having quantitative data that identifies key challenges in SGMA's implementation is crucial for steering future research. Using these data, my original research will be able to maximize time and resources by focusing on widely held concerns related to SGMA's implementation.

Empirical Case Studies

Case studies are essential for interpreting how SGMA's implementation has played out at the local government level, providing critical insights into managers' experience administering the law. Because SGMA is still in its infancy, with key development milestones still in progress, research looking into individual GSA's experiences is still in development. This literature review highlights three case studies describing GSA administration in divergent locations.

In their article, "The Future of Groundwater in California Lessons in Sustainable Management from Across the West." Babbit et al. (2018) set out to understand and help

groundwater managers and local government leaders better the tools and strategies employed throughout the western United States. In this effort, the authors explore basin management by two California groundwater authorities: the Kings Basin in the central valley and the Orange County Water District (OCWD) in southern California (Babbit et al., 2018). In the case studies, managers outlined concerns related to trust issues impeding stakeholder engagement (Babbit et al., 2018). To address trust gaps between stakeholders, managers developed trust with stakeholders through a process of data-centric educational outreach and mutual-benefit projects, such as on-farm groundwater recharge (Babbit et al., 2018). The OCWD case study similarly demonstrates the importance of data in nurturing trust. As part of its GSP, OCWD increased the price of groundwater it supplies to smaller water districts, disincentivizing groundwater use without capping pumping capacity (Babbit et al., 2018). To support this effort, OCWD's public relations team developed transparency-based trust-building efforts like annual reports, community meetings, and tours to build trust and better communicate the organization's strategies. These case studies reveal the extent to which stakeholder management using collaborative processes and data-driven approaches is central to GSA administration (Babbit et al., 2018).

Additionally, in a study of stakeholder motivation and governance structure, Conrad et al. (2018) observed the GSA formations in three subbasins (Central Valley Colusa, Yolo, and Eastern San Joaquin) to better understand stakeholders' concerns about GSA formation. From this study, Conrad et al. determine significant concern about maintaining local autonomy of subbasin management, especially among water district leaders and private pumpers. Farmers seem to be especially concerned about losing decision-making power, as larger, more impersonal

GSA may take action contrary to the interests of the agricultural community. Farmers are specifically concerned that GSAs will limit groundwater pumping, set extraction limits, impose additional fees, and fail to assign credit for groundwater recharge in relinquishing private control. GSAs in the three basins created collaborative governance agreements, developed multilevel governance structures, and assigned private pumper representatives with decision-making power to address these challenges. While these structures help facilitate collaborative decision-making, Conrad et al. warn that they may undermine GSP's effectiveness. Additional layers of government and diffused decision-making require additional resources to ensure coordination and accountability.

In his comparison of San Joaquin Valley subbasins, Hubbard identifies how key differences in basin characteristics impact GSA management (Hubbard, 2020). Hubbard's analysis centers around the governance of the GSAs: the Fox Canyon Groundwater Management Agency GSA, the Camarosa Water District – Oxnard Subbasin GSA, and the Oxnard Outlying Areas GSA. Hubbard identifies two key characteristics that affect stakeholder interest in engagement: access to surface water and underlying crop mixes (Hubbard, 2020). In subbasins with limited access to surface water, stakeholders are more likely to accept water reduction measures than those with some surface water access (Hubbard, 2020). Similarly, GSAs in row-crop dominant economies (as opposed to tree-nut dominant) are more likely to support GSPs that reduce pumping behavior than GSAs in primary tree nut economies (Hubbard, 2020). Understanding how these characteristics influence conservation preferences within these subbasins are critical, as powerful farming interests have significantly influenced groundwater management and governance (Hubbard, 2020). Hubbard concludes that the localization of GSA

decision-making mechanisms has created a two-class system, where some subbasins reduce pumping in compliance with SGMA. In contrast, others, particularly in the central valley, will refuse to adopt more conservation-focus practices, leaning on political capital to avoid consequences (Hubbard, 2020).

Several trends emerge in examining the lived experience of those engaged in the SGMA implementation process. First, stakeholders throughout California tend to have high levels of mistrust, leading to additional protectiveness. In some basins, like that overseen by OCWD, where a single GSA monopolizes groundwater pumping, managers have significant power to develop and implement GSPs with limited stakeholder engagement. In other basins, like those in the central valley, where agricultural interests are numerous, powerful, and engaged, buy-in is critical. In several cases, authors have criticized these actors' power, arguing that the cost of engaging certain stakeholder groups leads to compromises in organizational efficiency and effective groundwater management options. These dynamics are fundamental to GSA administration and implementation. Secondly, the authors stressed how stakeholders' concerns about autonomy seem omnipresent among water users and water managers. While acknowledging the hydrologic realities of aquifer conditions, water users, particularly in the agricultural sectors, are highly concerned about losing groundwater rights. Water managers are also concerned about autonomy, emphasizing the need to preserve local control of groundwater resources. Finally, the characteristics of a local subbasin are fundamental to GSA administration. Understanding key factors like surface water availability and agricultural makeup are key to determining the options stakeholders will consider meeting SGMA's requirements. In failing to

fully understand the political dynamics, stakeholders' concerns, and underlying basin characteristics, GSA leaders may face significant obstacles in implementing SGMA.

