A Look at Water Management Policies in Texas
By Lillian Michaud

Introduction

The incredibly vast range of topography and climate that varies across the United States is paralleled by a great diversity in culture, lifestyles and ideologies. Each state has an unequaled array of terrain and culture that gives rise to different perspectives on governance and management. Water is a natural resource that is indisputably essential for life and many aspects of the human lifestyle. Management of water resources is of great contention because it can traverse all state and international borders whereas policies and ideologies cannot. With a resource of such high demand, water resources face many challenges regarding the quality and quantity available, as well as who has a right to use it. The state of Texas has a unique chronicle regarding policy and ideological development, which has resulted in a wide variety of methods to improve conservation and management. "A Look at Water Management Policies in Texas" will consider the significant historical events that cultivated the current policies and ideologies towards managing water resources and relate them back to a theme of sustainability.

Regional and Climate Overview

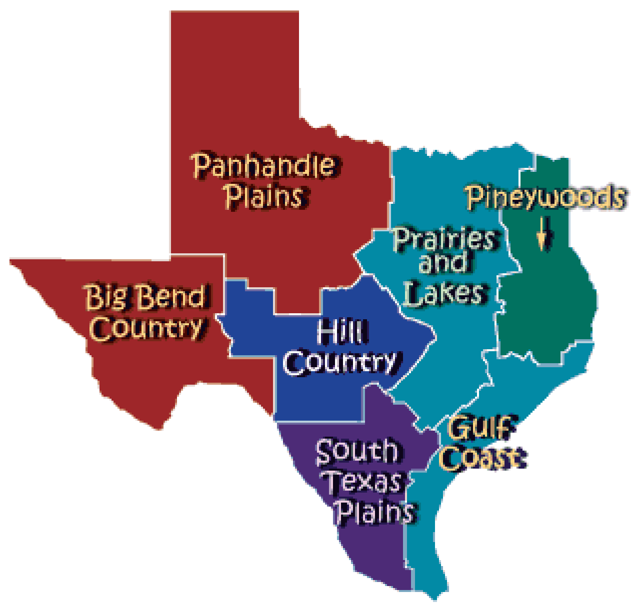

Figure 1: The seven regions of Texas

The state of Texas is located in the southwest U.S off the coast of the Gulf of Mexico and is the second largest state in the United States (Johnson, 2017). The state has a unique composition of seven distinct regions; each varying in climate, annual precipitation, surface water and groundwater reserves, wildlife, and topography ("TPWD Kids: Texas Regions," n.d.). According to the Texas Water Development Board the regions including Austin, Houston, and Dallas will experience the greatest water shortages in the next few decades (Water Development Board, 2017). The state's average annual twenty-seven inches of precipitation (Johnson, 2017) is unequally dispersed throughout the state, akin to the disproportionate array of groundwater and surface water resources that are located across the state. Texas has and heavily relies on the cooperative management of its major stores of both surface and groundwater to provide the necessary 16.1 million acre-feet for its inhabitants ("Groundwater Division | Texas Water Development Board," n.d.). For surface water, the state has 15 major river basins, about 191,000 miles of streams, and 188 major reservoirs ("River

Basins & Reservoirs | Texas Water Development Board," n.d.) and for groundwater, the state has 9 major and 22 minor aquifers.

