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NETWORK GOVERNANCE AND LONG-TERM WATER SUPPLY

A WHITE PAPER¹

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EXECUTIVE SUMMARY

Long-term fresh water sustainability has greater urgency than is commonly perceived by political leaders, or understood by the public. Until there is a serious water shortage or costs escalate dramatically, little attention is likely to be paid to the problem. Nonetheless, knowledgeable experts recognize the issue is looming on the horizon.

Hawai'i's 1.4-million residents remain almost entirely dependent on ground water. While there is no immediate statewide shortage such as Californians have experienced, allocation and transmission needs are increasingly fragile and burdened with infrastructure risks, by growing water quality issues, and by the rising costs of delivery. Hawai'i's water crisis is not about a physical shortage. It is a slow-moving financial calamity in a state already burdened with long-term debt.

Significant investments are needed for system upgrades, new source development, improved conservation, relocated wastewater management plants, decentralized and scaled water recycling, storm water capture, and more efficient transmission. Contamination from chemicals, pesticides, pharmaceuticals, and leaky cesspools and underground storage tanks will likely add further costs.

In the context of an impending financial crisis, “network governance” strategies can make a difference. Network governance is a term that speaks to sustained, robust, and specific collaborative initiatives in the face of collective threats or mutually important aspirations. Network governance always comes down to careful leadership and structured, persistent, and coordinated efforts by independent entities that act on one or more common long-range challenges.

IDEAS FOR ACTIONS

Recognizing that all government agencies struggle with adequate resources to achieve their primary legal mandates, we urge Hawai'i's water regulators and managers to work together on long-term challenges by engaging in specific catalytic long-range planning projects. As described in [§VI](#), here are some specific possible network efforts that could take place without large amounts of new funding:

1. Identify, analyze, and publicize current and future statewide dislocations to fresh water supply and transmission, especially the effects on water infrastructure.
2. Explore possible estimates of fresh water's “shadow costs” and its actual monetary value.
3. Review the potential array of mechanisms for long-term fresh water financing.

4. Initiate a preliminary reexamination of the way sustainable yields are calculated and how the RAM model might be improved.
5. Further sharpen estimates of future demands.
6. Anticipate the potential costs of “fully implemented” public trust obligations and how they eventually can be funded.
7. Explore the feasibility of creating a more comprehensive online water atlas with user-friendly visualization capabilities.
8. Examine the potential challenges of pollution and contamination and the future “costs of clean” water.
9. Advance a fresh round of watershed conservation efforts.
10. Strengthen the informal interagency cooperation that exists across water managers to formalize long-term integrated water resource planning.

Short-term work groups, task forces, roundtables, or other working forums can become the springboards and catalysts for longer-term strategies and lay the foundation for emergent network governance structures, where state and county water regulators may not be in a position to undertake the full depth and breadth of these tasks.

ABBREVIATIONS

ADC	Agribusiness Development Corporation
AWWA	American Water Works Association
CWB	Department of Health's Clean Water Branch
CWRM	State Commission on Water Resources Management
DBEDT	State Department of Business, Economic Development, and Tourism
DHHL	Department of Hawaiian Home Lands
DL&NR	State Department of Land and Natural Resources
DOA	State Department of Agriculture
DOH	State Department of Health
DOI	United States Department of the Interior
DOFAW	Department of Land & Natural Resources' Division of Forestry and Wildlife
EA	Environmental Assessment
EIS	Environmental Impact Statements
EPA	United States Environmental Protection Agency
EPSCoR	National Science Foundation's "Established Program to Stimulate Competitive Research"
FWI	Hawai'i Community Foundation's "Fresh Water Initiative"
GDE	Ground water Dependent Ecosystems
HBWS	Honolulu Board of Water Supply
HCF	Hawai'i Community Foundation
HDWS	Hawai'i County Department of Water Supply
HWP	CWRM's Hawai'i Water Plan which create a framework
'Ike Wai	University of Hawai'i's 5-year \$20-million EPSCoR research grant
KDOW	Kaua'i County Department of Water
MDWS	Maui County Department of Water Supply
MGD	Million Gallons per Day
OEQC	Department of Health's Office of Environmental Quality Control
RAM	Robust Analytic Model
ROI	Return on Investment
SDWB	Department of Health's Safe Drinking Water Branch
SLR	Sea Level Rise
SY	Sustainable Yield
UH	University of Hawai'i
UHERO	University of Hawai'i Economic Research Organization
UH-WRRC	University of Hawai'i Water Resources Research Center
UI	Ulupono Initiative
USGS	United States Geological Survey
UST	Underground Storage Tank
WRPP	CWRM's Water Resource Protection Plan

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I. INTRODUCTION

1. BACKGROUND

In March 2017, Dr. Gregory Chun, a principal with the 'Ike Wai water research program at the University of Hawai'i (UH)², and Dr. Peter Adler, a consultant to 'Ike Wai, were contracted by Ulupono Initiative (UI)³ to undertake stakeholder interviews with water regulators and other experts. The 2017 study was intended to explore:

- (1) How the UH 'Ike Wai research program might help meet some of the practical institutional needs for long-term water research; and
- (2) How UI might potentially assist with water governance. In particular, UI wanted to explore the potential value of "network governance" practices as they might apply to longer-term intergenerational fresh water supply.

Joining Greg Chun and Peter Adler for these initial consultations were Dr. Kimberly Burnett and Dr. Chris Wada of the UH Economic Research Organization (UHERO), and Aida Arik, a UH Ph.D. student in planning with a background in hydrology and economics. Also joining the meetings was UI's then new Manager of Social Systems, Dr. Nick Redding. An initial confidential report of that work was provided to UI's executives and to Dr. Gwen Jacobs, 'Ike Wai's Principal Investigator.

This paper, funded by residual project monies from that effort, incorporates and builds on that original work and is available to wider audiences who take interest in long-term fresh water sustainability.

2. AN IMPENDING EMERGENCY

The challenge of long-term fresh water sustainability has greater urgency than is commonly understood by the public. Unless there is a profound water supply shortage, source threats, or the cost of water escalates dramatically, we worry that insufficient attention will be paid to the mounting risks already in sight, especially with growing uncertainty associated with climate change. The problems are complex and nuanced. Nonetheless, knowledgeable experts understand the urgency ahead. We believe there are steps that can be taken by the agencies that play critical regulatory roles to help prepare for and mitigate the challenges that build on the emergent planning being done in some sectors to address these risks.

² 'Ike Wai is an interdisciplinary collaboration between water scientists at the University of Hawai'i. The effort is funded by the National Science Foundation EPSCoR Program #OIA 1557349. See <https://www.hawaii.edu/epscor/>.

³ Ulupono Initiative makes for-profit and non-profit investments that improve Hawai'i's food production, energy use, and waste management.

Hawai'i's 1.4-million residents remain almost entirely dependent on ground water. Ground water provides 99 percent of Hawai'i's domestic drinking supply and about 50 percent of all the freshwater used in the State.⁴ Other than bottled water, there is no recourse for importation. Any gains must come from smarter local strategies.

In general, water problems can be physical (a scarcity issue), political (not distributed sufficiently or equitably), technical (poor infrastructure), economic (not enough funding), or combinations of these. We believe that our challenge is a combination of technical and economic factors, the solutions to which are vetted through processes susceptible to the exigencies of local politics that often lead to suboptimal solutions.

The good news is we have no immediate statewide water shortage such as Californians, South Africans, and others are experiencing. Unlike the Middle East, North Africa, and cities like Beijing, Shanghai, and Mexico City, Hawai'i has access to a considerable amount of water. It is on the surface, in the ground, and surrounding the state.

The challenge is economic. Many of the places where a large portion of the state's growing 1.4-million residents look to for housing tend to be in ground water poor areas of the islands, or where the state's 10-million annual tourists tend to visit. This means reliable and efficient infrastructure is essential to capture and move water around. Good water supply will only be possible at the cost of new wells, purification systems, desalination plants, wastewater scalping, better reservoirs, and other sourcing and transmission strategies.

Supply and allocation needs are also increasingly unpredictable, vulnerable to contamination, and fraught with possible new costs. Because of climate fluctuations, some basic water conditions are changing faster than anyone thought. Shoreline salt-water inundation is underway, rainfall trends have been in decline since the 1920s, and our agricultural water diversion systems, most of them more than a century old, and need repair and modernization.

The warnings are clear. We must anticipate potential saltwater intrusion into streams, coastal wetlands, and unsealed infrastructure, as well as increased damage when hurricanes, tsunamis, and seasonal high waves strike.⁵ The precise coordinates of these impacts are slowly emerging through improving sea level rise and climate projections.

As conditions change, so too does the risk of breakdowns and the cost of repairs and upgrades. Barring an unanticipated "Black Swan," Hawai'i's water crisis is actually a slow moving but growing financial crisis.⁶ Major investments are needed for system upgrades, new source development, improved conservation, relocated wastewater management plants, decentralized and scaled water recycling, storm water capture, and more

⁴ Gingerich, S.B. and Oki, D.S., 2000, *Ground Water in Hawaii: U.S. Geological Survey, Fact Sheet 126-00, 6 p.*

⁵ *Sea Level Rise Guidance. City and County of Honolulu - Climate Change Commission. Adopted June 5, 2018.*

⁶ A "Black Swan" event describes an occurrence that comes as a surprise, has a major effect, and is often inappropriately rationalized after the fact with the benefit of hindsight. The event can be political (sudden break up of the Soviet Union), economic (2008 market crash), social (rapid rise of populism), technological (the internet), or environmental (Hurricane Katrina). The sudden, prolonged, and destructive eruption of Kilauea Volcano in 2018 has been a Black Swan for Big Island's tourism.

efficient transmission. Contamination from pharmaceuticals, pesticides, or leaky cesspools and underground storage tanks are other likely future costs for some sources.

Using data drawn from First Hawaiian Bank, Bank of Hawai'i, the state's DBEDT, and the U.S. Bureau of Economic Analysis, Paul Brewbaker has compared the state's past and current total infrastructure investments in roads, sewers, parks, and other backbone structures. Between 1960 and 1980, roughly 4% of Hawai'i's GDP was annually spent on infrastructure. Between 1980 and the present, average annual investment dropped below 2%.⁷

It is unclear what portion of Brewbaker's calculations were and are for water infrastructure. Nor have different water improvement scenarios been calculated for the whole state. Nonetheless, all estimates create sticker shock. For example, as part of their efforts to get ahead of these issues the Honolulu Board of Water Supply (HBWS) has prepared a 30-year capital improvement program that estimates an investment of \$4.3 billion to properly upgrade reservoirs, pumps, pipelines, treatment systems, and other critical water facilities.