Section 6: Analysis

Before 2014, water in California operated under two conceptual regulatory systems. One system, managed in partnership between the Federal government, the California State government, and local water agencies, oversaw managed and regulated surface water systems. Conversely, before SGMA's implementation, groundwater management accounted for 40-60% of state water use, depending on surface water conditions (Hanak et al.,2011). In creating a mechanism for localized regulation of groundwater, the Sustainable Groundwater Management Act fundamentally changed water policy, resolving the regulation gap between surface and groundwater resources (Owens et al., 2019).

In creating a structure to regulate and oversee groundwater resources, the legislature opted to give local governments a high level of flexibility to achieve groundwater sustainability as they see appropriate (CALAFCO, 2016; J. Mayer, personal communication, October 20, 2022). While GSA leaders and stakeholders applauded this approach for its efficiency advantages and versatility, it presents several complications that leaders must overcome (J. Mayer, personal communication, October 20, 2022).

First, GSA leaders needed to effectively engage multiple stakeholders with different interests and create consensus on the measurements, policies, and projects. Second, creating new organizations to manage groundwater forced GSA leaders to develop new funding sources. Upon

starting a GSA, administrators needed to finance several obligations, including GSA startup costs, personnel, consulting fees, and water projects. While the DWR has made funding available through grants and, at times, has lowered the administrative barrier for grant funding, GSAs continue to struggle to secure adequate funding necessary to fund ongoing organizational efforts and groundwater projects (J. Mayer, personal communication, October 20, 2022; K. Sicke, personal communication, November 4, 2022; D. Eggerton, personal communication, November 7, 2022). Finally, ambiguity around specific GSP responsibilities creates uncertainty around whether a GSP will be approved before it is submitted. This uncertainty forced GSA leaders to develop GSPs in a manner that balances stakeholders' desire to reserve control of groundwater resources and the need to present a plan that may be approved. SGMA's timeline compounds this challenge, as revising a plan takes critical time away from developing beneficial projects and limits the GSA leader's options to create groundwater neutrality. For these reasons, decentralizing groundwater administration into localized GSAs presents several factors that fundamentally impact leaders' ability to meet SGMA requirements.

In developing this Culminating Project, I answer the question, "what are the key factors that impact SGMA's implementation?". To answer this question, I analyzed various literature sources to answer this question and interviewed highly qualified water resources professionals. My research identifies five factors that significantly impact GSA leaders' effectiveness.

- The quality of stakeholder engagement
- The GSA's size and scale
- The GSA's funding availability and sources
- Leaders' timelines
- Interbasin partnerships

These factors affect leaders' ability to oversee groundwater resources in the basin. In considering these factors, leaders may achieve long-term groundwater sustainability while preserving a region's economic and environmental vitality.

Quality of Stakeholder Engagement

As groundwater is fundamental to managing agricultural, municipal, and environmental systems, engaging stakeholders and developing consensus is central to GSA administration. Recognizing this reality, legislators encouraged the creation of a collaborative structure through a unique stakeholder-centric governance model designed to manage groundwater basins and subbasins (J. Mayer, personal communication, October 20, 2022; D. Eggerton, personal communication, November 7, 2022). Unlike traditional local government leadership structures, where voters elect leadership in a general election, SGMA mandates a stakeholder-centered governmental system (Kiparsky et al., 2017). Under this system, stakeholders have decision-making power over all significant agency actions (Kiparsky et al., 2017). Because stakeholders have the power to empower or derail GSAs leaders, effective engagement is a critical component to moving through the SGMA process and ensuring compliance.

Many GSPs require groundwater users to significantly reduce groundwater use and contribute financially to GSA administration and project management. Rural and agricultural stakeholders tend to be highly protective of groundwater rights and notoriously challenging to reach through traditional engagement methods. Several conversations with water policy professionals highlighted the ongoing challenges and opportunities associated with stakeholder

engagement (B. Vanderwaal, personal communication, November 3, 2022). COVID-19 has exacerbated communication challenges, forcing GSAs to hold virtual meetings for extended periods (K. Sicke, personal communication, November 4, 2022). Communication breakdowns significantly impact GSA leaders' ability to conduct outreach, cultivate partnerships and develop buy-in from landowners and other critical stakeholder groups (Babbit et al., 2018; B. Vanderwaal, personal communication, November 3, 2022; R. Thomas, personal communication, November 18, 2022).

Each stakeholder group holds unique views on how GSAs should manage groundwater in their basin. Engaging different stakeholder groups also has the added value of reducing conflict that may otherwise derail the GSP process or tie GSAs into lengthy legal battles (D. Eggerton, personal communication, November 7, 2022). In engaging stakeholders, administrators must understand their concerns to work with the various groups to develop a plan agreeable to all groups. In this effort, the process GSAs employ can often be as important as the policy they develop. One interviewee described providing additional attention to how groundwater is monitored to accommodate the environmental and NGO communities, which are significant water users in their area (J. Mayer, personal communication, October 20, 2022). By incorporating a "big tent" model of incorporating stakeholders in the GSP process, GSA leaders can reduce conflict and legal challenges that may derail timelines and pull valuable resources (R. Thomas, personal communication, November 18, 2022; K. Sicke, personal communication, November 4, 2022; D. Eggerton, personal communication, November 7, 2022).