Figure 2: Major rivers in Texas

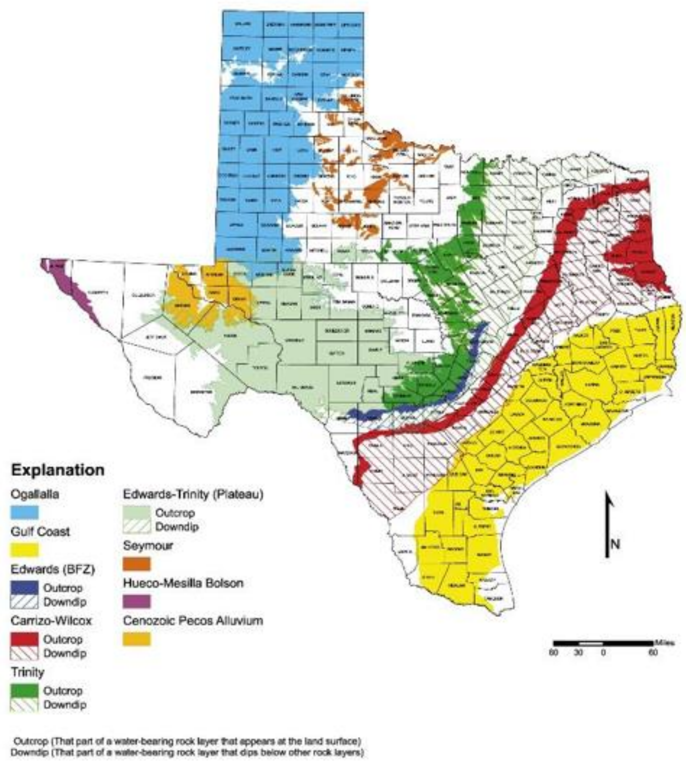

Figure 3: Groundwater Aquifers in Texas

The geographic location of Texas increases its susceptibility to both drought and extreme flooding events. Droughts and extreme flooding events in Texas have and will continue to influence economic success, distribution of people, and water policy. Texas has experienced many periods of drought, ranging in severity and duration (Henry, n.d.). From 2011-2060, the water demand is projected to increase by over twenty percent from the current 18 million acre-feet a year to 22 million acre-feet a year (Henry, n.d.).

The unequal population growth of certain regions in Texas adds another level of complexity to statewide water management. Texas experienced a large population growth in the past two decades and is expected to grow by 70% by the year 2070 (Water Development Board, n.d.). The population growth was not equally distributed across demographic groups or state regions which poses major challenges to existing infrastructure and economic growth (Texas Demographic Trends, Characteristics, and Projections Department of Savings and Mortgage Lending 10 th Annual Thrift Industry Day Austin, TX, 2017). In an already water-scarce region, population growth posits a challenge for both the existing surface and groundwater policies and management infrastructure (Texas Demographic Trends, Characteristics, and Projections Department of Savings and Mortgage Lending 10 th Annual Thrift Industry Day Austin, TX, 2017). Data modeling for assessment of current resources and predictive models will likely be imperative in the race against climate and population change.

The shared and unequal distribution of water resources contributes to the many convoluted water-related challenges that Texas and other western states share. One challenge these states face is the simultaneous increase of both water demand and threat of drought events ("History of the TCEQ and Its Predecessor Agencies" n.d.). This challenge is exacerbated by both dwindling water security due to climate change and inconsistent water management across states and international borders.

Historical Background

The current water policies in Texas are the result of a unique historical meld of Spanish, Mexican, and English influence, and the turmoil and triumphs throughout the history of the United States. Each cultural turnover left remnants of ideologies that culminated into the current structure that dominates Texas water law.

Starting in 1689, Spanish rule-controlled Texas (Whitehurst, n.d.) until it was superseded by Mexican rule from 1821 to 1836. In 1836, Texas declared its independence and remained a sovereign nation until joining the United States of America in 1845. Before Texas declared independence in 1836, settlers from Spain and Mexico who resided in regions now recognized as El Paso and San Antonio, "developed irrigation and municipal water systems" (Jarvis, n.d.). Interestingly, these irrigation systems closely resemble many existing water policies that are implemented around the world. The irrigation system, called "acequias", consisted of a series of ditches and were managed and operated by a local government that served a community of irrigators (Jarvis, n.d.). Aside from the acequia system, the surface water was governed by the king or government who granted permits for the right to use water for "larger uses not abutting a stream [...] for irrigation, commercial, and industrial purposes" (Jarvis, n.d.). No permit was necessary for the general domestic and livestock needs of people placed adjacent to a water body (Jarvis, n.d.). The establishment Mexican ideology through the acequia system embedded and perpetuated a version of deliberate water allocation, later coined prior appropriation, into the culture of Texas water management.

While Texas was a sovereign nation, Texas utilized the laws of Mexico until the introduction of the English common law doctrine in 1840 (Jarvis, n.d.). Nevertheless, both Mexican and Spanish law remained influential throughout the time period (Jarvis, n.d.). English common law originates from England in the Middle Ages and is based on judicial or court decisions rather than statutes or laws. With the adoption of the English Common Law, English influence was melded to the existing Spanish and Mexican influence. English common law introduced the 'riparian rights' ideology for water management, convoluting the existing appropriative ideology for surface water management. 'Riparian right' is a doctrine for managing surface water and "gives all owners of land contiguous to streams, lakes and ponds equal rights to the water" in which no one has full ownership (Abrams, n.d.). Riparian rights are only limited by a 'reasonable use' clause, which is only relevant if the use is impeding on a neighbors' rights (David Saxowsky, 2011). Riparian rights are commonly used in the Eastern United States (David Saxowsky, 2011) because water is climatically more abundant in these regions. The existence of two conflicting ideologies surrounding the ownership and right to use water set the stage for future contention in Texas water policy. Measures to realign diverting water policies were put on the backburner due to political pressures faced by the Republic of Texas (Jarvis, n.d.). Soon after the engravement of English common law into Texas water management, Texas was admitted into the United States in 1845 (Jarvis, n.d.). The admittance of Texas into statehood was unique because Texas was allowed to maintain ownership of its public land and natural resources, as opposed to having land converted into federal public lands as was common practice in other states (Jarvis, n.d.). With ownership of all their public land and natural resources, Texas was allowed to manage them with their existing dual-system.