Although Honolulu averages more than one water main break a day⁸, this problem isn't unique to Hawai'i. The U.S. has 1.6-million miles of water pipes, but many cities have yet to tackle critical water infrastructure repairs and upgrades or have done so without strong technical and financial plans. The American Water Works Association (AWWA), the leading organization of water professionals in the U.S., ranks the repair and replacement of aging water and wastewater infrastructure number one on a list of thirty challenges. Closely related (number two and three) is the financing for capital improvements and long-term water supply availability. AWWA estimates two trillion gallons of water are wasted each day as a result of 240,000 water breaks.⁹ Over the next 25 years, \$1-trillion is needed in investment if U.S. demands for fresh water are to be met. The private sector also needs to be challenged to ensure collateral action as older homes are repaired and new ones are built.¹⁰ Interestingly and at the bottom of the AWWA list (number thirty), is climate risk and resiliency.¹¹

More legal and political conflicts and their associated transactional costs may also lie ahead in Hawai'i. While we cannot find specific data on the exact number of water-related lawsuits, contested case hearings, and regulatory proceedings that have occurred since the Water Code was enacted in 1987, or their private and public costs, a partial list of significant legal actions is included in Attachment-1 ("Partial List of Water-Related Lawsuits, Contested Cases, and Regulatory Proceedings").¹² We also recognize that litigation is often used as a means for citizens to

⁷ Paul Brewbaker - Powerpoint presented at the Managed Retreat Symposium on Sea Level Rise, Hawai'i Pacific University at Aloha Tower, January 11, 2018.

⁸ Main Breaks - Board of Water Supply

⁹ 2017 Infrastructure Report Card

¹⁰ Utility Service Partners, CityLab "Aging Infrastructure Can Hit People Where They Live"

¹¹ American Water Works Association, "2017 State of the Water Industry Report"

¹² If Hawai'i bears similarity to the national patterns, we surmise that nearly 2% of the state's gross domestic product (GDP), or roughly \$1.23-billion, is spent on all forms of litigation. See <https://www.quora.com/What-percentage-of-the-US-GDP-is-spent-on-litigation-How-does-this-compare-with-other-countries>

bring about legal and political change. Native Hawaiian traditional and customary rights, for example, are sure to be further litigated in administrative agencies and the courts. Such changes usually have hefty financial implications.

As we look ahead, expanded watershed and stream conservation initiatives may also potentially collide with ongoing land use change for development and commercial agriculture. More consequential are the implications when and if water has to be priced closer to its full value to fund obligations under Hawai'i's evolving public trust doctrine. To our knowledge, the question of how much it would cost to fully pay for public trust obligations for instream flow standards and traditional customary Native Hawaiian uses has never been studied.¹³

These intergenerational challenges are not insurmountable.¹⁴ Hawai'i's history and culture are rooted in intelligent resource management strategies. Pre-contact Hawaiians and subsequently, the owners of large sugar and pineapple plantations, were astute managers and had careful water engineering approaches. Politics aside, we have the opportunity to build on this rich history and culture and respond to today's challenges in ways that will shape Hawai'i's water legacy for future generations.

3. IMPEDIMENTS AND CONSTRAINTS TO LONG-TERM PLANNING

Strategic water planning is vexed by political, economic, and technical constraints. Each year state legislators are pressed to pay attention to immediate constituent issues and statewide budgetary problems. Water competes with other public goods.

Short election cycles mean that County Council members are often wary of supporting decadal-scale projects. Contested administrative cases and attendant judicial litigation can take years, sometimes decades to resolve putting some decisions in suspended animation. Few investors (e.g., counties, developers, farmers, private landowners) want to advance millions of dollars in infrastructure if there is high uncertainty about access to water.

Additionally, there are gaps between development projections and water plans. State and county plans are imperfectly integrated with water plans, which are sometimes made with only rough conjectures about future land use demands. Indeed, the lack of integration between land use and water planning is cited by local professionals as an area of concern. Adaptive management and planning is always challenging. Current water governance structures are not arrayed in ways that allow for learning over time, since agencies must implement the law and existing sustainable yield numbers to the best of their ability.

¹³ The Public Trust doctrine embraces four pillars of water resources protection: the honoring of Native Hawaiian traditional and customary rights; the protection of fish and wildlife; the maintenance of ecological balance; and the preservation of water for municipal and public use. With further provisions for the water reservations for the Department of Hawaiian Home Lands. See the [State Water Code](#)

¹⁴ Although, Hawai'i's particular investment situation is further compounded by an unfunded liability of \$24-billion in pension and health care obligations.

In the background sits Hawai'i's unique political culture. We blend Asian, Oceanic, and Occidental worldviews, but the state has the lowest voter turnout in the nation and has been dominated by one party for more than half a century. Hawai'i is also unique among the U.S. states in that it is limited to two levels of government: the state and the four counties, each with a mayor and a council. In the face of numerous consultation requirements and an increased hunger for participation in planning and policymaking, there are no real structures for elected community decision-making below the level of the counties other than O'ahu's Neighborhood Boards, which are advisory.

Hawai'i was once dominated by "The Big Five": Castle & Cooke, Alexander & Baldwin, C. Brewer & Co., American Factors, and Theo H. Davies & Co. Most of these companies had their roots in sugar or pineapple and built much of the state's rural water infrastructure. They also kept careful water records but, unfortunately, most of their data appears to be lost. Today, some of these companies are gone and others have become diversified multinationals. While many celebrate the transition away from plantation-era land and water management, an under-recognized consequence is the loss of substantial private investment in water infrastructure and the general decline in the state's agricultural industries. This also raises the question of who is responsible for abandoned water diversions that are still diverting water?

There are also scientific and technical challenges. The state's volcanic hydrogeology is especially complex and varied. Each island has its own geologic idiosyncrasies that are not well understood. Most water agencies do not have the staff and/or resources to undertake their own science. They rely on models developed by the USGS or UH's Water Resources Research Center (WRRC) but studies and models are usually commissioned and then tailored for specific problems in specific geographic areas. A comprehensive understanding of each islands' unique hydrogeology is lacking and needed.

Finally, agencies do not have a central place to lodge and "mine" all types of old and new water data. While legacy data exists in separate government agencies, consulting firms, and research groups, it has never been combined into a clearinghouse that can be publicly accessed for research and management questions. UH 'Ike Wai may be developing a cyber infrastructure capable of serving some of this purpose, but that platform is years away and it is unclear if it will be accessible to agencies or simply a vehicle for UH researchers to pursue their own inquiries.

It is also not clear to what extent there will be the political will, financial resources, and institutional buy-in needed to maintain such a platform over the long-term.

4. "NETWORK GOVERNANCE"

In the context of approaching strategic and financial complexity, we think new "network governance" tactics will make a significant difference. Network governance is a term that speaks to sustained, robust, and specific partnerships in the face of collective threats. Network governance is created and implemented through structured, persistent, and coordinated efforts by independent entities that find common cause. They are "coalitions of the

willing.” The entities can be government, business, non-profit, or community enterprises, or any combination of these.

Network strategies have a variety of potentially sophisticated policy uses.¹⁵ Depending on the challenge, they can be deployed for:

1. **Problem Definition.** Networks can be mobilized to align views on the scope, severity, and causes of a problem.
2. **Policy Design and Planning.** Networks can be mobilized to examine policy alternatives and/or plan for the implementation of a policy.
3. **Policy Coordination.** Once policy tools (or a suite of tools) are selected, networks can be used to coordinate and manage implementation.
4. **Policy Implementation (Regulatory).** Networks can be created to agree on a principal regulatory lead and/or a regulatory agent.
5. **Policy Implementation (Service Delivery).** Networks can be mobilized to deliver a public good.
6. **Policy Evaluation/Monitoring.** Networks can be organized around ongoing monitoring and evaluations.
7. **Political Alignment and Action.** Networks can be mobilized to advance social, legal, or fiscal agendas that all parts of the network agree on.

Networks exist on spectra of formal to informal, binding to advisory, and hierarchical to horizontal. Regardless, when employed effectively they work to defy the gravitational pull of short-term thinking, silo-ed perspectives, and misaligned action that conventional systems encourage, which impedes effective long-term planning.

Vigorous governance networks can be imbued with greater or lesser degrees of power, ranging from group control to simple exchanges of data, and still be effective. The legal compact that governs users of Colorado River water, for example, has vast jurisdictional powers over city and state water users. In contrast, the Paris Agreement on climate change relies on influence and each signatory nation’s voluntary implementation. Networks form because no one entity can achieve a paramount goal alone. Enterprises then come together to achieve a superordinate result (or a piece of it), reduce unnecessary conflict, or increase efficiencies and effectiveness.

“Collaboration” is the implicit expectation in network governance, but the term *collaboration* tends to be bandied about in vague ways and requires specificity. Arthur Himmelman has described a ladder of four types of mutually supportive interactions.¹⁶ In his lexicon, these levels gain in challenge, complexity, investment, and assumptions of risk as they ascend and suggest four different organizing models.

¹⁵ See Koliba, Meek and Zia, *Governance Networks in Public Administration and Public Policy*, p. 122. CRC Press, 2011.

¹⁶ See Arthur Himmelman’s work at https://depts.washington.edu/ccph/pdf_files/4achange.pdf

Level 1 is focused on Intentional Communication, i.e., exchanging information, data, and ideas for mutual benefit.

Level 2 is designed for Coordination, i.e., regular communication that leads to altering actions or activities for mutual benefit.

Level 3 is set up for Cooperation. This involves exchanging information, altering activities, and sharing human and financial resources to achieve a common purpose.

Level 4 is designed for what Himmelman regards as true Collaboration: information and data are exchanged; activities are altered; resources are contributed; real risks, responsibilities, and rewards are shared.

In the private sector, Levels 3 and 4 network governance activities tend to be driven by a profit imperative or a perceived threat to the profits of all players who have “skin in the game.” Competitive actors in the same kinds of businesses associate when they need to pursue collective outcomes. At an individual company level, this can take the form of specific partnerships, joint ventures, or contracts aimed at new services, products, or markets. At a larger level, industry players often band together to pursue joint regulatory responses or subsidies.

Network governance in the private sector is an old idea going back to the 10th century when merchants formed scaled-up alliances to utilize agents to promote joint trading interests. The Hanseatic League in Northern Europe in 1400 and the Hudson Bay and the English and Dutch East India Companies in the 1700s were specific alliances between companies that wanted to expand markets, assure quality, and control predatory internal competition. In their time, they became powerful and wealthy.

In the public sector, “network” governance beyond Himmelman’s “Level 2” seems rare and is not always viewed as a useful development by administrators and public policy scholars. Aside from interpersonal and political frictions, many agencies have silo-ed missions, are underfunded, and struggling to get their mandated day-to-day business done. Some administrators remain skeptical of the ability of network participation to enhance their specific jobs or to achieve enough concrete results that balance the investment of time and money that may be required. Others cite legal constraints that do not allow for a dispersion of responsibility.

Nonetheless, examples abound, often driven by a precipitating crisis or a smaller or larger Black Swan event. In 1996 the “Amber Alert” system was established after a nine-year-old girl was kidnapped and murdered in Arlington, Texas. Media networks, in collaboration with law enforcement, were shocked and joined together a grassroots and governmental movement to broadcast quick alerts to prevent future crimes. This movement now includes all fifty states.

After the September 11th attacks, the United States moved quickly to improve coordination between national and local organizations focused on security. The Department of Homeland Security was formed and the Director of National Intelligence was explicitly required to respond to new security threats by working with state and local jurisdictions, each of which had its own agencies. As a result, “fusion” centers popped up in every state to create new hubs for law enforcement agencies to collaborate.

These types of efforts are predicated on a long-term view and a particular style of dynamic leadership that goes beyond everyday management and the immediacy of daily water crises. In the Tipping Point, Malcolm Gladwell described how small, seemingly modest new activities could, under the right circumstances, light fires to trigger and amplify bigger results.¹⁷ It is a process through which good ideas end up acquiring interested people. Some of his insights were:

Good ideas will spread fast once they achieve a certain tipping point. When a few people focus attention on something at the right moment, an idea will accelerate, achieve critical mass, and “tip.” It is an “S-Curve” in which the idea then starts to go “epidemic.”

