EACP Committee

From: Shay Chan Hodges <shay.chanhodges@gmail.com>
Sent: Thursday, July 30, 2020 11:47 AM
To: EACP Committee
Cc: Kasie M. Takayama; Gina M. Flammer
Subject: EACP-51, WATER DELIVERY SYSTEMS: STRATEGIC ASSESSMENT & ESG ROADMAP FOR EAST-MAUI
Attachments: E Maui Maui Water-Land Ecosystem—July 2020 As sessment, Roadmap & Recommendations SMALL.pdf

Aloha EACP Committee Members:

Please find attached a **STRATEGIC ASSESSMENT & ESG ROADMAP FOR EAST-MAUI t**o be presented on August 11, 2020 under Agenda Item**: EACP-51, WATER DELIVERY SYSTEMS**

This report provides a starting point for the development of an **actionable ESG investment plan** for East Maui — the result of which would be an **ESG and Impact investment that supports the needs of the community, including county priorities related to COVID-19 and unemployment**.

Included are a variety of examples of investments that can support East Maui and care of the watershed, while providing a financial return that adheres to ESG standards.

We've seen a high interest in the proposed technology recommendations, particularly with regard to utilizing, testing, and co-developing land- and community-based appropriate technology to provide immediate jobs for the community in areas that are meaningful to residents —data collection about the watershed, as well as testing and co-developing technology to measure and monitor stream flows, impacts, etc

For additional background on ESG Investment and the Maui ESG Project, please go to the website: www.mauiesgproject.org

Also, please note that while the report specifically addresses East Maui, it is meant to be a template for Impact and ESG investments throughout Maui County.

We look forward to presenting to the EACP Committee.

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_____
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IoTask

RESPONSIBLE Markets LLC

July 2020

STRATEGIC ASSESSMENT, ROADMAP & RECOMMENDATIONS FOR EAST-MAUI WATER-LAND ECOSYSTEM & WATERSHED

Gitanjali Swamy
Shay Chan Hodges
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Submitted to Maui County Government

‘A’OHE PU’U KI’EKI’E KE HO’Ā’O ‘IA E PI’I

(No cliff is so tall it cannot be climbed)

"No problem is too great when one tries hard to solve it"

A Hawaiian Proverb

Mary Kawena Pukui, "Ōlelo No‘eau," Bishop Museum Press (1983) page 25, No. 209

EXECUTIVE SUMMARY: TODAY MAUI HAS A UNIQUE, URGENT OPPORTUNITY TO ENVISION AND CREATE A DIFFERENT, ACHIEVABLE AND COMPELLING FUTURE

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1. Water is a Public Trust with dual objectives of protection and maximum reasonable beneficial use – these are not being met today.

2. Stakeholders require significant changes to the East Maui water situation in order to meet their needs that include environmental, social, economic and participative governance issues.

3. The EMI water infrastructure that delivers this water is complex, non-standard and in a state of disrepair – combined with the lack of transparency, legal restrictions and varied ownerships, it is unable to meet stakeholder requirements.

4. Thus, legal, structural, economic hurdles create a gridlock that results in unsatisfied stakeholder need and inability to meet goals of the public trust.

5. Legal interventions such as eminent domain may provide long term solutions though resolution could prove costly, time-consuming and risky. However, launching such actions could also generate additional political options for the near term.

EXECUTIVE SUMMARY: TODAY MAUI HAS A UNIQUE, URGENT OPPORTUNITY TO ENVISION AND CREATE A DIFFERENT, ACHIEVABLE AND COMPELLING FUTURE

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6. The current gridlock can be solved in the short term by harnessing technology and innovation to take the first steps towards measurement, monitoring and management without interfering legal restrictions to stall progress.

7. These technology solutions provide data that can then be used to re-negotiate legal boundaries and provide win-win solutions to all stakeholders.

8. In the long run it is critical to create a more holistic re-adjustment of both water and the associated land with new types of use through innovation, technology and new economic models for participation.

9. There is a unique opportunity to support the community's work and to envision a different type of future over the next 10 years and to instigate broad-based change today.

KEY DECISIONS FOR THE COUNTY AND COMMUNITY TO MAKE BASED ON THIS REPORT

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A. Which elements of the vision options will we adopt?
B. Where do we want to be 1,5,10 years from now?
C. Are we ready to start today?
D. Whom should we delegate accountability for different workstreams to?
E. What internal capabilities and resources do we have to help achieve this?
F. What external partners do we need to bring for capability and expertise?
G. How do we energize and employ the local community immediately?
H. How do we expect to finance the efforts?
    i. *What funds can we immediately deploy?*
    ii. *Do we raise capital as a whole for the county as an Impact or ESG (Environmental, Social, Governance) Bond and select where to deploy it?*
    iii. *Do we raise capital on a project by project basis?*
I. Do we delegate/outsource or form Public-private partnerships to act on it?

VISION OF A DIGITAL COMMUNITY-LED SMART WATERSHED AND LAND-WATER ECOSYSTEM

MODEL OF SMART WATERSHED

DEFINITIONS:

- ***Crowdsourcing*** refers to the practice of obtaining information or input into a task or project by employing the services of a large number of people, typically via the Internet.
- ***Crowd2Cloud*** directly aggregates crowd-sourced data in the network cloud.
- ***IoT (Internet of Things)*** is about extending the power of the internet beyond computers and smartphones to a whole range of other things, processes, and environments. IoT systems are sensor-enabled software-defined systems that are a combination of product, application, analytics and the Internet/networking. They are scalable, upgradable, automated and future ready and are often also referred to as "Smart" technology.
- **ESG** stands for Environmental. Social and Governance, a commonly used term to refer to public good impact other than monetary.

Source: IoTask led visioning 2020

THE ORGANIZATION OF REPORT IS IN 7 SECTIONS

IoTask

THE SECTIONS ARE:

1. Executive Summary and Questions for Action
2. Vision-roadmap for a Better Economic and Social Future with Respect to Water and Land
3. Economic Analysis to Support the Aforementioned Vision
4. Assessment of Stakeholder Requirements from the Water
5. Assessment of the Current State of the Water Systems
6. Assessment of the Legal Situation of the Water Systems
7. Assessment of the Frameworks and Best Practices in Technology for Water Systems
8. Conclusion

Notes: Hawaiian spellings may be inconsistent due to varied information sources and translations

VISION & ROADMAP RECOMMENDATION

VISIONING CLARIFIED THE DESIRED END GOAL

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- **Restoration of respect, tradition and opportunity with holistic land, water readjustment.**
- **Addressing stakeholder needs with total transparency, accountability and participation.**
- **Community-led care and sustainability of the watershed.**
- **Ahupua`a values driven approach to utilizing technology and innovation for a sustainable, participative economy and jobs.**
- **Maui as a center for Ahupua`a-based ESG sustainable agriculture, food security and water innovation.**

SUMMARY OF APPROACH

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- **We identified a ten year vision based on:**
  - Current assessment of the state of the system and legal constraints
  - Stakeholder assessment of requirements and needs
  - Technology, ESG and best practice assessment from around the globe
- **The vision was broken into 4 workstreams: Technology, Infrastructure, Legal & Governance, Economic.**
- **The vision was then converted into a roadmap of action steps in Year 1, Year 2, Year 3/4, Year 5 and Year 10.**

WE IDENTIFIED 4 *WORKSTREAMS* FOR THE ROADMAP TO GET TO THE VISION

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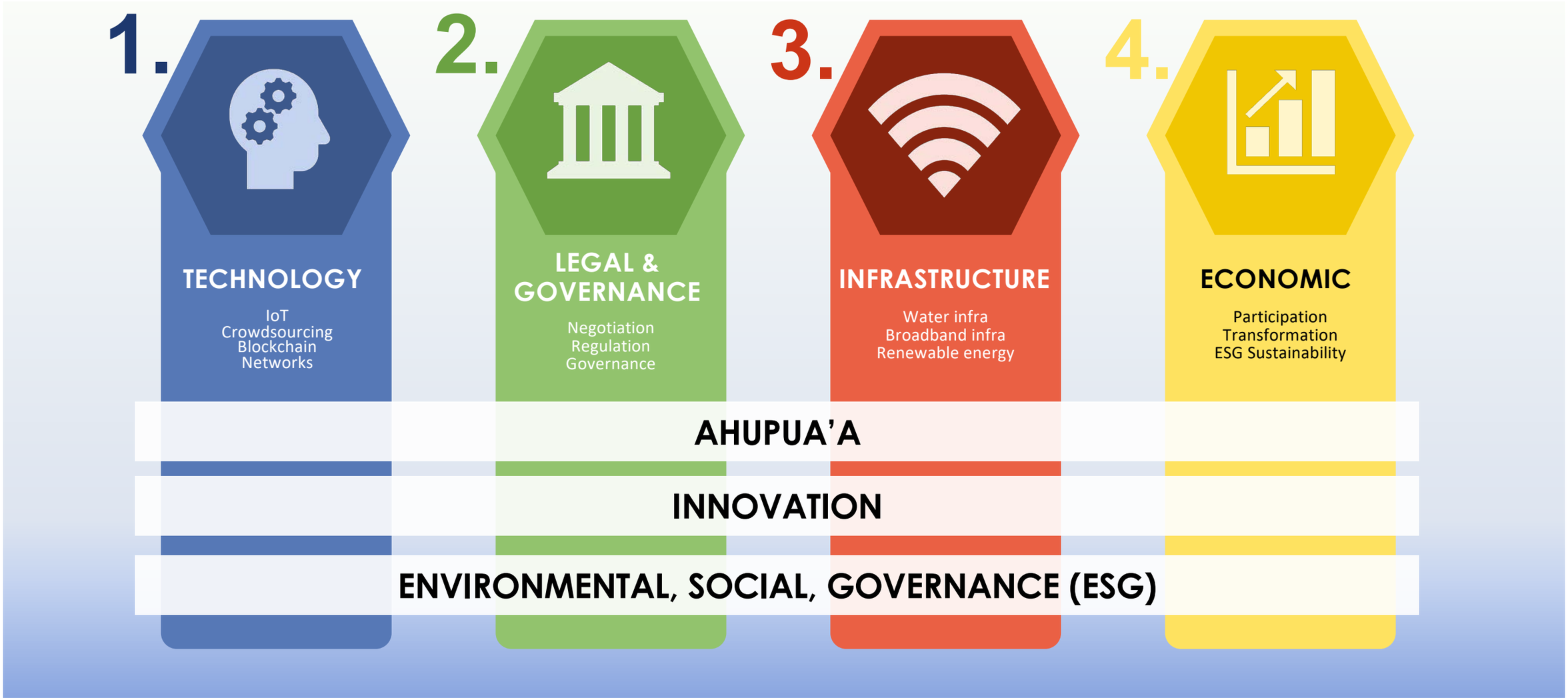
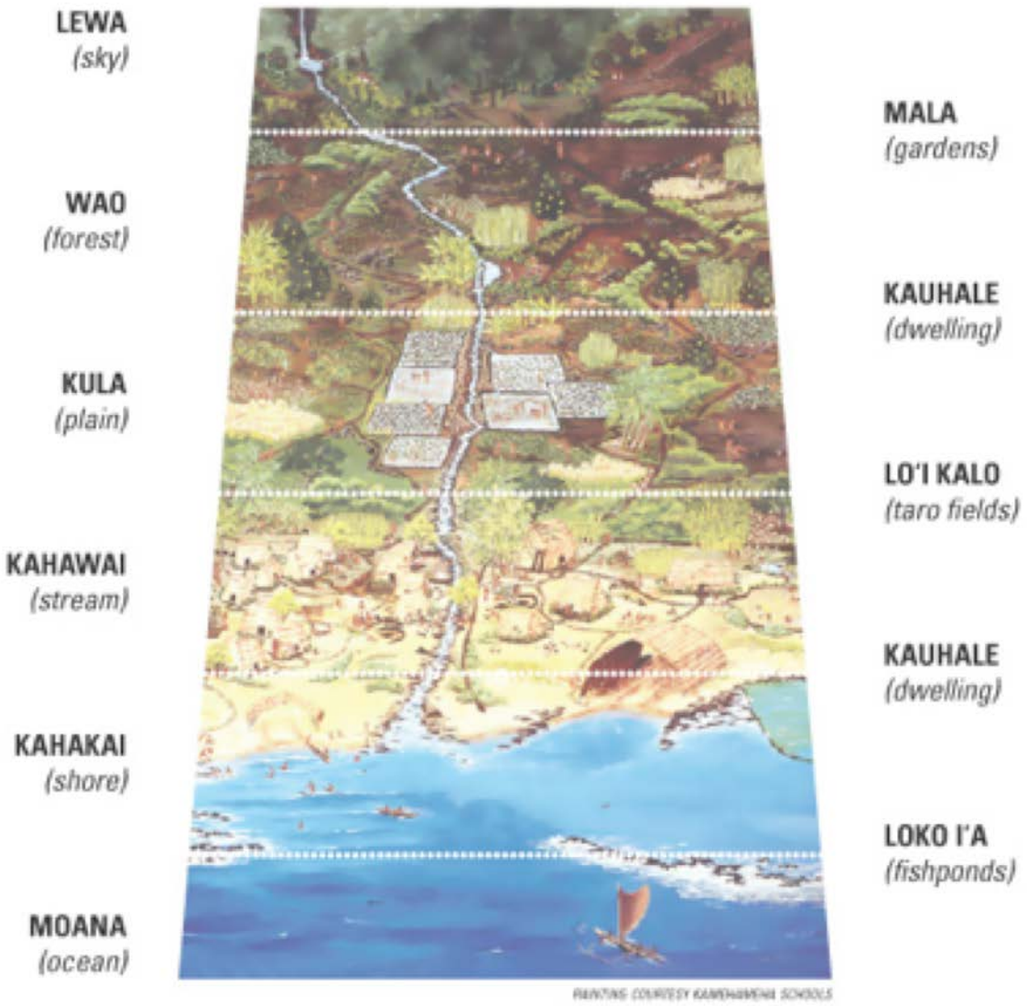


SELF-SUSTAINING AHUPUA`A LAND-MANAGEMENT SYSTEM FOLLOWS THE NATURAL BOUNDARIES OF HAWAII'S WATERSHEDS



AHUPUA'A, INNOVATION AND ESG ARE FACTORED INTO ALL WORKSTREAMS THROUGH ESTABLISHING THE RIGHT CULTURE AND METRICS

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AHUPUA`A BASED UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS (SDG)

AHUPUA`A SDGS: CONNECTIVITY FROM THE MOUNTAINS TO THE SEA

Source: UN SDG's

STAKEHOLDER INTERVIEWS IDENTIFIED 10 NEEDS RELATED TO THE STREAMS OF EAST MAUI AND THE EMI AQUEDUCT

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- Provide fair access to streams, stream water and surface water
- Address watershed management & stream care with return of water to the streams
- Address depreciation of EMI infrastructure
- Ensure monitoring and data on stream flows, rainfall, and traditional usage
- Ensure support for traditional uses
- Ensure sustainability including long-term sustainable yields
- Provide transparency, oversight and allocation prioritization
- Provide environmental protection, including flora & fauna
- Address incentive misalignment & private sector accountability
- Enable public stakeholder representation in water governance

Source: EIS Focus Groups, RM Interviews, IoTask Analysis 2020

THE BROADER COUNTY AND STATE PRIORITIES TODAY MUST ALSO BE FACTORED INTO THE NEEDS

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ECONOMIC DEVELOPMENT

- Growth, rebuild, jobs creation,
- Post Covid exigency - 35% unemployment

ECONOMIC PARTICIPATION

- Poverty, economic disparity
- Native Hawaiians experience worst economic indicators compared to other groups

FUTURE OF WORK – TECH DEVELOPMENT, BROADBAND INFRASTRUCTURE

- High quality employment from a better future of work
- Lack of opportunities for technically proficient talent

CLIMATE CHANGE PRESSURES BECOME CRITICAL

- Highest ever temperatures recorded
- Natural resources are depreciating

FOOD SECURITY

- 90% of food is imported

Source: Maui County Government 2020

CURRENT STATE ASSESSMENT OF THE SYSTEM INDICATED THAT THE WATER COMPLEXITY AND DISREPAIR ARE CHALLENGING TO ADDRESS

IoTask

- EMI system is very complex and difficult to understand.
- There is no uniformity of components or sections.
- Current land ownership is complicated and chain of ownership unclear.
- The system is in serious disrepair with non-functioning parts.
- There is a lack of proper understanding of upgrade and repair costs.
- An overall assessment is long overdue.
- The system doesn't realize its potential either in meeting needs or generating significant economic upside.

COUNTY MUST MAKE REGULATORY CHANGES IF IT WANTS A MORE ACTIVE ROLE IN TRANSFORMING THE EXISTING EAST MAUI WATER INFRASTRUCTURE

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- Under the Hawaiian Constitution and State law, currently the **county has limited power** compared to a municipality in a home-rule state.
- The county **cannot by itself set** up a public utility corporation to manage its water assets, and is subject to different State agencies' review and approval.
- The county **does have the power to *levy fees and taxes, issue bonds, and set up special improvement districts*** to fund for the maintenance, repair, and improvement of infrastructure, so long as it follows proper procedures.
- The current Board of Water Supply and Department of Water Supply **have limited power to do any of these** and would require ordinance and charter amendments to vest them with the power to set up, finance, and operationalize these tools.

THERE IS A GLOBAL AND INCREASING DEMAND FOR ESG INVESTMENTS THAT CAN MET THROUGH THE RIGHT VISION

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- Globally, the percentage of investors that apply environmental, social, and governance principles to at least a quarter of their portfolios jumped from 48% in 2017 to 75 % in 2019.

- ESG-mandated assets in the US could grow almost three times as fast as non-ESG-mandated assets to comprise 50% of all professionally managed investments by 2025 for a total of **$34.5 trillion assets** under management.

- ESG investments outperformed their conventional counterparts in the first quarter of 2020, even as the impact of COVID-19 caused a severe market downturn.

- The popularity of ESG and Impact Investing means that the risk of impact and ESG-washing will increase.

Source: Deloitte, February 20, 2020, https://www2.deloitte.com/us/en/insights/industry/financial-services/esg-investing-performance.html , CNBC, April 14, 2020, https://www.cnbc.com/2020/04/15/investing-advice-coronavirus-downturn-shows-esg-investment-opportunity.html

SOME EXTERNAL BEST PRACTICE CASE STUDIES GUIDED OUR THINKING

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Medellin	Deschutes River	Amazon Conservation	Crowd Smart Hydrology
• Empresas Públicas de Medellín (EPM), multi-utility corporation owned by the City of Medellín, Colombia, • Dividend has increased nearly 20-times since reform • Directed business operations and social responsibility to addresses inequalities and promotes peace. • Transformed walled off water storage tanks throughout the city into high quality open public spaces, working with communities, • Increased connections of low-income households to water and power grids through scaled water pricing structures, prepaid electricity meters, and other pro-poor means of formalizing access to services	• Deschutes River Stakeholders comprehensive restoration strategy to guide habitat restoration • Water transactions programs to facilitate the scalable trading of water between districts and to the Deschutes River to restore Upper Deschutes flows. • Moved water between irrigation districts to increase reliability of junior users, • Restored and protected flows in the Upper Deschutes River. • Meets the State's minimum flow requirement instead of running dry • Restore stream conditions to support the successful reintroduction of salmon and steelhead. • Restoration through creating a more efficient irrigation system	• Amazon Conservation Team (ACT), sees the survival of Rainforests and Indigenous cultures as inextricably linked under "biocultural conservation." • Key to the ultimate success of this process is improving indigenous partners' ability to meet many challenges • Process can entail everything from protecting forest species to knowing the potential uses of those plants and animals. • Aim to protect Amazonian lands first and foremost for those who live there • Use Google software and the latest computer and global positioning system technology, and top personnel from Google Earth headquarters have come to the Amazon to train the Indians directly	• Multiple projects using in situ sensing and information and communications technology (ICT), enable effective water monitoring "smart water quality monitoring techniques". • Project CrowdHydrology develops innovative methods of collecting spatially-distributed hydrologic data. • Community reads the stream stage, uses mobile phone texting to gauging station • Gathered stream data is added to database and published for public use on the CrowdHydrology web page • Project CrowdWater uses a "geocaching" type approach with the help of smartphones • Citizens can find existing sites and participate in the collection of hydrological data (stream water level, streamflow and soil moisture) using a smartphone app • Many other crowdsourcing and smart sensing water systems found all around the world

SOME EXTERNAL BEST PRACTICE CASE STUDIES GUIDED OUR THINKING

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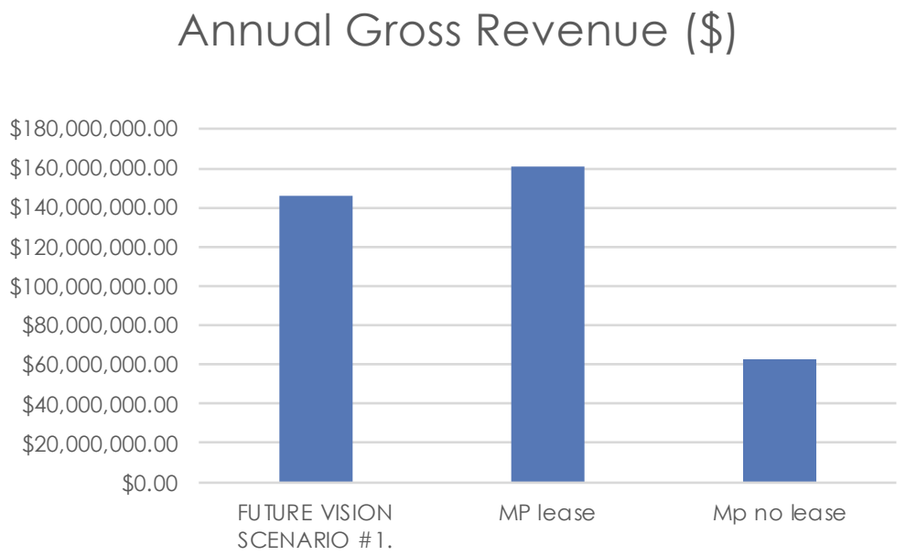
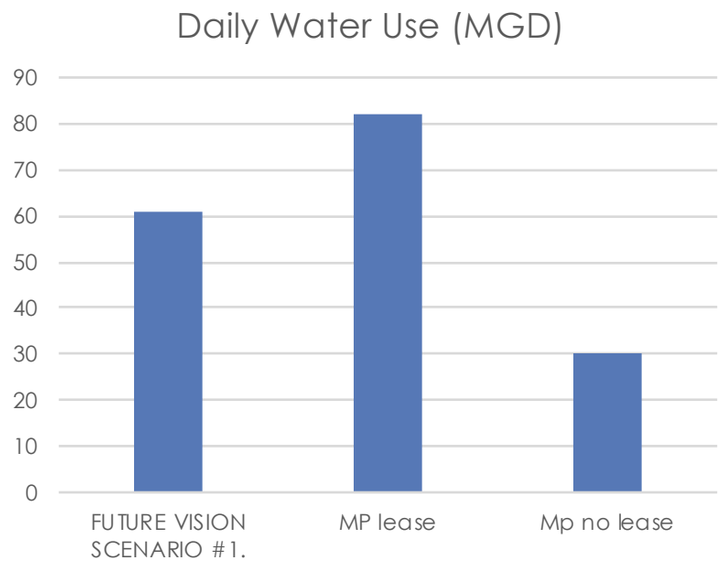
Price River in Utah	SIMA in Magdalena River Basin	Opihi Monitoring East Maui	Walker Basin
• Price River is a tributary of the Green River in central Utah. • Diversions from the Price River irrigate approximately 16,300 acres of land • Multiple demands on Price River flows and lack of storage capacity have resulted in shortages in both agricultural and municipal water supplies. • Irrigation diversion structures completely inhibit fish passage and sometimes leave sections of the River entirely dry. • Effected through partnership of public and private entities, including local governments, state and federal agencies, irrigation associations, major water users, and environmental organizations • Total estimated cost for the project is $113 million	• SIMA is an open access, scientific tool that helps government officials, industry and communities to predict the cumulative impact of development decisions. • Magdalena River Basin is the social, environmental and economic heart of Colombia. It is home to 80% of the nation's 48 million inhabitants and produces 86% of the nation's GDP, and 75% of the agriculture. • Rapid growth threatens the environmental health of the basin • SIMA provides an early warning system for anticipated development impacts and helps in design nature-based solutions to guide public and private investments for conservation. • Holistic, interdisciplinary, and science-based, the integrated river basin approach brings together stakeholders to solve the land-and water-use dilemmas facing great rivers, from pollution, flooding and climate change to water scarcity and declining fisheries.	• Community groups have been monitoring and documenting the decline in 'opihi populations along two miles of coastline for several years • Revived the traditional Hawaiian practice of resting an area to reverse the decline • Three species of 'opihi, aquatic limpets, that cling to rocks on island shorelines, are found only in Hawai'i and play a key role in coastal biodiversity. • These are a staple of the Hawaiian diet but dwindled due to increasing demand and unsustainable • The "rest areas" give the populations a chance to recover and to re-populate other areas down-current. • Their monitoring provides important insights into patterns of spawning and larval dispersal, guiding resource management decisions and improving the chances of restoring populations.	• Walker Basin Conservancy was established by Congress to restore and maintain Walker Lake, a desert terminal lake in Nevada • Acquired water rights and protected instream to increase freshwater flows to lake • Protected agricultural, environmental and habitat interests in the Walker River Basin • Conservation and stewardship program focused on land stewardship, water conservation, alternative agriculture, watershed improvement and establishment of a local non-profit entity. • BOR grant funds in excess of $300m for conservation investments in the Walker and other DTL watersheds under 2002, 2008, and 2012 Farm Bill authorities, $ 81.40 mil in revenues 2010-2015.