The ideological schism wasn't apparent until the passage of the Irrigation Act of 1852, where the state "authorized counties to regulate dams and distribute shares of the water". This act had principles remnant of the Spanish and Mexican ideologies that historically dominated Texas water law. Around the same time, the Texas Supreme Court "judicially adopted" the riparian rights doctrine in the influential case *Haas v. Choussard* in 1856 ("In Re Adjudication of the Water Rights, Etc. :: 1982 :: Supreme Court of Texas Decisions :: Texas Case Law :: Texas Law :: US Law :: Justia," n.d.). Throughout the next century, Texas legislature continually passed a series of acts that supported the appropriative ideology that paralleled a succession of court cases that supported riparian ideology. As a result, many court cases attempted to appease growing public and environmental confusion regarding water rights (Jarvis, n.d.). These acts include the Irrigation Acts of 1889, 1895, 1913, 1917, the Conservation Amendment of 1917, and the 1918 and 1925 Acts, until the passage of the Water Rights Adjudication Act of 1967 (Jarvis, n.d.).

The Water Rights Adjudication Act of 1967 finally addressed the tangled, binary system and initiated an investigatory process for any new water claims that included a catalog of past claims on all waterways. The goals of the Adjudication act were to "quantify and inventory all water rights," set priority dates, and put an acre-foot limitation to existing water rights while considering the location, diversion rate and ownership of the water right. The implications for quantifying all existing rights (both riparian and appropriated) resulted in limiting previously unregulated riparian rights because they followed the principle based on the principle of reasonable use (Jarvis, n.d.).

The Act also facilitated a preliminary procedure to deal with exceptions and contest rather than going straight to the judicial system, where previous adjudications had created a muddled and complicated precedence for water rights (Jarvis, n.d.). This Act also created a water rights enforcement program called the Watermaster program. Once water rights were adjudicated, the rights would be protected and enforced by a watermaster; watermaster programs have been implemented for many major water bodies including the Rio Grande and a conglomerate program was implemented for the Colorado, Guadalupe, San Antonio, Nueces, Lavaca, and Navidad rivers. This act was successful in alleviating a lot of confusion about the water rights system and many court cases in the next few years were resolved at the District Court level, rather than Texas Supreme Court (Jarvis, n.d.). Slowly, through Supreme Court cases, the Supreme Court limited riparian rights and claims to bodies of water and strengthened a unified front towards water management.

Current Policy Ideology

Although the riparian-appropriative water rights schism was attenuated, another schism within the Texas water culture, and ubiquitously found in water management all over the world, exists between surface water and groundwater. The current policies for governing surface water and groundwater treat them as two separate entities, even though scientific research has shown that they are part of the same, larger hydrologic cycle.

Current Policies ~ Surface Water

Surface water is now owned, regulated, and delegated by the state under the prior appropriation doctrine (Diamond-Ortiz, Gold, Kay, & Martinez, 2014b). Prior appropriation follows a 'priority rights' permit system which allocates water based on seniority; older water rights are higher on the priority list, especially in times of drought (Diamond-Ortiz et al., 2014b). Prior appropriation is commonly associated with the slogan "first in time, first in right" (Diamond-Ortiz et al., 2014b). Typically, the date, or priority number, on each water right is traced back to the first time that water was diverted or used; however, new water rights are dated using the time the water right was applied for ("Water Law Overview - National Agricultural Law Center," n.d.). Texas is one of many states to the west of the 100th meridian to adopt the prior appropriation doctrine (Diamond-Ortiz et al., 2014b). Appropriated water under this doctrine generally require the diverted water to follow three guidelines. The diverted water must 1) come from a natural course, 2) the water must be intended for a beneficial use, and 3) the water must actually be applied to the intended use ("Water Law Overview - National Agricultural Law Center," n.d.). A 'beneficial use' typically refers to domestic, municipal, industrial, recreational, and agricultural uses ("Water Law Overview - National Agricultural Law Center," n.d.). The ‘beneficial use’ determines the limitation, or amount adjudicated, for the water right (“Water Law Overview - National Agricultural Law Center,” n.d.). Once a water right is established, even if an arguably better use of water develops later, it has seniority over all water rights established after it (“Water Law Overview - National Agricultural Law Center,” n.d.). There are only two ways to legally obtain a surface water right; the Texas Commission on Environmental Quality (TCEQ) can issue permits or permits can be transferred between people (Diamond-Ortiz et al., 2014b). The TCEQ is the governing body for water resources in Texas that surveil, issue, and manage surface water permits (Diamond-Ortiz et al., 2014b).