In many of Gladwell’s political and business examples, alliances of three kinds of people appear to be catalytic converters. “Connectors,” he says, have large social networks that enable ideas to spread and go contagious. “Mavens” are knowledge and data holders. They love information, amass it, and become hugely influential in making the case and offering proof points for a new idea. “Salespeople” are persuaders. They intuitively know how to frame a new idea and translate it to different audiences.

Finally, for an idea to “tip,” it needs to have some level of timely receptivity. Gladwell calls this the “stickiness factor” and suggests that an idea must become memorable enough for people to see its value and take action. This requires well-crafted messages and appropriate channels to move messages out.

There are numerous strategies available to water professionals.¹⁸ Pertinent to this study, the question is: *Do impending long-range water challenges warrant special network governance efforts and, if so, what might they focus on that are in everyone’s mutual interest and worthy of the time and energy that may be required?*

II. POSITIVE TRENDS

In the face of Hawai‘i’s looming water challenges, we recognize that our assertions sound like “gloom and doom.” However, there are important positive trends happening that are exceptionally valuable and noteworthy for their innovation and contribution to addressing these challenges. For example, per capita water demand seems to be slowly decreasing from the installation of efficient plumbing fixtures, growing use of recycled water, and the shifting economic incentives created by higher water and sewer rates. Many other constructive efforts by diverse water

¹⁷ Gladwell, M. *Tipping Point: How Little Things Can Make a Big Difference*. Little, Brown, 2000.

¹⁸ A recent Special Issue of the journal *Water* devotes an entire issue to research articles covering a cross-section of stakeholder engagement, tools for building water management and governance capacity, and perspectives on water management and governance across a broad geography. (see Megdal, Sharon B, Susanna Eden, and Eylon Shamir. 2017. “Water Governance, Stakeholder Engagement, and Sustainable Water Resources Management.” *Water* 9 (190): 1–7. doi:10.3390/w9030190.)

actors are further contributing to progress, especially in the areas of water conservation and efficiency improvement.

Collectively, these initiatives all represent broad scale collaboration across public and private interests that set the foundation for an emergent network governance structure. All of them are helping to extend existing water supply, keep rates and costs as affordable as possible, and helping to close the gap between forecasts and demands. We believe the focus on water can be further turbocharged, but here are some of the creative advancement now taking place:

1. GOVERNANCE

- The Office of Climate Change, Sustainability and Resilience was established by City and County of Honolulu Charter in 2016 and is, among other initiatives, working to coordinate infrastructure and water supply responses to sea level rise across the relevant county agencies. See <https://www.resilientoahu.org>
- The Aloha+ Challenge (Green Growth) is a State and county government effort to maintain a dashboard of quantitative targets for conservation, recharge, and reuse and is systematically tracking progress on a number of indicators. See <https://dashboard.hawaii.gov/aloha-challenge>
- The City & County of Honolulu has been selected as part of the Rockefeller 100 Resilient Cities, with up to three years of funding and guidance for a Chief Resilience Officer. See <http://www.100resilientcities.org/cities/honolulu/>
- In 2016, Legislature and Land Board directed all revocable permit (RP) holders to obtain a long-term water leases by June 30, 2019 (Act 126 SLH 2016). This seeks to enforce HRS §171-58.

2. INNOVATION

- In 2016, the National Science Foundation's EPSCoR program awarded \$20 million over five years to the University of Hawai'i for 'Ike Wai: Securing Hawai'i's Water Future, a research partnership, including funding for work on establishing a data repository. Detailed studies are underway in the Pearl Harbor and Keauhou aquifer. See <https://www.hawaii.edu/epscor/>
- In 2016, Hawai'i hosted the World Conservation Congress, which placed a special emphasis on fresh water sustainability issues and brought local, national, and international attention to the issue. See <https://2016congress.iucn.org>

3. WATER SECURITY

- The Blueprint for Water Action by the Fresh Water Initiative is a collaborative effort involving knowledgeable experts from the public, private, and civic sectors with an action-oriented focus on increasing the supply of fresh water. Headway has been made on improving the antiquated 2006 Uniform Plumbing Code to enable a greater use of recycled water across the Islands and legislative efforts for broader watershed protection. See www.hawaiicommunityfoundation.org/file/cat/Fresh_Water_Blueprint_FINAL_062215_small.pdf
- The State legislature has established a two-year pilot program to foster public-private partnerships that will improve water security. See https://www.capitol.hawaii.gov/session2016/bills/GM1274_.PDF
- Increases of 6.4% and 5.5% in the use of recycled water were accomplished in 2017 and 2016 respectively. See <http://health.hawaii.gov/wastewater/files/2018/02/rw.pdf>

4. CONSERVATION

- Annual water audits are now required for public water systems. See https://www.capitol.hawaii.gov/session2016/bills/GM1271_.PDF
- The Building Owners and Management Association (BOMA) is undertaking a two-year initiative that supports real estate professionals to benchmark water consumption and waste system reduction. See <https://bomahawaii.com>

5. WATER-ENERGY NEXUS

- Up to 30kW of hydropower is now allowed on agricultural lands. See https://www.capitol.hawaii.gov/session2016/bills/HB2077_CD1_.pdf
- Hawai'i County Department of Water Supply received a \$130,000 rebate for its energy conservation efforts. See <http://www.hawaiidws.org/5%20events%20news%20notices/5c%20news/Press%20Release%20re%20Big%20Check%20Refund%20to%20DWS%2020160503%20js.pdf>

6. SURFACE WATER PROTECTION

- Staff initiated instream flow values have been set for Ukumehame, Olowalu, Launiupoko, and Kaua‘ula streams on West Maui, the first staff initiated flow standards since 1988. See <https://dlnr.hawaii.gov/blog/2018/03/21/nr18-040/>
- An innovative mediated settlement was reached to restore mauka to makai flows in the Waimea River on Kaua‘i; the key concept of “shared water” provided for uninterrupted “mauka-to-makai” flows and a renewable energy project to be built on both DLNR and DHHL lands enabling water for Hawaiian homesteading on DHHL Waimea lands. See <http://dhhl.hawaii.gov/2017/05/05/historic-settlement-reached-in-west-kauai-waimea-river-water-dispute/>

7. WATERSHED & GROUNDWATER PROTECTION

- Sustainable Hawai‘i Initiative has established a goal of a 30% increase in priority watersheds protected by 2030. The goal is to protect 30% (253,000 acres) of priority watershed forests by 2030. This builds on a previous commitment to protect 20% by 2021. Currently, 17% (140,000 acres) are protected. See https://governor.hawaii.gov/wp-content/uploads/2016/09/30x30-Watershed-Forests_FINAL.pdf
- Over \$7 million has been awarded in Capital Improvement Project funding by the Hawai‘i legislature in 2019 to protect over 23,000 acres of priority watersheds statewide.
- The State of Hawai‘i and Navy are slowly moving forward to find a long-term solution to the Red Hill storage tank problems after the First Circuit Environmental Court ruled that the fuel storage tanks violate state law. See <https://www.epa.gov/sites/production/files/2016-03/documents/red-hill-aoc-press-release.pdf>

8. OTHER PROACTIVE INITIATIVES

- The Honolulu Board of Water Supply and the Water Research Foundation’s Tailored Collaboration Program are developing a vulnerability assessment to mitigate climate change risks emanating from forecasted sea level rise and projected temperature and precipitation changes.
- Different local community groups on all islands have initiatives underway to protect watersheds, maintain ground water dependent ecosystems, and to protect old or renewed lo‘i systems.

III. ORIGINS OF THE FIRST REPORT

1. WHAT WE INITIALLY SOUGHT TO LEARN

Different state and county agencies play regulatory and legal gatekeeping roles in the management of water. One of our initial goals in March 2017 was to inform UH 'Ike Wai's water research by understanding agency needs, take stock of the interactions between the agencies, and gain insight into how they are grappling with the inescapable changes that lie ahead. To do this, we needed to understand each agency's unique role and responsibilities and the individual challenges they face in carrying out their missions.

Our original interviewing team developed a list of potential questions to anchor wider-ranging conversations. The full list is in [Attachment-2 \("Initial Interview Questions"\)](#). Each of those meetings was prefaced with background on 'Ike Wai's research efforts and UI's emerging interest in water as a potential fourth long-term investment area.

The interviews and discussions were cordial and informative and proved to be excellent dialogues. Each agency kindly provided us background on their mission and challenges followed by a discussion of Hawai'i's overall water governance system, the specific roles that their agency plays, how they interface with other agencies, and the water challenges they and the state collectively face short and long-term.

A series of more specific questions focused on sustainable yield and the ground water and stream models agencies rely on, their sources of data, their data challenges, and the decision support tools that might prove helpful should 'Ike Wai be able to generate them.

2. WHO WE MET WITH

The interview team met with senior individuals from the following water managing agencies beginning in January and running through August 2017: State Commission on Water Resource Management (CWRM); State Department of Health Clean Water Branch (DOH-CWB); State Department of Health Safe Drinking Water Branch (DOH-SDWB); State Department of Agriculture (DOA); State Department of Hawaiian Home Lands (DHHL)¹⁹; Division of Forestry and Wildlife (DOFAW); State Office of Environmental Quality Control (OEQC); United States Geological Survey (USGS); Honolulu Board of Water Supply (HBWS); Hawai'i County Department of Water Supply (HDWS); Maui County Department of Water Supply (MDWS); and Kaua'i County Department of Water (KDOW).

Separately, we also met with some landowners, developers, water professionals, and others having extensive knowledge of water governance and its challenges. Time and budget constraints did not allow us to meet with many others that should have been consulted: county wastewater agencies; community stakeholders; water

¹⁹ Present also were representatives from the Office of Hawaiian Affairs (OHA) and Native Hawaiian Legal Corporation (NHLC)

lawyers; water economists. These are tasks we hope could be accomplished in the future. Our primary focus, therefore, was on water managing agencies with critical legal, regulatory, and gatekeeping powers.

IV. HAWAI‘I’S WATER REGULATORS

Our discussions provided us great insight into each agency’s role and some of the issues, concerns, and dilemmas they face. More detail on each agency’s jurisdiction and their reported issues and dilemmas is in [Attachment-3 \(“The Agencies and their Expressed Concerns”\)](#). While federal agencies—the Environmental Protection Agency, the Department of Interior, the Department of Defense, and the Army Corps of Engineers—form a critical part of the legal and financial picture, the state’s regulatory scheme is largely in the hands of six entities and/or their branches and sections:

1. STATE COMMISSION ON WATER RESOURCE MANAGEMENT

The Commission on Water Resource Management (CWRM) is housed within the State Department of Land and Natural Resources (DL&NR) and in significant ways, is the state’s master water controller, as defined by the State Water Code. It designates water management areas for regulation; establishes standards and reporting processes; provides permits for wells and pumping equipment; maintains the registration of water sources; issues water use permits; determines surface-water management areas; provides minimum standards for stream diversions; conducts administrative hearings on contested matters; collects basic hydrologic data; maintains an inventory of all water uses and water resources; sets sustainable yield and instream flow standards; compiles the Hawai‘i Water Plan; and drafts the Water Resource Protection Plan, both of which are critical analytic and strategic centerpieces.