Understanding the nuances of a subbasins' water various water usage is essential to GSA administration, as it defines the projects and initiatives outlined in the GSP. In agricultural regions, stakeholders typically prefer a project-oriented model of groundwater sustainability, as taking land out of production has a direct economic cost on groundwater users (J. Mayer, personal communication, October 20, 2022; L. Bair, personal communication, October 25, 2022). Alternatively, more urban GSAs prefer adopting a fee structure to reduce consumption and redirect the municipal water market toward surface water. In understanding the administrator's service area, GSA leaders can better identify the impact of different groundwater strategies and work with stakeholders to choose the best options for the region.

In discussing engagement challenges, GSA leaders outlined best practices for incorporating difficult-to-reach stakeholders. First, GSA leaders should consider both traditional outreach methods, such as community meetings and mailers, and nontraditional methods, like virtual meetings, to increase understanding of the GSA's role, process, and plan to achieve groundwater sustainability. Second, GSAs may incorporate and engage specific communities through associations and organizations representing their unique needs. Partnerships with these organizations can be critical in bridging gaps between hard-to-reach communities. For farming communities, the Farm Bureau plays a crucial role in engaging farmers and representing their interests on GSA boards (K. Sicke, personal communication, November 4, 2022; B. Vanderwaal, personal communication, November 3, 2022). This association demonstrates how third-party organizations can be effective in outreach and management. Demonstrating GSAs' effectiveness in addressing groundwater issues is essential for creating buy-in among skeptical stakeholders (L. Bair, personal communication, October 25, 2022) GSA leaders described how data proving

the effectiveness of a recharge project on private land helped demonstrate the importance of strategic groundwater planning and projects (Babbit et al., 2018; L. Bair, personal communication, October 25, 2022; B. Vanderwaal, personal communication, November 3, 2022). As a result of this data, the leader was able to generate interest from neighboring farms, looking to become more involved in the GSAs' work (L. Bair, personal communication, October 25, 2022). Finally, groundwater projects are central to developing groundwater banking accounting systems, necessary for scaling pilot projects to the point they can be implemented basin-wide (L. Bair, personal communication, October 25, 2022). While outreach may be one of the most challenging elements of GSA administration, it presents an opportunity to increase awareness, generate valuable input, and cultivate future partners in groundwater sustainability initiatives.

Size and Scale of the GSA

GSA size and scale are vital components of GSA administration. In developing the system of localized control of groundwater, SGMA recommends that GSAs assemble based on basin and subbasin divisions. Localization is highly advantageous to GSA administration, as it allows local leaders a high degree of agency over GSP development and increases proximity to local partners (J. Mayer, personal communication, October 20, 2022). Despite these advantages, the localization of groundwater resources does have some disadvantages. One key tradeoff of localization is the loss of an economy of scale critical to financing resource-intensive obligations. As the area or population a GSA oversees decreases, leaders lose access to households and businesses with whom they may solicit fee revenues or consult to facilitate mutually-beneficial

partnerships. In managing effective GSAs, administrators should be conscious of how their size and scale impact their ability to access and manage resources within a basin.

GSAs struggling to access adequate resources needed to develop and implement a GSP may consider increasing their footprint. GSAs may meet this need by consolidating subbasin governance or developing lasting economic and resource-sharing partnerships with neighboring GSAs. To better accommodate existing political barriers, Yolo Subbasin Groundwater Agency assumed control of multiple subbasins, allowing subbasins to consolidate resources and simplify groundwater strategies into one cohesive GSP (K. Sicke, personal communication, November 4, 2022). This economy of scale helped the Yolo Subbasin Groundwater Agency move faster through the SGMA process and increase project funding (K. Sicke, personal communication, November 4, 2022). In taking steps to increase a GSA's footprint, leaders may help create an economy of scale and increase efficiency in meeting their legal obligations.

Conversely, GSAs struggling to meet the unique needs of their constituency may consider steps designed to increase the level of localization within their subbasin. In Yolo County, leaders accommodate differences in the subbasin by creating separate working groups with a level of agency over their subbasin. In the Yolo County case, this organizational structure returns the agency to subbasins while providing the benefits of a consolidated subbasin. GSAs struggling to manage groundwater over a large or diverse area may also consider finding ways to divide groundwater users into groups based on geographic conditions.

Funding Availability

GSA leaders' access to sustainable funding sources is fundamental to meeting groundwater sustainability goals. In creating and overseeing GSAs, SGMA outlines several obligations that GSA leads must complete within a limited timeline. To meet these SGMA's timeline and other obligations, GSAs have relied heavily on costly outside consultants with specialties in groundwater monitoring, stakeholder engagement, legal interpretation, and developing minimum groundwater thresholds, among others (K. Sicke, personal communication, November 4, 2022; B. Vanderwaal, personal communication, November 3, 2022; R. Thomas, personal communication, November 18, 2022). GSAs also must complete projects, such as subsurface recharge projects, to increase the amount of water that returns to the basin (L. Bair, personal communication, October 25, 2022; B. Vanderwaal, personal communication, November 3, 2022). Because these projects rely on GSAs redirecting surface water, they can be highly resource-intensive, especially in drought conditions (L. Bair, personal communication, October 25, 2022). Finally, GSAs must staff adequately to oversee the day-to-day tasks of the agency (K. Sicke, personal communication, November 4, 2022). Due to their specialties, staffing requires competitive salaries to remain focused on the agency's mission (K. Sicke, personal communication, November 4, 2022; R. Thomas, personal communication, November 18, 2022; D. Eggerton, personal communication, November 7, 2022). To address these cost considerations, GSAs have aggressively explored various funding opportunities and managed expenses to meet these obligations effectively.