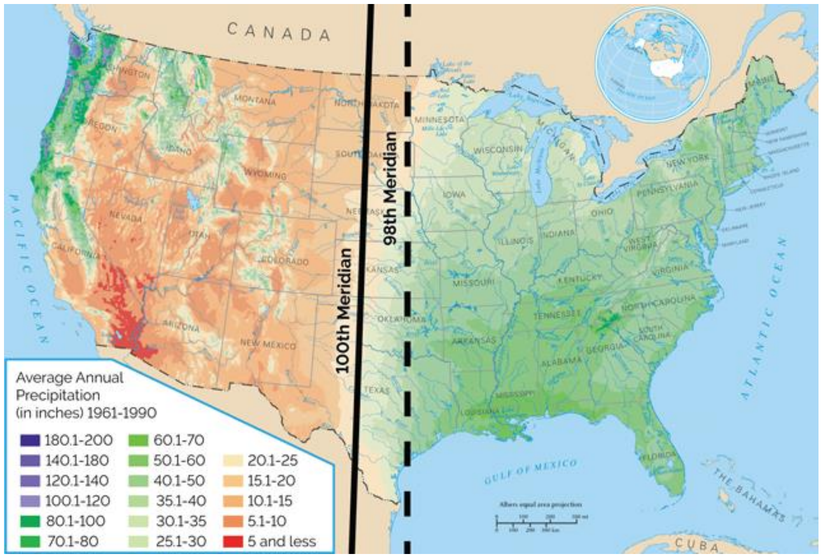

Figure 4: Map of the 100th Meridian, symbolizing the divide between East and West (Rosenburg, 2018)

The origin and course of surface water presents another complication; surface water is partitioned into diffused surface water and natural surface water (Diamond-Ortiz et al., 2014b). Diffused surface water is defined as water that flows in an irregular course and encompasses rain runoff (Diamond-Ortiz et al., 2014b). Diffused water has been ordained as belonging to a landowner until it converges with a natural waterway at which point it becomes state property (Diamond-Ortiz et al., 2014b). Natural water is defined as “surface water flowing in every natural watercourse in the state with a definite bed and bank”; prior appropriation doctrine only applies to natural surface water (Diamond-Ortiz et al., 2014b).

Water allocation from surface waters within Texas can be contentious, but the Rio Grande River presents a magnified example of an inter-state and international challenge for Texas, New Mexico, Colorado, and Mexico. This river basin plays a significant role for the economy, culture and environment for both the United States and Mexico (Ballew, Bolhassani, Koplos, Montgomery, & O’connor, 2014). The traversing waters of the Rio Grande are shared between the United States and Mexico under the initial Water Treaty of 1933 and eventually the Rio Grande Compact of 1938 (Ballew et al., 2014). The 1933 Water Treaty is an agreement between the U.S and Mexico that allots water from the Colorado river to Mexico in exchange for Rio Grande water to the U.S. from Mexico in five-year cycles (Ballew et al., 2014). The Rio Grande Compact of 1938 is an agreement between New Mexico and Texas because the water allocated from Mexico is shared between the two states (Ballew et al., 2014). The combination of increased water demand for all stakeholders involved and a long enduring drought has raised tension between Colorado, New Mexico, Texas, and Mexico (Ballew et al., 2014). The many Rio Grande contentions stem from the over-allocation of the river and differing ideologies surrounding water management and politics (Ballew et al., 2014). Mexico has not delivered the promised amount of water to Texas for some time, employing the undefined 'extreme drought' clause in the agreement (Ballew et al., 2014). In an attempt to remedy old issues and prevent new issues with New Mexico, an addendum to "better manage and allocate flows" in the Rio Grande was added to the 1938 Compact in 2008 (Ballew et al., 2014); however, Texas sued New Mexico for violating the compact by diverging water intended for Texas (Wallace, 2018). New Mexico motioned for the case to be dismissed, claiming that the compact has ambiguous rules for interference under the Bureau of Reclamation's Reservoir (Wallace, 2018). In order to bring suit against New Mexico, the Supreme Court had to first decide whether the United States could bring a claim against New Mexico because they are not apportioned any water from the compact (they are not a 'party' in this case) (Wallace, 2018). The courts eventually devised that because of the federal nature of the compact, the United States interest in protecting a compact with Mexico, and because the Compact's association with the Bureau of Reclamation, the United States could be a plaintiff in this case. The case currently remains in the United States Supreme Court where a final adjudication will be made (Wallace, 2018). Interestingly enough, when the United States was established as a plaintiff in the case, the Court emphasized that in this case, the ruling will not establish "precedent or a standard of law applicable to other original actions" (Wallace, 2018). This decision has implications for future intra-state lawsuits over water allocation; each case will be heard on a case-by-case basis and will likely go through the same divisive process as this case because no basis for intra-state water conflicts will be established.