ECONOMIC ANALYSIS SUGGESTS MANY BETTER OPTIONS THAT YIELD 90% OF MAHI PONO PLAN REVENUES & RETURN MORE THAN 30% OF WATER REQUESTED UNDER LEASE

RESULTS ON 30,000 ACRES





This suggests that maintaining the current level of diversion is not a requirement for ensuring that the land is commercially viable.

Source: IoTask Team Analysis 2020

THUS THE COUNTY MUST ACT IN WELL STAGED STEPS TO ACHIEVE ITS GOALS

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Stage 1: The county can achieve certain aspects of the vision such as the technology or new digital Infrastructure workstreams within **its current authority.**

Stage 2: The county has the **power to exercise** its authority by:

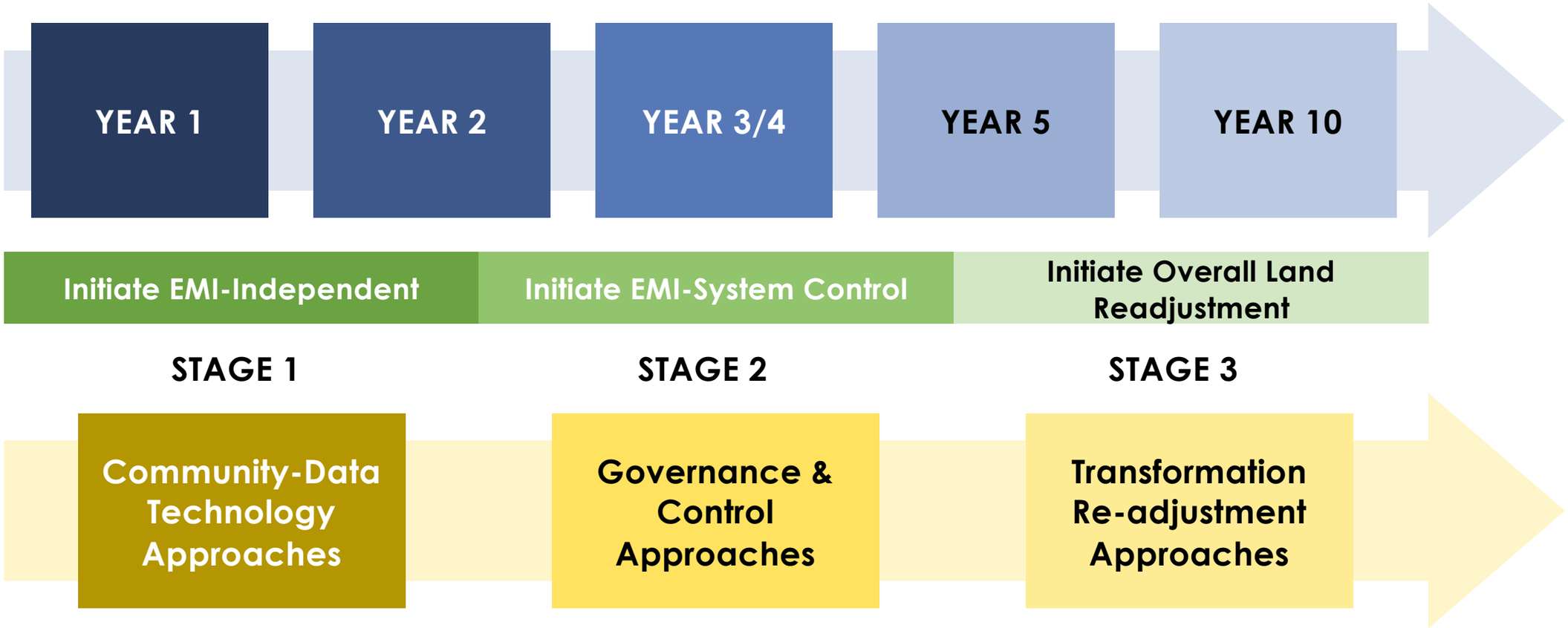
- Re-negotiating its water- contract with EMI.
  - With more transparency on water-data provided by stage 1.
  - With requirements for repair, maintenance and liability issues.
  - With acknowledgement of historical injustices.
- Acquire state water leases.
- Build new parallel water-related infrastructure.

Stage 3: Any aspects centered on expanding the **county's ownership and control** over the existing EMI infrastructure will likely require **concurrence of** state agencies, legislative and executive action by the County, as well as an **appropriate political** process.

Source: Mike Williams' assessment, Lance Collins, Bianca Isaki, Lincoln-IoTask analysis 20

MAPPING OUT THE STAGES OF ACTION TO REALIZE THE VISION

INITIAL STAGES FOCUS ON EMI-INDEPENDENT HIGH VALUE INTERVENTIONS – LATER STAGES ATTEMPT TO FACTOR IN PUBLIC CONTROL OF EMI AND SURROUNDING LANDS



BUT MOST IMPORTANTLY, AS THE COUNTY INITIATES ACTION ON ANY OF THESE, IT MUST INSTITUTE A CONTINUOUS PROCESS TO ALIGN STAKEHOLDERS

IoTask

- **Align:** Important to align stakeholders' interests and ensure that they agree upon the future and roadmap, ensuring that outcomes are visible and measurable.
- **Explore:** With the common vision in mind, the stakeholders will have the direction to further continue to explore various options and add to the roadmap.
- **Act:** But it is also very important to demonstrate early wins through shovel-ready projects in the early years.
- **Requirements:** The aforementioned requires the county to:
  - Take immediate action on shovel-ready projects (stage1)
  - Continue to conduct detailed planning to make remaining projects viable (stage 2)
  - Execute roadmap steps to complete workstreams
  - Conduct continuous stakeholder communication
  - Initiate process to solicit county funding either for the entire transformation through an ESG Bond or on a project by project basis

IN 5-10 YEARS YEARS EAST MAUI WILL BECOME A MODEL FOR BOTH THE REST OF HAWAII AND THE WORLD

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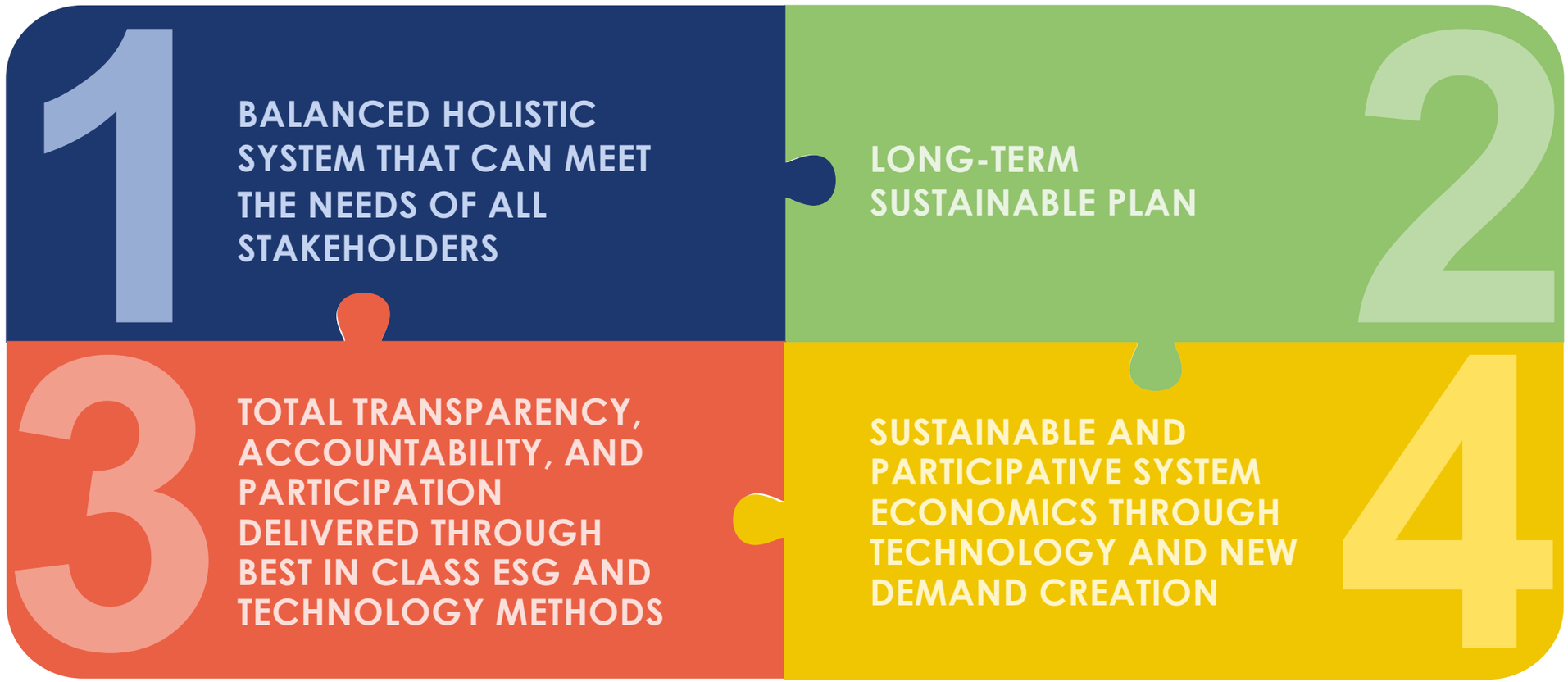
STAKEHOLDER ENGAGEMENT COMBINED WITH TECHNOLOGY & INNOVATION, WILL ACCOMPLISH MUTUAL REINFORCEMENT OF COMMUNITY VITALITY, ECOLOGICAL SUSTAINABILITY, AND AUTHENTIC ECONOMIC DEVELOPMENT.



#1. BALANCED HOLISTIC SYSTEM THAT CAN MEET THE NEEDS OF ALL STAKEHOLDERS

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- Bring water back to the streams so that it can flow sustainably and be used by local community and indigenous groups, including taro farming and other local ahupua'a needs.
- Provide a means for helping and supporting sustainable agriculture in the central valley to support the goals of job creation and achieve food security, but recognizing that those needs cannot trump other community stakeholders and must be secondary to the need for a sustainable water system.
- Leverage technology innovation to achieve previous bullet points, including not just current or future water monitoring and other related technical solutions but also AgTech and innovations around agriculture and crops that can be more sustainable and require less water.
- Become a benchmark or template for others in Hawaii and the world to learn from.

#2. LONG TERM ECONOMIC AND SUSTAINABLE PLAN

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- Deliver a balance of water supply and demand along with preparation for climate impacts.
- Function in a financially viable and sustainable system.
- Satisfy needs of system owners (be that a public, private or hybrid system).
- Address community and other stakeholder needs with a clear plan for meeting achievable short and long term objectives.
- Link to a capital improvement plan that addresses critical short term and longer term needs for a depreciated system in disrepair.

#3. TOTAL TRANSPARENCY, ACCOUNTABILITY, PARTICIPATION DELIVERED THROUGH BEST IN CLASS ESG AND TECHNOLOGY METHODS

IoTask

- Provide full transparency with up-to-date data into every gallon and person anywhere on the system in real time.
- Enable real time adjustment of flows, interventions, connections to end uses for maximum efficiency, including crops for optimal agriculture and productivity.
- Monitor both ESG budgets and cash budgets dynamically with innovations such as ESG tokens based on multifactors that deliver more participation.
- Resolve disputes dynamically and renegotiate based on transparency, real time application development through APIs and data.
- Provide mechanisms for accurately valuing and rewarding community contributions to intellectual property development.

#4. SUSTAINABLE AND PARTICIPATIVE SYSTEM ECONOMICS THROUGH TECHNOLOGY AND NEW DEMAND CREATION

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- Deliver a water system built to meet the needs of multiple stakeholders sustainably.
- Provide the capacity to monitor and maintain the water supply to users. The system should manifest the potential of all water sources.
- Create a pricing system so that all stakeholder needs can be met based on ability to pay and cross-subsidized by those who can pay more.
- Create a set-aside for “nature” to get its share of water, which must be subsidized by other users.
- Leverage technology to support transparency and accountability of multiple stakeholders (as described in #3).

THE TEAM HAS DEVELOPED A FRAMEWORK FOR THE BREADTH OF SOLUTION OPTIONS THAT REALIZE THE VISION, WHICH INCLUDES:

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- Measurement & Monitoring of leaks, usage, pressure, flow speed, stream levels, and environmental impacts including invasive species, flooding, and wildfires
- Management including storage for reliability and quality of service including pressure, temperature, flow speed
- Maintenance of the EMI system, and surrounding forests and streams
- Economic Participation, ESG, & Development
- Local Technology Competency, Education & Livelihood Creation
- End-to-end from streams, to ditches, tunnels, aqueducts, dams, reservoirs/storage
- Consideration of both Participative Distribution and End-Uses

ANY VISION MUST COVER ENTIRE FRAMEWORK FOR BREADTH OF SOLUTIONS

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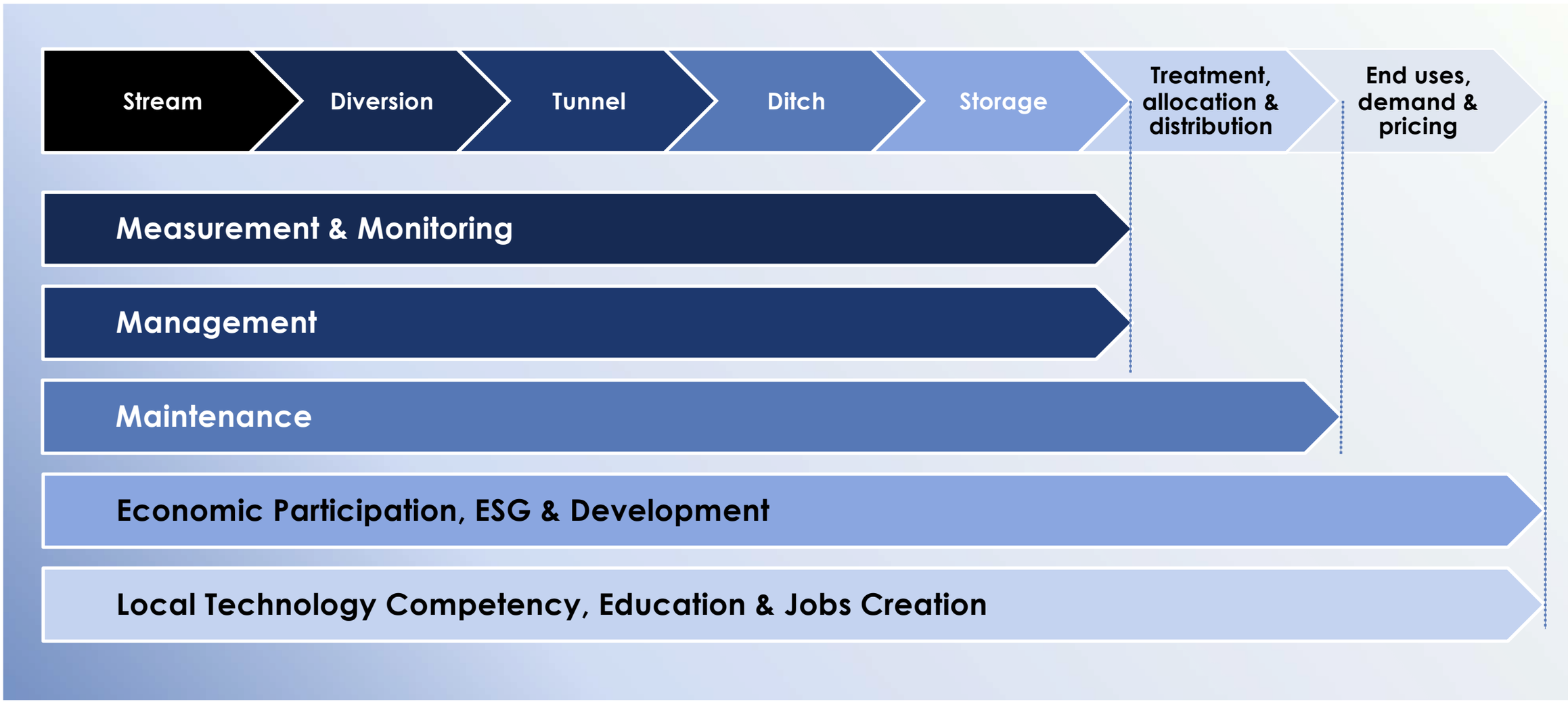

THE VISION SOLUTION OPTIONS WERE ORGANIZED UNDER 4 INTERACTING WORKSTREAMS

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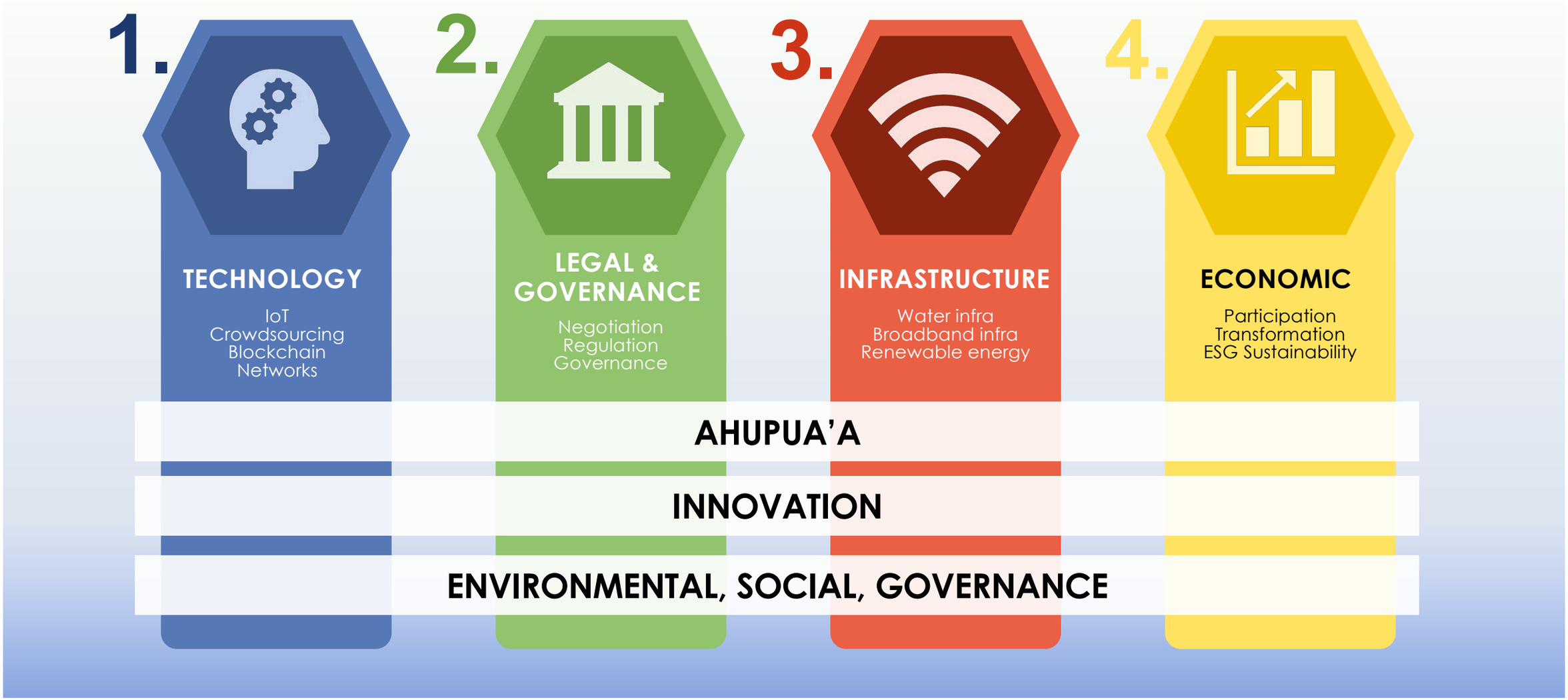
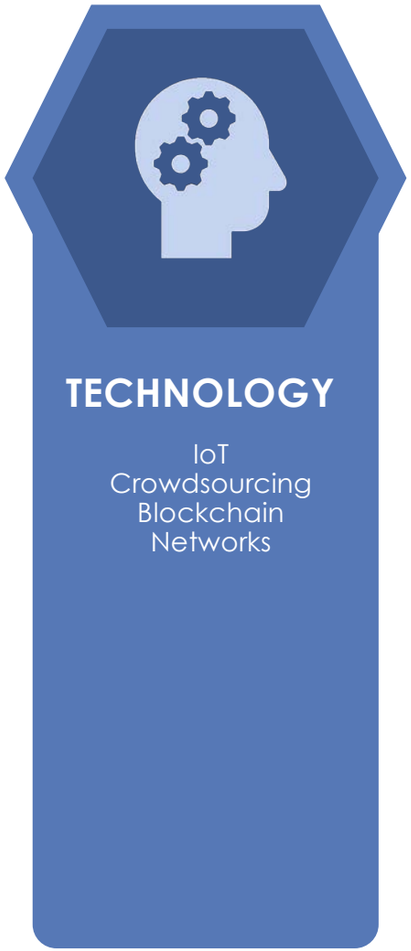


TECHNOLOGY WORKSTREAM

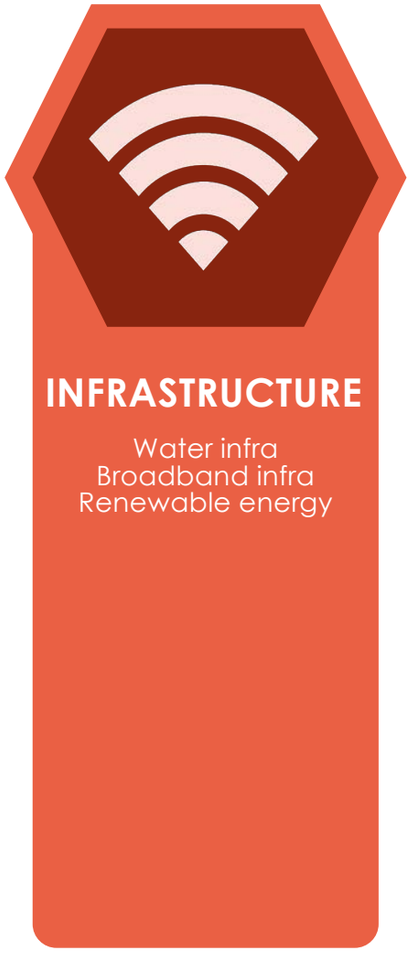


- **Use technology innovation to immediately take steps where legal, economic strategies provide less immediate paths (e.g. measurement)**
- **Employ local community in crowdsourced measurement and maintenance through collection of stream, forest, ocean (ahupua'a) data**
  - Create a simple mobile application to enable crowd-data collection
  - Expand mobile application capability by adding hardware sensors
  - Integrate crowd-data into cloud-based dashboards providing transparency
  - Reward community members for work already being done, and integrate work into technology economy, as appropriate
- **Use a "crowd2cloud" database to evolve situation**
  - Re-negotiate EMI contracts and pricing using data
  - Monitor and manage EMI usage through data
  - Use data to renew watershed by identifying progress and changes from the mountains to the sea
  - Provide community with total real time transparency into watershed
- **Use Technology to factor in ESG impact and economic participation**
  - ESG-Blockchain credits for water distribution
  - ESG-impact measurement data collection and tracking
  - Identify and foster technology supported innovation in food and water security, sustainability

LEGAL WORKSTREAM

- **Clarify and if necessary, set up and create the county's or the appropriate entity's general powers**
- **Set up key objectives, Including the ability to buy, rent, and sell property, acquire leases, borrow money, set up special improvement district, issue revenue bonds, the power to contract, and manage and operate project**
- **Bottom lines, benchmarks, and deliverables based on crowd-hydrology data**
  - Identify and engage key stakeholders and make sure they are represented and establish mutual understanding
- **Due Diligence review to identify and calculate project risks**
- **Project management, operation, and enforcement**
  - Within current legal power and regulatory framework, determine bylaws and policies on contract management and project operating procedures
  - Ensure that all operations and transactions are transparent and subject to public scrutiny
- **Draft template legislation to revise current legal and regulatory framework if necessary**

INFRASTRUCTURE WORKSTREAM



- **Support federal and state efforts to install supporting digital communications infrastructure**
  - Deliver last mile solutions to connect broadband infrastructure
  - Collaborate with federal/state efforts to rollout infrastructure
- **Initiate EMI water system upgrades via EMI-Mahi Pono**
  - Use crowd-hydrology to negotiate change in behavior
  - Use lease acquisition to negotiate change in covenants
- **Build parallel water infrastructure to increase independence**
  - Build parallel reservoirs, dams and micro-hydro installations
  - Build crowd-hydrology measurement, monitoring and maintenance
- **Create educational and research infrastructure to build on community capabilities**
  - Establish outside partnerships to bring capabilities to Maui
  - Work with existing sustainability programs, layer in skilling in technology workstream components
  - Establish world-class center for excellence (fresh water, mauka to makai sustainability, and regenerative agriculture)
  - Establish local institute to train and enhance community capabilities