2. STATE DIVISION OF FORESTRY AND WILDLIFE

Technically, DOFAW is not a regulator, but a manager. As part of DL&NR, the Division of Forestry and Wildlife (DOFAW) is responsible for the management and protection of watershed forests in the state. DOFAW’s Watershed Partnerships Program provides technical and financial resources to support the implementation of watershed plans and helps coordinate statewide protection efforts across public and private lands.

3. STATE DEPARTMENT OF HEALTH

The Department of Health (DOH) has four different units that regulate or manage aspects of fresh water, many of them driven by federal requirements and receiving funding from EPA. DOH regulates Hawai'i's drinking water and is tasked with protecting ground water sources from contamination (SDWB). It ensures the health effects of surface water on Hawai'i's coastal and inland water resources (CWB), regulates wastewater including the water that flows into and out of sewage treatment facilities (Wastewater Branch); and reviews environmental assessments (EA) and environmental impact statements (EIS) for new developments (OEQC). DOH is also responsible for drafting the Water Quality Plan—a key component of the Hawai'i Water Plan.

4. STATE DEPARTMENT OF AGRICULTURE

The State Department of Agriculture (DOA) manages irrigation water systems, and agricultural water reservoirs including the five major state irrigation systems: Ho'olehua, Kahuku, Waimanalo, Waimea, and Honoka'a-Paaulo. The Agribusiness Development Corporation (ADC) plays a central role in maintaining and transitioning legacy plantation water systems for new agricultural uses. DOA is also responsible for drafting the Agricultural Water Use and Development Plan—another critical component of Hawai'i Water Plan.

5. FOUR COUNTY DEPARTMENTS OF WATER SUPPLY

The County departments of water supply are generally semi-autonomous or fully incorporated county entities responsible for the extraction and transmission of fresh water for residential and commercial/industrial use. Maui's is a county department.

- A. The Honolulu Board of Water Supply (HBWS) is the largest and manages O'ahu's municipal potable water resources and distribution system. HBWS provides the majority of water consumed for residential and commercial use in the county. Different from the other counties, HBWS has zero reliance on surface water systems for supply.
- B. The Hawai'i Department of Water Supply (HDWS) is charged with delivering water through 23 water systems and 74 sources around the island, supplying most of the county's potable water needs. Individual water systems are not interconnected except in the districts of South Hilo and Kona.
- C. The Kaua'i Department of Water (KDOW) is composed of twelve separate water systems, of which only three are connected. This represents a large percentage of the water consumption on the island. A small proportion of overall water supply is derived from treated surface sources.

- D. Maui Department of Water Supply (MDWS), unlike Kaua'i, O'ahu, and Hawai'i, is an agency of the county rather than an independent or semi-autonomous entity. The department's responsibilities span three islands (i.e., Maui, Moloka'i and Lāna'i), and serve a much smaller proportion of water customers in the county. Maui also differs from the other counties in that surface water is a significant source of supply.

6. DEPARTMENT OF HAWAIIAN HOME LANDS

The Department of Hawaiian Home Lands (DHHL) is mandated to situate Native Hawaiians on their land holdings and provide them with housing and water. Unlike other state entities, DHHL holds land but does not receive state support for developing and installing water systems. They also have "first call" for water in many places²⁰, but have not fully quantified reservation needs for all of their lands.

V. FINDINGS AND OBSERVATIONS

We observed the following from our 2017 discussions regarding cross-cutting obstacles to greater efficiency and collaboration across agencies.²¹

1. STAFFING, FUNDING, AND BUREAUCRACY ARE BARRIERS.

Universally, state and county water managers suffer from a lack of funding sufficient to strategically address the challenges ahead. It is not just the failure of state and county legislative bodies to allocate adequate money. Some former employees are especially critical of the state's cumbersome, often byzantine bureaucracy and the resulting inertia this creates. Criticisms include low, uncompetitive pay for skilled water professionals, positions that cannot be filled in a timely manner (and are then taken away by the legislature for failure to fill the positions), and recruitment procedures that are slow, burdensome, and ineffective.

²⁰ The State Water Code recognizes and upholds these water rights as established by "the Hawaiian Homes Commission Act, 1920, as amended, and by chapters 167 and 168, relating to the Moloka'i Irrigation System." Haw. Rev. Stat. § 174C-101(a).

²¹ Findings pertinent to the University of Hawai'i's research interests and the Ike Wai NSF-EPSCoR grant can be found in [Attachment-4 \("Findings on Research Preferences"\)](#).

2. AGENCY INTERACTION WORKS WELL ENOUGH ON SHORT-TERM ISSUES, BUT LESS SO ON LONG-TERM CHALLENGES.

The people who work for Hawai'i's water agencies are consummate, seasoned professionals. Many of them are engineers, scientists, lawyers, and planners and many have long tenures in their agencies. Bearing in mind that state and county agencies regulate each other, they tend to coordinate and deal with mutual challenges when they arise. They meet when needed, work together on legally required plans, albeit slowly and not fully on schedule, stay abreast of each other's issues and challenges, and address short-term issues or frictions when they arise. Thus, agency interactions normally only involve Himmelman's Level 1 and 2-type interactions, as discussed in [§L4](#).

Periodically, they also convene at technical conferences or around the table as part of the Hawai'i Community Foundation's Fresh Water Initiative (FWI). While the FWI provides a "safe haven" for working with others, there is no real analog for government regulators and issues that fall outside or go beyond FWI's agenda.

3. FEWER RESOURCES AVAILABLE FOR ADDRESSING LONGER-TERM CHALLENGES.

State and county water managers work well together issue-by-issue, formally and informally, but concentrated long-term water planning on the financial issues discussed in this paper does not appear to be taking place systematically. Each agency does its own planning and must report to its own legislative and executive constituencies. Honolulu Board of Water Supply appears to be the most advanced in anticipating the economic problems that loom ahead, but a statewide-consolidated projection of needed water infrastructure and repair backlogs does not exist.

4. EDUCATION FOR POLICY MAKERS AND THE PUBLIC IS SILO-ED.

Each agency pursues its own public information and education efforts but there does not appear to be a coordinated state-county campaign aimed at increasing the public's knowledge and appreciation of fresh water supply and delivery. Most legislators also tend to be unfamiliar with water issues. Faced with many competing needs and public agendas, and barring a serious water availability problem, there may be no compelling reason for legislators to pay attention. As a result, legislation with funding implications quickly gives way to other political priorities. Water as a general topic does not compel attention and action. The state and the counties tend to focus their education and outreach efforts on their own separate constituencies.

5. USER COSTS APPEAR TO BE A TABOO TOPIC.

Beyond the current rate increases sought by HBWS, water agencies try to avoid the political challenges of new requests. Consumer criticisms and potential public backlash make it difficult to focus on the price of water. Water pricing is a sensitive topic for many reasons, including the already high cost of living and the disproportionately higher cost of supplying water to some areas (e.g. mauka urban areas). Hence, water remains an undervalued resource and largely a public subsidy. As the cost of repairs, maintenance, and future source development escalates, the pricing issue will come to the fore but likely will be addressed separately by each county.

6. LEGACY WATER SYSTEMS ARE A CHALLENGING INHERITANCE.

Hawai'i's old plantation water systems are engineering marvels that could not be built today. However, they are expensive to maintain and may not be providing enough real return on investment. In some agricultural locations, it appears to be cheaper to switch to ground water sources for irrigation rather than repairing legacy surface systems or incurring the additional costs of using recycled water. For some regions, this may potentially pit agricultural water desires against increasing residential development needs.

This already appears to be the case in Maui, where surface water is a significant source of the drinking supply. An example of how protracted resistance can become can be seen in the process for determining minimum instream flow standards, disputes that have been ongoing since 2001. Lack of sufficient monitoring of water quantity and quality adds a further complication to establishing standards; it comes as no surprise that lack of monitoring is also resultant from underfunding.

Navigating challenges resulting from deteriorating agricultural water systems will require coordination between multiple agencies: Hawai'i Department of Agriculture (and the Agribusiness Development Corporation), CWRM, Department of Health (both the Safe Drinking Water and Clean Water branches), DOFAW, and the county department of water supply. Currently, it is not clear what vehicles there are for this to occur.

7. THE WATER NEEDED FOR DEPARTMENT OF HAWAIIAN HOME LANDS REMAINS UNFULFILLED.

Historically, many of the State's water systems were built without regard to the impacts they would have on Native populations. Although the drafting of the State Water Code prioritized Native Hawaiian rights to water, there are many ongoing challenges related to the exercise of rights. The Department of Hawaiian Home Lands (DHHL) is the primary agency charged with providing Native Hawaiians with land to live and work on and it serves multiple roles, sometimes simultaneously: a guardian of Hawaiian water rights; developers in need of water; reviewers on the well

permit applications of others; commentators and interveners on possible aquifer designations, and on other permitting issues that come before CWRM and the Counties. They are advocates for their beneficiaries.

Their multiple roles spring from unfulfilled commitments to Native Hawaiians but also create conflicts with other agencies and stakeholders as DHHL struggles to be more closely integrated into water resource planning decisions. DHHL has considerable agency expertise on water and believes CWRM's "RAM" model that is used to calculate sustainable yield has important technical shortcomings.

8. CONTINUING ADMINISTRATIVE AND JUDICIAL LITIGATION IS OFTEN NECESSARY, BUT A DRAIN ON RESOURCES.

All of the gatekeeping agencies involved in regulating water periodically find themselves embroiled in administrative contested case hearings and judicial lawsuits, or both. Many disputes are extremely political and litigation becomes a critical tool, sometimes the only one, for rectifying old problems or maturing key constitutional rights. Nonetheless, legal fights pull time, energy, and money away from the other demands, not the least of which is strategic foresight, analysis, and planning. While there may be no perfect fixes, collaboration and settlement strategies may help reduce some unnecessary legal friction.

VI. IDEAS FOR ACTION

A majority of the individuals with whom we spoke believe that CWRM is in a natural, and arguably mandated, position to lead, convene, and inspire on matters concerning statewide, long-term, fresh water sustainability.²² Although CWRM is stretched for resources and short-term regulatory roles take priority, the Commission has a "bully pulpit" and is a logical convener. CWRM works well with other water managers and, even in the face of periodic contested case litigation, with most community and business stakeholders.

CWRM also cannot take actions alone. Like CWRM, DOH, DOFAW, DOA, DHHL, and the four county water departments have varying limitations in what they can do on longer-term matters by resource constraints and the press of current needs. Any new initiatives to address intergenerational issues must therefore be a mutually organized, limited in scope, and worthy of the effort. There must be good pay offs.

²² HRS §174C-5-13: [The Commission] Shall plan and coordinate programs for the development, conservation, protection, control, and regulation of water resources based upon the best available information, and in cooperation with federal agencies, other state agencies, county or other local governmental organizations, and other public and private agencies created for the utilization and conservation of water.

We believe CWRM, together with other agencies (and possibly with an invitation to US-EPA and other federal partners along with highly informed community stakeholders) could initiate meaningful short-term projects that will yield long-term dividends. This can be accomplished by convening interagency work groups that evaluate, frame, and prioritize high impact, longer-term tasks.