Strategies for Conservation

Aside from at-home water saving techniques, Texas has attempted many state- level initiatives to curb the growing concern about water scarcity.

In 2015, the idea for a statewide water pipeline resurfaced after its initial proposal in the 1968 State Water Plan (Jose & Schreiber, n.d.). The House of Natural Resources Committee approved the proposal to conduct a study for a statewide pipeline in 2015 and the study would be carried out by the Texas Water Development Board (TWDB) (Jose & Schreiber, n.d.). The proposed plan would create a water grid network that would redistribute 12-13 million acre-feet of water from the Mississippi River, a water rich region, to water poor regions of Texas (Jose & Schreiber, n.d.). Supporters of the water pipeline argued that it was an efficient transfer of water from areas of excess to areas in need in addition to improving water security for the state and preventing damage to the economy and environment (Jose & Schreiber, n.d.). Critics of the water pipeline were concerned about the implications the project would have on private property rights and existing water rights. Critics were also apprehensive about the cost, environmental impacts, political challenges among regions receiving and losing water in the state, and how energy intensive the project would be (Jose & Schreiber, n.d.). This proposal created the unique alliance of environmentalists, farmers and ranchers, and conservative Texans as the opposing force and big businesses as the supporters (Jose & Schreiber, n.d.). The proposed water pipeline was nicknamed "Gridzilla" and was eventually terminated.

An idea of growing interest is water reuse. The idea of water reuse is becoming more pertinent in Texas, especially on the regional scale, because wastewater treatment is a necessary component for this method (Policy Memorandum Subject Future Water Resources-Alternative Sources, n.d.). Water reuse is defined as the "domestic or municipal wastewater that has been treated to a quality suitable for a beneficial use" and is used both directly and indirectly (Policy Memorandum Subject Future Water Resources-Alternative Sources, n.d.). Direct use of 'water reuse' is returning treated wastewater to the water distribution system and an indirect use of 'water reuse' is to return the treated water back to the source of the water supply for the distribution system (Policy Memorandum Subject Future Water Resources-Alternative Sources, n.d.). In Texas, there are 6 major sites of water reuse, located in Abilene, Tarrant Regional Water District, Cleburne, San Antonio, the Colorado River Municipal Water District, and Wichita Falls (Policy Memorandum Subject Future Water Resources-Alternative Sources, n.d.).

Desalinization is another approach to expand the amount of available water to water scarce regions and is also growing in application throughout the West coast of the U.S. Desalination is "the process of removing dissolved solids and other minerals from saline water sources, which can include brackish groundwater and seawater" (Lake, Jackson, Paup, & Walker, 2018). Desalination on a large scale usually refers to the thermal or semi-permeable membrane techniques to remove the salt (Policy Memorandum Subject: Future Water Resources-Alternative Sources, n.d.). In 2002, the TWDB, began developing a proposal to build the first large-scale seawater desalination plant in Texas for drinking water purposes and in 2003, the TWDB was tasked with expanding and providing funding for desalination efforts throughout the state ("Innovative Water Technologies - Desalination | Texas Water Development Board," n.d.) through the Desalination Program (Lake et al., 2018). Currently, desalination has the potential to provide municipalities with approximately 142 million gallons per day, with the Kay Bailey Hutchison plant serving as the greatest contributor of about 27.5 million gallons per day ("Innovative Water Technologies - Desalination | Texas Water Development Board," n.d.). According to the "The Future of Desalination in Texas", the 2018 Biennial report on seawater and brackish groundwater desalination written by the TWDB, the capacity and number of desalination plants in Texas is continuing to increase (Lake et al., 2018).