ECONOMIC WORKSTREAM

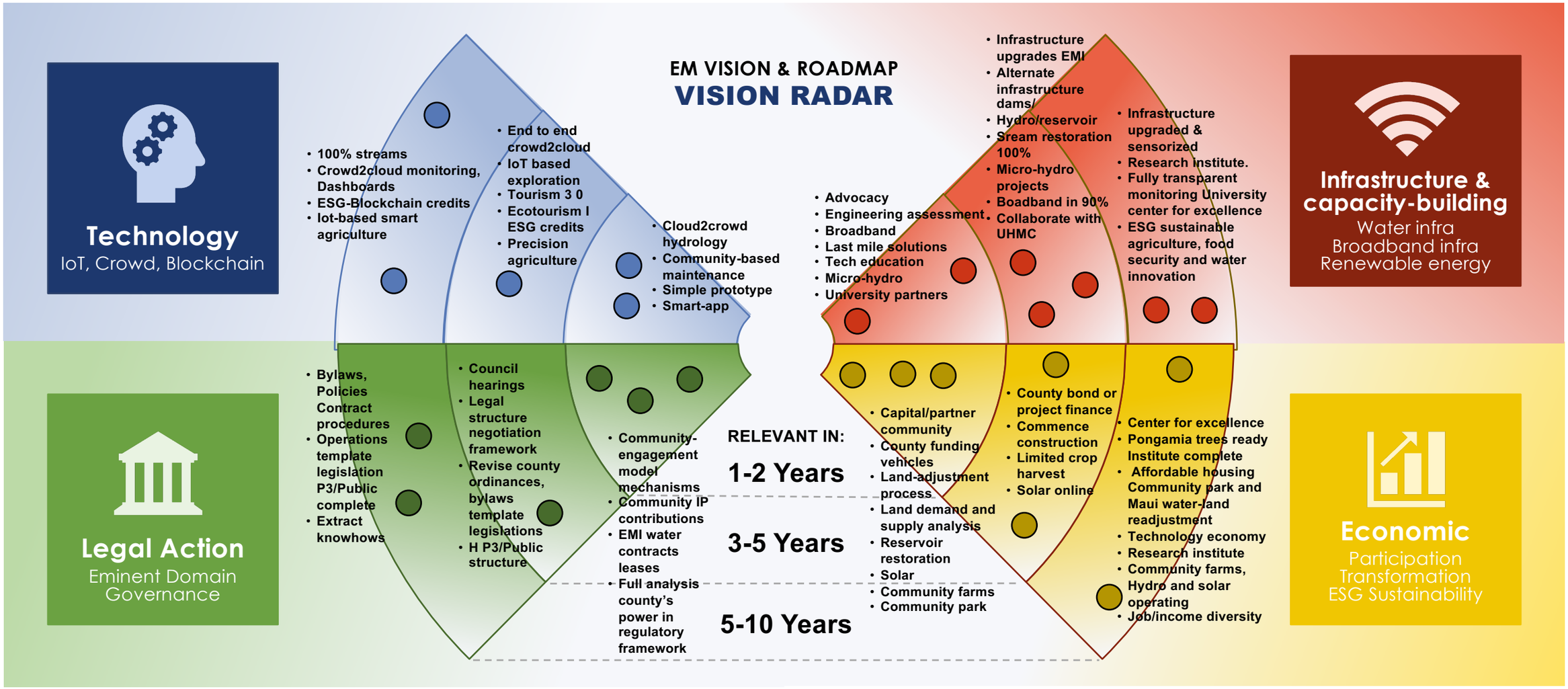
ECONOMIC

Participation
Transformation
ESG Sustainability

- **Create new models for end-use to enhance demand and viability**
  - Low-income housing
  - Different agricultural crops
  - Smart sensorized eco-tourism
  - IoT enabled precision agriculture
  - Food for local consumption
- **Develop the best balanced multi-use model for land and water**
  - Initiate and complete land-water readjustment plan
  - Analyze options for land-water use with community input
- **Leverage established centers for excellence to change economic model**
  - Establish Maui center for excellence in ESG, regenerative agriculture, water technology

THE WORKSTREAMS DEFINE A VISION AND ROADMAP FOR COUNTY ACTION

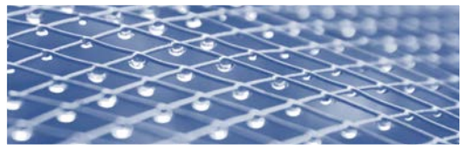
IoTask



ROADMAP YEAR 1 PRIORITIES: DATA, MEASUREMENT, COMMUNITY ENGAGEMENT, EDUCATION, HAZARD REDUCTION

IoTask

TECHNOLOGY WORKSTREAM



- Community crowd-hydrology – basic measurement and livelihood for 20% streams
- Extension of community-based stream measurements and maintenance
- Simple prototype with 50-100 persons linked to Covid-19 recovery job creation
- Develop Smart-app for data collection and collation
- Collaborate with existing monitoring programs
- Establish additional monitoring programs from the mountains to the sea
- Survey existing local sustainable agricultural and food security innovation initiatives

LEGAL AND GOVERNANCE WORKSTREAM

- Establish community-engagement model and process
- Acknowledge historic land-water claims and mechanisms for achieving equitable, practical resolution
- Develop mechanisms for valuing and rewarding community contributions to intellectual property development
- Put EMI water contracts leases in abeyance pending data-driven re-negotiation
- Apply for state leases
- Full analysis of the county's power and functions under current legal and regulatory framework

INFRASTRUCTURE WORKSTREAM

- Engage with infrastructure advocacy groups
- Engineering assessment of EMI to identify hazards
- Support digital communications infrastructure.
- Engage with federal programs for broadband
- Support 90% coverage but no last mile
- Explore last mile solutions
- Design community tech education programs

ECONOMIC WORKSTREAM

- Develop the capital and partner community
- Kickoff county vehicles for funding
- Initiate land-adjustment process
- Research and socialization land-water readjustment process
- Investigate sources of demand and supply of land - Low income housing

Source: Current Assessment, Stakeholder Assessment, Technology Assessment, Responsible Markets, IoTask Analysis 2020

ROADMAP YEAR 2 PRIORITIES: EXECUTION, INCREASE COVERAGE, EMI INTERVENTIONS

TECHNOLOGY WORKSTREAM

- Begin smart sensors hardware for community crowd-hydrology
- Complete 50% stream measurement
- Begin cloud-based dashboards for monitoring
- Begin smart water management
- Negotiate Mahi Pono-EMI water-use through crowd-hydrology data
- Identify global patterns for food security and sustainable agriculture innovation
- Establish roadmap for sustainable agriculture and food security on Maui

LEGAL AND GOVERNANCE WORKSTREAM

- Council hearings on eminent domain
- Design appropriate legal structure and negotiation framework to represent best interest of the public and various stakeholders
- Revise county ordinances necessary to create general powers that enable infrastructure upgrade, investment, oversight, and revenue generation
- Draft template legislation and advocate for change in state laws if necessary
- Establish P3/Public corporation structure for EMI intervention

INFRASTRUCTURE WORKSTREAM

- Support digital infrastructure development
- 10% last mile connection
- Negotiate and initiate repairs through Mahi Pono-EMI on identified hazard repairs
- Initiate micro-hydro projects
- Identify center-institute partners
- Initiate community tech education programs

ECONOMIC WORKSTREAM

- Finalize land use plan
- Begin planting
- Start stream monitoring
- Begin reservoir restoration
- Begin solar
- Begin community farms
- Begin ranching
- Begin community park and resources
- Continue priming the capital and partner community

Source: Current Assessment, Stakeholder Assessment, Technology Assessment, Responsible Markets, IoTask Analysis 2020

ROADMAP YEAR 3 & 4 PRIORITIES: COMPLETE NON-EMI INTERVENTION, INITIATE EMI INTERVENTION

TECHNOLOGY WORKSTREAM

- Smart water development continued
- Build end to end system infrastructure
- Smart use propagation to local economy
- IoT based exploration – Tourism 3.0
- Ecotourism of EMI areas
- Initiate ESG credits for participative water distribution
- Initiate IoT-based precision agriculture

LEGAL AND GOVERNANCE WORKSTREAM

- Project management, operation, and enforcement
- Within current legal power and regulatory framework, determine bylaws and policies on contract management and project operating procedures
- Ensure that all operations and transactions are transparent and subject to public scrutiny
- If necessary, draft template legislation and push for reform of state-local water regulatory framework
- Authorize and execute on P3/Public corporation structure for EMI intervention

INFRASTRUCTURE WORKSTREAM

- Initiate infrastructure upgrades via EMI-Mahi Pono OR initiate alternate infrastructure dams/hydro/reservoirs
- Begin stream restoration
- Begin micro-hydro projects
- Complete digital infrastructure development - broadband in 90%
- Collaborate with UHMC on training programs in sustainability

ECONOMIC WORKSTREAM

- Issue county bond or project finance
- Commence construction (residential)
- Commence construction (institute)
- Commence construction (affordable housing)
- Continue planting
- Limited crop harvest
- Solar is on line

Source: Current Assessment, Stakeholder Assessment, Technology Assessment, Responsible Markets, IoTask Analysis 2020

ROADMAP YEAR 5 PRIORITIES: INSTITUTIONALIZE LEARNING

TECHNOLOGY WORKSTREAM

- Fully employ local community in stream measurement and maintenance
- Coverage of 100% streams inlets and outlets
- Complete smart crowd-hydrology measurement
- Complete community-data water measurement, monitoring, dashboards complete
- Cloud based smart water (streams, ditches, etc.) management
- ESG-Blockchain credit mechanism for distribution is complete
- IoT-based smart agriculture in operation

LEGAL AND GOVERNANCE WORKSTREAM

- Commence cultural and community events
- Continue to push for relevant state-local water management reform
- Monitor the projects and establish evaluation and feedbacks system
- Continue to engage various stakeholders to steward public interest
- Revise and update bylaws, governance structure, and continue to improve project operation if necessary

INFRASTRUCTURE WORKSTREAM

- EMI physical water infrastructure is upgraded either directly (P3) or indirectly (MP)
- Ditches, tunnels, aqueducts sensorized and repaired
- Dams/reservoirs up to barest minimum
- Launch research institute

ECONOMIC WORKSTREAM

- Center for excellence in water and sustainable agriculture
- Pongamia trees ready to harvest
- Complete institute construction
- Complete some affordable housing
- Complete community park and resources

Source: Current Assessment, Stakeholder Assessment, Technology Assessment, Responsible Markets, IoTask Analysis 2020

ROADMAP YEAR 10 PRIORITIES: COMPLETE TRANSFORMATION

TECHNOLOGY WORKSTREAM

- Smart community-based water transformation complete
- Demonstrate world-class sensorized crowd-hydrology
- Address stakeholder needs with total transparency, accountability and participation
- Complete community-driven care and sustainability of the watershed
- Complete center for next generation agri, water, land technology

LEGAL AND GOVERNANCE WORKSTREAM

- Community is integrated and completely aligned with water systems
- Restoration of respect, tradition and opportunity with holistic land, water readjustment
- Document lessons learned, identify successes and missed opportunities
- Continue to improve systems and procedures to ensure proper operation and long-term success of the enterprise
- Continue to steward public resources and the community as well as stakeholders' interests

INFRASTRUCTURE WORKSTREAM

- Water infrastructure is sensorized, updated best in class
- Fully transparent monitoring systems for water
- University center for excellence in Maui
- Maui as a center for ESG sustainable agriculture, food security and water innovation

ECONOMIC WORKSTREAM

- East Maui water-land readjustment complete
- Technology driven approach to a sustainable, participative economy and jobs
- Research institute is up and running
- Real estate development has been completed
- Community farms are established and profitable
- Hydro and solar are operating
- Job and income diversity

Source: Current Assessment, Stakeholder Assessment, Technology Assessment, Responsible Markets, IoTask Analysis 2020

ECONOMIC ANALYSIS

ECONOMIC ANALYSIS

We conducted a three-pronged approach to understanding the economic potential of different scenarios:

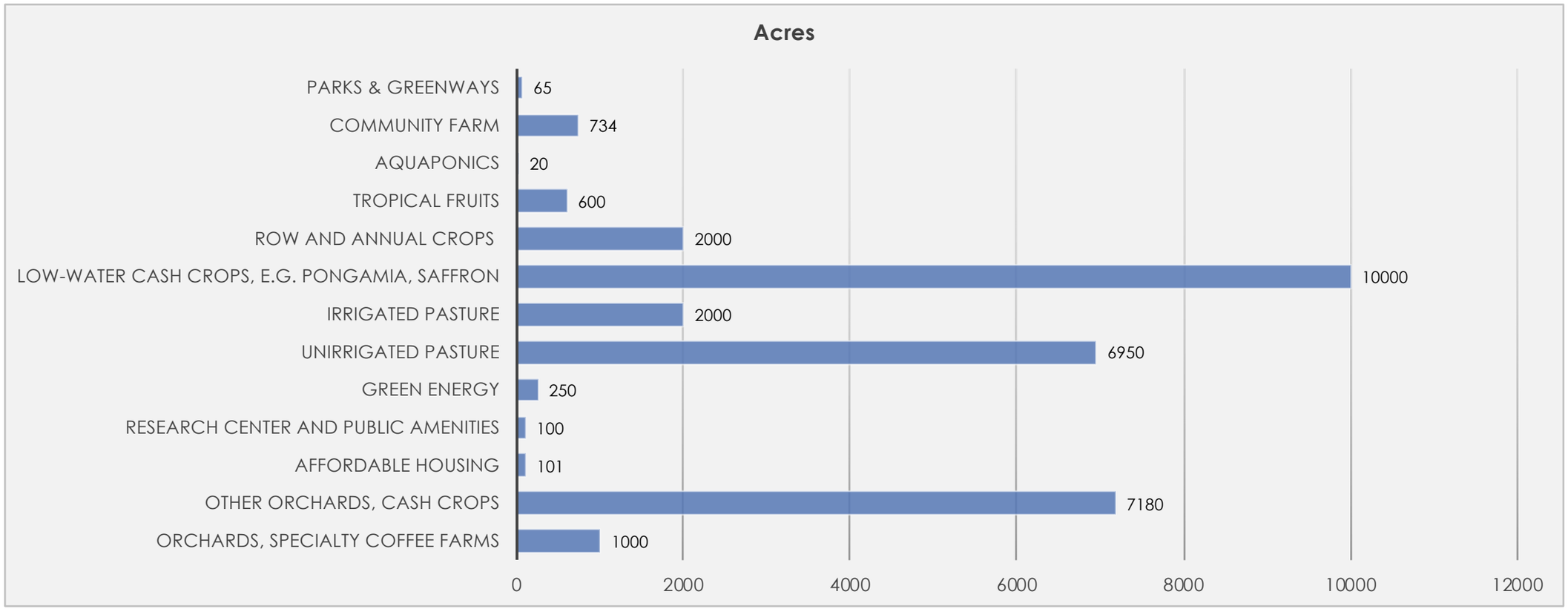
- Revenues: We looked at options of better use of land and other demand generation
- Costs: We looked at the costs of upgrading infrastructure using next-generation technologies
- Social and environmental impact: At every stage, we sought options that would strengthen communities, respect heritage, and nurture the natural environment in East Maui

WE WENT A STEP FURTHER IN THE ECONOMIC SCENARIOS

IoTask

- **The highest and best end use of land involves**
  - Financial sustainability
  - Risk reduction
  - Environmental, Social & Governance (ESG) benefits
- **We identified an array of high-value options for the 30,000+ acres of land which result in a profitable investment that uses less water than the Mahi Pono plan, and which would provide numerous ESG benefits.**
  - Potential ESG benefits include environmental restoration, community strengthening, job creation, cultural preservation, education
- **At market rates, current delivery of water could generate 40 mgd x $1.1/1000g = $16 Mil/year.**
- **The stated reason for the deeply discounted pricing of $160,000/year that EMI receives today is its purported infrastructure investment costs.**
- **End use is not a limiting constraint for our vision.**

THE ECONOMIC ANALYSIS EXAMINED A PORTFOLIO MIX 13 DIFFERENT END-USES OF LAND OVER A TOTAL 30,000 ACRES



Source: Iotask Team Analysis

A PROFITABLE, COMMUNITY CENTERED PLAN THAT USES SIGNIFICANTLY LESS WATER IS ACHIEVABLE

IoTask

FUTURE VISION SCENARIO #1: Community-centered, Innovation-enabled	Acres	Annual water consumption (mg, Mahi Pono usage assumptions)	Annual water consumption (mg, with IoT- "smart" irrigation)	Capital Expenditure	Plan year when Capital Expenditure incurred	Annual gross revenue per acre--MP estimate	Annual net revenue per acre	Total Annual Gross Revenue
High-end realty / orchards / specialty coffee farms	1000	929	557	$27,500,000.00	3	$15,782.63	$10,846.00	$15,782,625.00
Other orchards / cash crops	7180	13337	8002	$25,130,000.00	3	$5,649.78	*$1,200.00*	$40,565,418.50
Affordable housing	101	77	77	$100,980,000.00	3	*$6,000.00*	*$1,500.00*	$606,000.00
Research Center and public amenities	100	29	29	$0.00	3	*$100,000.00*	$4,000.00	$10,000,000.00
Green energy, solar	250	0	0	$7,500,000.00	3	$32,800.00	$6,560.00	$8,200,000.00
Unirrigated pasture	6950	0	0	$0.00	0	$347.00	$257.00	$2,411,650.00
Irrigated pasture	2000	848	848	*$100,000.00*	1	$347.00	$257.36	$694,000.00
Low-water cash crops	10000	2600	2600	$35,000,000.00	3	*$5,000.00*	$1,200.00	$50,000,000.00
Row and annual crops	2000	2476	1486	$5,000,000.00	3	$5,000.00	*$1,000.00*	$10,000,000.00
Tropical fruits	600	1095	657	$1,500,000.00	3	$7,500.00	*$1,500.00*	$4,500,000.00
Aquaponics	20	44	44	$2,000,000.00	3	$100,000.00	$40,000.00	$2,000,000.00
Community farm	734	882	529	*$100,000.00*	3	$1,500.00	$1,000.00	$1,101,000.00
Parks & Greenways	65	0	0	*$500,000.00*	3	$0.00	$0.00	$0.00
TOTAL	30000	**16001**	**8,514**	**$204,810,000.00**				**$145,860,693.50**
MP lease	30000	23725	23725					**$160,700,000.00**
MP no lease	30000	11104	11104					**$62,400,000.00**

Our analysis shows 90% of revenue can be achieved using less than 70% of water required in Mahi Pono's plan, returning 32% of water requested under lease to streams. With smart irrigation solutions it's possible to achieve the same outcome using only 36% of water required by MP, returning even more water to streams.

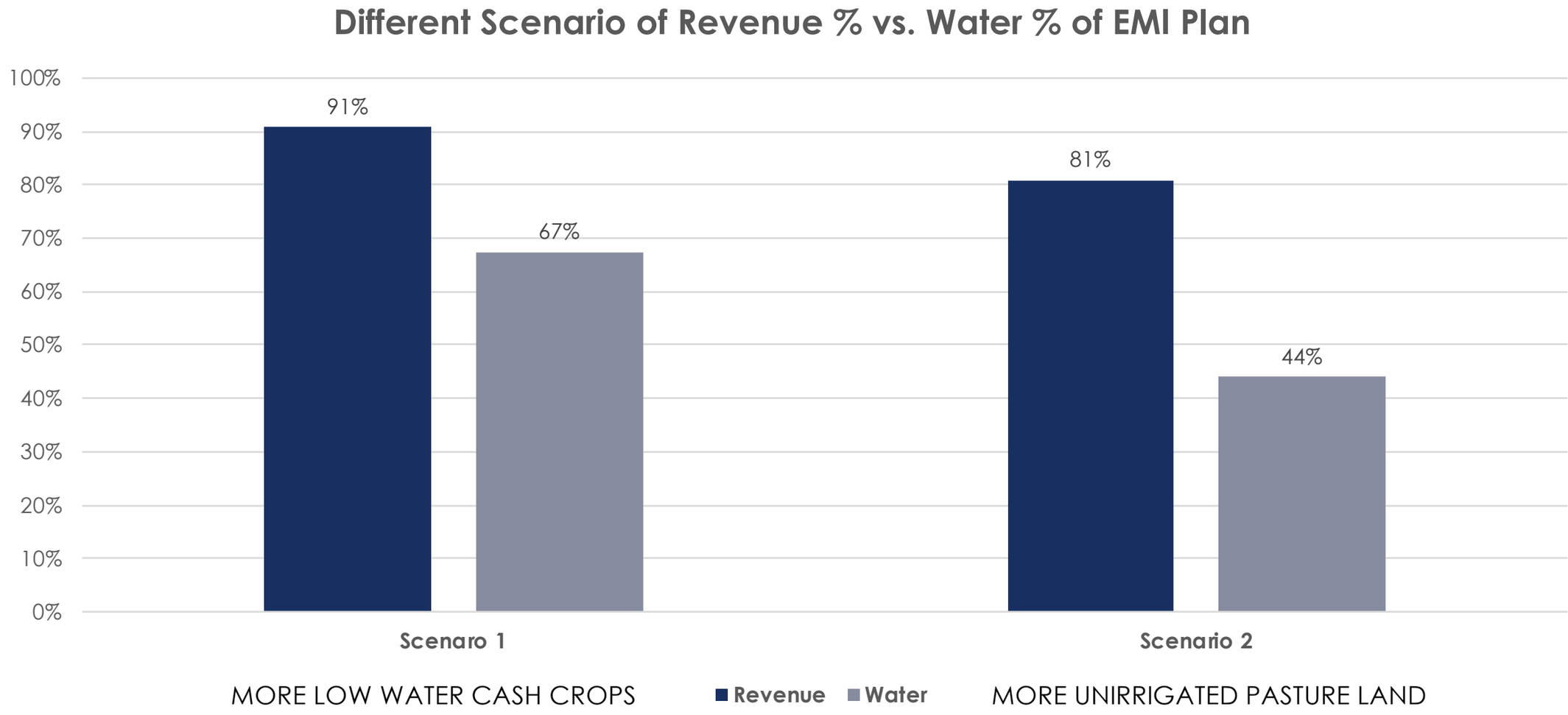
Source: IoTask team proprietary analysis, 2020. http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2019-09-23-MA-DEIS-East-Maui-Water-Lease.pdf

THE ECONOMIC ANALYSIS SUGGESTS MANY BETTER OPTIONS FOR THE COUNTY

IoTask

- In order to illustrate, we constructed one scenario out of many possible. Experimenting with economic scenarios shows that many other better uses of land-water with comparable returns but better social, economic, governance and cultural outcomes exist.
- Economic analysis suggests far better options exist for the water use
  - Land can yield **90%** of the gross revenue that Mahi Pono has estimated to be attainable with the requested water lease.
  - While returning more than **30%** of the water requested under the lease to the streams.
- With additional water efficiencies such as IoT-supported "smart" irrigation systems, Mahi Pono can likely **return more than 60% of the water requested under the lease to the streams** and still yield 90% of the gross revenue projected previously.
- This suggests that **maintaining the current level of diversion is not a requirement for ensuring that the land is commercially viable for Mahi Pono.**

DIFFERENT SCENARIOS OF LAND-WATER END USE ALLOWED US TO SEE THE TRADEOFFS BETWEEN IMPACT AND FINANCIAL RETURN



Source: Iotask team analysis 2020

MORE IMPORTANTLY, THE ESG IMPACT CAN BE SUBSTANTIVELY BETTER

IoTask

Our plan results in substantial Environmental, Social & Governance (ESG) benefits:

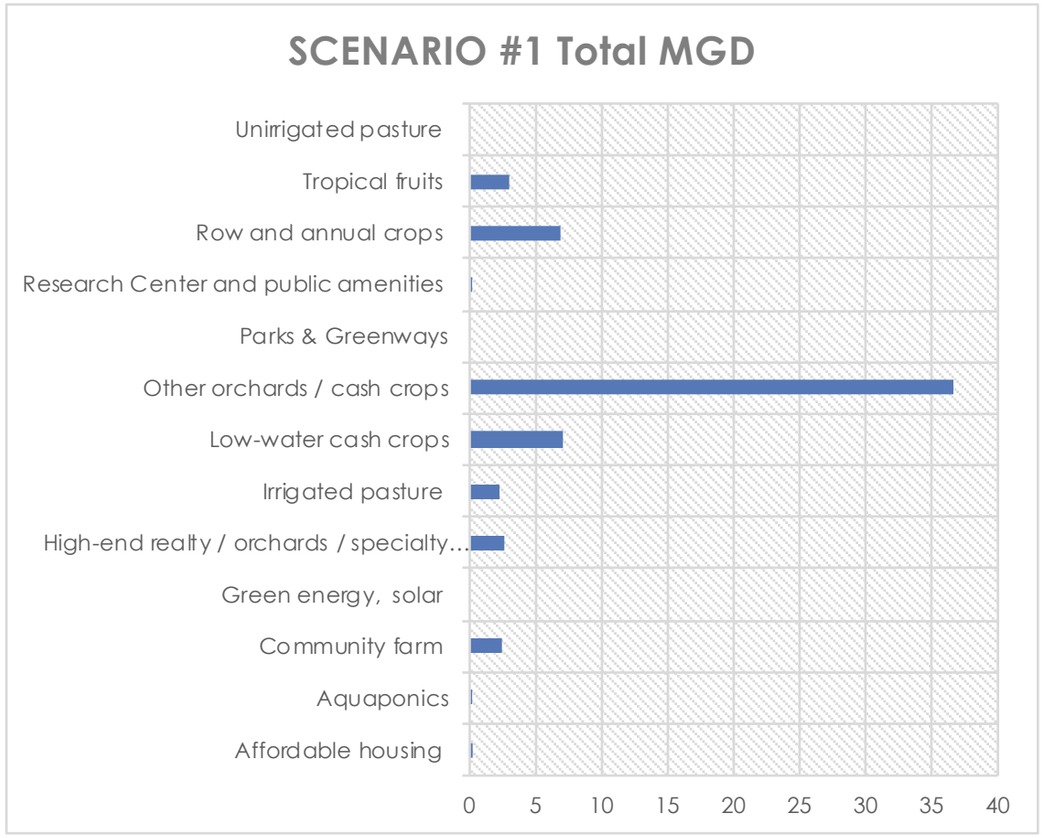
- Respect for, and strengthening of, the cultural and economic practices of native Hawaiian communities in East Maui through restored stream flow.
- The creation of high-quality jobs and job-training opportunities in a variety of industries, including technology, agriculture (including horticulture), "tourism 3.0" and a world class research and education center on Maui.
- The mitigation of flood and fire risks.
- The creation of a world-class research center upcountry and/or in East Maui, similar to the Santa Fe Institute in Santa Fe New Mexico, or the Woods Hole Oceanographic Institute in Woods Hole Massachusetts, in a manner consistent with the Community Plan.
- Construction of affordable housing in a manner consistent with the Community Plan.
- Support of community food security priorities.
- The creation of a global model for the stewardship of land and water resources to strengthen communities.