In interview conversations, participants described how the life cycles of grant funding have both helped and hurt implementation (D. Eggerton, personal communication, November 7, 2022). Multiple participants described the role DWR seed funding played in the various steps of

GSA development but lacked sufficient resources to fund projects central to GSPs (L. Bair, personal communication, October 25, 2022; D. Eggerton, personal communication, November 7, 2022). To fill gaps, GSAs have increasingly moved towards a fee structure (K. Sicke, personal communication, November 4, 2022). In more urban areas, like the ones managed by the Orange County Water District, the GSA can charge a fee based on the water a household consumes (Babbit et al., 2018). In more agricultural areas, GSAs have explored charging fees based on the number of acres a landowner irrigates (L. Bair, personal communication, October 25, 2022). Naturally, charging consumer fees is a delicate negotiation, as stakeholders can object to decisions within the GSA power structure (L. Bair, personal communication, October 25, 2022). Recently, the DWR has increased the quantity of funding available and reduced the administrative barriers to grant funding (J. Mayer, personal communication, October 20, 2022). This funding has been a lifeline for many struggling GSAs but has been insufficient in fully meeting all GSA needs (L. Bair, personal communication, October 25, 2022). This reality likely pushes GSAs to prefer outside funding and be more aggressive in seeking state grants.

GSAs have several resources available to reduce costs and increase funding availability. In reducing costs, GSAs may consider looking to their neighbors to identify where GSAs may be duplicating tasks, then find ways to create voluntary agreements that would ensure cooperation and increase efficiency. GSA leaders have recommended highlighting the community's unique characteristics and the multiple benefits projects may create to increase the amount of grant funding available. Communities in rural or disadvantaged communities can leverage those community needs to increase the competitiveness of their applications. Similarly, GSAs can leverage the multiple benefits of their projects to access a wider variety of grants from different

state and federal agencies and increase the likelihood that applications are accepted. Addressing these funding challenges effectively and promptly is fundamental to GSA administration and meeting GSA's obligations to SGMA.

Leaders' Timelines

In creating SGMA, the legislature developed an aggressive timeline for GSAs to create and implement GSPs (D. Eggerton, personal communication, November 7, 2022). The legislature designed this timeline to ensure administrators meet groundwater sustainability targets before the impacts of overdrafting become unmanageable (D. Eggerton, personal communication, November 7, 2022). SGMA's legislation requires administrators in high and medium-priority basins to move quickly to meet checkpoints such as establishing a GSA, developing a GSP, and achieving sustainability goals. Appendix A outlines SGMA's timeline. To meet aggressive timelines, leadership had to efficiently gather data, organize stakeholders, and implement projects, among many other duties.

One particularly challenging aspect of SGMA's timeline is its failure to acknowledge the pace of other state and federal regulations, which may slow implementation (J. Mayer, personal communication, October 20, 2022). Often, groundwater projects rely on the conveyance of water resources from streams and rivers to substitute groundwater use or contribute to recharge. Because stream conveyance may have an environmental impact, GSA leaders must account for the time and resources needed for regulators to approve a project (J. Mayer, personal communication, October 20, 2022). If the regulatory process moves slowly, leaders' timelines for designing and implementing projects will be impacted, possibly impacting SGMA compliance.

In an interview with James Meyer, he stressed how the competing timelines between regulatory agencies create a timeframe issue, forcing GSA leaders to manage within a complex and ambiguous atmosphere (J. Mayer, personal communication, October 20, 2022). This uncertainty may affect leaders' ability to experiment through pilot projects and choose options more likely to impact stakeholders (J. Mayer, personal communication, October 20, 2022).

The impact of climate change exacerbates timeline issues (J. Mayer, personal communication, October 20, 2022; D. Eggerton, personal communication, November 7, 2022). As climate change increases both the frequency and severity of drought in California, leaders may need to reevaluate their groundwater sustainability options (J. Mayer, personal communication, October 20, 2022). Drought impacts the GSA administration in two significant ways. First, historically California has used groundwater to supplement surface water resources. During drought, groundwater use increases, affecting basin health and sustainability goals (J. Mayer, personal communication, October 20, 2022). Second, drought fundamentally affects the pricing mechanisms for surface water. As the DWR reduces water allocations statewide, water prices increase on the open market. As prices rise, the cost of recharge projects similarly increases, reducing the amount of water a GSA can afford to bank (B. Vanderwaal, personal communication, November 3, 2022). As a result, increased groundwater use and the rising costs of implementing groundwater projects may impact GSAs' timelines. Climate change’s impacts on basin health and water resource availability may affect leaders' policy windows for developing and implementing recharge projects, pushing leaders toward unpopular following and other water reduction policies (J. Mayer, personal communication, October 20, 2022; D. Eggerton, personal communication, November 7, 2022). While SGMA does outline exemptions

for GSA during drought periods, leaders express concern that the increased frequency and intensity of droughts will push the state to reconsider exemptions to meet long-term sustainability goals.