Current Policies ~ Groundwater

In contrast to the prior appropriation doctrine used for surface water, the groundwater in Texas is regulated by the Absolute Ownership rule ("Water Law Overview - National Agricultural Law Center," n.d.). The Absolute Ownership rule, also referred to as the Absolute Dominion Rule, reflects many aspects of the Riparian doctrine, emanating from English influence ("Water Law Overview - National Agricultural Law Center," n.d.). The Absolute Ownership Rule is based on the premise that a landowner owns any and all water underneath their land and is therefore permitted to pump all the water they can from under their land with few exceptions ("Texas water law," n.d.). This doctrine for groundwater management is commonly nicknamed the "law of the biggest pump" ("Texas water law," n.d.). While some other states that use the Absolute Dominion Rule have adopted the American rule of "reasonable use", Texas does not have this limitation set in place ("Texas water law," n.d.).

Strategies for Conservation

Groundwater protection strategies are limited after a Texas Supreme Court ruling in 1904 formally cemented the precedence for rule of capture in Texas groundwater policy (Diamond-Ortiz, Gold, Kay, & Martinez, 2014). However, following two significant droughts in 1910 and 1917, Texas elected to grant authority to Texas legislature to pass laws to conserve and protect the natural resources in the state, including water (Diamond-Ortiz, Gold, Kay, & Martinez, 2014). This shift in public attitude set the stage for the creation of Groundwater Conservation Districts, or GCDs, in 1949 (Diamond-Ortiz, Gold, Kay, & Martinez, 2014). The Texas Water Resources Institute defines GCDs as a "local unit of government authorized by Texas Legislature and ratified at the local level to manage and protect groundwater" (26); they are a regional tool to modulate groundwater pumping. In plain language, GCDs are given special permission by Texas Law to "modify the rule of capture" by regulating the removal of groundwater (26). An elected board directs the GCD and are financed through a compilation of taxes and fees in the corresponding district (Diamond-Ortiz, Gold, Kay, & Martinez, 2014). The first GCD was established in the High Plains Conservation District in 1951, and by 2013, the state-wide number of GCDs had soared to 97 (Diamond-Ortiz, Gold, Kay, & Martinez, 2014). GCDs were created to act as local, regulatory agencies; they are given the power to "establish registration requirements, production standards, well-spacing requirements, reporting requirements, permit requirements, and production limitations" while establishing a "comprehensive management plan" with the goals of "conservation, preservation, protection, recharge, and groundwater protection" (Diamond-Ortiz, Gold, Kay, & Martinez, 2014). Every district management plan must include regulations and records of well drilling in order to create a sustainable management plan (Diamond-Ortiz, Gold, Kay, & Martinez, 2014). The Texas legislation that created the GCDs emphasizes the importance of planning for a sustainable future, a component worth noting. The creation of GCDs are an example of a localized regulatory tool, as opposed to the traditional route of federal, top-down control.

As the range of GCDs expanded throughout the state, districts of variable size and disproportionate monetary support from unequal tax revenues began to emerge (Diamond-Ortiz, Gold, Kay, & Martinez, 2014). Political pressure began to morph and shift the conservation district boundary lines from aquifer boundaries to county boundaries (Diamond-Ortiz, Gold, Kay, & Martinez, 2014). Water can pervade political boundaries while ideologies cannot; governing aquifers and creating sustainable management plans across multiple counties with varying levels of support, funding, and potentially different economic objectives, is very difficult (Diamond-Ortiz, Gold, Kay, & Martinez, 2014).

To counter the stratified governance of single aquifers, Texas Legislature created Groundwater Management Areas, or GMAs (Diamond-Ortiz, Gold, Kay, & Martinez, 2014). GMAs are designated and governed by the TWDB and are designed for "joint planning and managing groundwater resources" among districts (26). These management areas focus on monitoring groundwater availability through data collection and emphasize the creation of a groundwater management plan (26). A groundwater management plan must outline a GMAs goals, such as "efficient use of groundwater, controlling and preventing groundwater waste and subsidence, and addressing conjunctive surface water management issues, natural resources, drought conditions, conservation and groundwater recharge, and desired future aquifer conditions" (26). Currently, there are GMAs in Texas and all but 1 GMA contain a range of 2 to 21 GCDs within their boundaries ("Groundwater Management Areas | Texas Water Development Board," n.d.).