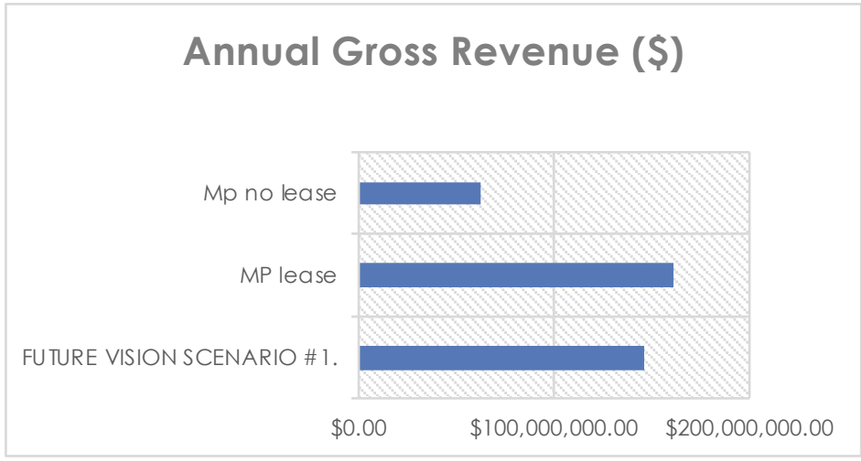
Note: ESG defined earlier refers to Environmental, Social and Governance.

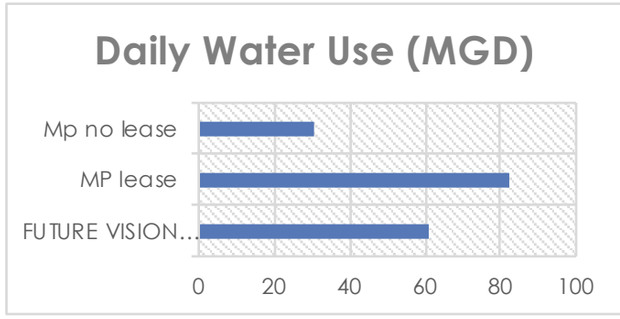
AS COMPARED TO THE PORTFOLIO OF 13 OPTIONS EXAMINED FOR END-USE OF LAND, MAHI PONO'S OPTIONS ARE NOT AS COMPELLING

IoTask

RESULTS ON 30,000 ACRES







Use 17.1 MGD of brackish water.

SIMILAR FINANCIAL RESULTS FOR PORTFOLIO WITH BETTER ESG OUTCOMES

Source: IoTask Team Analysis 2020

ESTIMATE INVESTMENT TO REPAIR AND UPGRADE BASIC INFRASTRUCTURE

IoTask

- **The EMI system will need a significant amount of repair and on-going maintenance. The EMI system consists of three components:**
  - STREAM DIVERSIONS (of which there are 355).
  - THE AQUEDUCT SYSTEM (consisting mostly of ditches and tunnels. 73% of the ditch system is tunnels and 27% is open ditches, some lined, some not. The youngest section of the ditch system is 95 years old, but some sections and intakes have been upgraded over the years).
  - RESERVOIRS The six remaining reservoirs will need restoration in order to be fully operational.
- **While detailed cost estimates for the restoration and maintenance of the EMI system are not available, Hawaii already oversees and operates similar irrigation systems. Mahi Pono has estimated $50-100 Mil to fix the reservoirs.**
- **Our economic analysis used benchmarks to derive median estimates $71 Mil with a range of $22-$263 Mil depending on the type of repairs, location and capabilities chosen.**

Source: http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2019-09-23-MA-DEIS-East-Maui-Water-Lease.pdf

THE RESERVOIRS DOMINATE OUR ESTIMATE INVESTMENT TO REPAIR AND UPGRADE BASIC INFRASTRUCTURE

IoTask

Total estimated restoration and upgrade costs range from $22-$263 Mil with a median at $71 Mil. The high end reflects costs in a New York like environment and are not as applicable to Maui.

NAME	TOTAL	BENCHMARK COST PER UNIT (HIGH)	BENCHMARK COST PER UNIT (MEDIUM)	BENCHMARK COST PER UNIT (LOW)	TOTAL ESTIMATED COST HIGH ($Mil)	TOTAL ESTIMATED COST MEDIUM ($Mil)	TOTAL ESTIMATED COST LOW ($Mil)
Aqueduct (miles)	74	$2.54 Mil	$0.12 Mil	$0.11 Mil	$187.96 Mil	$8.88 Mil	$8.14 Mil
Stream diversions (number)	355	0.821 Mil	0.267 Mil	0.134 Mil	$29.15 Mil	$9.48 Mil	$4.76 Mil
Reservoirs (MG)	339.3	$0.23 Mil	$0.16 Mil	$0.03 Mil	$76.68 Mil	$52.93 Mil	$9.50 Mil
				TOTAL:	$264.64 Mil	$71.29 Mil	$22.40 Mil
					NYC costs	Ohio costs	East Kaui
				EMI Estimates	$200 Mil with $50-100 Mil for Dams		

Source: IoTask team analysis 2020

UNDERLYING BENCHMARKS SUGGEST $10MIL IN COSTS TO REPAIR AN AQUEDUCT

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Type	Name	Length in Miles	Cost in Mil	Cost Per Mile	Total Cost for EMI
Aqueduct Restoration	**Saint Mary's, Ohio**	6	$0.67 Mil	$0.11 Mil	$8.28 Mil
Repairing Aqueduct	**Catskills, New York**	59	$150.00 Mil	$2.54 Mil	$188.14 Mil
East Kauai Irrigation System	**Hawaii**	22.5	$1.96 Mil	$0.09 Mil	$6.45 Mil

AQUEDUCT INCLUDES

AQUEDUCT	Tunnel
	Ditches lined
	Ditches partially lined
	Ditches unlined
	Flumes
	Siphons
	Weirs

Source:
https://drive.google.com/file/d/1fqNTrAeW0D6oBo10w3jbcp8ZL9_4Ixc2/view?usp=sharing
http://files.hawaii.gov/dbedt/op/spb/Volume_III_Assessment_of_Irrigation_Systems_in_Hawaii_FINAL.pdf ,
https://hdoa.hawaii.gov/arm/files/2012/12/AWUDP-Dec2003.pdf
Prof. Andrew Whittle, Massachusetts Institute of Technology (MIT)

THE CHARACTERISTICS OF DITCHES IN EAST MAUI ALLOW ONE TO ESTIMATE COSTS OF REPAIR

IoTask

Name	(New) Haiku***	Spreckels**	Lowrie	Manuel Luis	Center	Kauhikoa	New Hamakua	Wailoa	Koolau
Capacity	70 MGD*,		70 MGD*				100 MGD*	195 MGD*,	
Approx Elevation	400-500 ft	300-1200 ft	600-800 ft	500 ft	500 ft	400-900 ft	1000-1200 ft	1000-1200 ft	1250 ft
Length	9.68 miles	4.62 miles	12.41 miles	1.79 miles	2.2 miles	4.96 miles	8.05 miles	9.56 miles total	10.2 miles
Characteristics	9.3 miles tunnel, .38 lined	2.42 miles tunnel, .02 lined, 1.31 partially lined, .86 lined	4.61 miles tunnel, .21 lined, .13 partially lined, 7.46 unlined	.97 miles tunnel, .06 partially lined, .76 unlined	1.51 miles tunnel, .11 lined, .04 partially lined, .54 unlined	4.78 miles tunnel, .16 lined, .02 partially lined	5.61 miles tunnel, .13 lined, .86 partially lined, 1.44 unlined	9.49 miles tunnel, .07 lined Wailoa & Koolau are sections of same ditch	7.7 miles tunnel, 2.47 lined, .02 partially lined Wailoa & Koolau are sections of same ditch
How much in Lease area?	None	Portions	A lot is outside of lease area	Portions	Portions	None	Almost all is inside lease area	Primary source of water in lease area	Primary source of water in lease area
Claimed Land Ownership	Primarily EMI/Mahi Pono	Combination EMI/Mahi Pono & State	Combination EMI/Mahi Pono & State	Combination EMI/Mahi Pono & State	Combination EMI/Mahi Pono & State	EMI/Mahi Pono Only	Combination EMI/Mahi Pono & State	Combination EMI/Mahi Pono & State	Combination, mostly State
Comments		Joins several streams, Ko'olau and Lowrie Ditch		Joins Lowrie	Joins Lowrie	Joins New Hamakua			Joins Wailoa

Source: *Per Draft Water Use & Development Plan, Koolau, ** also referred to as "Old Haiku", *** Replaced portions of Old Haiku-Spreckels Ditch

BENCHMARKS SUGGEST COSTS TO REPAIR STREAM DIVERSIONS

IoTask

Hawaii 2004 Low End	Hawaii 2004 High End	Colorado Basin
$134,000*	$260,000*	$821,734

Estimate	Hawaii 2004 Low End	Hawaii 2004 Hight End	Colorado Basin
Cost Per Unit	$0.13 Mil	$0.26 Mil	$0.82 Mil
Total Costs	$4.76 Mil	$9.23 Mil	$29.17 Mil

The model assumes 10 percent of the stream diversions require maintenance and upgrades. This assumption is based off the EIS report, and current best practice.

Hawaii figures are adjusted for inflation.

Source:
IoTask team analysis 2020
https://drive.google.com/file/d/1fqNTrAeW0D6oBo10w3jbcp8ZL9_4Ixc2/view?usp=sharing
http://files.hawaii.gov/dbedt/op/spb/Volume_III_Assessment_of_Irrigation_Systems_in_Hawaii_FINAL.pdf
https://hdoa.hawaii.gov/arm/files/2012/12/AWUDP-Dec2003.pdf
https://hdoa.hawaii.gov/arm/files/2012/12/AWUDP-Dec2003.pdf
https://www.usbr.gov/lc/socal/reports/SMCUPPermit15000/appendices/AppF.pdf
https://dnrweblink.state.co.us/cwcb/0/edoc/207567/SWSI%20Appendix%20B_v3.pdf?searchid=2c0bd01b-36ef-494b-8be0-b346ecde0153

BENCHMARKS SUGGEST COSTS TO REPAIR DAMS/RESERVOIRS

IoTask

TITLE

Australia Estimate (with hydro)	$76.2	in Mils
American Rivers Estimate (with hydro)	$53.1	in Mils
Small Dams Estimate (with just irrigation)	$9.6	in Mils
EIS Estimate	$50-100	in Mils

TITLE

Australia Estimate (with hydro)		
American Rivers Estimate (with hydro)		
Small Dams Estimate (with just irrigation)	$0.22	mills per MG
American Rivers Estimare (with hydro)	$0.16	mills per MG
Small Dams Estimate (with just irrigation)	$0.03	mills per MG

DAM/RESERVOIR CHARACTERISTICS

RESERVOIR NAME	ACRE-FT/MG	ACRES	MG	MGD
Haiku Reservoir	266.0 acre-ft / 86.7 MG	266	86.6	2.8
Kapala'alalea Reservoir	197.0 acre-ft / 64.2 MG	197	64.2	2.1
Kaupakaulua	210.0 acre-ft / 68.4 MG	210	68.4	2.2
Papa'aea Reservoir	154.0 acre-ft / 50.2 MG	154	50.2	1.6
Pauwela Reservoir	142.0 acre-ft / 46.3 MG	142	46.3	1.5
Peahi	72.0 acre-ft / 23.5 MG	72	23.5	0.8
Kolela Reservior	NA			
	TOTAL:	1041	339.2	11.1

Source: Prof. Andrew Whittle, Massachusetts Institute of Technology (MIT)
https://www.americanrivers.org/conservation-resource/money-pit/
https://aurora.auburn.edu/bitstream/handle/11200/4089/BULL0647.pdf?sequence=3&isAllowed=y
http://dams.hawaii.gov/DamInformation.aspx?id=63a91150-ea1a-42d6-bd13-671b9645cad2
https://www.sciencedirect.com/science/article/pii/S2589915519300100

THE FUNDING TO UNDERTAKE THIS REPAIR CAN BE SUPPORTED WITH A BOND ISSUE FOR $250MIL WITH OWNERSHIP OF THE SYSTEM AND THE RIGHT PLAN

IoTask

- **Revenue derived from the delivery of water at current market rates would comfortably cover payments on a $250 million bond.**
- **Additional recurring revenues are obtainable from the installation of micro-hydropower plants at the six (of eight) restored reservoirs, generating an additional $9 Mil per year.**
- **Recurring revenue flows can support a bond issue by Maui county of $200-250 Mil to finance**
  - EMI infrastructure upgrades (including the restoration of reservoirs)
  - Installation of micro-hydro plants
  - Support deployment of ubiquitous Broadband in the East Maui watershed
  - The construction of a world-class research and learning center focused on land and water stewardship
- **EMI has failed to invest in the upkeep and upgrade of the infrastructure and is using the infrastructure degradation to subsequently justify discounted future prices. The county could easily undertake and guarantee the upgrade of the infrastructure through a bond that would be paid back rapidly through market priced water delivery.**

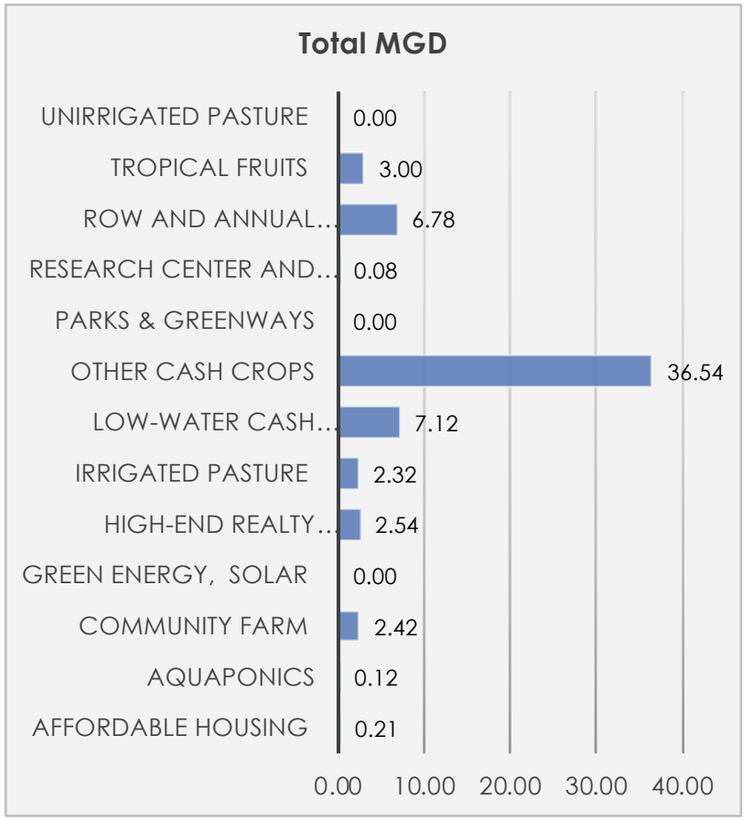
KNOWN PRIOR INVESTMENTS TO DATE IN THE EAST MAUI IRRIGATION SYSTEM TOTAL LESS THAN $5 MIL IN TODAY'S DOLLARS

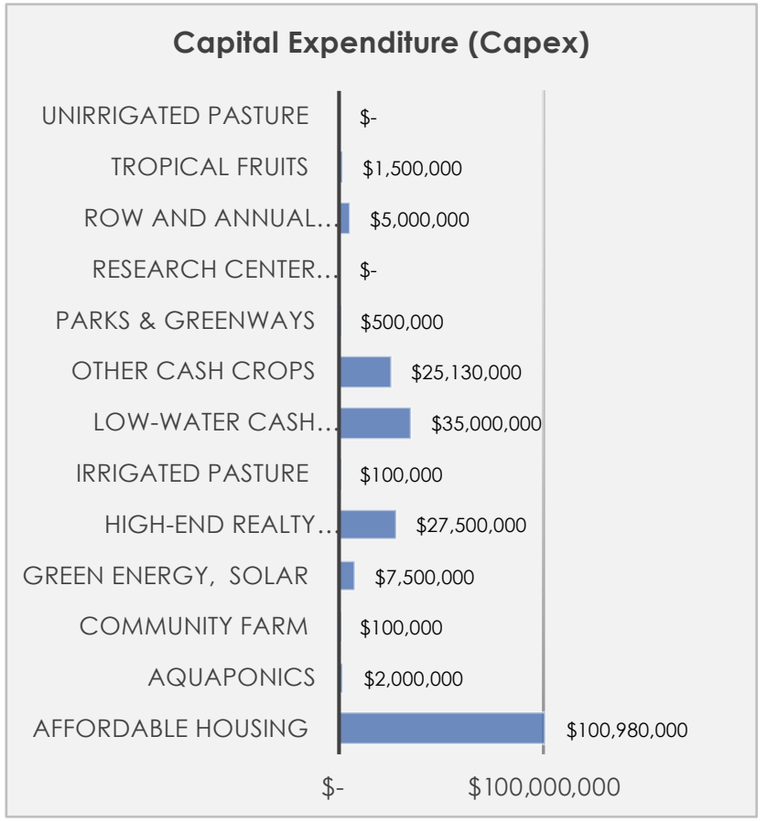
IoTask

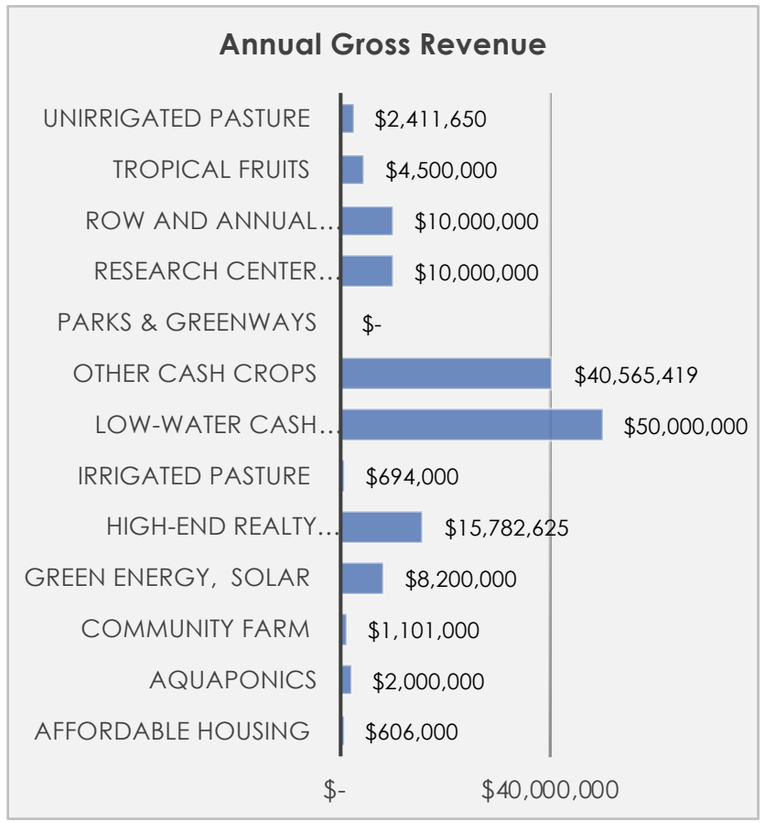
- September 9th, 1876, King Kalākaua granted the first Water License which was necessary for the construction of the first "ditch," which sourced water out of streams of the Hāmākua Loa District.
- September of 1878 the Hāmākua ditch was completed at a cost of **$80,000** with financing from Castle and Cooke, of Honolulu. The reported final cost far exceeded the initial estimate of **$25,000.**
- Spreckles Ditch, the second ditch was completed at a construction cost of **$500,000**. It was 30 miles long with a capacity of 60 Mil gallons per day.
- January 9, 1922, East Maui Irrigation Company announced that it would be issuing **$750,000** in 15-year first mortgage gold bonds yielding 7 percent. The Hawaiian Trust Co underwrote the entire issue and served as trustee. Alexander & Baldwin stated that the proceeds from the bond sale would be used, in part, to repay advances made to enlarge and extend the ditch system as well as to complete the work, including
    - cementing all of the main tunnels and enlarging them to a height of 9 feet.
    - widening and deepening the open ditches and lining them with concrete.
    - increasing the volume of water delivery, plans were made for extensive hydroelectric installations.
- The EMI water system was valued at around **$5 Mil** in the sale from A&B to Mahi Polo in 2016.

Source Associated Press, Honolulu, January 10, 1922 :

DIFFERENT END-USE OPTIONS FOR A TOTAL 30,000 ACRES RESULT IN SIGNIFICANT OPTIONS FOR IMPROVED OUTCOMES







LOW WATER CASH CROPS PROVIDE A COMPELLING ALTERNATIVE

Note: There is NO CAPEX associated with the Research Center because the model assumes a separate funding source
Source: IoTask team analysis 2020

A MORE DETAILED ANALYSIS OF EACH TYPE OF CROP FOLLOWS SUBSEQUENTLY

IoTask

- **The following examples are not meant to be in-depth analysis but provide examples to promote community discussion and policy makers with potential options to consider.**
- **Each example is compared to the baseline of Sugarcane to comment on**
  - Economic Pros and Cons
  - ESG Pros and Cons
  - Market potential
  - Market pricing
- **Options considered include Sugarcane, Specialty crops like saffron, lavender, food security crops like potatoes, Horticulture crops like pongamia trees, solar, low-income housing and university campuses.**

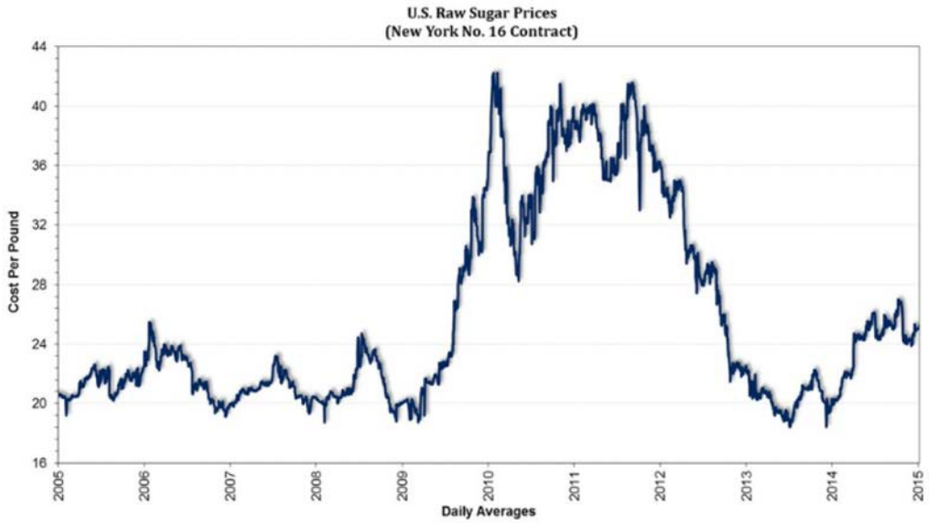
SUGARCANE IS THE WORST OPTION FOR BOTH ECONOMIC AND ESG OUTCOMES

Agribusiness, 2014 compared with 2013

(dollars in Mils)	2014	2013	Change
Revenue	$120.5	$146.1	-18%
Operating profit (loss)	-$11.8	$10.7	NM
Operating profit margin	NM	7.5%	
Tons sugar produced	162,100	191,500	-15%
Tons Sugar Sold	154,300	159,600	-3%

Sugar production was not profitable for A&B when the price for sugar fell bellow $24 per pound.

But A&B had previously made an operating profit off sugar when prices were lower.