While effective, the threat of State Water Board takeover is a major concern of water policy leaders interviewed. Water leaders are concerned about the State Water Board takeover for two principal reasons. First, there is significant ambiguity around the water board takeover process and expectations (L. Bair, personal communication, October 25, 2022). In designing SGMA, the law failed to identify the specific triggers that lead to a state takeover of a GSA's territory (L. Bair, personal communication, October 25, 2022). Also, SGMA is unclear about the policies the water board intends to pursue and the duration the water board will assume control before returning control to local GSAs. This ambiguity impacts GSAs leader's ability to experiment with projects that may offset groundwater sustainability timelines. Leaders also express concerns about how the Water Board takeover will impact ongoing momentum and project administration. In speaking with groundwater professionals, several discussed how the Water Board takeover might derail existing projects in favor of rationing water pumping and fallowing farmland. These policies negatively impact the agricultural economy and may also have an environmental impact. For these reasons, GSA leaders are highly aware of their GSAs' timelines and the various barriers to meeting prescribed sustainability goals.

Quality of Partnerships

Coordination between different governmental bodies is fundamental to project implementation, information sharing, and regulatory compliance. In my research, sources

identified three critical types of partnerships that Impact the GSA administration, and these include interbasin partnerships, association partnerships, and partnerships with state agencies.

Interbasin partners are fundamental to a GSA leader's ability to coordinate plans and meet sustainability goals. Basin sustainability depends on subbasins' abilities to collectively develop groundwater neutrality. To meet these goals, neighboring GSAs must be proactive about sharing data and coordinating water extraction and recharge. In discussion with James Mayer, he described how failures to coordinate GSP plans within basins had been a driver of friction between GSAs. According to some GSA leaders, consultants who support multiple GSAs within a basin are fundamental to bridging strategy and communication gaps and improving cohesion within a given basin (B. Vanderwaal, personal communication, November 3, 2022).

Associations like ACWA and NCWA are critical in facilitating research and overseeing multiple communication channels. Representatives from NCWA and ACWA upheld the work their taskforces and workgroups play in knowledge-creation on SGMA and groundwater issues (J. Mayer, personal communication, October 20, 2022; D. Eggerton, personal communication, November 7, 2022). These groups employ built-in distribution channels to communicate information to GSA leaders directly. In bringing GSAs and other groups together, associations provide a space for leaders to express concerns, share best practices, resolve conflicts and advocate for change under one voice (J. Mayer, personal communication, October 20, 2022; D. Eggerton, personal communication, November 7, 2022). Associations provided an essential resource for GSA leaders while moving through the GSP development process. Leaders could reference and optimize their operations by observing and referencing other GSA administrative

practices and procedures (J. Mayer, personal communication, October 20, 2022). In maximizing their relationships with associations, leaders have been able to take advantage of the association's groundwater research and reference other association members' decisions when developing their systems and processes.

Relationships between GSA leaders and staff from state agencies are critical for developing a feedback mechanism necessary to reduce ambiguity and increase efficiency throughout the planning process. Through the GSP development process, the Department of Water Resources deployed staffers to attend meetings and answer clarifying questions from GSA leaders and stakeholders (J. Mayer, personal communication, October 20, 2022; B. Vanderwaal, personal communication, November 3, 2022; K. Sicke, personal communication, November 4, 2022; D. Eggerton, personal communication, November 7, 2022). In interview discussions, multiple groundwater professionals described how access to state regulators helped them more efficiently manage GSA operations, as they received answers to regulatory concerns efficiently (J. Mayer, personal communication, October 20, 2022; B. Vanderwaal, personal communication, November 3, 2022; K. Sicke, personal communication, November 4, 2022). Additionally, groundwater professionals suggested that GSA leaders consider nurturing relationships with regulators to improve the likelihood of SGMA compliance and expand the resources available to GSA leaders.

Recommendations

GSA administration requires a high level of competency in policy, administration, stakeholder management, and organizational development, among others. In developing this

culminating project, I set out to provide recommendations to support my target audience of GSA administrators, policymakers, professors, and peers at the Sacramento State Masters in Public Policy and Administration program. To accomplish this task, I engaged literary and interview participants to understand better their ongoing administrative and organizational challenges and the resources and policies that may be employed to help leaders better meet SGMA requirements. In this effort, interview participants provided valuable guiding recommendations, as leaders were able to explain specific practices and assets that have impacted their success and where strategic investment could help other basins. These data help guide recommendations directed toward the three target audiences.

Groundwater Professionals Working to Support GSAs

In developing and overseeing GSAs, groundwater professionals need to navigate challenging obstacles, particularly around stakeholder outreach and financing, that require nuanced approaches. In meeting these challenges, I suggest GSA leaders employ specific techniques to improve GSA's outreach, effectiveness, and efficiency as well as leverage collective actions to improve access to resources and investment that would otherwise not be available.