We think short-term CWRM-convened work groups, task forces, roundtables, or other working forums could become springboards, catalysts, and showcases for important strategic efforts towards an emergent network governance structure. Support for future in-depth projects will inevitably require public and/or private sector funding where CWRM and its state and county colleagues are limited in ability to undertake the full depth and breadth of these tasks, but we see valuable leadership opportunities that can call attention to the issues and lead to future work by others. Actions that we identified to such end are as follows.

1. IDENTIFYING AND PUBLICIZING CURRENT AND FUTURE DISLOCATIONS

There is considerable practical and scholarly work on the impacts of ocean and atmospheric changes that will further impact Hawai'i, especially their effects on infrastructure. While there have been significant efforts to understand the impacts of sea level rise on critical infrastructure and the economy²³, a comprehensive statewide assessment of possible future dislocations of fresh water supply and delivery has yet to be undertaken.²⁴ This would include estimations of probabilities of occurrence of dislocations over the next 25 years. Future dislocations could come from dramatic rainfall events (both heavy rains and droughts) and sea level rise leading to saltwater intrusion. It could also come from a sudden economic recession (similar to 2008), a loss of tourism, or even a shipping crisis that renders the state unable to adequately address urgent infrastructure needs that may arise.

A group composed of state and county leaders, experts at local universities and others can convene to frame the question, begin the analysis to quantitatively assess ranges of risk, and initiate the public discussion. A significant step will be to bring together information that is silo-ed in different agencies, in the private sector, and in different university departments.

2. ESTIMATING SHADOW COSTS AND THE TRUE VALUE OF WATER

Shadow costs, or shadow "pricing," refer to the assignment of a dollar value to an abstract commodity that is not ordinarily quantifiable as an ordinary market price, but would need to be assigned a valuation to in order to

²³ See <https://www.pacioos.hawaii.edu/shoreline/slr-hawaii/>

²⁴ Honolulu Board of Water Supply is doing considerable work on this and can offer analytic models that may have relevance to a statewide examination of coming infrastructure challenges.

conduct a full cost-benefit analysis.²⁵ Full economic value of fresh water use includes: water supply costs (i.e., capital cost, operations and maintenance cost, and resource administration costs), social opportunity costs (i.e., present and future foregone value of alternative uses), and external costs (i.e., the in-situ value).²⁶ The fresh water developed, purveyed, monitored, and regulated by the state and counties is heavily subsidized by the public. While we cannot provide exact numbers, we are reasonably confident that the fees paid by consumers or financed by public and private developers are unlikely to cover the full water supply costs alone, and definitely do not “pay for” social opportunity costs or external costs. Moreover, the public has little notion of the connection between competing water uses that have value and the water that comes out of their kitchen taps and garden hoses, or that is used to flush their toilets.

What would a full cost accounting begin to look like? DLNR’s future water lease rates will help further define this question, but there are other factors. Deferred repairs and maintenance is one. New sourcing is another. So too are the costs of watershed protection and the return on investment produced. Transforming infrastructure is another. The goal is not to send an invoice to tax payers. It is to educate everyone on the true economic value of water, and the fiscal tradeoffs of the various water-related regulatory and policy priorities.

3. FINANCING RESILIENCE

Related to shadow costs and creating a true picture of the water subsidy is a future effort that would evaluate the comparative efficacy and viability of long-term water financing mechanisms. Financing adaptation and resilience in the face of climate change and sea level rise is a major challenge, but exploring the water portion of those larger challenges can reveal potential strategies.

At a minimum, these could identify future projects that have federal cost-share options, will be shovel-ready in the next several years, and create short-term action plans. At a more sweeping and impactful level, a joint state-county working group could explore future financing mechanisms such as green bonds, special water taxes, penalizing waste, or creating better tax credit policies that incentivize the use of recycled water use. Again, a state-county work group does not need to undertake the full task, but needs to inaugurate it.

4. THE SUSTAINABLE YIELD CHALLENGE

Counties, other state agencies, developers, NGOs, and community groups rely completely on the sustainable yield numbers set by CWRM to determine the safe withdrawal numbers for the State’s ground water. For its calculus, CWRM uses the Robust Analytic Model, or “RAM.” This model was developed more than two decades ago, with

²⁵ See <https://www.investopedia.com/terms/s/shadowpricing.asp>

²⁶ IUCN. Spring: *Managing groundwater sustainability*. 2016. p. 70-71

one important update in 2007 resulting in “RAM-2.” The RAM models have the great virtue of being simple since they rely on wellheads and salinity levels in both monitoring and production wells. Even coupled with CWRM’s additional precautionary practices, however, RAM leaves out of its calculus a considerable number of increasingly important factors including:

- Pollution and contamination;
- Calculations of coastal ground water discharge;
- The spatial definitions of aquifers and hydrological units²⁷;
- Alternative sources of recharge and reuse;
- Interactions with surface water;
- Interactions between aquifers.

Thinking through the possible value of a new SY model may have far reaching intergenerational ramifications. A state and county leadership group could begin preliminary discussions as to whether a future “RAM-3” algorithm may be needed, if it is practicable, and if so, how it might be conceptualized.

5. SHARPER ESTIMATES OF FUTURE DEMAND

The Hawai‘i Water Plan (HWP) is a center of gravity for state planning. It provides an overall statewide framework. Further, the Water Resource Protection Plan (WRPP) may be the most important tool and instrument for coordination between the state and the counties. At the state level, future demand for water from development may not yet be sufficiently understood and calibrated. Development translates into land cover changes and land cover directly influences supply through ground water recharge. Yet, there doesn’t appear to be a requirement to coordinate the HWP with the State’s Office of Planning that, among other things, regulates land use.

Furthermore, counties rely on CWRM for long-term water supply data and CWRM relies on the counties for their long-term demand scenarios for the HWP. Thus, it is critical for CWRM to understand how much ground water is being pumped in relation to the SY. CWRM is the only agency that has the overt legal authority to require data reports from all wells and diversions (pumpage, water levels, and chlorides) to help assess impacts to the available resource. Much progress has been made to keep pumpage reports current and to develop ongoing estimates that can help monitor SY. CWRM staff has reporting and enforcement authority that is not used, but the ability to assess fees for users that do not report usage may eventually be needed.

²⁷ On CWRM’s official maps, designated aquifer boundaries assume no transfer of water between sector boundaries which are drawn in solid lines but do assume waters move between system boundaries that are marked in dotted lines.

A state/county task group could initiate discussions that more carefully analyze and define the problems involved in integrating plans and lay out strategies for bringing the HWP and the WRPP into even tighter sync.²⁸

6. THE PUBLIC TRUST DOCTRINE

State and county administrative rules are slowly but steadily acknowledging the public trust doctrine. The doctrine is also being crystalized through administrative and judicial lawsuits. It is embedded constitutionally and is likely to continue being defined issue-by-issue and jurisdiction-by-jurisdiction, judicially and legislatively, and with greater and greater granularity.

A state/county study-group could anticipate what is likely to develop and, more importantly, examine how a scenario of what “fully implemented” public trust obligations might look like and how they eventually would be funded. A state and county water work group could define and anticipate the issues and perhaps even help set the agenda for wider discussions.

7. AN ONLINE WATER ATLAS

In 2015, Jeffery Melrose and the Spatial Data Analysis and Visualization Research Lab at the University of Hawai‘i–Hilo prepared an extensive statewide online mapping study of agriculture to portray what had occurred in the islands since plantation shut downs.²⁹ In effect, they produced an agricultural atlas and maps that accurately portrayed the current profile of agricultural resources as the state continues its assessments of food production.

Similarly, Professor Tom Giambelluca of the University of Hawai‘i’s Department of Geography has created a high-quality rainfall atlas that builds on historic data, current information, and future projections. The atlas has excellent visualization tools and is quickly becoming a critical instrument for water planners.³⁰

A state and county leadership group could formulate a plan towards developing a comprehensive online water atlas that graphically portrays multiple facets of water resources and uses in the state, inclusive of such further aspects of the water picture such as shifting wastewater use, aquifer health, and irrigation. As with the Giambelluca and Melrose efforts, such an atlas would help with education, interagency planning, and stakeholder

²⁸ One preliminary reviewer of this paper noted that past environmental assessments (“EAs”) and environmental impact statements (“EISs”) contain a wealth of information on area-specific information on local water matters. Those could, on a test basis, be mined for pertinent water data.

²⁹ The project was initiated and supported by Scott Enright, Board of Agriculture Chair and director of DOA. See <http://hdoa.hawaii.gov/salub/>

³⁰ See <http://rainfall.geography.hawaii.edu/rainfall.html>

engagement on specific water challenges. Our interviews suggested agencies were especially interested in practical visualizations that could be a part of such an atlas.

8. A MULTI-AGENCY LOOK AT WATER QUALITY

Water quality concerns and contamination risks are of increasing concern, and may turn out to have a great impact on drinking water supply over the next generation. Contamination threats can come from cesspools and septic tanks; underground fuel storage tanks; agricultural, commercial, and household pesticides; and commonly used and known hormone disrupting pharmaceuticals. Either as part of one of the previous projects, or separately, a state-county working group could focus on a clear articulation of the emerging challenges and the potential “costs of clean” water for both domestic and agricultural purposes.

9. MORE AGGRESSIVE CONSERVATION

Many water planners in the public, private, and civil sectors believe watershed protection in mauka forested areas is the single most important factor to assure long-term fresh water supply.³¹ DOFAW manages Hawai'i's state forests but the counties along with private and civil sector groups have rallied around the push for greater conservation. A working group could convene all of the players “taking stock” and further planning discussions and advance further rounds of public and private discussions.

10. STRENGTHEN THE INFORMAL INTERAGENCY COOPERATION THAT EXISTS ACROSS WATER MANAGERS TO FORMALIZE LONG-TERM INTEGRATED WATER RESOURCE PLANNING

All of the above-identified projects could serve as a catalyst for interagency and cross-sector collaboration, but the emergence of true Level 3 and 4 efforts, as discussed in [§1.4](#), will require leadership and network weaving. There are strong examples of this already occurring but if we are to successfully address the complexity and nuance of our water challenges we need to formalize our intentions to creating a network structure. A cooperative analysis linking the current and future roles of HCF's FWI, UH's WRRC, the USGS Pacific Islands Water Science Center, and various municipality-based organizations resulting in a roadmap to formalize long-term, integrated water resource planning would be one strategy towards this end.

³¹ See “The Rain Follows the Forest- Hahai nō ka ua i ka ululā'au” <https://dlnr.hawaii.gov/rain/>

VII. FINAL THOUGHTS

“Kites rise highest against the wind, not with it.”

- Proverb

The above ideas are offered for consideration as possible ways to better hedge the future and lend leadership to strategic and intergenerational thinking. Any or all of them must be cooperative efforts if they are to have a chance at combatting the tendency towards strategic complacency. They are offered with respect and appreciation for the work state and county agencies do now.

Beyond Himmelman’s hierarchy discussed earlier in §I.4, there are rich and pragmatic literatures on both long-term strategy and the critical levers for high performing teams. Michael Porter, a top tier Harvard business teacher who works with Fortune-500 companies, calls strategy your single best answer to a core question: how will an enterprise position itself to achieve superior sustainable performance and deliver the highest value at the lowest cost.³²

Similarly, there are a few proven factors for high performing work groups as shown in rigorous studies of cardiac surgery hospital units, Navy Seal Teams, and unique business innovators. We also, have a few strong local examples: The Hawai’i Energy Policy Forum at UH and the previously mentioned Fresh Water Initiative.³³ A clear, elevating objective is always essential. So, too, competent team members, a collaborative but performance-driven atmosphere, and a time-limited and results-oriented working structure. Hawai’i’s state and county water agencies cannot do everything by themselves but they are well positioned to initiate a few tasks that will leverage far ranging and reverberating intergenerational impacts.