A&B'S COSTS:
- **Labor**
- **To Market (Shipping)**
- **Production**
- **Legal**
- **Water**

Food Products, 2004 compared with 2003

(dollars in Mils)	2004	2003	Change
Revenue	$112.8	$112.9	- - -
Operating Profit	$4.8	$5.1	-6%
Tons Sugar Sold	198,800	205,700	-3%

Data from A&B's 2014 annual report: http://investors.alexanderbaldwin.com/static-files/c0e53439-c668-4729-9f9d-f0be1510e208

Data from 2005 annual report: http://getfilings.com/o0000003453-05-000019.html

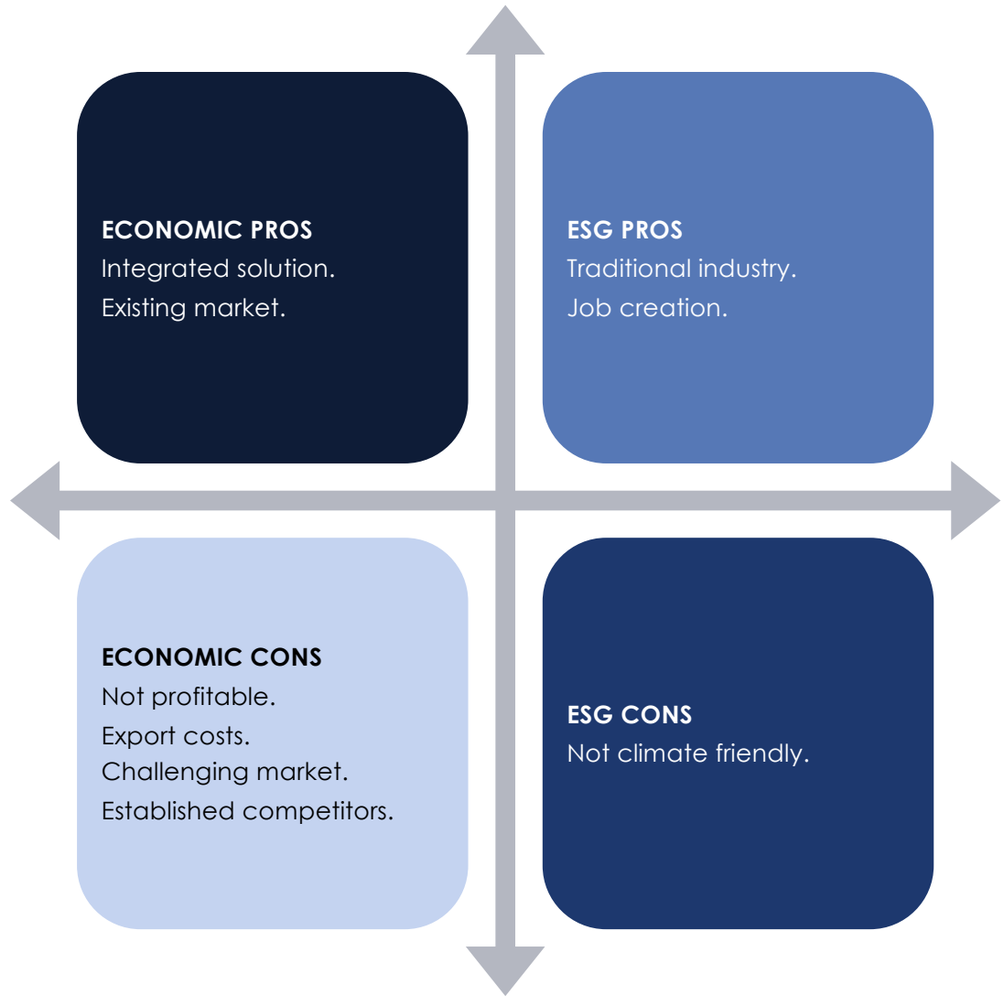
RANCHING HAS BENEFITS IN TERMS OF TRADITIONAL JOB CREATION

IoTask

- **Ranching is a $45Mil a year industry for Hawaii.**
- **Already some ranch land on Mahi Pono, and access to processing facilities.**

LIST OF FACILITIES

Program	Year	Period	Geo Level	State	State ANSI	watershed_coc	Commodity	Data Item	Domain	Domain Category	Value
SURVEY	2019	YEAR	STATE	HAWAII	15	00000000	CATTLE	CATTLE, INCL CALVES - PRODUCTION, MEASURED IN $	TOTAL	NOT SPECIFIED	41,387,000
SURVEY	2019	YEAR	STATE	HAWAII	15	00000000	CATTLE	CATTLE, INCL CALVES - PRODUCTION, MEASURED IN LB	TOTAL	NOT SPECIFIED	35,038,000
SURVEY	2019	FIRST OF JAN	STATE	HAWAII	15	00000000	CATTLE	CATTLE, INCL CALVES - INVENTORY, MEASURED IN $ / HEAD	TOTAL	NOT SPECIFIED	700
SURVEY	2018	YEAR	STATE	HAWAII	15	00000000	CATTLE	CATTLE, INCL CALVES - PRODUCTION, MEASURED IN $	TOTAL	NOT SPECIFIED	45,056,000
SURVEY	2018	YEAR	STATE	HAWAII	15	00000000	CATTLE	CATTLE, INCL CALVES - PRODUCTION, MEASURED IN LB	TOTAL	NOT SPECIFIED	34,610,000
SURVEY	2018	FIRST OF JAN	STATE	HAWAII	15	00000000	CATTLE	CATTLE, INCL CALVES - INVENTORY, MEASURED IN $ / HEAD	TOTAL	NOT SPECIFIED	750



Data from USDA. https://quickstats.nass.usda.gov/results/7853C708-128A-3D99-982A-D11D834C2DAB

TRADITIONAL HIGH VALUE CROP COULD DELIVER HUNDREDS ($00'S) MILS IN REVENUES

- **The market price for Saffron is around $1,500 per lb.**
- **Approximate yield is 5 lb. per acre.**
- **$300Mil from 41,000 acres.**

ECONOMIC PROS
Profitable.
$300Mil for 41,000 acres.

ESG PROS
Job Creation.
Low water usage.
Potential for small farmers.
Learn new skills.

ECONOMIC CONS
Dependent on external market prices.
High cost to get product to market.
Need to develop a market for U.S. saffron.

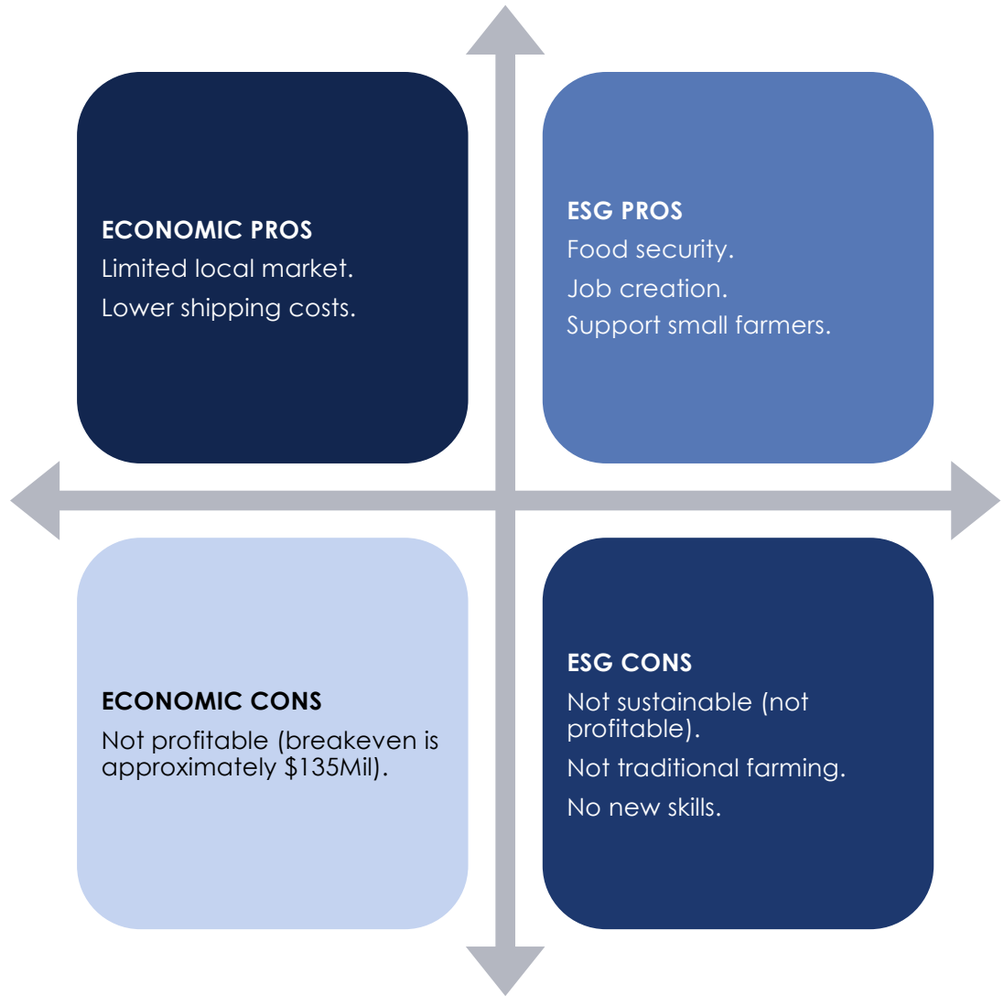
ESG CONS
Does not offer food security.
Not additive to the community (outside of jobs).
Not traditional farming.
Not sustainable farming.

CROPS LIKE POTATOES COULD PROVIDE FOOD SECURITY

MAHI PONO POTATOES

PRICE FOR POTATOES

- **Potatoes = $0.11 per lb.**
- **21,200 lbs. per acre.**
- **$96Mil from 41,000 acres.**



https://www.ams.usda.gov/mnreports/fvdidnop.pdf

INNOVATION CROPS LIKE PONGAMIA HELP REACH SUSTAINABLE FOOD GOALS

PONGAMIA TREES ON OAHU'S NORTH SHORE.

Ag tech start up Terviva is already active in Hawaii and on Maui.

"We offer an economically attractive, permanent crop with low input costs, mechanical harvesting and a diversified basket of protein and oil products for food, feed and fuel."

ECONOMIC PROS
- Highly profitable product.
- Built in buyer, end to end solution.
- Potential for production and innovation.
- Already partnered with A&B.
- Availability of impact financing and partners.

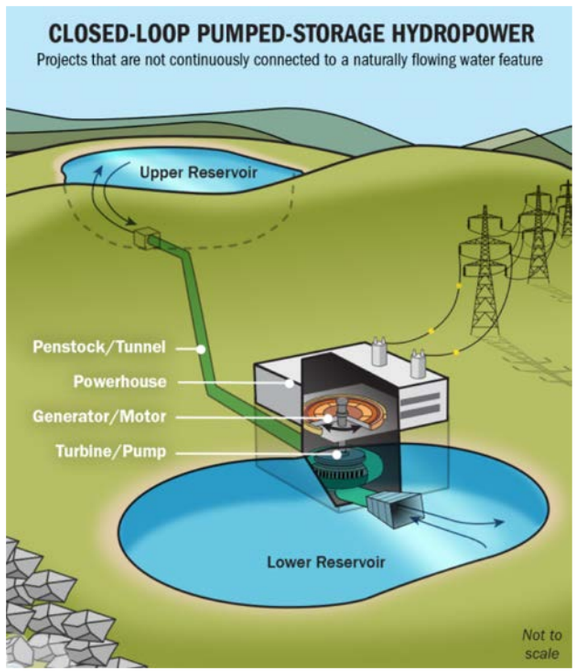
ESG PROS
- Help Hawaii reach carbon goals.
- Sustainable food.
- Help fix global food system.
- Jobs.
- New skills, potential for innovation.
- Low water usage.
- Values aligned partners.

ECONOMIC CONS
- Trees take four years to grow.
- Don't currently have capacity for the entire acreage.
- New market.
- Innovation risk.
- Shipping costs.

ESG CONS
- Only indirectly helps with food security.
- Not traditional agriculture (although trees do already grow on Hawaii).

Source: https://www.terviva.com

SOLAR + PUMPED STORAGE TO REDUCE ENERGY COSTS AND HELP REACH CLIMATE GOALS



Agrivoltaics with reservoir pumped hydroelectric storage can provide multiple benefits across the Food-Energy-Water nexus.

ECONOMIC PROS

Low operating costs once established.

Work with known partners e.g. Maui Electric.

Increase crop production.

ESG PROS

Helps Hawaii achieve its climate goals.

Low water usage.

Increases food security

ECONOMIC CONS

Higher set up costs.

Lower density of PV panels.

Economic benefits untested at scale.

ESG CONS

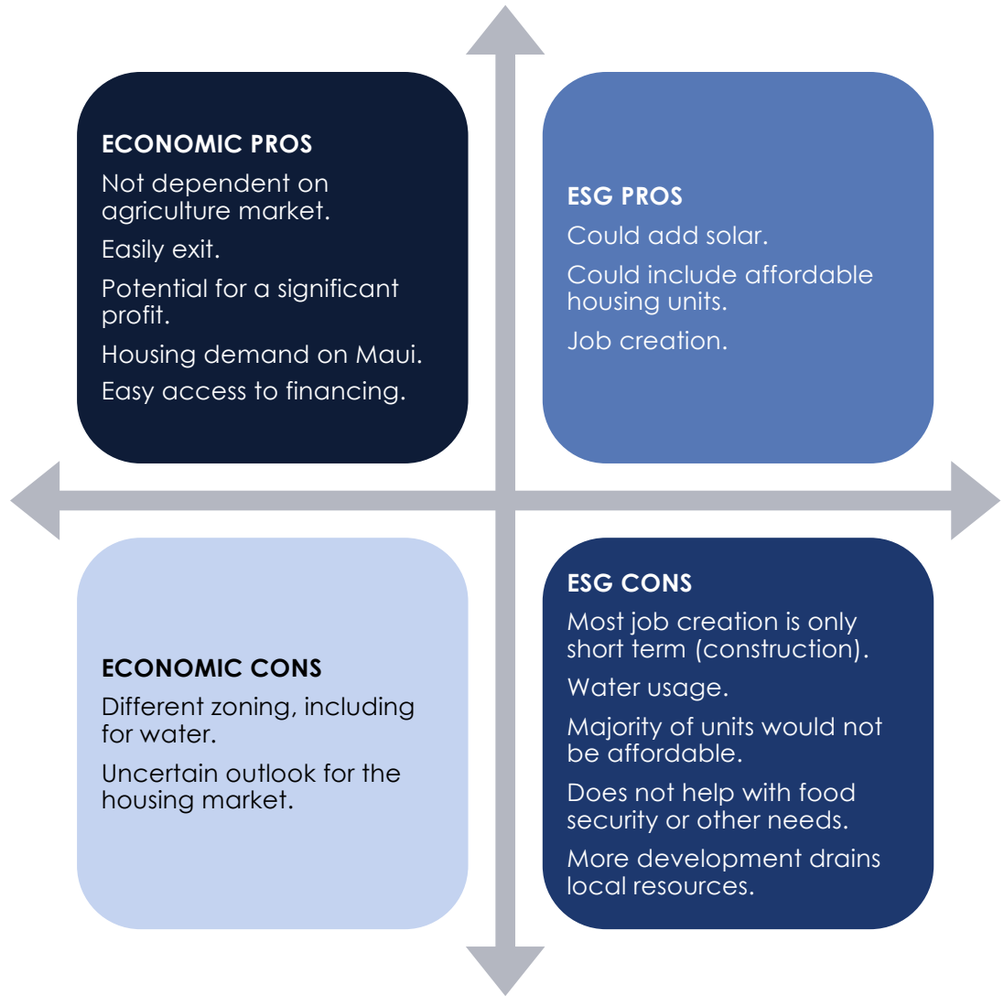
Potentially low job creation.

Potentially low aesthetics.

NON-AFFORDABLE CONDO DEVELOPMENT HAS SIGNIFICANT ESG COST AND NO LONG TERM NET BENEFIT TO LOCAL ECONOMY

CONDOMINIUMS	THIS QUARTER 2020 Q1	LAST QUARTER 2019 Q4	LAST YEAR 2019 Q1
Median Sale Price	▼ $562,500	▼ $511,000	$528,450
Average Sale Price	▼ $731,372	▲ $704,132	$703,551
Condos Sold	▲ 410	▲ 398	396
Median Days on Market	▼ 93	▲ 82	92
Bid Ups	▲ 10%	▼ 15%	10%

- Construction costs for a 350 condo development can be estimated at approximately $250 Mil, based on comparable developments in the state*. In addition to the money already paid for the land. Or, around $700k per unit.
- To convert the whole property into condos could total $1.6B, with a profit for investors of around $1 billion.
- The average sales price for a unit is $731,000.



See A&B financials

AFFORDABLE HOUSING COULD PROVIDE AN ALTERNATIVE WITH ESG BENEFITS

- Construction costs for affordable housing in Hawaii are approximately $400,000 per unit (excluding the cost of land.) Development of 500 affordable units would cost approx. $200mm.
- There is a serious need on Maui for affordable housing for teachers, healthcare workers, and hospitality sector workers.
- Annual rental revenue for 500 units for people making 60% MCMI totals $7.5mm. Annual rental revenue for 500 units for people making 30 % MCMI totals $3.85mm.
- Some construction costs can be offset by subsidies and grants.

http://www.hawaiibusiness.com/wp-content/uploads/HB-04-16-Affordable-Housing_CHART.pdf
https://www.stanfordcarr.com | https://www.census.gov/quickfacts/mauicountyhawaii

ECONOMIC PROS

Not dependent on agriculture market.

Easily exit.

Potential for profit.

Housing demand on Maui.

Easy access to financing.

ESG PROS

Could add solar.

Could make housing water efficient.

Job creation.

Huge local need for affordable housing.

Could provide housing for healthcare workers, teachers, etc.

ECONOMIC CONS

Different zoning, including for water.

Uncertain outlook for the housing market.

Affordable housing is less profitable than high end real estate.

It's a challenge to make the economics work.

ESG CONS

Most job creation is only short term (construction).

Water usage.

Does not help with food security.

NIMBY objections.

A CENTER OF EXCELLENCE CAMPUS OR INSTITUTE CAN CREATE A BETTER FUTURE FOR MAUI'S CITIZENS

Santa Fe Institute, Santa Fe, New Mexico

CENTER NEEDS:

- **Classrooms**
- **Laboratories**
- **Student housing**
- **Faculty housing**
- **Communal space**
- **Innovation hub**

Median dorm: 140,000 square feet for 380 residents, $200 per sq. ft
Assuming 4 buildings, construction costs: $100Mil each.

Add in faculty and administrative housing, plus teaching facilities.

Total construction for typical 2,000 student capacity campus: $500 Mil
Annual operating budget: approx. $270 Mil.

REVENUES FROM: Tuition fees, Grants, Tech transfer

ECONOMIC PROS

Potential grant funding from not-for-profits and high-net-worth individuals.

Potential state and government funding.

Possibility for diversified revenue streams and investment in R&D.

Attracts technology and investment.

ESG PROS

Potential for economic development and partnership.

Job creation, education.

Testbed for ESG innovation.

Model for sustainable ag.

ECONOMIC CONS

Long term project with many stake holders.

Higher ed. in crisis.

Requires a zoning change.

ESG CONS

Potential for elitism.

Doesn't fully address food security.

EVENTUALLY THE MOST ROBUST OPTION IS A PORTFOLIO OF MIXED USE

Woods Hole Oceanographic Institution (above) provides another model for a research center – in this case, dedicated to ocean research, exploration, and education.

A mixed use scenario would take the best of these ideas combined in a way that is profitable for investors, sustainable, and accretive to the community.

A plan could include:

- University campus or research center
- Innovation hub
- Sustainable regenerative agriculture
- Renewable power
- Community farming
- Affordable housing

University of Hawaii Maui College has a 4-year Sustainable Science Management program and the Sustainable Living Institute of Maui (SLIM) that could be potential partners and collaborators.

STAKEHOLDER ASSESSMENT

STAKEHOLDER SUMMARY

IoTask

- **We identified, researched and interviewed 17 categories of stakeholders**
  - 10 Local community
  - 5 Government
  - 2 Investors
- **We learned that it is important to**
  - Acknowledge historical injustices and inherent conflict
  - Resolve divergent stakeholders needs creatively
  - Recognize that many stakeholders belong to or have binding relationships with other stakeholder groups
  - Create solutions through innovation that extend the potential of the resources

STAKEHOLDER SUMMARY

IoTask

- **In Hawaii, water is a public trust established for benefitting society**
  - Dual protection and maximum reasonable beneficial use
- **But today, many stakeholders don't believe that the trust is upheld**
  - Need to establish mechanisms for adherence to public trust
  - Confidence in public trust adherence must be achieved
- **The existing mechanisms for ensuring the public trust don't function because**
  - There is no transparency into the (dynamic) current state of water
    - Need mechanisms that allow for measurement in steams
    - Need to conduct an engineering assessment
  - Besides legal or legislative actions, there are few mechanisms to allow more dynamic, participative and equitable distribution of the water
    - Provide more dynamic, ESG-respecting and innovative ways to handle distribution

WE IDENTIFIED 17 CATEGORIES OF LOCAL STAKEHOLDERS BASED ON EXISTING REPORTS, FOCUS GROUPS AND INTERVIEWS

IoTask

LOCAL COMMUNITY

- Traditional Users
- Community Users (East Maui)
- Upcountry Farmers & Ranchers
- Hunters
- Recreational Users
- Researchers
- Environmental Community
- Agriculture/Business Community
- Development Community
- Organized Labor

GOVERNMENT

- Dept of Land and Natural Resources
- Dept of Hawaiian Home Lands
- Maui County Dept of Water Supply
- Maui County Government
- Hawaii State Legislature

INVESTORS

- ESG/Mission-aligned Investors
- Pure profit-seeking Investor

HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES (DLNR)

IoTask

MISSION STATEMENT:

"Enhance, protect, conserve and manage Hawaii's unique and limited natural, cultural and historic resources held in public trust for current and future generations of the people of Hawaii Nei, and its visitors, in partnership with others from the public and private sectors."

ABOUT:

Headed by a 7-member executive BOARD OF LAND AND NATURAL RESOURCES (BLNR), DLNR is responsible for managing, administering, and exercising control over public lands, water resources, ocean waters, navigable streams, coastal areas (except commercial harbors), minerals, and all interests therein.

JURISDICTION:

Jurisdiction encompasses nearly 1.3 Mil acres of State lands, beaches, and coastal waters as well as 750 miles of coastline (the fourth longest in the country). It includes state parks; historical sites; forests and forest reserves; aquatic life and its sanctuaries; public fishing areas; boating, ocean recreation, and coastal programs; wildlife and its sanctuaries; game management areas; public hunting areas; and natural area reserves.

MANAGEMENT, PROTECTION & STANDARDS:

In East Maui, DLNR manages unencumbered state land, including surface and ground water. Commission on Water Use Management (CWRM), which is also part of DLNR, has the mission of protecting and enhancing the water resources of the State of Hawaii through wise and responsible management. CWRM establishes Interim Instream Flow Standards (IIFS).

Source: https://dlnr.hawaii.gov/boards-commissions/

HAWAII DEPARTMENT OF HAWAIIAN HOME LANDS (DHHL)

IoTask

- Governed by Hawaiian Homes Commission Act of 1920, enacted by the U.S. Congress to protect and improve the lives of native Hawaiians, who are defined as individuals having at least 50 percent Hawaiian blood.

- Department headed by 9-member Executive Board. Primary responsibilities are to serve beneficiaries and manage its extensive land trust, consisting of over 200,000 acres on the islands of Hawai‘i, Maui, Moloka‘i, Lāna‘i, O‘ahu, and Kaua’i.

- DHHL lands are not currently directly serviced by water conveyed from the EMI system. Homesteaders in Keokea and Waiohuli receive water from the County Upcountry water system, some of which derives from the streams diverted by the EMI system.

- DHHL has first right of water use for future development.

- **DHHL would like to further and more directly access water from the EMI system to provide water to our lands in Waiohuli-Keokea (Upcountry) and Pulehunui (Central Maui) and will be submitting a water reservation request to the state CWRM for water from EMI.**

Sources: http://dhhl.hawaii.gov/dhhl/, Koolau Water Use and Development Plan, page 43, Survey 6/19/20, Survey, 6/19/29

HAWAII DEPARTMENT OF HAWAIIAN HOME LANDS (DHHL) (CONTINUED)

VALUES RELATED TO WATER ARE ARTICULATED IN DHHL'S WATER POLICY PLAN:

1. **Waiwai: Mōhala i ka wai ka maka o ka pua.** Unfolded by the water are the faces of the flowers. The availability of water to our lands and people is integral to the trust and our mission.

2. **Waihona: `Ua lehulehu a manomano ka `ikena a ka Hawai`i.** Great and numerous is the knowledge of the Hawaiians. Honoring and documenting our knowledge about water is essential to managing it.

3. **Mālama: He ali`i ka `āina; he kauwā ke kānaka.** The land is a chief; man is its servant. We consider water to be part of our genealogy and so we manage it in a manner that cares for its long-term sustainability for all things, as we also use it productively for our mission.

4. **Laulima: E lauhoe mai na wa'a; i ke kā, i ka hoe; i ka hoe, i ke kā; pae aku i ka 'āina.** Everybody paddle the canoes together; bail and paddle, paddle and bail, and the shore is reached. We are one people who now share Hawai`i with others. DHHL is only one of many Hawaiian serving institutions. We will assert our rights while considering our larger lāhui `ōiwi and the larger world in which we live.

Sources: http://dhhl.hawaii.gov/dhhl/, Koolau Water Use and Development Plan, page 43, Survey 6/19/20, Survey, 6/19/29

DETAIL ON GOVERNMENT

Maui County Department of Water Supply

- Mission is "to provide clean water efficiently".
- Enterprise Fund; budget is separate from the Maui County budget.
- Total operating expenses for 2019 were $62.3 Mil.
- DWS operates 780 miles of water transmission and distribution lines for 36,719 accounts on Maui and Moloka'i.
- DWS operates six water treatment plants.
- As of January 1, 2020, there were 1,569 applications on the Upcountry Water Meter priority list. In 2019, the DWS processed 51meter applications total.