In discussing engagement challenges, GSA leaders outlined best practices for incorporating difficult-to-reach stakeholders. While outreach may be one of the most challenging elements of GSA administration, it presents an opportunity to increase awareness, generates valuable input, and cultivate future partners in groundwater sustainability initiatives. To address these challenges, GSA leaders recommended that their peers consider traditional outreach

methods, such as community meetings and mailers, and nontraditional methods, like virtual meetings (B. Vanderwaal, personal communication, November 3, 2022). In pursuing multiple communications streams, I believe GSA leaders may be more likely to reach a larger and more diverse set of constituents, increasing understanding of GSA's role, process, and plan to achieve groundwater sustainability. Additionally, GSAs have been successful when engaging associations and organizations that represent unique communities with nuanced demands of their GSA. (J. Mayer, personal communication, October 20, 2022). Proactively pursuing partnerships with these organizations can be critical in bridging gaps between hard-to-reach communities, improving the quality of the community, and engaging throughout the basin. GSAs should incorporate the group into their process to increase the level of collaboration in the GSP process and GSA administration, critical to basin sustainability.

Demonstrating GSAs' effectiveness in addressing groundwater issues is essential for creating buy-in among skeptical stakeholders (L. Bair, personal communication, October 25, 2022) In interview discussions, GSA leaders described how data proving the effectiveness of a recharge project on private land helped generate data that showed the importance of strategic groundwater planning and projects (Babbit et al., 2018; L. Bair, personal communication, October 25, 2022; B. Vanderwaal, personal communication, November 3, 2022). As a result, the leader was able to generate interest from neighboring farms, looking to become more involved in the GSAs' work (L. Bair, personal communication, October 25, 2022). In reviewing this leader's experience, I agree that GSA should pilot groundwater projects as soon as possible to demonstrate the GSA's value and build community buy-in.

One common constraint GSA leaders will face when developing groundwater projects like subsurface recharge is funding constraints. To address these challenges, I argue leaders should leverage the multiple benefits of their projects to access a wider variety of grants from different state and federal agencies. By justifying the project on grounds such as environmental conservation or infrastructure security, GSA may increase both the diversity of revenue sources and the probability that grants are accepted. Addressing these funding challenges effectively and promptly is fundamental to GSA administration and meeting GSA's obligations to SGMA.

This culminating project identifies GSA's funding availability and sources as a key factor in SGMA implementations. To secure the funding, GSAs have relied on grant funding and various fees to finance operations. Recognizing the success of recharge projects in improving basin health and generating interest in GSA operations, GSAs would likely benefit from exercising a collective voice to issue a bond measure on the 2024 ballot. This measure would help GSAs fund the various steps of recharge project implementation, including planning fees, water purchases, and groundwater monitoring. In doing so, GSA leaders solve financing issues related to basin health, recharge, metrics, and accounting systems needed to scale projects (L. Bair, personal communication, October 25, 2022).

Legislators and Regulators

GSA interactions with the state are central to defining their scope of work and the resources available to meet state regulatory mandates. In developing this culminating project, I set out to better understand GSA's relationship with state actors to better define how the state may better support GSA administrators through SGMA's implementation. After consulting

academic literature and interviewing participants, I identify areas where additional state involvement may support GSA administration.

In increasing the amount of financial assistance, the state makes available to GSAs, legislators, and regulators can support GSA leaders in meeting critical SGMA milestones (D. Eggerton, personal communication, November 7, 2022). When SGMA was approved in 2014, the state released seed funds to support GSA development. Over time, state funding has not kept up with GSA costs as agencies move toward project implementation (D. Eggerton, personal communication, November 7, 2022). In increasing funding available to GSAs, the state should consider targeting grants toward recharge projects and administrative costs. (R. Thomas, personal communication, November 18, 2022; D. Eggerton, personal communication, November 7, 2022; B. Vanderwaal, personal communication, November 3, 2022). In funding recharge projects, the state can help reduce the impact of drought on vulnerable environments, residents, and agribusinesses, who would be disproportionately impacted by low water availability and high water prices. Alternatively, funding toward staffing would help GSA leaders better manage efforts centered around data management, stakeholder engagement, reporting obligations, and a growing portfolio of projects (L. Bair, personal communication, October 25, 2022). In increasing the amount of grant funding available and targeting areas that would support implementation efforts, the state can help GSAs meet suitability requirements within SGMA's prescribed timeframe.

The state may also support GSAs by expanding upon ongoing technical and policy support. In meetings with groundwater professionals, several praised DWR's efforts to have

representatives attend meetings. These individuals provided valuable insight into ongoing policies, expectations, and funding opportunities (D. Eggerton, personal communication, November 7, 2022, B. Vanderwaal, personal communication, November 3, 2022; J. Mayer, personal communication, October 20, 2022). With real-time technical assistance, GSAs can optimize decisionmakers time, reducing the number of meetings necessary for major decisions and increasing the probability that GSPs will move through the regulatory system. One groundwater leader formalized a feedback mechanism to improve communication between GSAs and the state. (J. Mayer, personal communication, October 20, 2022) Under this system, GSA leaders and DWR/Water Board leaders can work together to modify regulations to support GSA leaders in meeting groundwater sustainability goals. After researching ongoing challenges GSAs face, I agree that this system should be pursued to continually strengthen GSAs' governability and to make modifications when necessary. In developing this mechanism, lawmakers should look at other state mandates that successfully incorporate industry feedback throughout the implementation process. In taking these steps, the state may improve ongoing communications between state and local actors.