A significant factor in the groundwater management plans is having a comprehensive understanding of the groundwater resources. Recognizing the need to understand all the complexities of underground water systems, Texas Legislature approved funding for the Groundwater Availability Modeling Program, which is administered by the TWDB (Water Development Board, n.d.). This program aims to create a standardized, publicly available model for GCDs and regional water planning groups (Water Development Board, n.d.). These models include in-depth information about each aquifer, such as recharge, geology, surface water sources, aquifer properties, and pumping data (Water Development Board, n.d.). These models are, and will continue to be, critical in the planning for future population growth and for current water management planning.

Initiatives to restore overdrawn aquifers and to maintain current storage in aquifers include a method called Aquifer Storage and Recovery. Aquifer Storage and Recovery, or ASR, is "the storage in a suitable aquifer through a well during times when water is available, and the recovery of water from the same aquifer during times when it is needed" ("Innovative Water Technologies - Aquifer Storage and Recovery | Texas Water Development Board," n.d.). Currently, there are three ASR systems in Texas, compared to 175 ASR systems in the United States ("Innovative Water Technologies - Aquifer Storage and Recovery | Texas Water Development Board," n.d.). The main benefits of ASR are that the there is no water loss to evaporation (a downside to surface water storage) and no loss of storage capability due to sedimentation ("Innovative Water Technologies - Aquifer Storage and Recovery | Texas Water Development Board," n.d.). Although ASR only stores existing water and does not create new sources of water, ASR can help improve water security in times of water scarcity ("Innovative Water Technologies - Aquifer Storage and Recovery | Texas Water Development Board," n.d.).

Analysis

Texas has navigated through the trials and tribulations related to many historical affairs associated with water resources. The historical background of Texas water law and policies facilitated the development of the disparity between surface water and groundwater resources. This has deeply influenced the interactions of water resources and Texas within the state, with other states, and among nations.

While water scarcity is arguably the most pronounced, overarching challenge in Texas water management, the embedded challenges of varying political and cultural perspectives about the allocation and management of water, the ambiguous nature of the language used in policy, and wide variety of stakeholders involved makes a solution very difficult. Texas has implemented policies on the federal, state, and regional levels to attempt to create a solution that works for them and has had successes, like the GCDs and GMAs, and failures, such as the "gridzilla" proposal. Although the "gridzilla" proposal was ultimately vetoed, it poses an interesting question about the sustainability and ethicality of transferring water from water-rich regions to water-poor regions. While both GCDs, GMAs, and the "gridzilla" project were proposals from the state level, the GCDs and GMAs are dealt with largely at a more local level, which may have contributed to why they were more successful. This is a great example of how Texas recognized the political atmosphere and adjudicated that a bottom-up approach would be more effective than a top-down, federally-mandated approach. Policy has to be a motivating force; it has to both cater to its audience and inspire the change it was created for. Effective policies must communicate both the cultural intellect of the place it is designed for and the rigid guidelines necessary to effectuate changes in behavior. But how do you create this kind of policy for the countless cultures, beliefs, stakeholders, and political ideologies in the United States?

One place to start is to focus on the specific language used in environmental policy. There have been many instances in the history of environmental policies where high-profile rules and regulations have contained ambiguous words that muddled the true meaning and true ambitions of the regulation. With contention surrounding a piece of legislation, it will likely get tied up in the courts. The Clean Water Act's use of the phrases "navigable waters" and "significant nexus" serve as great examples of unclear phrases that can be interpreted many different ways. The different interpretations of these key words quite literally change what waterways fall under EPA regulatory jurisdiction. As a new wave of environmental policies are likely to be created in the next decade, there should be a special focus on the specific word choice for the regulatory framework. Focusing on specific word choice is comprised of predicting how the presence or omittance of certain words could change the potential meaning and interpretation of what the policy is intended to accomplish and communicate. Further, the omission or superfluous use of language can do just as much damage to the effectiveness of a policy. In the case of the Rio Grande River dispute among Texas, Mexico, New Mexico, and Colorado, the Rio Grande Compact between the U.S and Mexico failed to clearly define what 'extreme' drought conditions are, and Mexico has exercised this clause to explain their noncompliance with the agreement for many years. In the Texas-New Mexico dispute, New Mexico claimed that the addendum has ambiguous rules for interference so the case that Texas brought against them should be dismissed. Ambiguous rules without specifically outlined outcomes hurt the longevity of policies and can make conflict resolution very difficult. The United States courts system can take a long time and is intermingled with a complex set of precedents and exceptions that can make adjudications unpredictable. Writing policy by using specific language and definitions with clearly outlined consequences and outcomes for noncompliance will save stakeholders a lot of time when conflicts arise. This approach, in theory, will create policies that attempt to prevent conflict by clearly defining all terms and ensuring that all stakeholders are on the same page for accountability.