Maui County Government

- Consists of the Administration led by the Mayor, elected every four years, and 9 council members, elected every two years. Administration of DWS falls under the Mayor, the Director of DWS appointed by the Mayor, approved by the County Council.
- Within County Council, Water, Infrastructure, and Transportation Committee and Environment, Agriculture, and Cultural Preservation Committee (handles East Maui water) have legislative oversight for water.

Hawaii State Legislature

- State representatives serve for two years, state senators for four years.
- Legislature meets annually, generally from January to May to pass legislation and budgetary items.
- Relevant committees in Senate include Water & Land, and in the House Water, Land, and Hawaiian Affairs.

Source: Maui County Government 2020

NON-GOVERNMENTAL LOCAL STAKEHOLDER DETAILS

IoTask

TRADITIONAL USERS

include East Maui kalo (taro) farmers and other indigenous cultural users of the streams and watershed. Users advocate individually and through traditional and current governance bodies.

COMMUNITY USERS

include East Maui residents who live near steams and/or depend on them. Majority do not have access to County systems so are dependent on catchment and/or streams, for which they do not pay directly.

UPCOUNTRY (on slopes of Haleakala) **FARMERS and RANCHERS**

access water from Dept of Water Supply, which pays EMI to deliver water to Kamole Weir to augment other DWS surface and well sources.

HUNTERS

can be from East Maui or outside of the area. They contain invasive species such as deer and pigs; have firsthand knowledge of watershed.

RECREATIONAL USERS

include tourists and residents. Road to Hana is 2nd most popular tourist destination in Hawaii with waterfalls as a primary attraction. COVID-19 closed road to non-residents through 7/1/20.

RESEARCHERS

include USGS, University of Hawaii, other scientists and independent community-based experts.

ENVIRONMENTAL COMMUNITY

includes Maui Tomorrow, Sierra Club, and individuals. Other advocates include Native Hawaiian Legal Corp and other Hawaiian-rights focused individuals and groups.

AGRICULTURE / BUSINESS COMMUNITY

includes owners of East Maui land and water system: Alexander & Baldwin, Mahi Pono, ranching consortium as well as Hana Ranch and Trevassa Hotel.

DEVELOPERS

include anyone wishing to build who is interested in accessing East Maui water, whether in central valley or upcountry or for affordable housing.

Source: Iotask team analysis 2020

CURRENT ECONOMIC STAKEHOLDERS

IoTask

MAUI COUNTY OR STATE OF HAWAII

PRIVATE CAPITAL MANAGERS

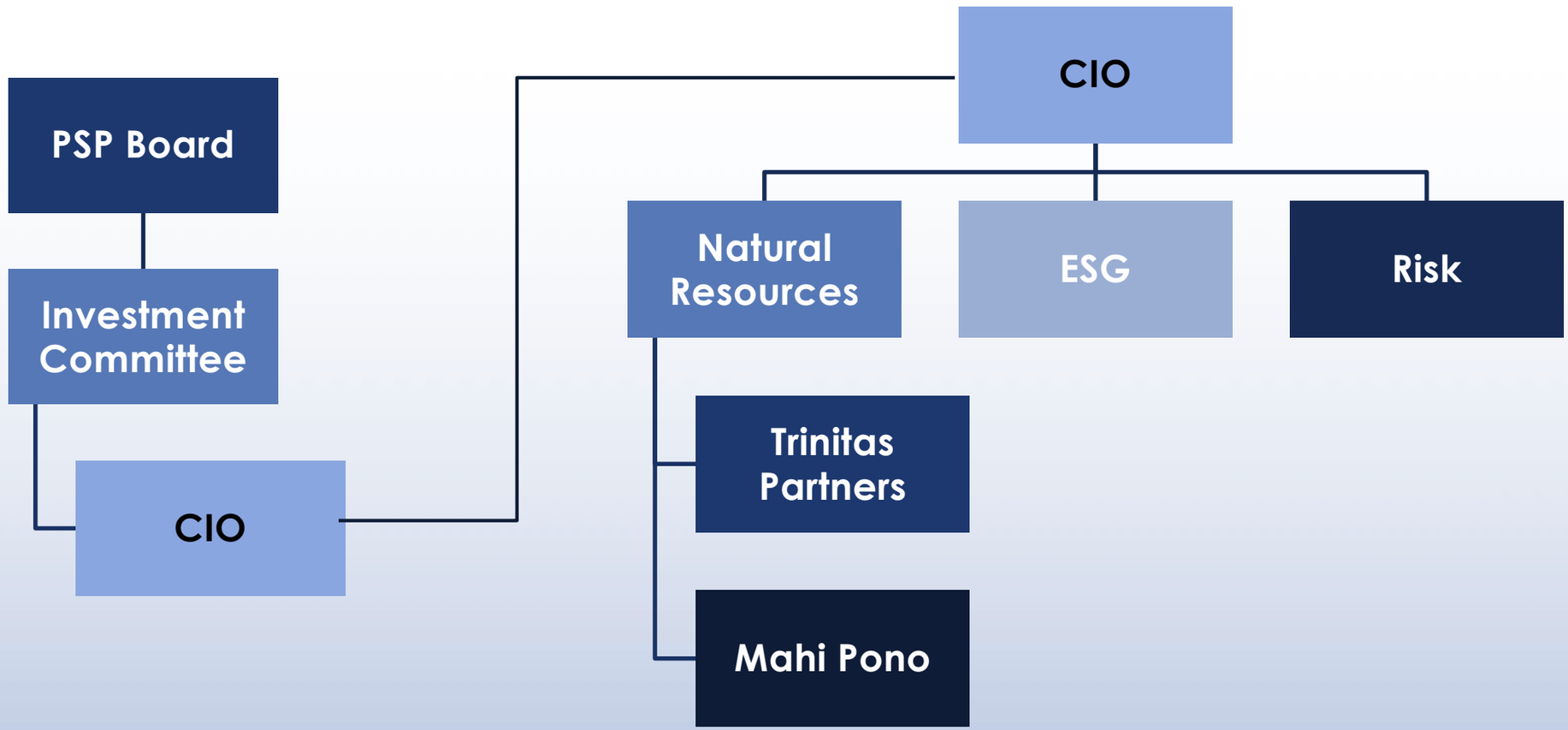
CAPITAL PROVIDER
Institutional Asset Owners
Organized labor
Retail Investors

IMPACT INVESTORS

MISSION RELATED INVESTORS

GRANT GIVING INSTITUTIONS

THE PUBLIC SECTOR PENSION INVESTMENT BOARD



MAHI PONO HOLDINGS LLC

ADDITIONAL SOCIAL CONSIDERATIONS

IoTask

Recreation	Ecosystem Maintenance	Aesthetics	Navigation	Hawaiian Rights	Non-instream Uses
• Swimming • Nature Study • Fishing • Boating • Parks • Other	• Estuaries • Wetlands • Riparian areas • Nearshore Waters • Natural Area Reserves • National Parks • Other Protected Areas • Other	• Scenic Views • Waterfalls • Tourism • Other	• Boating • Other	• Traditional & Customary Rights • Taro Cultivation • Appurtenant Rights • Cultural Values • Other	• Diversion • Domestic/ Municipal Use • Agriculture • Industrial • Present vs Potential Use • Economic Impacts

LOCAL COMMUNITIES ARTICULATED THE FOLLOWING AS THE SINGLE MOST IMPORTANT ISSUES

1. Provide an efficient working, equitable, forward thinking solution for everyone, addressing future needs including environmental and climate risks.

2. Address private-sector incentive misalignment with public good, combined with a lack of trust, fairness, negative impact in historical actions and lack of follow-through on past commitment.

3. Modernize system, impartially & professionally assess system, address lack of accurate information and transparency.

4. Incorporate value as not monetary but far more about public access & participation, justice and reconciliation, balance, traditional use, food supply – money can't buy water.

5. Determination, governance, & management around rights, access to water, traditional trails, streams must be determined by people.

Source: EIS, Community interviews, IoTask team analysis 2020

LOCAL COMMUNITY STAKEHOLDERS IDENTIFIED 13 BROAD CATEGORIES OF CRITICAL NEEDS

IoTask

1. Diverted surface water provision and delivery (continuity, storage, reliability).
2. Undiverted stream water — (connectivity, temperature, setbacks, flow).
3. Watershed management and stream care, including flood control.
4. Depreciation of EMI infrastructure and attendant safety issues.
5. Affordability, fair access, distribution and priority schemes for access to streams and water.
6. Allocation prioritization and transparency: including accurate projections for DHHL.
7. Monitoring & data on stream flows, rainfall, amount of traditional usage.
8. Support for traditional uses (taro/kalo farming, hunting, and other cultural practices).
9. Water sustainability that ensures long-term sustainable yields of the aquifer and equitable access to water.
10. Transparency, oversight into water measurement, management and distribution.
11. Environmental protection, including flora & fauna from mauka to makai (the mountains to the sea).
12. Incentive misalignment and private-sector accountability.
13. Public stakeholder representation in water governance

Source: EIS, Community interviews, IoTask team analysis 2020

ECONOMIC STAKEHOLDERS HAVE VERY DIFFERENT MOTIVATIONS

IoTask

LEGACY OWNER – A&B

- Seek a remunerative exit from ownership/investment.
- Want to avoid paying Mahi Pono $67mm, payable if the water rights are not secured.
- Serve their shareholders.

PRIVATE CAPITAL MANAGER – TRINITAS PARTNERS

- Make about 15% IRR over a 10 year period (assume a hurdle rate of 8 percent).
- Raise capital from institutional asset owners.
- Establish and maintain their brand.
- Be regarded as a lead ESG fund manager in agriculture.

CAPITAL PROVIDER – THE PUBLIC SECTOR PENSION INVESTMENT BOARD (PSP)

- Achieve an annualized rate return of 6.4%.
- Need to put large amounts of capital to work.
- Support ESG framework.
- Pay pension beneficiaries (organized labor).
- Fiduciary duty of care (and oversight).

ORGANIZED LABOR

- Create jobs and benefits for members.

Source: PSP Annual Report, IoTask team analysis 2020

PSP ON MAHI PONO

- **ENVIRONMENTAL:** "If we didn't have the irrigation assets and associated water licenses, we wouldn't be able to undertake the cropping plan we have here, it's all very integrated," -Marc Drouin, head of Natural Resources, PSP Investments

- **WORKING WITH COMMUNITIES:** "Mahi Pono, one of our farming joint ventures, acquired former sugar cane plantations on the island of Maui in Hawaii. Our ESG analysis of the transaction included an in-depth assessment of the sustainability of the water required for operations and the potential long-term impact of climate change. We also engaged with community stakeholders and our agri-food partners worldwide to help develop a sustainable and diverse farming plan. The resulting plan will provide many benefits, including creating local jobs, increased local food supply, dedicated land for local farmers to grow their own crops with assistance from farm managers, an on-site farmers' market, and local agriculture training programs."

Source: Agri Investor, February 2019 https://www.agriinvestor.com/hawaii-cropping-plan-reflects-ag-strategys-growth-psp-investments/, PSP 2019 Responsible Investment Report, https://www.investpsp.com/media/filer_public/documents/PSP-2019-responsible-investment-report-en.pdf

THE UNIVERSE OF ESG, IMPACT INVESTMENT IS GROWING

IoTask

- **The ESG, Impact investment community has numerous potential funders and investors.**
- **There are grant giving entities that can fund early stage innovation, and mission orientated investment that can be used as catalytic capital.**
- **Foundations and investment managers are looking to invest in ESG fixed income opportunities, including social impact bonds and municipal debt.**
- **True ESG real estate and real asset impact investors are looking for mission aligned opportunities.**
- **Venture capital investors are seeking partners for innovation.**

ESG, IMPACT INVESTORS MARKET MAP

IoTask

ESG Investors, Market Makers, Fund Managers Include

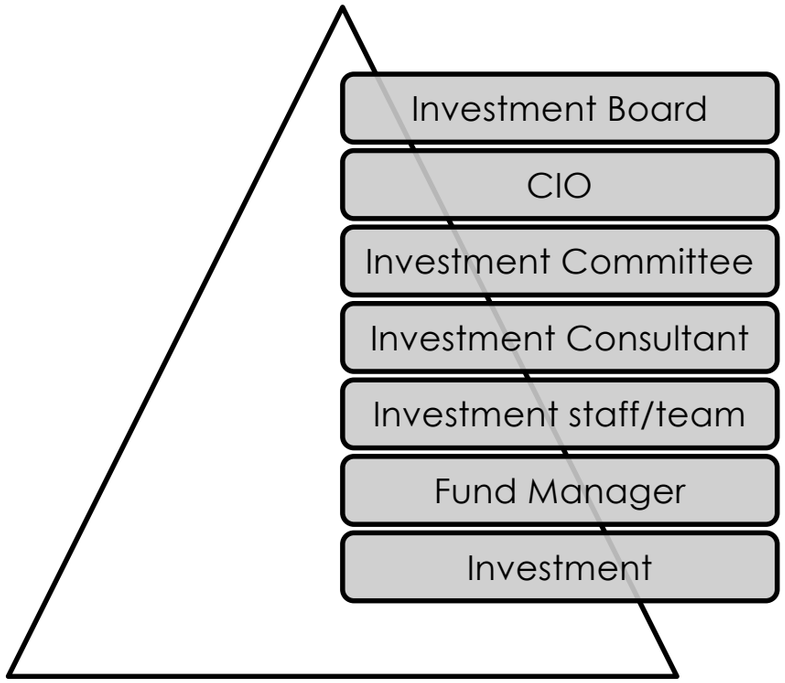
Catalytic Capital	Debt	Real Assets	(Private) Equity	Venture
•Rockefeller Foundation •Social Finance U.S. •Rockefeller Brothers Fund •Omidyar Network •Elemental Excelerator •McKnight Foundation •MacArthur Foundation	•Avenue Capital •Quantified Ventures •Heron Foundation •Vison Ridge •Goldman Sachs Asset Management •BNY Mellon •Community Capital Management •Spring Lane Capital	•Turner Impact •Bio-Logical Capital •PGIM •Jonathan Rose Companies •The Lela Goren Group •UC Regents •LACERA	•Generation Investment Management •Bain Capital Double Impact •Sightway Capital •MidOcean Partners •EQT •Bridges Fund Management •TPG Rise •Inclusive Capital Partners •Impactive Capital	•Ecosystem Integrity Fund •Capricorn Investment Group •Congruent Ventures •New Energy Nexus •Blue Haven •MIT Engine •Palm Ventures •Breakthrough Energy Coalition •Gratitude Railroad

Some impact, ESG investors in our network include:

INSTITUTIONAL ASSET OWNERS HAVE AN AGENCY PROBLEM

Institutional investors hire consultants and fund managers to invest on their behalf. This creates an agency problem and a lack of transparency

Capital flows from one investment office to many investment funds, and numerous investments.



Fund managers are responsible for sharing information about their investments with investment consultants and investment staff, who then communicate with their investment leadership. As trusted sources of information, and authorities on their investments, fund managers are given the benefit of the doubt.

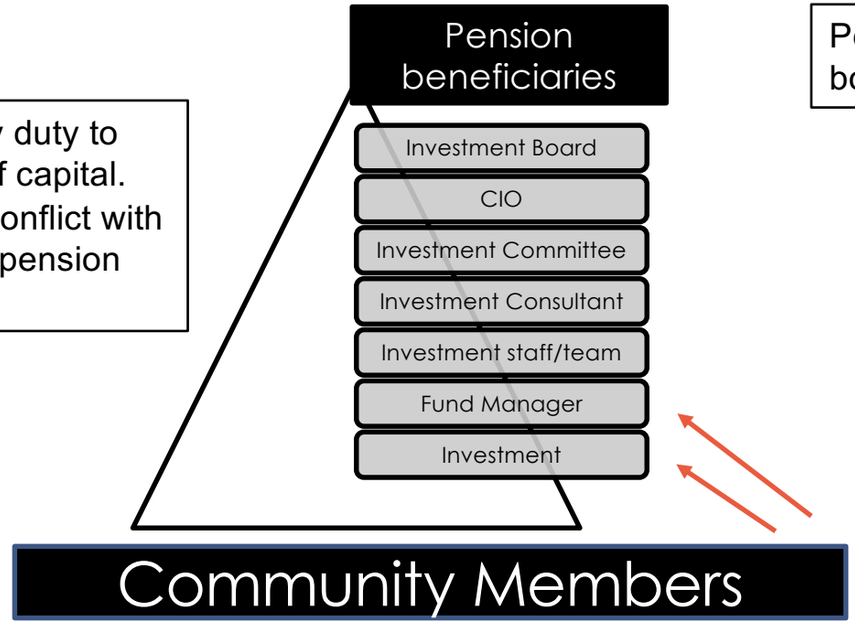
More often than not, fund managers decide on the ESG credentials of an investment. The investment staff might review their analysis and ask questions, but fund managers are hired to do a job: invest. Credible ESG metrics are often lacking.

IT'S DIFFICULT FOR INSTITUTIONAL INVESTORS TO HEAR THE VOICES OF THE LOCAL COMMUNITY

IoTask

Institutional investors are responsive to their stakeholders (pension beneficiaries) but the voice of local stakeholders (community members) rarely trickles up to them. Unless issues are communicated through an organized campaign, at which point it is often too late for the investor to take action. E.G. Toys R Us.

Investment staff have a fiduciary duty to seek the highest and best use of capital. That can, at times, put them in conflict with the interests and values of their pension beneficiaries.



Pension beneficiaries communicate primarily with the board and their pension representatives.

The community members engage with the investment and, sometimes, the fund manager. It is the job of the fund manager to manage that relationship and risk.

INVESTORS CAN BE SUSCEPTIBLE TO GREENWASHING

IoTask

- Green, or impact, washing occurs when an investment or business claims to be a good ESG investment but, in fact, is not and is using the appearance of ESG or impact to cover up bad actions.
- In a well know example, the car manufacture Volkswagen Group sought out, and received, sustainability awards, while falsifying its emission tests.
- If investors are getting all, or most, of their ESG information from the company or fund manager then it is depending on the company or fund to form its opinion on whether an investment is meeting its ESG standards.
- An investor can do its own independent ESG due diligence but that takes time and resources and may require information not accessible to the end investor.
- For some investments ESG audits are being required, but these are paid for and mostly use data provided by the fund managers.
- Outside of circumstances where behavior is regulated (e.g. diesel emissions) there is often no legal penalty for false ESG reporting.

PSP ESG FRAMEWORK

General ESG framework

E–

Environmental factors capture both the impact of a company's activities on the ecosystem and the ecosystem's impacts on that company

S–

Social factors focus on the impact that a company has on a community or society as a whole, as well as the impact of a community or society on that company

G–

Governance factors assess how companies are governed, in areas such as board composition and effectiveness (e.g., skillset, diversity, board renewal and independence); executive compensation; and business ethics, including anti-bribery, corruption

ESG integration framework

	Investment opportunity	Investment decision	Investment monitoring	Investment review
Internally managed investments	Identify key ESG factors and determine due diligence scope	In-depth assessment of material ESG risks and opportunities	Monitoring of ESG risk and performance, shareholder engagement and *proxy voting**	Re-assessment of material ESG risks and opportunities
Externally managed investments	Define due diligence scope based on investment strategy	In-depth assessment of ESG integration practices	Engagement on ESG best practices	Re-assessment of ESG practices

* *Applicable to public market investments*

PSP 2019 Responsible Investment Report
https://www.investpsp.com/media/filer_public/documents/PSP-2019-responsible-investment-report-en.pdf

EXTENSIVE STAKEHOLDER OVERLAP AMONG RESIDENTS

IoTask

- Tri-isle multi-generational population of 165,000.
- Most "stakeholders" belong to more than one stakeholder group (traditional user can also be community user; hunters can also be upcountry rancher…)
- Familial linkages across the island mean upcountry users may be related to East Maui traditional users, for example; DHHL beneficiaries may be related to farmers; traditional users may have relatives who work in tourism; etc.
- In spite of conflicting needs, there is a general desire among stakeholders to find solutions that support all users, as long as there are appropriate safeguards in place.
- Many stakeholders also feel a sense of kuleana/responsibility to the overall Maui island community.

THE BROADER COUNTY AND STATE PRIORITIES TODAY MUST ALSO BE FACTORED INTO THE NEEDS

IoTask

ECONOMIC DEVELOPMENT

- Growth, rebuild, jobs creation,
- Post Covid exigency - 35% unemployment

ECONOMIC PARTICIPATION

- Poverty, economic disparity
- Native Hawaiians experience worst economic indicators compared to other groups

FUTURE OF WORK – TECH DEVELOPMENT, BROADBAND INFRASTRUCTURE

- High quality employment from a better future of work
- Lack of opportunities for technically proficient talent

CLIMATE CHANGE PRESSURES BECOME CRITICAL

- Highest ever temperatures recorded
- Natural resources are depreciating

FOOD SECURITY

- 90% of food is imported

Source: Maui County Government 2020

MANY TRADITIONAL VALUES THAT ARE IMPORTANT TO STAKEHOLDERS

IoTask

Traditional Users:

- **Aloha** for water, people, grounds; **Kuleana** (responsibility) - to want/need to take care; **Ho`oulu** (propagate) - to work together, share, vital to healthy ecosystem and lifestyle; **`Ike** (knowledge) - including use of technology

Upcountry Farmers:

- Ability to make a living to support families in a way that's responsible to the land and future generations, keeping agriculture in our families in the world.

Hunters:

- Water (wai): the diversion of pristine water disrupted thousands of years of Hawaiian life.

Recreational Users:

- Education, reverence, balance, communication, and respect. The watershed is a gift, sacred, healing; all users need to speak up for it.

Developers:

- Families need to be able to afford to live on Maui.

STAKEHOLDER PRIORITIES HAVE SIGNIFICANT COMMONALITY

IoTask

Users/ Communities	1. Surface water provision, uses	2. Stream Use	3. Watershed management	4. State of infrastructure	5. Equity in access	6. Allocation prioritization	7. Measurement monitoring
Traditional	X	X	X		XX		X
Community	X			X			
Upcountry Farmer/Rancher	XXX				XX	XX	
Hunters		X	X	X	X	X	X
Recreational		X	X		X	X	X
Researchers	X	X	X	X	X	X	XX
Environmental		X	X		X		
Ag/ Business	X			X		X	X
Development (Afford-able Housing)	X	X		X	X	X	
Total	6	6	5	5	7	6	5

Source: EIS, Community interviews, IoTask team analysis 2020

STAKEHOLDER PRIORITIES HAVE SIGNIFICANT COMMONALITY(CONTINUED)

Users/ Communities	8. Traditional uses	9. Water sustainability	10. Transparency, accountability, oversight	11. Environment, flora & fauna sustainability	12. Incentive misalignment	13. Public representation in governance
Traditional	XX	X	X	X	X	X
Community		X	X	X		X
Upcountry Farmer & Rancher			X		XX	XX
Hunters	X	X	X	X	X	
Recreational	X	X	X	X		X
Researchers	X	X	X	X	X	X
Environmental	X	XX	XX	XX	X	XX
Ag/ Business						X
Development (Afford-able Housing)	X	X				
Total	6	7	7	6	5	7

Source: EIS, Community interviews, IoTask team analysis 2020

THE MAJORITY OF STAKEHOLDER GROUPS AGREED ON A NEED FOR PUBLIC TRANSPARENCY, ACCOUNTABILITY AND REPRESENTATION

ISSUES OF MOST INTEREST TO ALL STAKEHOLDER GROUPS:

1.Public stakeholder representation in water governance.

2.Surface water provision and delivery as well as stream water access.

3.Water sustainability that ensures long-term sustainable yields of the aquifer and equitable access to water.

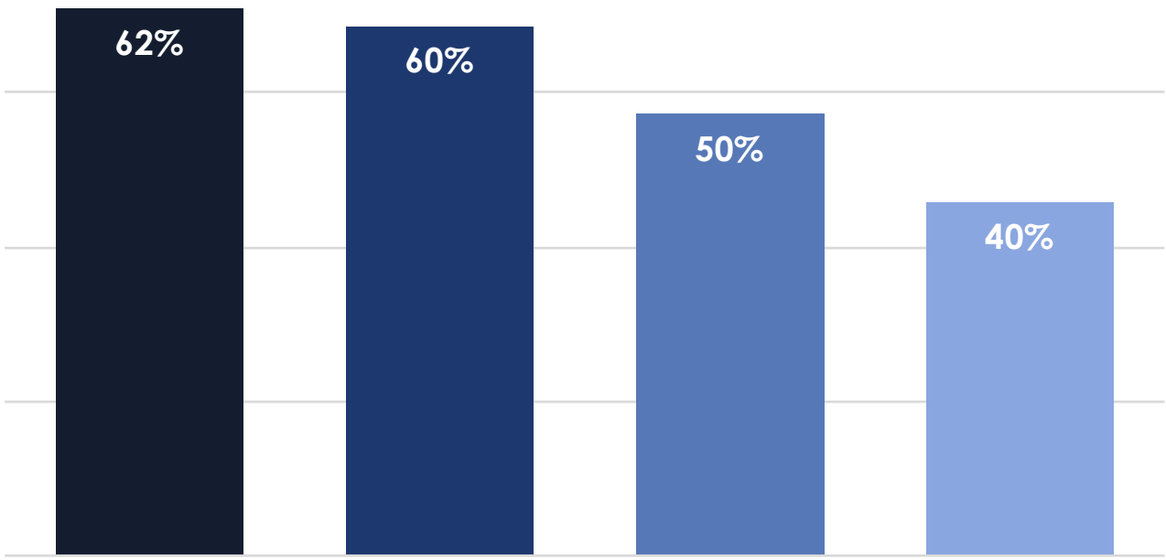
4.Transparency, oversight into water measurement, management and distribution.