Groundwater leaders also expressed frustration with a lack of clarity around several key elements of SGMA's regulations. For several groundwater professionals, the process around Water Board takeovers remains unclear, with leaders desiring more information related to policy triggers and Water Board management practices during a takeover (D. Eggerton, personal communication, November 7, 2022; L. Bair, personal communication, October 25, 2022). Leaders also expressed concern over the amount of tolerance DWR, and the Water Board will extend GSAs during drought. Presently SGMA permits exceptions for GSAs not meeting key

groundwater milestones during drought periods. As climate change intensifies and droughts frequent increases, groundwater professionals are concerned that the State will change the law to reduce these exemptions' latitude. In providing and circulating written clarifications to these and other pressing concerns, the state can help administrators better plan for the future.

Finally, the state can support GSAs by increasing the surface water available during dry periods. As climate change intensifies, the quantity of water stored in Sierra Snowpack is expected to decrease as more precipitation falls in liquid form (Mount et al. 2019). Without the infrastructure to capture rainwater, more water will flow through rivers and aqueducts into the Pacific Ocean. Reduced surface water resources will likely lead users to conserve water resources and increase groundwater pumping. This phenomenon will likely impact GSA administrators, as increased groundwater pumping will impact basin health and GSAs' ability to meet SGMA requirements. To avoid these challenges, the state can invest more funding and personnel toward completing water infrastructure projects like Sites Reservoir (R. Thomas, personal communication, November 18, 2022). In doing so, the state may better prepare its surface water system for climate change and reduce pressure on GSA administrators.

Recommendations for Sacramento State University Professors and Peers

Upon completing this culminating project, I intend to present my finding to peers and professors at the Sacramento State Master of Public Policy and Administration. These individuals possess diverse academic and professional backgrounds and interests and will likely not interface with groundwater policy and administration issues in their careers. Because SGMA

implementation grapples with high-level administrative and organizational concepts, my peers and professors would benefit from common themes gleaned from my research.

Solving problems in a highly contentious atmosphere can be challenging for leaders to navigate as stakeholders enter negotiations with divergent ideas of how the final product should be designed. One interview suggested that leaders should push stakeholders to work from a broader perspective when addressing contentious issues (L. Bair, personal communication, October 25, 2022). Incorporating divergent stakeholders in the decisionmaking process is key to developing a broader perspective. By bringing divergent groups together and working collaboratively to define the problem and steps necessary to create the solution, leaders can build a more nuanced plan from a place of commonalities, possibly leading to fewer outside challenges that may derail the planning and implementation process. Collaborative techniques designed to increase dialogue and trust and reduce positionality are critical to this strategy. By incorporating collaborative techniques, leaders can identify different groups' concerns, then work in tandem with these stakeholders to build systems that adapt to stakeholders' needs while also meeting state requirements.

Future Research

One significant constraint of employing the "snowball" interview method is a possible lack of diversity in participants. The participants surveyed for this culminating project came from administration backgrounds, focused primarily on the central valley and northern Californian water issues, and came from a specific demographic. In replicating this project, researchers may consider taking steps to acquire a more diverse set of participants. In conducting future research

on SGMA implementation and GSA administration, I recommend interviewing participants from State agencies like DWR and the Water Board. Interviewees from State agencies may provide valuable data, as they occupy a unique role in GSA administration, providing both support and enforcement mechanisms, the key to guiding GSA leadership's behaviors. Researchers should also consider reaching out to GSA leaders and stakeholders from southern California and more urban basins. This input may show differences in how GSAs should be structured, stakeholder engagements, or options to prioritize in GSPs. Finally, my interview sample consisted mainly of white men over 50. This is because they have worked in the water policy area longer and have achieved prominence. Future researchers with significantly more time available for interviews may be able to identify a more diverse set of contacts.

Conclusion

When SGMA was signed into law in 2014, the law changed not only the state's water regulations but also paradigms around local regulation of natural resources. In creating GSAs in high and medium-priority groundwater basins and empowering them to develop and implement GSPs, the state allowed GSA leaders to take on the role of regulators and implementors of groundwater resources (Water Education Foundation, 2015). This culminating project identifies five key administrative and organizational factors that impact GSA leaders' ability to navigate implementation challenges (outlined in Section 6). In overcoming challenges, leaders continue displaying a high level of creativity and ingenuity in meeting critical milestones, elevating stakeholder engagement, strengthening partnerships, and securing long-term financial sustainability, despite constraints. While unique, this case study provides a snapshot of GSA leaders' challenges and opportunities as they move through the SGMA process. By studying the

administrative and organizational factors that impact SGMA's implementation and how GSA leaders continue overcoming obstacles, administrators from other disciplines may draw parallels to their organizational challenges across disciplines. In doing so, leaders may gain valuable insights into novel strategies and tools useful for overcoming obstacles and guiding long-term organizational initiatives.

Appendix A. Timeline for SGMA's Developments (LAO)

Date	SGMA Requirement
September 16, 2014	Sustainability Groundwater Management Act was signed into law.
January 2015	DWR released initial basin prioritization. High and medium-priority basins are subject to SGMA requirements.
January 2016	DWR identified final list of basins subject to critical conditions of overdraft. These basins face some expedited compliance deadlines.
June 30, 2017	Local agencies must establish groundwater sustainability agencies (GSAs). SWRCB may designate probationary basins subject to intervention for areas that fail to comply.
January 31, 2020	GSAs from basins in critical overdraft must adopt and begin to implement groundwater sustainability plans (GSPs). DWR will review plans for adequacy after adoption.
January 31, 2022	GSAs from basins not in critical overdraft must adopt and begin to implement GSPs. DWR will review plans for adequacy after adoption.
January 31, 2040	GSAs from basins in critical overdraft must achieve sustainability goals.
January 31, 2042	GSAs from basins not in critical overdraft must achieve sustainability goals.