³² Magretta, J., *Understanding Michael Porter: The Essential Guide to Competition and Strategy*, Harvard Business Review Press, 2012.

³³ See also Bennis W. and Biederman P. W., *Organizing Genius: The Secrets of Creative Collaboration*, Addison-Wesley, 1997.

ATTACHMENT 1

PARTIAL LIST OF WATER-RELATED LAWSUITS, CONTESTED CASES, AND REGULATORY PROCEEDINGS

- 1988. Administrative Rules for Water Code adopted
- 1988. Interim Instream Flow Standards adopted
- 1989. Robinson v. Ariyoshi dismissed
- 1989. Pearl Harbor aquifer uses and sustainable yield revised: 225 mgd to 195 mgd
- 1990. County Water Use and Development Plans reviewed
- 1991. Water Code and HHCA amended: DHHL's future water needs included in plans and permits
- 1992. Windward Oahu Interim Instream Flow Standards developed
- 1992. Windward Oahu ground water designated
- 1992. Molokai ground water designated.
- 1992. Declarations of Water Use required
- 1994. Waiahole Ditch contested case initiated
- 1994. Water Code Review Commission reports to Legislature
- 1994. Ewa Marina contested case initiated
- 1995. Waiahole contested case hearings
- 1996. Koolau Ag v. CWRM; Windward Oahu ground water designation upheld
- 1996. Waiahole Contested Case Hearings
- 1996. Laie contested case hearings
- 1996. Waiahole Hanalei River Laie (Oahu) Ewa Marina Molokai Ranch
- 1997. Ewa ground water management hearings
- 1997. Waiahole contested case decision and appeals
- 1998. Hanalei River designated as American Heritage River
- 1999. Laie contested case decision
- 1999. Molokai Ranch contested case decision
- 2000. "Waiahole I" – Waiahole Ditch
Combined Contested Case Hearing – Water Use Permit applications, Petitions for Interim Instream Flow standard Amendments, and Petitions for Water Reservations. Appeal from Case No. CH-0A95-1
- 2001. Restoration of Hi'ilawe Stream
- 2003. Repair of Hamakua Ditch

-
2003. Designation of lao aquifer
2004. In Re Wai'ola O Molokai Ranch, contested case No. CCH-MO96-1 Hearing on Applications. Appeal from CWRM Contested Case Hearing. Hawaiian Homes. First Supreme Court decision to interpret Hawaiian Homes Commission Act water rights.
2004. "Waiahole II". Waiahole Ditch Combined Contested Case Hearing - Water Use Permit Flow Standard Amendments and Petitions for Water Reservations. Appeal from the Commission on No. CCH-0A95-1.
2006. Kelly v. 1250 (DOH Hawaii County public trust responsibilities to protect coastal waters in Kona, Hawaii)
2007. In Re Kukul, (Molokai), 116 Haw. 481, 174 P.3d 320 (2007), Appeal from CWRM Hearing (Hawaiian Homes) Court Commission on decision involving Hawaiian claims on Molokai.
2010. "Walahole III" - Waiahole Ditch Combined Contested Case, Water Use Permit Applications, Petitions for Interim Instream Flow Standard Amendments, and Petitions for Water Reservations (Case No. CCH-0A95-1) (October 13, 2010) (Memorandum Opinion). Supreme Court reversed and remanded Commission on Water Resource Management's third decision on Waiahole water case.
2012. In Re lao [Maui] Ground Water Management Water Use Permit Applications and Petition to Amend Interim Instream Flow Standards (No. CCH-MAO6-01). Supreme Court reversed and remanded Commission on Water Resource Management decision setting Instream Flow Standards for Na Wai Ehe (Maui) for failure to properly analyze public trust duties and traditional and customary rights.
2012. In Re Petition to Amend Interim Instream Flow Standards for East Maui (No. CAAP-1 0-0000161); Memorandum Opinion - Intermediate Court of Appeals reversed and remanded Commission on Water Resource Management decision denying contested case to set instream flow standards in East Maui despite clear constitutional due process rights (pursuant to In Re lao decision).
2013. Po'ai Wai Ola / West Kaua'i Watershed Alliance files Combined Petition to Amend Interim Instream Flow Standards for Waimea (Kauai) River and head waters and tributaries, and Complaint / Dispute Resolution and Declaratory Order Against Waste (July 24, 2013).
2013. Kaloko-Honokohau National Park Service files petition to designate Keauhou Aquifer (North Kona, Hawaii) as ground water management area (September 13, 2013).
2014. Kauai Springs v. Kauai Planning Commission, (SCWC 29440) (February 28, 2014). Supreme Court vacated and remanded Kauai Planning Commission decision for failure to assess alternative water sources and carry out Public Trust duties in approving county zoning permits. The State was not a party in this case, but zoning applications before county agencies may now require great review of water sources.

ATTACHMENT 2

INITIAL INTERVIEW QUESTIONS

Organizational and Water Governance

- What are the routine and non-routine decisions you face in the course of your work?
- What water issues worry you the most? What keeps you up at night?
- What water issues are unique to you and different from other jurisdictions?
- What issues do all the counties and the state have in common?
- Which other water agencies and organizations do you most closely coordinate with, over what issues, and how?
- Which of the following issues rise to the top of your list for potential coordinated study or action by all the counties and the state?
 - Enhancing supply through forest restoration projects directly within the 2 and 10-year rainwater migration ellipses?
 - Storm water reclamation projects to capture large rain events and reduce sediment loading of coral reefs
 - Analysis of county and statewide water pricing, fees, costs, and funding?
 - Organization of water conservation measures across public/private organizations?
 - Accelerated state and county drought planning?
 - Accelerated integrated water use reporting and data collection statewide?
 - Research, analysis, and education/outreach on the water/energy nexus?
 - Upgrading agriculture water systems?
 - Reduce hard infrastructure and impervious surfaces?
 - Development and application of full life cycle accounting across natural resource issues?
- Do you have MOUs or MOAs in place with other water agencies and can we see them?
- What institutional barriers or constraints seem to delimit or impede consultation with other water managers on data sharing and decision-making?
- Ideally what specific kinds of cooperation from others do you need and want from others?

Technical and Scientific Information

- What current science issues are you most struggling with?
- What studies do you currently have underway? What are you trying to find out and how?
- What big technical issues loom over the next few years that will inevitably involve science centered conflicts and expert fights?
- Having heard about 'Ike Wai and Ulupono's interests, how might we be most helpful if we're able to be of assistance?

Data

- Whose data do you most rely on, especially for more complex and contested issues?
- What data do you need the most for decision making (high priority); would like to have if you could get it (medium priority); and would love to have if you had abundant funds (lower priority)?
- What data do you have that might be relevant to 'Ike Wai research?
- How readily available is it?
- Can your data be pooled into a new centralized IT system that you and others would have full access to and use?
- What conditions would be required and whose approvals would be needed?
- What kind of MOUs or MOAs are needed, with whom, and on which matters?

ATTACHMENT 3

THE AGENCIES AND THEIR EXPRESSED CONCERNS

STATE COMMISSION ON WATER RESOURCES

Roles and Responsibilities

The Commission on Water Resource Management (CWRM) is housed within the Department of Land and Natural Resources (DLNR) and was created by the 1987 Hawai'i State Legislature to administer the State Water Code.³⁴ CWRM is tasked with a general mission "to protect and enhance the water resources of the state of Hawai'i through wise and responsible management." The Commission is overseen by a seven-member board composed of five governor appointees with geographic and expertise-based representation, and two ex-officio appointments of the Directors of DLNR and the Department of Health (DOH).

In significant ways, CWRM is the state's master water controller. Under the State Water Code, CWRM performs critical functions. The **Groundwater Regulation Branch**, designates water management areas for regulation, establishes minimum standards and processes, provides permits for wells and pumping equipment, maintains a registration of water sources, and issues water use permits.

The **Stream Protection and Management Branch** determines surface-water management areas, provides minimum standards for stream diversions, establishes in-stream flow standards, and conducts administrative hearings on contested matters.

The **Survey Branch** collects basic hydrologic data, maintains an inventory of all water uses and water resources, sets sustainable yield and instream flow standards, and generally supplies technical support to other CWRM programs.

The **Planning Branch** is tasked with compiling the Hawai'i Water Plan, and drafts the Water Resource Protection Plan.

Overall CWRM plans and coordinates the development, conservation, protection, control, and regulation of water resources based upon the best available information. The agency is responsible for setting overall water conservation and quality issues as they apply to permits and designations; water use policies that are consistent with federal requirements as administered by DOH; defining beneficial and reasonable uses; protecting ground and

³⁴ Hawai'i Revised Statutes §174C.

surface water resources, watersheds and natural stream environments; establishing criteria for water use priorities while assuring appurtenant rights and existing correlative and riparian uses; and establishing procedures for regulating all uses of Hawai'i's water resources. In effect, CWRM is Hawai'i's bulk water allocator.

Expressed Challenges and Dilemmas

- Similar to all of the water agencies we interviewed, staff and funding are woefully insufficient to the work they are tasked to do. CWRM is the “master” bulk water allocator but in the face of day-to-day issues, it lacks the resources required to do much of the forward-looking planning they believe is really needed.
- CWRM processes about 150 well permits per year. There are 200-300 private water systems across the state only 19 of which are regulated by the PUC. Per the State Water Code, “no permits shall be required for domestic consumption of water by individual users.” Thus, many private systems are exempt from regulation and CWRM's authority as they fall under this definition.
- The issues that tend to come up at the interface between CWRM and the counties mainly concern responsibility for resource monitoring activities and funding for critical projects. For example, the state encourages counties to share the costs of monitoring some of its water resources, but technically it is CWRM's responsibility. This is an area of occasional friction between the counties and CWRM.
- Related, the counties rely on CWRM for long-term water supply data but CWRM relies on the counties for their long-term demand scenarios. The Hawai'i Water Plan is the locus and process that focuses this and that allows CWRM to work closely with the counties and other state agencies, but the development and submission of plans from the counties is slow and, in some cases, years behind. Like CWRM, counties face their own budgeting constraints and must prioritize their needs, which are often essential capital improvement projects, against the state's requirement for producing plans.
- CWRM has the legal authority to require others to report their pumping data. Compliance with these reporting requirements is a continuing challenge. They currently receive usage data from about 40% of the users they regulate. While this 40% represents approximately 80% of fresh water use, capturing the remaining 20% of use may be critical for fully effective monitoring.³⁵
- In general, the agencies and well owners regulated by CWRM provide only the minimal data that is required of them. As such, CWRM does not have access to much of the existing and potentially useful data from other agencies that would allow for improved short- and long-term planning.
- When CWRM makes decisions that communities dispute, they periodically end up in costly and time-consuming litigation. The courts, including the Supreme Court, often order CWRM to correct procedural deficiencies with additional assessments, essentially to “try again”. This can create enormous repetition and, in the words of one

³⁵ CWRM is taking steps to make it easier for users to report through an online reporting system, which has resulted in improved compliance rates. Rather than imposing fines, which they have the authority to do, they seek to work with water users as amicably as possible.

interviewee, an “endless loop” that constrains efficient governance. The recent petition to designate the Keauhou Aquifer, for example, took several years, while the process for determining minimum stream flow standards in East Maui has been ongoing since 2001.