5.Environmental protection, including flora & fauna from mauka to makai (the mountains to the sea).

Source: EIS, Community interviews, IoTask team analysis 2020

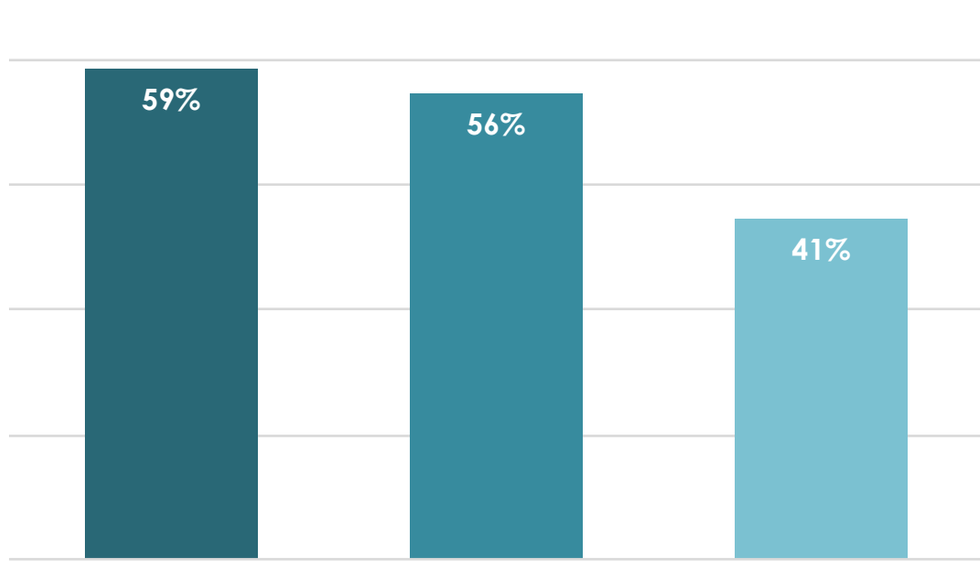
FUTURE NEEDS INCLUDE CONSERVATION, RECHARGE, REUSE AND LESSENING PRESSURES ON WATER

FUTURE CRITICAL NEEDS



Source: H20 Roundtable 2018

BEST OPTION FOR GROWING WATER



THE COUNTY OF MAUI HAS SIMILAR STAKEHOLDER NEEDS TO LOCAL COMMUNITIES BUT MINIMAL RESOURCES TO ACHIEVE

Policies related to water resource management include:

- Protect, preserve and increase natural marine, coastal and inland resources, encouraging comprehensive resource management programs.
- Ensure that groundwater and surface water resources are preserved and maintained at capacities and levels to meet the current and future domestic, agricultural, commercial, ecological and traditional cultural demands.
- Recognize residents' traditional uses of the region's natural resources, which balance environmental protection and self-sufficiency.
- Discourage water or land development and activities which degrade the region's existing surface and groundwater quality.
- Encourage resource management programs that maintain and re-establish indigenous and endemic flora and fauna.
- Protect, restore and preserve native aquatic habitats and resources within and along streams.
- Ensure that the development of new water sources does not adversely affect in-stream flows.
- Increase water storage capacity with a reserve for drought periods.
- Improve the existing potable water distribution system and develop new potable water sources prior to further expansion of the State Urban District boundary or major subdivision of land in the State Agricultural or Rural Districts.
- Ensure adequate supply of groundwater to residents of the region before water is transported to other regions of the island.

Source: Maui Island Water Use and Development Plan Draft, Ko`olau Aquifer Sector (ASEA)

THE WATER BOARD SUMMARY OF STAKEHOLDERS NEEDS WERE MORE FOCUSED ON WATER RESTORATION AND MANAGEMENT

WATER BOARD STAKEHOLDER NEEDS SUMMARY

1. Watershed restoration
2. Address reclaimed water, non-potable, R1
3. Continuity of managing all water, collaborative & coordinated management approach
4. Create a vehicle for implementation, provide effective entity for water management
5. Commitment to Ahupua`a management, support resurgence of interest in cultural practices
6. Implement more monitoring, maintenance and setbacks of streams
7. Centralize resources (county and private), private/public is dysfunctional

STAKEHOLDER SUMMARY

IoTask

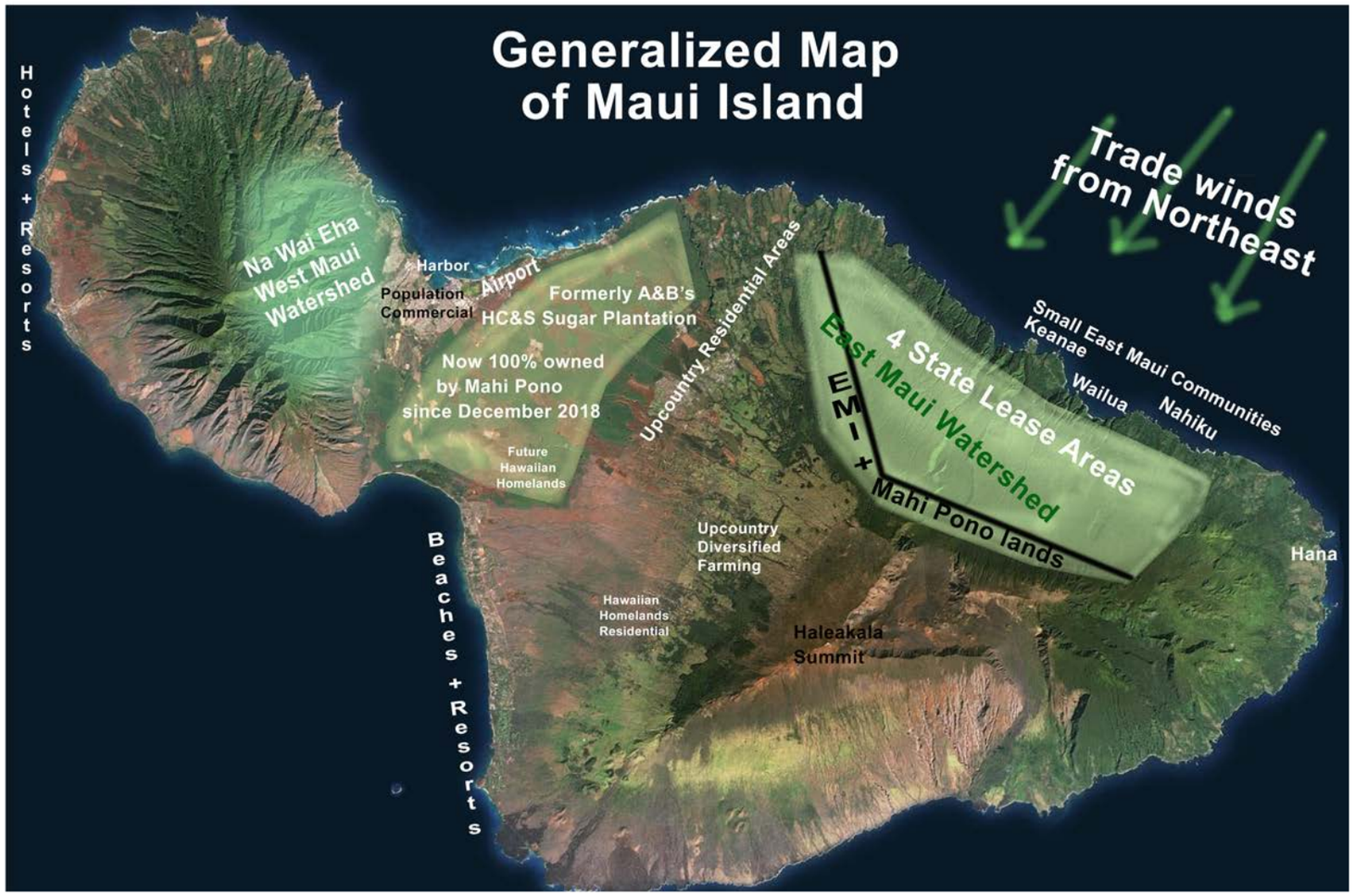
- Stakeholders have multiple needs that are not necessarily mutually exclusive; and in some cases are interdependent, particularly with regard to the natural environment.
- Many stakeholder needs remain unfulfilled despite constitutional, statutory, judicial protections, and safeguards, which are built upon the Public Trust Doctrine.
- Most stakeholder values are rooted in community and sustainability, such as aloha, kuleana (responsibility) for the land and people, and respect.
- Even stakeholders with a primary motivation of revenue generation cite ESG principles as priorities but because of the agency problem they can be susceptible to "green-washing".
- Therefore, developing innovative and transparent solutions that increase community ownership and governance aligned with ESG and community values, and which meet the needs of multiple stakeholders, is both a necessary and realistic goal.

CURRENT STATE ASSESSMENT

CURRENT STATE SUMMARY

- EMI system is very complex and difficult to understand.
- There is no uniformity of components or sections.
- Current land ownership is complicated and chain of ownership unclear.
- The system is in serious disrepair with non-functioning parts.
- There is a lack of proper understanding of upgrade and repair costs.
- An overall assessment is long overdue.
- The system doesn't realize its potential either in meeting needs or generating significant economic upside.

MAUI ISLAND



Source: Dick Mayer, retired economics professor

SOME EXTERNAL BEST PRACTICE CASE STUDIES GUIDED OUR THINKING

IoTask

Medellin	Deschutes River	Amazon Conservation	Crowd Smart Hydrology
• Empresas Públicas de Medellín (EPM), multi-utility corporation owned by the City of Medellín, Colombia, • Dividend has increased nearly 20-times since reform • Directed business operations and social responsibility to addresses inequalities and promotes peace. • Transformed walled off water storage tanks throughout the city into high quality open public spaces, working with communities, • Increased connections of low-income households to water and power grids through scaled water pricing structures, prepaid electricity meters, and other pro-poor means of formalizing access to services	• Deschutes River Stakeholders comprehensive restoration strategy to guide habitat restoration • Water transactions programs to facilitate the scalable trading of water between districts and to the Deschutes River to restore Upper Deschutes flows. • Moved water between irrigation districts to increase reliability of junior users, • Restored and protected flows in the Upper Deschutes River. • Meets the State's minimum flow requirement instead of running dry • Restore stream conditions to support the successful reintroduction of salmon and steelhead. • Restoration through creating a more efficient irrigation system	• Amazon Conservation Team (ACT), sees the survival of Rainforests and Indigenous cultures as inextricably linked under "biocultural conservation." • Key to the ultimate success of this process is improving indigenous partners' ability to meet many challenges • Process can entail everything from protecting forest species to knowing the potential uses of those plants and animals. • Aim to protect Amazonian lands first and foremost for those who live there • Use Google software and the latest computer and global positioning system technology, and top personnel from Google Earth headquarters have come to the Amazon to train the Indians directly	• Multiple projects using in situ sensing and information and communications technology (ICT), enable effective water monitoring "smart water quality monitoring techniques". • Project CrowdHydrology develops innovative methods of collecting spatially-distributed hydrologic data. • Community reads the stream stage, uses mobile phone texting to gauging station • Gathered stream data is added to database and published for public use on the CrowdHydrology web page • Project CrowdWater uses a "geocaching" type approach with the help of smartphones • Citizens can find existing sites and participate in the collection of hydrological data (stream water level, streamflow and soil moisture) using a smartphone app • Many other crowdsourcing and smart sensing water systems found all around the world

SOME EXTERNAL BEST PRACTICE CASE STUDIES GUIDED OUR THINKING

IoTask

Price River in Utah	SIMA in Magdalena River Basin	Opihi Monitoring East Maui	Walker Basin
• Price River is a tributary of the Green River in central Utah. • Diversions from the Price River irrigate approximately 16,300 acres of land • Multiple demands on Price River flows and lack of storage capacity have resulted in shortages in both agricultural and municipal water supplies. • Irrigation diversion structures completely inhibit fish passage and sometimes leave sections of the River entirely dry. • Effected through partnership of public and private entities, including local governments, state and federal agencies, irrigation associations, major water users, and environmental organizations • Total estimated cost for the project is $113 million	• SIMA is an open access, scientific tool that helps government officials, industry and communities to predict the cumulative impact of development decisions. • Magdalena River Basin is the social, environmental and economic heart of Colombia. It is home to 80% of the nation's 48 million inhabitants and produces 86% of the nation's GDP, and 75% of the agriculture. • Rapid growth threatens the environmental health of the basin • SIMA provides an early warning system for anticipated development impacts and helps in design nature-based solutions to guide public and private investments for conservation. • Holistic, interdisciplinary, and science-based, the integrated river basin approach brings together stakeholders to solve the land-and water-use dilemmas facing great rivers, from pollution, flooding and climate change to water scarcity and declining fisheries.	• Community groups have been monitoring and documenting the decline in 'opihi populations along two miles of coastline for several years • Revived the traditional Hawaiian practice of resting an area to reverse the decline • Three species of 'opihi, aquatic limpets, that cling to rocks on island shorelines, are found only in Hawai'i and play a key role in coastal biodiversity. • These are a staple of the Hawaiian diet but dwindled due to increasing demand and unsustainable • The "rest areas" give the populations a chance to recover and to re-populate other areas down-current. • Their monitoring provides important insights into patterns of spawning and larval dispersal, guiding resource management decisions and improving the chances of restoring populations.	• Walker Basin Conservancy was established by Congress to restore and maintain Walker Lake, a desert terminal lake in Nevada • Acquired water rights and protected instream to increase freshwater flows to lake • Protected agricultural, environmental and habitat interests in the Walker River Basin • Conservation and stewardship program focused on land stewardship, water conservation, alternative agriculture, watershed improvement and establishment of a local non-profit entity. • BOR grant funds in excess of $300m for conservation investments in the Walker and other DTL watersheds under 2002, 2008, and 2012 Farm Bill authorities, $ 81.40 mil in revenues 2010-2015.

OVERVIEW OF SYSTEM

- **The EMI System Consists of**
  - 388 separate intakes
  - 24 miles of ditch
  - 50 miles of tunnel
  - 12 inverted siphons, and numerous small feeders, dams, intakes, pipes, and flumes
  - 8 Reservoirs

- **Supporting infrastructure includes**
  - 62 miles of private roads
  - 15 miles of telephone lines

- **The system primarily captures surface water from multiple watersheds**
  - Combined catchment area of approximately 56,000 acres
    - 18,000 acres are owned by EMI
    - Remainder by State of Hawaii, including 33,000 acres in the State Lease Area
  - System drops from a high of approximately 1200 ft to sea-level

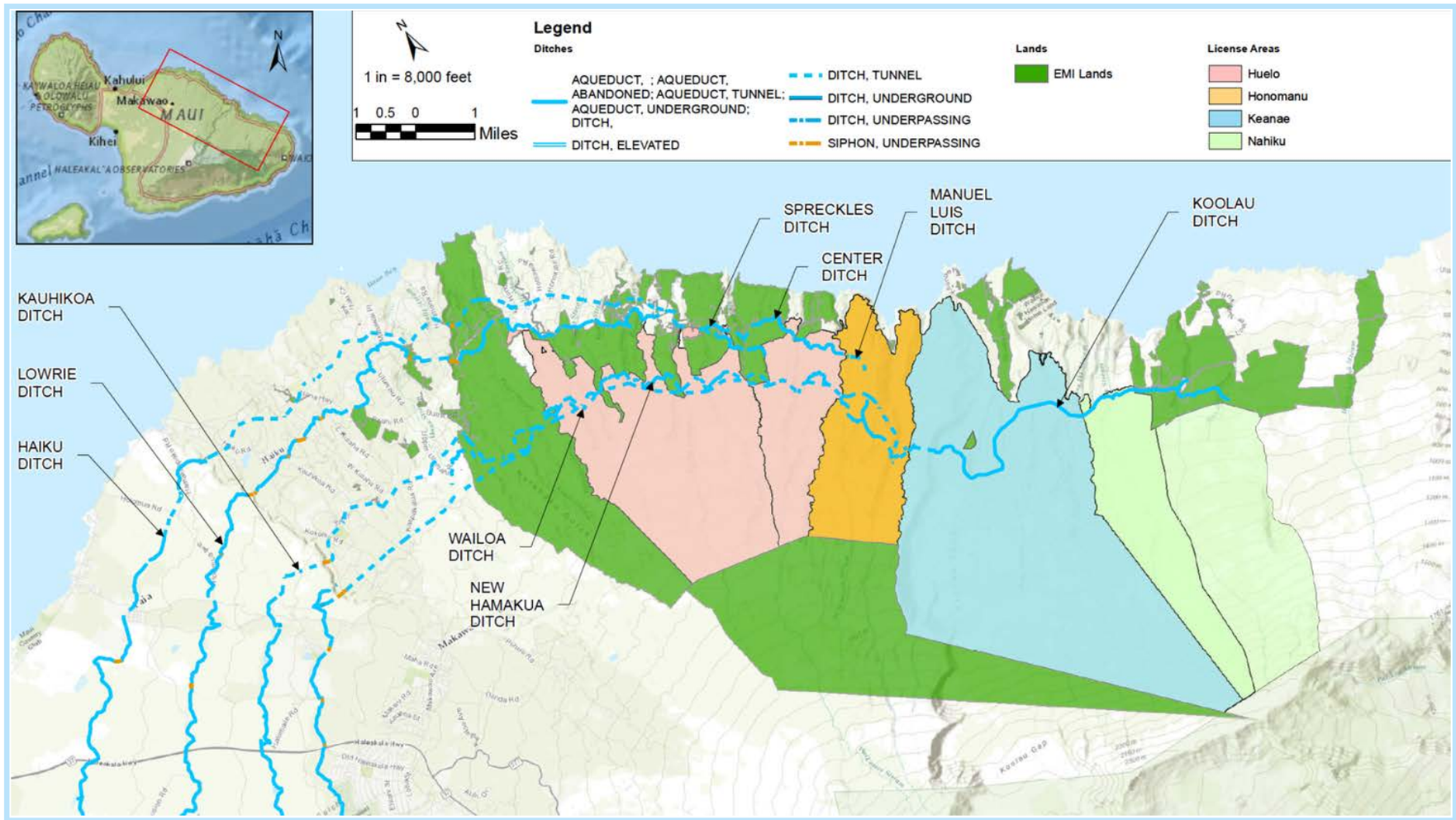
- **At one time EMI system was the largest privately owned water company in the United States and possibly the world with a total delivery capacity of 445 mgd.**

OVERVIEW OF SYSTEM

- **Water is a Public Trust**
  - Dual objectives of protection and maximum reasonable beneficial use
  - No one can charge for the use of the water, just the delivery
- **East Maui Irrigation system is a water distribution network only**
- **No wastewater capabilities**
- **Treatment of Wailoa Ditch water at Kamole-Weir (Average Daily Use 3.6 mgd)**
- **Storage capabilities through 8 (currently unused) reservoirs operated by EMI mostly along the lower ditch systems**
- **Water supply**
  - 70% water from public lands and 30% from private (A&B)
  - No reliability of water supply currently for Upcountry (farmers have to cut back in times of drought)

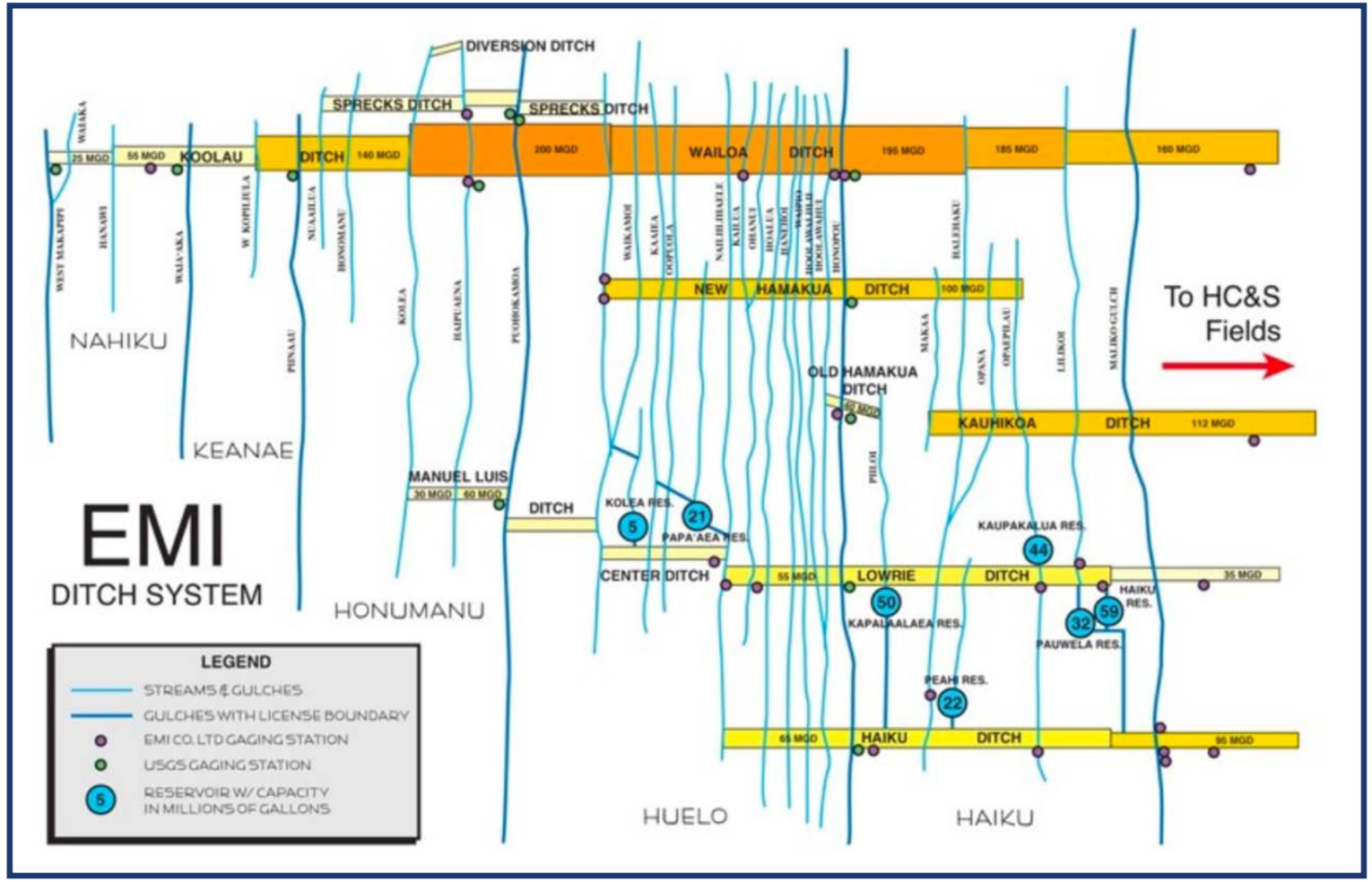
Source: Draft EIS, page 87 of 2700

MAP OF EMI SYSTEM AND WATERSHED



OVERVIEW OF EMI SYSTEM

NOTE: Schematic runs east to west counter to traditional maps.



HISTORY

- **September 1881:** Native tenants of Keanae area petitioned the King not to "dispose of" the crown lands.
- **1890:** Hamakua Ditch company "sued" to have their lease extended 20 years from 1896, in fear that the government might lease to another or take over the system.
- **1898:** A&B assumed control of Spreckel's HC&S lands, mill and ditch system, including Spreckels Ditch — also referred to as "Old Ha'iku Ditch" (capacity 60 mgd) which had over 40 miles of ditches, crossing 30 gulches to Honomanu stream. A&B also began building a series of new Diversions in East Maui at various elevations.
- **1898-1900:** Lowrie Ditch built, emanating from Kailua Watershed in Makawao District, receives water from a reservoir in Papaaea and Kailua Stream where diversion intercepts with older Haiku Ditch. Additional capacity of 60 mgd, at 800 ft elevation.
- **Early 1900's:** Lowrie ditch is extended east by Manuel Luis and Center ditches 500 ft elevation. Parts of the Lowrie/Center ditch system, which only goes as far as Waikamoi Stream, are already basically shut down. It's not clear if they will reopen.
- **1904:** Wailoa and New Hamakua Ditches built, with an additional capacity of 72 mgd, at 1000-1200 ft elevation, extending the system to Waikamoi stream. (Now carries water to the HC&S/Mahi Pono ag fields.)
- **1905:** Combined capacity of EMI ditch system had gone from 80 mgd (up to 1897) to 212 mgd. or 165% increase. Addition of Keanae and Nahiku watersheds increased water capacity by only 40%. 27 year Old Hamakua ditch leaky, but still used.
- **1908:** HC&S and Maui Agricultural Co. form East Maui Irrigation Co. to manage their ditch system and share the water between the plantations.
- **1908:** HC&S installs its first hydroelectric plant in Paia, providing 800 kwt of electricity to power the plantation's mills and 15 irrigation wells. Currently there are 3 hydro-plants on the EMI system, powered by flows from Wailoa ditch.