Appendix B. Interview Questions

1.	Can you tell me a little about your experience working with groundwater agencies or groundwater policy?
2.	Can you tell me a little about how you see SGMA's implementation has been rolled out?
3	What were the stages of the rollout? GSA development, creating GSPs, monitoring? What different resources were needed during each
4.	What concerns do you hear when talking with GSA leaders about SGMA implementation?
5.	"What parts of the law could have been drafted in such a way as to make implementation easier, if any?"
6.	Was there thought given to implementation when designing the law? How well have those expectations been met?
7.	Moving forward, what would you recommend lawmakers/the state do to help ease the implementation process?
8.	What are some best practices you would highlight that would assist GSAs who are struggling with different elements of SGMA implementation?
9.	After going through the SGMA process, are there lessons you have learned that can support professionals in different disciplines?

References

"Appropriative Rights." *Water Education Foundation* https://www.watereducation.org/aquapedia/appropriative-rights.

"The 2014 Sustainable Groundwater Management Act: A Handbook to Understanding and Implementing the Law ." *Water Education Foundation*, 2015, pp. 1–49., https://groundwater.ucdavis.edu/files/208021.pdf. Accessed 9 Oct. 2022.

Bair, L. (2022, October 25). SGMA research interview. personal.

California Association of Local Agency Formation Commissions. (2016). CALAFCO White Paper Sustainable Groundwater Management Act and Local Agency Formation Commissions.

Cantor, A., Owen, D., Harter, T., Green Nylen, N., & Kiparsky, M. (2018). Navigating groundwater-surface water interactions under the Sustainable Groundwater Management Act.

Conrad, E., Moran, T., DuPraw, M., Ceppos, D., Martinez, J., & Blomquist, W. (2018). Diverse stakeholders create collaborative, multilevel basin governance for groundwater sustainability. *California Agriculture*, *72*(1), 44-53.

Dyble LN. (2017). Aquifers and Democracy: Enforcing Voter Equal Protection to Save California's Imperiled Groundwater and Redeem Local Government. California law review.105(5):1471-1512.

Eggerton, D. (2022, November 7). SGMA research interview. personal.

Escriva-Bou, A., McCann, H., Hanak, E., Lund, J., & Gray, B. (2016). Accounting for California water. *California Journal of Politics and Policy*, *8*(3).

Hanak, Ellen, et al. (2011). "Floods, Droughts, and Lawsuits: A Brief History of California Water Policy." *Public Policy Institute of California* https://www.ppic.org/publication/managing-californias-water-from-conflict-to-reconciliation/.

Hubbard, Tyler. (2020). California's Sustainable Groundwater Management Act: The Paradox of Local Control of a Precious Public Resource. Theses and Dissertations Collection, Digital Initiatives, University of Idaho Library.

Katz, Jacob. "Study: Floodplains Key to Restoring Salmon, Boosting Waterfowl." *California Waterfowl*, 4 June 2020, https://calwaterfowl.org/news/study-floodplains-key-to-restoring-salmon-boosting-waterfowl.

Kiparsky, M., Milman, A., Owen, D., & Fisher, A. T. (2017). The importance of institutional design for distributed local-level governance of groundwater: The case of California's sustainable groundwater management act. *Water*, *9*(10), 755.

Leach, W. D., An, B. Y., & Tang, S. Y. (2021). Evaluating California's Sustainable Groundwater Management Act: The first five years of governance and planning. *JAWRA Journal of the American Water Resources Association*, *57*(6), 972-989.

Mark Lubell, William Blomquist, Lisa Beutler. (2020) Sustainable Groundwater Management in California: A Grand Experiment in Environmental Governance. Society & Natural Resources 33:12, pages 1447-1467.

Mayer, J. (2022, October 10). SGMA research interview. personal.

Méndez-Barrientos, L. E., Bostic, D., & Lubell, M. (2019). Implementing SGMA: Results from a stakeholder survey. *Center for Environmental Policy and Behavior, University of California Davis, Davis, California, United States of America*

Milman, A., & Kiparsky, M. (2020). Concurrent Governance Processes of California's Sustainable Groundwater Management Act. *Society & Natural Resources*, *33*(12), 1555-1566

Mount, J., Swain, D., & Ullrich, P. (2019). *Climate change and California's water*. Public Policy Institute of California. Retrieved October 23, 2022, from https://www.ppic.org/publication/climate-change-and-californias-water/

Owen, D., Cantor, A., Nylen, N. G., Harter, T., & Kiparsky, M. (2019). California groundwater management, science-policy interfaces, and the legacies of artificial legal distinctions. Environmental Research Letters, 14(4), 045016.

Sicke, K. (2022, November 4). SGMA research interview. personal.

Thomas, R. (2022, November 17). SGMA research interview. personal.

Water Education Foundation "The 2014 Sustainable Groundwater Management Act: A Handbook to Understanding and Implementing the Law ." 2015, pp. 1–49., https://groundwater.ucdavis.edu/files/208021.pdf. Accessed 9 Oct. 2022.

Vanderwaal, B. (2022, November 3). SGMA research interview. personal.