- CWRM is particularly challenged to get reliable empirical information regarding freshwater flows required to support traditional and customary Native Hawaiian practices. This includes stream flow sources that support agricultural activities and submarine discharge near coastlines essential for ecosystem health, fishing, and gathering. They must navigate contested cases where groups often claim that mauka water uses impede their coastal practices.

STATE DIVISION OF FORESTRY AND WILDLIFE

Roles and Responsibilities

In addition to the preservation of native ecosystems and the protection of natural and cultural resources and recreational areas, the Division of Forestry and Wildlife (DOFAW) is responsible for the management and protection of watersheds in the state. DOFAW secures the technical and financial support for the research and implementation of watershed management plans through the Watershed Partnerships Program, which provides resources to support watershed management plans.

Expressed Challenges and Dilemmas

DOFAW does not have sufficient data to determine the recharge economic benefit of protecting and restoring watershed land. There are working assumptions and some observational evidence that this is important, but no hard data that makes a clear statewide return-on-investment (ROI) case, and which may then be highly place-specific.

- Watershed protection benefits multiple parties in the water management system, but DOFAW is challenged to get other agencies to collaborate on conservation and restoration efforts.
- The general lack of water advocacy in the state makes it particularly challenging to build a strong case for allocating public funds for watersheds.

STATE DEPARTMENT OF HEALTH

Roles and Responsibilities

The Department of Health (DOH) **Safe Drinking Water Branch (SDWB)** regulates Hawai'i's drinking water and is tasked with protecting ground water sources from contamination. SDWB's mission is driven by a number of federal and state laws through programs that include the Safe Drinking Water Program, Underground Injection Control Program (UIC), Ground water Protection Program (GWPP), and the Drinking Water State Revolving Fund (DWSRF). The U.S. Environmental Protection Agency (EPA) sets most of the water quality guidelines enforced by the DOH and is a significant source of funding that supports enforcement and compliance.

Whereas the SDWB is focused on drinking water, the DOH **Clean Water Branch (CWB)** focuses on the health effects of surface water on Hawai'i's coastal and inland water resources. They restore inland and coastal marine life and protect wildlife through statewide coastal water surveillance and watershed-based environmental management, as well as a combination of permit issuance, monitoring, enforcement, sponsorship of polluted runoff control projects, and public education. As regulators of water quality, they monitor and manage point-source discharges, engage in partnerships to minimize pollution, issue permits for wastewater treatment, monitor power plant cooling water and storm water discharge, and conduct other relevant inspections for compliance and enforcement.

The SDWB and CWB, along with the DOH **Wastewater Branch** are responsible for contributing the *Water Quality Plan* component of the overall *Hawai'i Water Plan*.

Also administered by DOH is the **Office of Environmental Quality Control (OEQC)**, which plays a more general role in water governance by evaluating environmental assessments (EAs) and environmental impact statements (EISs) for new developments, which must disclose the impact of land alteration on water and other natural resources. The director of OEQC is appointed by the Governor and has a role in advising the Executive Branch on environmental matters.

Expressed Challenges and Dilemmas

- Immediately after the implementation of the Hawai'i Water Plan, all departments appeared to have sufficient funds to carry out their mandates. Today, funds are more constrained and SDWB struggles to fully cover its mandate. While their purview is statewide, their resources are too limited to monitor comprehensively. Further, agricultural ditches fall under the DOH purview but they do not have enough resources to monitor these.
- Like other state agencies, these branches are understaffed and underfunded, however DOH seems to be particularly affected by this deficiency. Approximately 80% of their funding comes from the EPA. Given the recent change in federal government administration, there is significant concern about budget cuts that will result in the further loss of technical staff with years of expertise.

- In addition to resource constraints, SDWB is limited by the extent to which it can monitor private water sources. Permission is required from landowners to take samples from these sources. Further, SDWB does not have the capacity to conduct continuous monitoring of water systems. Essentially, monitoring and surveillance are more episodic and reactive than constant.
- CWB increasingly recognizes there is a connection between surface and ground water (i.e., SDWB) because of contamination issues, but has not been able to identify valid empirical information and a course of action to begin to remedy this disconnect.
- The DOH is one of three parties to the ongoing “consent discussions” alongside the EPA and the Navy concerning current and future leakage from the Navy’s Red Hill Fuel Storage Facility. The possibility of litigation raised by the Honolulu Board of Water Supply has limited data-sharing and threatened trust across agencies and is indicative of the challenges of the multiple, and sometimes conflicting, roles water managers have with each other.

STATE DEPARTMENT OF AGRICULTURE

Roles and Responsibilities

The state Department of Agriculture (DOA), in addition to other activities supporting local agriculture, is tasked through the **Agricultural Resource Management Division**, with providing irrigation water, managing irrigation water systems, and managing water reservoirs (for agriculture). The division manages five state irrigation systems: Ho’olehua, Kahuku, Waimanalo, Waimea and Honoka’a-Paauilo, as well as six agricultural use reservoirs across the state. Additionally, the Division provides the *Agricultural Water Use Development Plan* portion of the Hawai’i Water Plan.

The **Agribusiness Development Corporation** was established to facilitate the transition from the plantation era of pineapple and sugar production to a more diversified and economically productive agriculture industry. It plays a central role in maintaining and transitioning legacy plantation water systems for other agricultural uses.

Expressed Challenges and Dilemmas

- Due to resource constraints, the DOA’s agricultural water work is focused primarily on the surface water systems that they currently manage. In some cases, and for other legacy agriculture water systems, it may be cheaper for producers to switch to ground water sources rather than repairing legacy surface systems.
- With regard to surface water diversions for agriculture, DOA struggles with what seems to be arbitrary standards for instream flows established by CWRM. Continuous monitoring systems are needed to better understand stream flow, and determine flow standards.

- DOA has the authority to provide farmers with potable water, which would be useful for small-scale farm use as is slowly being required by new food safety regulations, but lacks the resources to offer this.
- There is some friction with DOH regarding non-point source pollution in streams from agriculture land (e.g., pesticides, fertilizers, etc.), usually spurred by litigation or the threat thereof. DOH asserts that this should be continuously monitored, but DOA does not think this is possible.

COUNTY DEPARTMENTS OF WATER SUPPLY

Roles and Responsibilities

The County departments of water supply are generally semi-autonomous or fully incorporated county entities responsible for the extraction and distribution of fresh water for residential and commercial/industrial use. Maui's is a department and not semi-autonomous.

Unlike the state's regulatory oversight bodies at DL&NR and DOH, the counties must recoup the cost of conducting their activities through water rates. While not responsible for the entirety of water use in their areas, departments of water have significant influence over how water supply is sourced, delivered, and managed at the island level and play a significant role in drafting the County Water Use and Development Plans that become part of the Hawai'i Water Plan.

The **Honolulu Board of Water Supply (HBWS)** manages O'ahu's municipal potable water resources and distribution system and provides a major percentage of the water consumed for residential and commercial use in the county. Different from the other counties, HBWS has zero reliance on surface water systems for supply.³⁶ HBWS is governed by a seven-member Board of Directors, five appointed by the Mayor and approved by the City Council. The remaining two directors are the Director of the Hawai'i State Department of Transportation and the Chief Engineer of the City Department of Facility Maintenance.

The **Hawai'i Department of Water Supply (HDWS)** is charged with delivering water through 23 water systems and 74 sources around the island, supplying most of the county's potable water needs. Individual water systems are not interconnected except in the districts of South Hilo and Kona. As compared to HBWS, the nine members of the Water Board appointed by the Mayor are representatives from each of the nine county council districts.

The **Kaua'i Department of Water (KDOW)** is composed of twelve separate water systems, of which only three are connected. This represents a large percentage of the water consumption on the island. A small proportion of overall water supply is derived from treated surface sources. The seven-member board consists of four members appointed by the Mayor, and three ex-officio appointments: the County Planning Director, the County Engineer and the State District Engineer.

³⁶ If HBWS were to incorporate surface water sources, they would be subject to more stringent water quality regulations that would be more onerous to implement.

The County of **Maui's Department of Water Supply (MDWS)** is different from other counties in several ways. MDWS is an agency of the county rather than an independent or semi-autonomous entity, and is governed by a nine-member board composed entirely of mayoral appointees.³⁷ The department's responsibilities span three islands (i.e., Maui, Moloka'i and Lāna'i), and serve a much smaller proportion of water customers in the county. Maui's circumstances are also different from the other counties in that surface water is a significant source of supply.

Common Challenges and Dilemmas

- The counties' problems are financial and political more than technological. There are insufficient resources for water system improvements and maintenance. One verbal estimate puts the current cost of deferred maintenance across the state's water systems at over \$1 billion (i.e., repairs to storage tanks, pipes, meters, valves and other infrastructure).
- Legacy agricultural water systems are leaky, in need of improvements, and in some cases, under utilized. This is especially true for Maui whose potable water is highly dependent on surface water and to a lesser extent for O'ahu.
- With the exception of O'ahu, counties assert that their primary concerns tend to revolve around challenges related to moving water from source locations to places of high demand. This includes the energy costs associated with water delivery over distance or elevation. In the aggregate, insufficient water availability is not a problem.
- Departments are faced with significant community and political resistance to setting water rates that move closer to the true value of water and the true cost of operating, maintaining, and upgrading water systems.
- Opposition groups commonly fight against water system improvements and upgrades such as extending underground pipes to link separate water systems, based on water rights and allocation disputes. They often express important considerations but are also often successful in delaying or stopping improvement projects.
- There is not enough data for sufficient long-term planning. This would enable greater understanding of ground and surface water interactions, the ability to identify optimal sites for new wells and their effects on each other, and adaptation to impacts of climate change.
- Both economic and scientific data is lacking in ways that would lead to quantifying the benefits of investing in alternative water sourcing (such as watersheds, storm water capture, or recycled water systems). The missing ROI figures presents a challenge when proposing improvement projects to water boards or the public.

³⁷ The Director of the Department of Planning and the Director of the Department of Public Works also participate as non-voting ex-officio members.

County-Specific Challenges and Dilemmas

O'ahu

- Climate change is recognized as having a potentially serious impact on future fresh water supply on O'ahu, but HBWS is effectively the only department with the purview to be proactive around this.³⁸ The department is actively working with the City's new resilience office to pinpoint specific emerging threats to infrastructure from creeping sea level rise.
- Billings to water users are combined with sewer charges which inflates the perceived cost of water. This makes it difficult to propose necessary increases in water rates to address water infrastructure needs.
- Unlike the other counties, water use on O'ahu would be significantly impacted in urban areas by even a small reduction in the sustainable yield (SY) calculations for several aquifers, most notably, Pearl Harbor.
- HBWS is deeply involved in the Red Hill underground tank leaks, which it believes could pose a major contamination threat to future water supply if the tanks are not upgraded.