In addition to using proactive, conflict-resolution language, the content in the policies should be environmentally proactive rather than reactive. Proactive policies usually contain a conservative strategy that attempts to plan and prepare for future needs and stresses. For water policy, proactive planning would entail implementing conservation strategies that would ensure surface water and groundwater resources for future generations. This is a challenge for states that abide by the prior appropriation doctrine because if the water is not used by one person, it will get sent to the next most recent water permit rather than being devoted to conservation efforts. Texas water management proves to be especially challenging because they abide by both the prior appropriation doctrine (for surface water) and the absolute ownership rule (for groundwater) so there are little to no policy incentives to conserve water resources in either doctrine. The implementation of GCDs and GMAs have retrofitted groundwater policy, however the lack of policy incentives still pervades to create water scarcity issues. Proactive policies, in combination with other approaches, such as the bottom-up management approach in Texas, could improve the sustainability of the water resources that Texas currently has. Proactive policies can be hard to get support for and hard to implement. However, once they are implemented, changing future people's behavior won't be difficult because it won't be changing already-established routines; sustainable practices will become the routine.

Building off the idea of proactive policies, what is accepted as 'proactive' varies depending on the political atmosphere and culture of the region the policy is intended for. Policy makers typically have two main routes for approaching the scope and level of governmental involvement they want for their policy. A Top-Down approach refers to a command-control enforcement strategy [by] using statutes, executive orders, or court decisions ("Top-down and Bottom-up Approaches within Implementation | Political Pipeline," 2013). A Bottom-Up Approach refers to initiating the policy creation process with the target groups ("Top-down and Bottom-up Approaches within Implementation | Political Pipeline," 2013). While both have their advantages and disadvantages in implementation and effectiveness, a key piece to consider when pondering these approaches, is what the corresponding community will receive best. The political atmosphere, the cultural significance of freedom, heritage, and ancestry, all play a role in determining what type of policy will be received best by any given community. For example, proactive policies in California follow a Top-Down approach towards environmental policy, meaning that the overarching political atmosphere accepts the "system-level changes driven by policy and operational directives" (Gallup, 2018). Top-down approaches have the potential to create rapid, widespread, mandatory change on people's behavior through policy, compared with the Bottom-Up Approach, which focuses more on the changes that begin with the individual and result in policy change (Gallup, 2018). The political atmosphere in Texas reflects a greater acceptance of policy approaches that stem from local understanding of communities and their needs. GCDs serve as a great example for a Bottom-Up Approach towards the regulation of groundwater. GCDs are meant to give communities in Texas the means and efficacy to regulate their own local aquifers (Metzger, 2017). GCDs are likely to face new pressures caused by economic development and increased demand for water, so it is imperative that they stay on top of current scientific research regarding water resources.

Overcoming cultural and ideological barriers pose possibly the greatest challenge to water management. Water can traverse all boundaries, while stakeholders, ideologies, and perception of these factors may not. One approach that attempts to rectify these seemingly unconquerable differences is to bring all stakeholders together in one place to come to an agreement. Bringing all stakeholders to one place opens the dialogue to increase understanding about each group's perspectives and how each group's actions will impact the others ("Stakeholder Engagement - Meaning, Definition and Strategies," n.d.). So often communication can get lost in translation, misinterpretation, or even omission, which leads to lawsuits and unpleasant means of resolving the issue. According to the E-CSR Team, high levels of stakeholder involvement augment communication from negotiation and consultation to empowerment and collaboration ("Stakeholder Engagement - Meaning, Definition and Strategies," n.d.). Collaboration in water management is absolutely vital because water resources are already shared among stakeholders and this overlap is only going to increase as demand grows from population and climatic changes. Collaboration would increase efficacy for stakeholders to defend their case but also, in theory, compromise after hearing arguments from all sectors.

Although Texas has faced many water-related challenges throughout its history, it has been creating and implementing state-wide strategies to address these areas of concern. The issues outlined in this paper, while only focused on Texas, are not unique to Texas. Water scarcity and water security issues have been an emerging problem not only for the western United States, but in many regions around the world. Further, policy issues, whether it's the language choices, the political barriers, behavioral inertia, or miscommunication among stakeholders, are also global challenges. The unique historical background of Texas and the development of a hybrid water management system has led to an interesting set of challenges for Texas. Texas has both passed many barriers, but like places all over the world, still has some kinks to work out. Texas has implemented many innovative strategies and I am intrigued to see what they come up with next.

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