Hawai'i

- Like all counties, HDWS struggles with insufficient data to conduct long-term planning, forecasting, and the identification of future well locations, especially in the Kona area.³⁹ The onus of data collection lies on HDWS, whereas in the past they relied more on CWRM.
- Agricultural use of county water taxes the system. When county water is used for agricultural purposes, it is subsidized by higher rates to non-agricultural users. In many cases, individuals obtain favorable rates without conducting productive agriculture through so called "gentleman estates".

Kaua'i

- KDOW reports that they rely on large project developers to invest in well development and their transmission and distribution infrastructure. While this is the case in all counties, this was most clearly indicated by KDOW. Community opposition groups often object to development and try to stop projects through delays in the form of disputed Environmental Impact Statements (EISs) and contested case proceedings. When this happens, the cost of a project skyrockets. On Kaua'i, as elsewhere, the EIS has, in effect, become a primary tool for

³⁸ However, the Department did express optimism that the new Office of Climate Change, Sustainability and Resiliency of the City and County of Honolulu is a step in the right direction.

³⁹ Which was in a state of emergency during the time that interviews were conducted for this report in 2017, with one-third of the source wells out-of-commission for repairs. This crisis emphasizes important concerns about the spatial dynamics of ground water extraction and the interaction with SY.

community groups to shut down projects they dislike – raising challenges for the department as they attempt to expand and/or upgrade county water systems.

- Community pushback is especially challenging on Kaua'i. There are voices advancing a narrative that Kaua'i is running out of water, which KDOW disputes. There are anti-pesticide/GMO conflicts that bleed over to water issues, alleging contamination. The lack of sufficient stream flow monitoring, and other water data makes it hard for KDWS to sufficiently counter these arguments.

Maui

- Agricultural water use is at the center of one of Maui's most challenging water concerns. There is no clear definition of a healthy stream, only a few instream flow standards, and ambiguity around water needs and rights for traditional and customary Native Hawaiian practices.
- Farms located "up country" (i.e., 3000-4000 foot elevation) essentially do not have access to water because of their elevation, requiring the pumping of water up 1,000 to 2,000 feet above the source, which can be prohibitively expensive.
- Water reuse is a key potential source of water, but this falls under the domain of the Wastewater Reclamation Division.
- The most persistent management challenge is getting business plans through the council that reflect the actual cost of water system improvements. The current "pain-point" around water supply is securing the financing needed to expand delivery from sources (primarily in the northeast).⁴⁰

UNITED STATES GEOLOGICAL SURVEY (USGS)

USGS is purely a science agency, but most government agencies rely heavily on USGS as a "go-to" group for scientific expertise on complex water analyses in the state. Because of their extensive consultative work across the state, representatives were able to offer some valuable insights and observations. After peer review and approval, all USGS studies and models are made public. At different times we heard that Counties hesitate to share some of their data with the public, because they are concerned that the data collected will be used out of context to characterize inappropriate conclusions.

Most everyone we spoke with believes UH is potentially the best place to do water data management because of its emerging IT capacity and computing power. This also was an implied promise to government stakeholders from

⁴⁰ As an alternative, MDWS has proposed to offset many water supply problems for the next 10-15 years by enacting conservation measures (such as banning residential lawns), but the political will to do that does not exist either.

their multi-year EPSCoR grant.⁴¹ Guam is a good example. By law, all water data is stored with the University of Guam, which is the water data for the whole Territory.⁴² However as of this dates, no plan for the new water cyber platform has been issued and how matters of homeland well security can be met while still insuring data access needs to be discussed

DEPARTMENT OF HAWAIIAN HOME LANDS

The Department of Hawaiian Home Lands (DHHL) is mandated to situate Native Hawaiians on their land holdings and provide them with housing and water. Unlike other state entities, DHHL holds land but does not receive state support for developing and installing water systems. They also have “first rights” to some water⁴³, but have not fully quantified reservation numbers for all of their lands.⁴⁴

LARGE LANDOWNERS AND LAND MANAGERS

While not regulators, we met with a small number of landowners and managers in a roundtable format since the decisions they make are often crucial to the health and resilience of water systems. Much of the state’s aging water infrastructure was designed, built, and managed to support agriculture. This is especially true for Maui, though remnants of these legacy systems exist across all counties.

Further, water managers often rely on private landowners and developers for the investments required to build new wells and transmission and distribution systems. Their investments are usually a part of a developer’s community benefits package negotiated during the entitlements process when seeking the land use zoning and other permit approvals that may be required. The following challenges were expressed during the roundtable discussion held with landowners and developers regarding the state’s overall water governance network:

⁴¹ A significant amount of the \$20-million 5-year NSF grant to ‘Ike Wai appears to be targeted to expand the state’s cyber and water informatics capacity.

⁴² Water managers do not need pure research, but instead applied research to address their specific needs. In general, UH is seen as more interested in advancing general water science than addressing water management issues. USGS services fall somewhere in between UH and the private consultants that managers use: rigorous research combined with practical interpretation of results.

⁴³ The State Water Code recognizes and upholds these water rights as established by “the Hawaiian Homes Commission Act, 1920, as amended, and by chapters 167 and 168, relating to the Moloka‘i Irrigation System.” Haw. Rev. Stat. § 174C-101(a).

⁴⁴ Along with DHHL, the Office of Hawaiian Affairs (OHA) and the Native Hawaiian Legal Corporation (NHLC), consider themselves as advocates and stewards for lands and waters dedicated to Native Hawaiians, and as such, plays a critical role in the management of these lands as well as broader conversations around traditional and customary rights across all lands. OHA and NHLC participated in our interview with DHHL.

- A major challenge with the CWRM's current management and permitting process is that all approvals within their jurisdiction are subject to contested case hearings. A contested case ensures the public's concerns regarding water sustainability are adequately addressed through due process but, as quasi-judicial forums, they are often duplicative of court proceedings and subject potential water investors to lengthy and costly litigation and financial uncertainty. Uncertainty in the timeliness of an approval becomes a major risk factor landowners and developers weigh when deciding on whether to move forward with an investment. This can then have a significant impact on the public's access to water.⁴⁵
- The challenge of dealing with public perception of a contentious water issue that is fueled by the distribution of questionable data through social media is increasingly problematic. It presents community engagement challenges requiring significantly more effort and cost to ensure the public is informed with valid data and interpretations.
- The need for more reliable monitoring data and improved water sustainability models exists across the board, from water managers to developers to the public. There is a sense that water managers are hamstrung in their decision-making process by incomplete and, sometimes, conflicting data that usually results in a battle to decide whose consultants are more believable.
- This group acknowledges the lack of trust that can exist with sharing data across agencies and interests, but identifies with the need for better data and is actively willing to share data (though this may not necessarily apply to large landowners that were not part of the conversation). There is always a concern of how data will be used.

PRIVATE SECTOR WATER PROFESSIONALS

Private sector water professionals include hydrological engineers, hydrologists, well drillers, water/wastewater system managers, and planners. Collectively, this group holds substantial practical and detailed field knowledge of the state's water sources, infrastructure, and water governance processes. They are usually hired by landowners, water managers, and developers, or by agencies, to conduct feasibility and engineering studies, develop new source wells, operate water systems, and to function as technical experts in permit approval processes.

The following challenges were expressed during a roundtable discussion regarding water governance in the state:

- Water management and sustainability data are scattered across agencies and jurisdictions. There is a need for a paramount water data repository that can serve multiple interests and purposes. This is especially relevant to this group as they are typically the featured participants or witnesses in legal expert battles.
- Specific to the issue of the way sustainable yield is determined and managed, there is a need to: 1) integrate quantity and quality considerations; 2) understand how to accommodate legally-defined rights to water that

⁴⁵ Alternatively, we also know from NGO and community advocacy group conversations, that litigation is an important tool for challenging what are perceived as bad decisions by landowners and government.

certain groups hold (such as DHHL and Native Hawaiian traditional and customary rights); 3) better understand impacts to coastal ecosystems of increased ground water extraction to accommodate development and growth; 4) improve recharge estimates, especially as they occur from sources such as irrigation and waste water systems; 5) improve estimates of submarine ground water discharge (SGD) and how it factors into SY estimates; and 6) revisit the current hydrologic unit boundaries for their ability to reflect a reasonable estimation of hydro geologic characteristics and recharge source.

- A need for improved hydrological models that consider inter-aquifer flow and unique regional characteristics of aquifer structure and connectivity.
- The lack of investment and prioritization by government agencies in monitoring efforts and data collection, including drilling of new wells, stream flow measurements, and precipitation.

ATTACHMENT 4

FINDINGS ON RESEARCH PREFERENCES

A foundational premise of the NSF's 5-year, \$20-million EPSCoR grant to the University of Hawai'i is that UH's work would be stakeholder-driven. One of the purposes of the 2017 interviews with water managers was to ascertain what 'Ike Wai might ideally produce for water regulators in terms of new education, research, and cyber infrastructure development, if it could. We heard significant interest in the following:

1. GREATER PRECISION IN SUSTAINABLE YIELD ESTIMATES

In the face of climate and sea level rise, land development, and agricultural water needs, resource regulators would find value in more dynamic and inclusive measures of sustainable yield. Current calculations of ground water sustainable yield are based on the 30 years old Robust Analytical Model (RAM) models and monitored through salinity and head levels. They are reasonably simple to use but do not quantitatively account for water quality issues and surface water interactions and fluctuations, and assume no transfer of water between aquifer boundaries. Better definitions and more representative boundaries of hydrologic units would improve accuracy and inform maximum pumping constraints based on well proximities and depths.

2. BETTER ANALYTIC FRAMEWORKS FOR COASTAL RESOURCES

Currently, the specific customary uses and ecological stabilities of coastal resources is under examination. Ground water dependent ecosystems (GDEs) lack good metrics or even a framework or methodology for gathering and quantifying actual numbers. Lack of quantification fosters conflicts over the maintenance of water resources. CWRM is currently investigating this through a symposium planned for November 2018. The symposium will involve local Native Hawaiian knowledge holders, hydrologists, biologists, and staff from both CWRM and the National Park. The goal is to capture the current state of knowledge about the underground flows that support anchialine pools, fishponds, and other coastal habitats.⁴⁶

⁴⁶ This project, initiated and led by CWRM, is underway in partnership with lineal Native Hawaiian descendants from four of the ahupua'a on which Kaloko-Honokōhau National Historical Park sits and with researchers affiliated with UH-'Ike Wai and other organizations; and in cooperation with the National Park.

3. VISUALIZATION TOOLS

Water managers are especially interested in 3-D visualizations of aquifers for both analytic and public education purposes. They would like dynamic visualizations to simulate water use scenarios and accurately display to the public changing conditions. In particular, they would like to be able to show that existing uses are or are not diminishing and that water is constantly flowing through the aquifer at different speeds and in different directions. As one water expert said: "It's not just a bath tub. It's a sponge. We need the water equivalent of an MRI."

An ideal tool would be a computer simulation of each island showing how underground water moves and how it responds to different stresses on surface and ground conditions. If validated and accepted by regulators, these would be especially useful management and education tools.

4. DATA REPOSITORY

Water managers continue to be especially interested in having an established central location for water data. In concept, they would contribute their data to a central repository, provided there is a guarantee of long-term maintenance, access, and security and provided they, as contributors, could access the contributions of others. They would welcome the opportunity to examine or "mine" data accumulated from all contributing agencies and entities. However, it was also noted that much of the legacy data accumulated by state and county agencies (and the private sector) is currently stored in paper records, and will eventually need to be digitized.