Source: East Maui Waters, Watershed, and Water System, H2O Roundtable, Lucienne de Naie

HISTORY

- **1914:** New Ha'iku and Kauhikoa Ditches built, with an additional capacity of 100 mgd, at 400 ft elevation. Feeds reservoirs that supply the county Ag park. 72 mgd, 1200 ft.
- **1915-1923:** Newest part of the system is the Wailoa-Ko'olau ditch, which is the part that serves the county's Kamole treatment plant. This system is mostly tunnels. The County depends on this lease district. Some tunnel sections of the Wailoa/Ko'olau ditch have water coming in from old EMI "development tunnels" that siphon off underground springs and dump them into the tunnels, so these 'sources" will be flowing into the "ditch" whether or not that section of the ditch is being utilized.
- **1923:** Ko'olau Ditch built, extending system to Makapipi stream, Nahiku, with an additional capacity of 160 mgd, at 1200 ft elevation.
- **1925:** Five more ditches pass through Ha'iku to Nahiku. Most of the old ones are abandoned over time.
- **1928:** Reappraisal report issued by EMI chief engineer JH Foss to Public Lands Commission. gave history of Govt Water Licenses; described 5 licenses: Honomanu, Hamakua, Spreckels, Keanae, and Nahiku. three leases were up for renewal in 1928.
- **1930's:** Territory renewed licenses.
- **1940:** The Nahiku-Ke'anae section of Ko'olau ditch had 18 of these development tunnels listed in old records (1940's).

Source: East Maui Waters, Watershed, and Water System, H2O Roundtable, Lucienne de Naie

KAMOLE-WEIR: END POINT OF WATER TRANSPORTED BY EMI FOR USE BY MAUI COUNTY DEPARTMENT OF WATER SUPPLY

IoTask

Kamole Water Treatment Plant:

- Water produced during FY19 – 610.8 Mil gallons; 1.67 Mil gallon daily average
- Existing Water Use is Maui Department of Water Supply Upcountry System.
- New automated chemical control system installed in 2019: "streaming current monitor" locks in on the electrical charge in the water to devise the optimal coagulant chemical dose.
- In FY19, conversion was completed at all six water treatment plants from chlorine gas to on-site generation of liquid chlorine solution using salt and electricity.

In addition to groundwater, DWS relies on three surface water sources for upcountry domestic and agricultural use:

- #1 delivered by EMI through the Wailoa Ditch
- #2 and #3 through two MDWS higher elevation aqueducts maintained by EMI

Aqueduct transports water to Olinda and Kula, under a contractual agreement originated under the 1973 East Maui Water Agreement and subsequent agreements.

Source: excerpted from Dept of Water Supply 2018 Annual Report

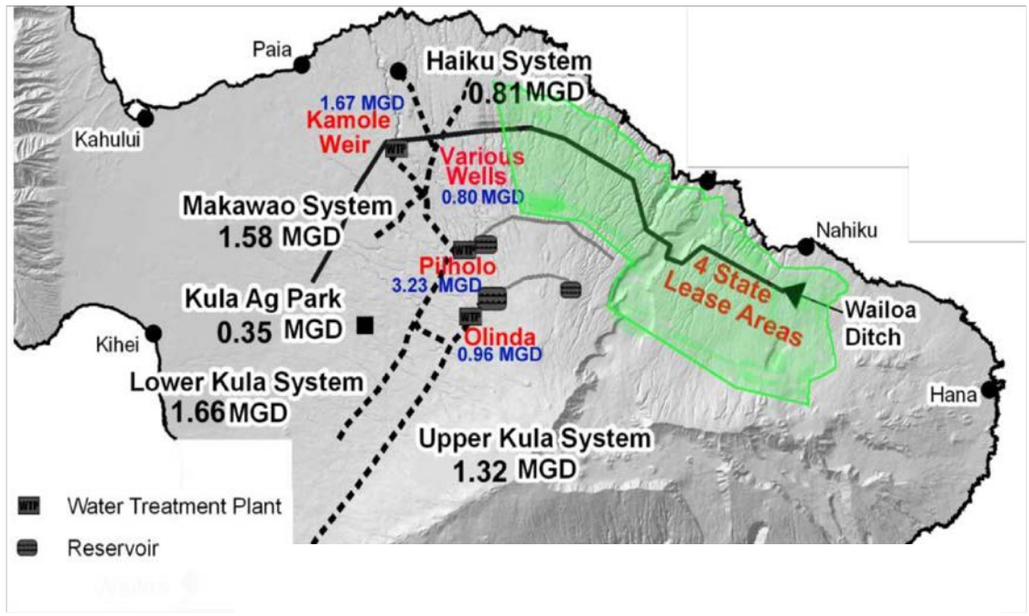
KAMOLE-WEIR: END POINT OF WATER TRANSPORTED BY EMI FOR USE BY MAUI COUNTY DEPARTMENT OF WATER SUPPLY

MDWS and EMI divert water from Ko`olau ASEA, conveyed to treatment plant facilities located in Ko'olau ASEA (Piiholo Water Treatment Facility) and the Central ASEA (Olinda and Kamole Weir Water Treatment Facilities).

Water Treatment Facility	Elevation	Conveyance System	Production Capacity	Average Production	%	Source
Wells	NA			0.8 mgd	12.0%	
Olinda	4,200 feet	Upper Kula Flume	2.0 mgd	0.96 mgd	14.4%	Upper Waikamoi Flume
Piiholo	2,900 feet	Lower Kula Flume	5.0 mgd	3.32 mgd	48.5%	Lower Waikamoi Flume
Kamole-Weir	1,120 feet	Wailoa Ditch	6.0 mgd	1.67 mgd	25.1%	Ko`olau/Wailoa Ditch

Source: Maui Island Water Use and Development Plan Draft, Part III, Regional Plans, Ko`olau Aquifer Sector Area (ASEA), Page 119

EMI PROVIDES ONLY 25-27% OF EAST MAUI WATER



Source: Maui Dept of Water Supply Annual Report FY 2019, Page 124, https:www.mauicounty.gov/DocumentCenter/View/121026/COM-DWS-FY2019-Annual-Report

CURRENT STATE OF EMI RESERVOIRS - STORAGE

IoTask

Storage essential due to drought, agricultural needs, etc.

- EMI Aqueduct System has eight (8) reservoirs in East Maui – lower ditch systems.
- Central Maui field irrigation system has forty eight (48) major reservoirs.
- System includes 62 miles of ditch access trails.
- EMI Reservoirs store high flows from various ditch systems allowing flexibility.

Most reservoirs are not currently used

- Closed due to closure of sugar production in 2016
- Closed due to dam safety requirements
- Combined potential storage capacity of all existing reservoirs:1,344 mg

Potential amount of flow available for irrigation approx. 92.32 mgd.

- Potential storage capacity: 16 days

Source: Draft Environmental Impact System, Page 87, 3.1.1.3 Added Storage Alternative, Akinaka, 2019, regional Water Use and Development Plan Drafts, Central WUDP, Page 123

CURRENT STATE OF THE RESERVOIRS - STORAGE

IoTask

According to EMI, reservoirs require extensive upgrades to be operational:

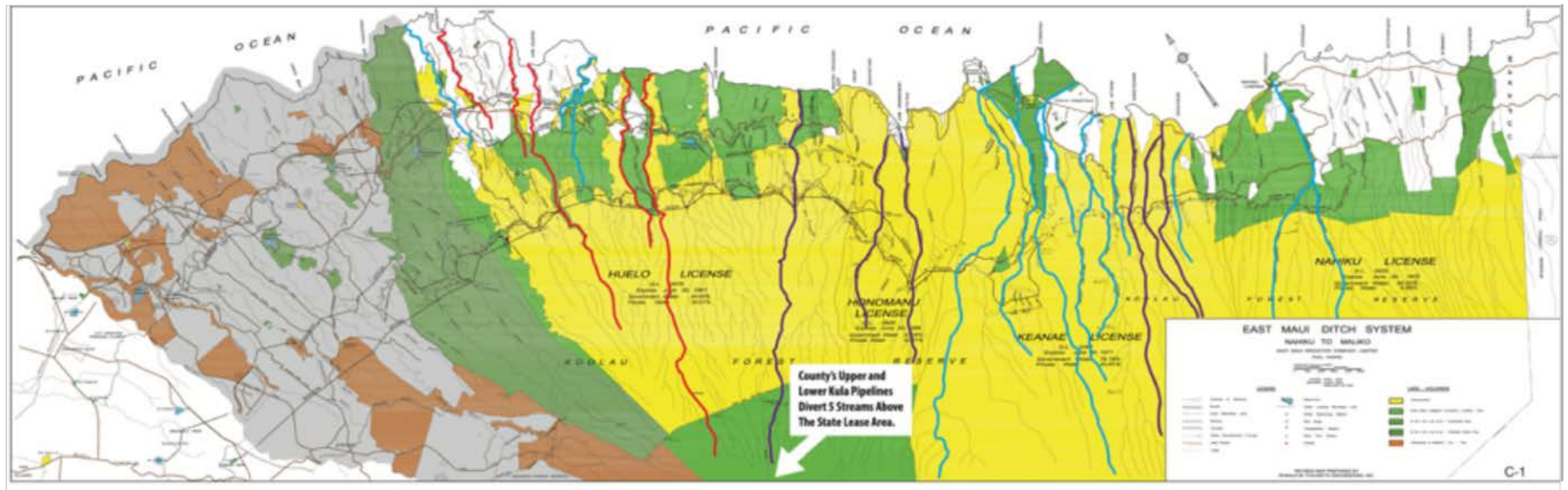
- Cost: $50 – $100 Mil
- Obtaining permits to upgrade and repair these reservoirs is challenging due to current dam safety requirements.

Reservoir and treatment plant expansion benefits:

- Improve reliable capacity.
- Economical water supply that minimizes expensive groundwater pumping costs.
- Defer source development in Haiku aquifer in light of uncertainties related to the East Maui Consent Decree.
- Recharge regional groundwater in wet season when maximizing use of stormflow from rainfall.

Source: Draft Environmental Impact System, Page 87, 3.1.1.3 Added Storage Alternative, Akinaka, 2019, regional Water Use and Development Plan Drafts, Central WUDP, Page 123

CURRENT SITUATION OF STREAM DIVERSIONS IS A MOVING TARGET



16 streams and tributaries between Honopou and Maliko Gulch that are completely diverted by EMI and require no permits or license. EMI averages 8 million gallons a day from this area.

Streams Promised to be Completely Restored:

- Makapipi
- Waiohue
- West Wailuaiki
- Wailuanui
- Kualani
- Waiokamilo
- Ohia (Waianui)
- Palauhulu
- Piina'au
- Hanehoi
- Puolua
- Honopou

Streams Promised to be 64% Restored:

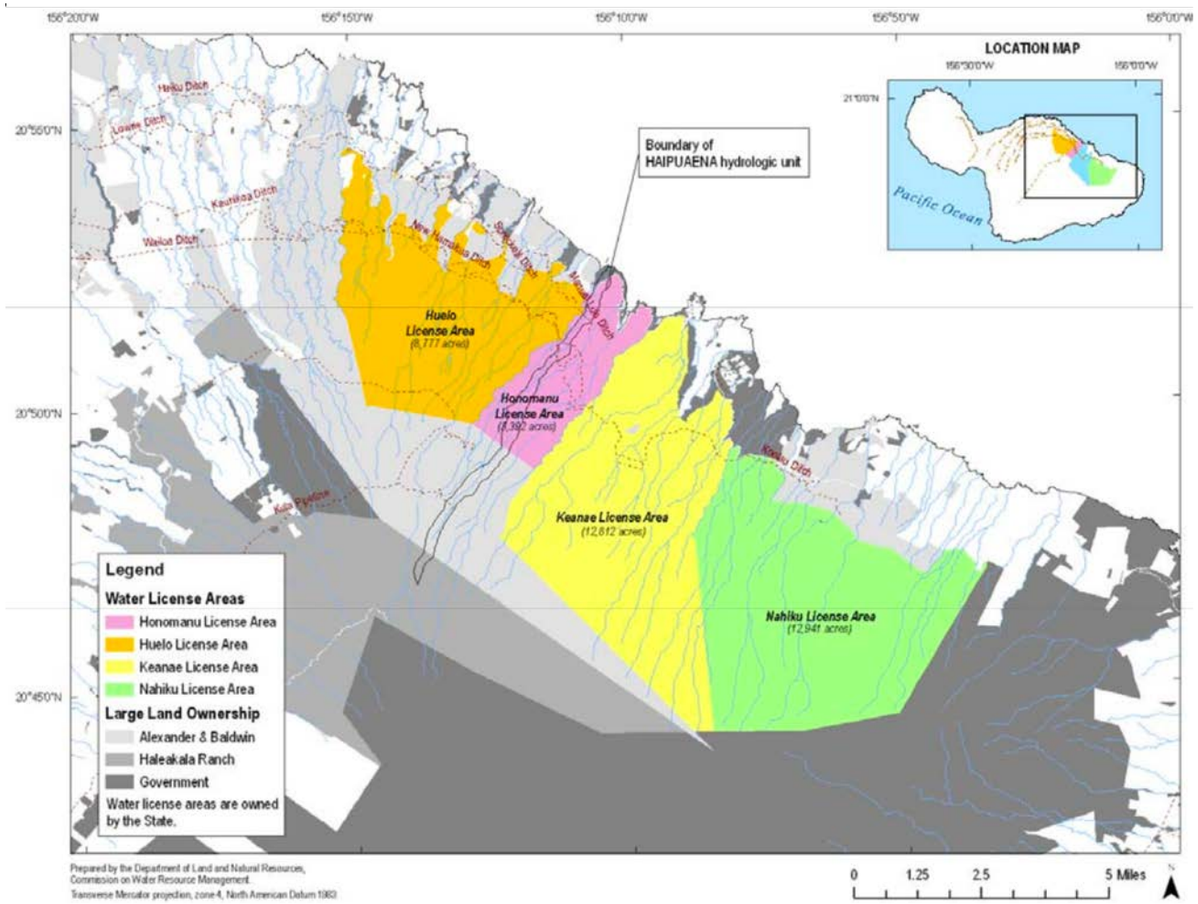
- Kopiliula
- East Wailuaiki
- Punalau/Kolea
- Waikamoi
- Honomanu

Community Streams Where Hundreds of People Live with No Restoration

- Kailua
- Hanawana/Ohanui
- Waipio
- Mokupapa
- Ho'olawa

Around 40 streams are in 33,000 acre State Lease Area. 23 of these can be completely diverted under current lease agreements. Current leases don't require stream flow measurements or monitoring to make sure streams have enough flow for residents or wildlife.

EMI LEASES CURRENTLY IN FLUX COVER WATER RIGHTS OVER 33,000 ACRES – THE DETERMINATION WILL AFFECT CURRENT SITUATION



- **LEASES (only refer to diversions on state lands)**
- **Huelo: 8777 Acres**
- **Honamanu: 3392 Acres**
- **Keanae: 12,812 Acres**
- **Nahiku: 12, 941 Acres**

Prepared by the Department of Land and Natural Resources, Commission on Water Resource Management. Transverse Mercator, zone 4, projection, North American Datum 1983.

SUMMARY OF KEY LEASE AND AFFECTED AREAS INCLUDING HYDROLOGICAL UNITS

HAIKU

The Haiku area with a population of about 8,000 is located along the north shore of Maui with Paia to the west and several smaller communities to the east such as Keanae, Wailua, and Hana. In 1858, the Haiku Sugar Company was formed and began to grow and process sugar at the Haiku Mill. Later, the Haiku area became a pineapple plantation. It is now a rural residential area with a very small “town center.” What was once a pineapple cannery is now the Haiku Marketplace, which along with the Aloha Aina Center includes restaurants, a post office, markets, hardware store, and gym. Most people in Haiku receive their water from the Maui County Water System and/or catchment.

HUELO

Huelo is more rural and “off-the-grid” than Haiku. Many people in Huelo live on streams and are dependent on catchment and stream water and bottled water. The "Huelo Lease area” includes all the streams in the “Honopou hydrological unit”, including Puniawa, Honopou, Ho’olawa, Waipio, Waipio iki, Mokupapa, Honokala, Puolua, Hanehoi, Hoaloa, Hanawana, Kailua and Naii’iliha’ele plus at least 8 more. Of the 13 streams in the "Honopou unit", only Honopou, Hanehoi and Puolua have had any studies and only Honopou has a stream gauge. A gauge is being proposed for Na’ili’iliha’ele but has not been installed. There is no public water supply so there is no baseline info on all but two of those streams.

HONOMANU

Honomanu Bay's black sand beach is a landmark along the Road to Hana. Volunteers are currently working to restore stream flow and replant taro patches, which were formally active in the area. Puehu, O'opuola, Ka’aiae, Punalu’u, Kolea, Waikamoi-Alo, Wahinepe’e, Puohakamoa, along with Haipue’ena’ena, Punalau, Honomanu, Nua'ailua are all part of the Waikamoi hydrological unit, the last four of which comprise the Honomanu Lease Area. Of the 12 streams in that Waikamoi Hydrological Unit, 8 have had some stream studies done. The rest have been overlooked.

KEANAE

Ke‘anae is a peninsula known best for being one of Hawaii's major taro growing regions. Ke‘anae peninsula was originally made from lava from Haleakala Crater. Keane’s population has dwindled and in 2005, the 100-year-old Ke‘anae School officially closed as enrollment had dropped to three students, after an average of 5 students per year for several years. There are 18 streams that are considered part of the Ke’anae Hydrological Unit area, some of which are in the "Ke'anae Lease area."

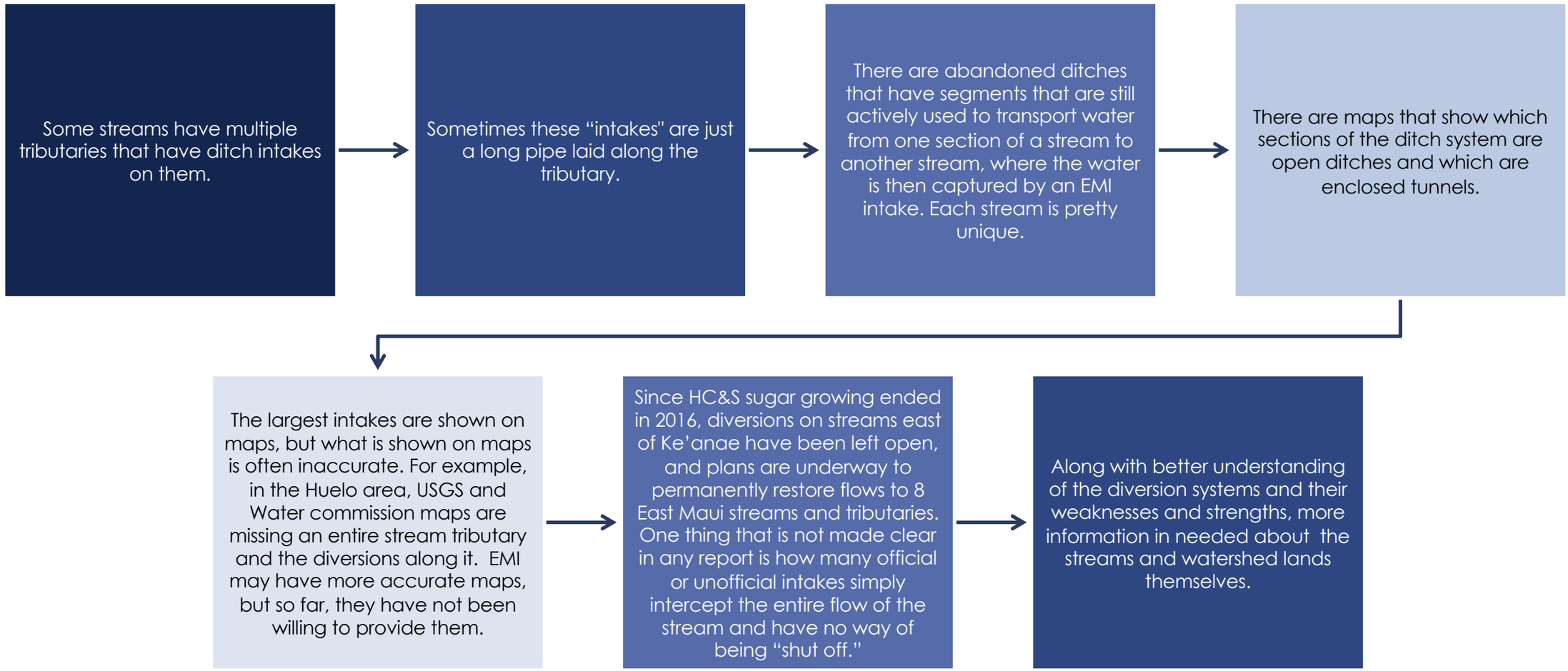
NAHIKU

Nahiku is a small community located along the Hana Road, approximately 11 miles before Hana Town. Nearby is the Pua’a Ka’a State Wayside for picnicking as well as the Kopilula and Waikani Falls. Its popularity amongst visitors has exploded in recent years. The state license system breaks the Ke‘anae hydrological unit up into the "Ke'anae Lease area" and the "Nahiku lease area.”

The East Maui Watershed Partnership has a management plan for the upper elevation of a number of the Hydrological units, but the natural systems function mauka-makai, not East to West. The cultural perspective of the relationship of various streams and watersheds could add another adjustment in areas covered.

Source: Lucienne de Naie

UNDERSTANDING THE SYSTEM



Source: Lucienne de Naie

SUMMARY OF MAJOR STREAMS FEEDING SYSTEM – 388 STREAMS

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323 declared stream diversions in the Ko`olau ASEA

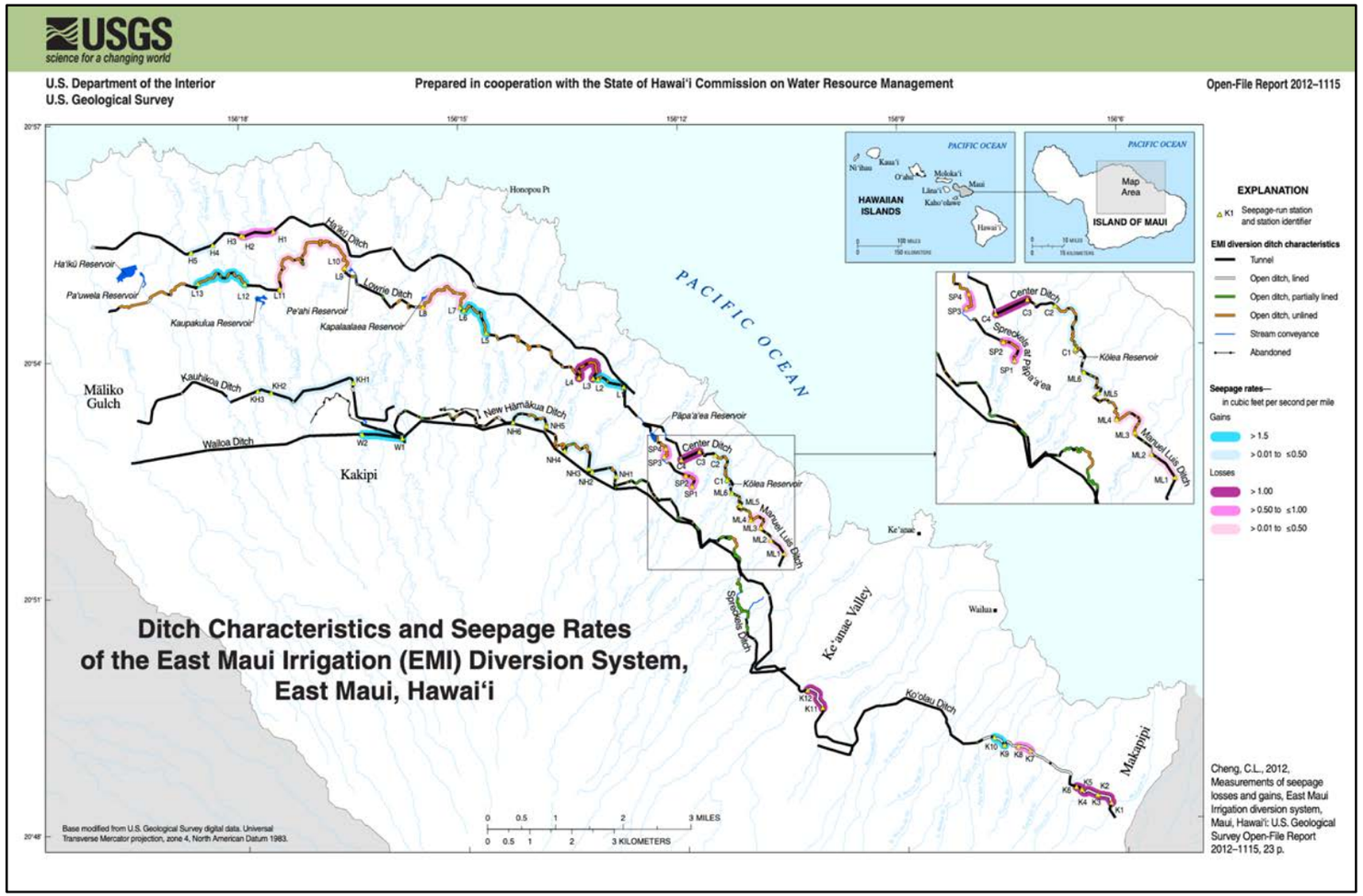
- Surface water is diverted for a variety of purposes.
- Surface water diversion data reported to CWRM for the Ko`olau ASEA is very limited.
- Most diversions belong to the East Maui Irrigation Company (EMI).

Intakes

- From Maliko gulch in Haiku to Honomanu the EMI system has diversion ditches at multiple elevations intercepting each stream's flow several times.
- From Honomanu to Nahiku there is a single ditch intercepting each stream.
- Since HC&S sugar production ended in Dec. 2016 only the ditch intakes west of Ke'anae are in use.

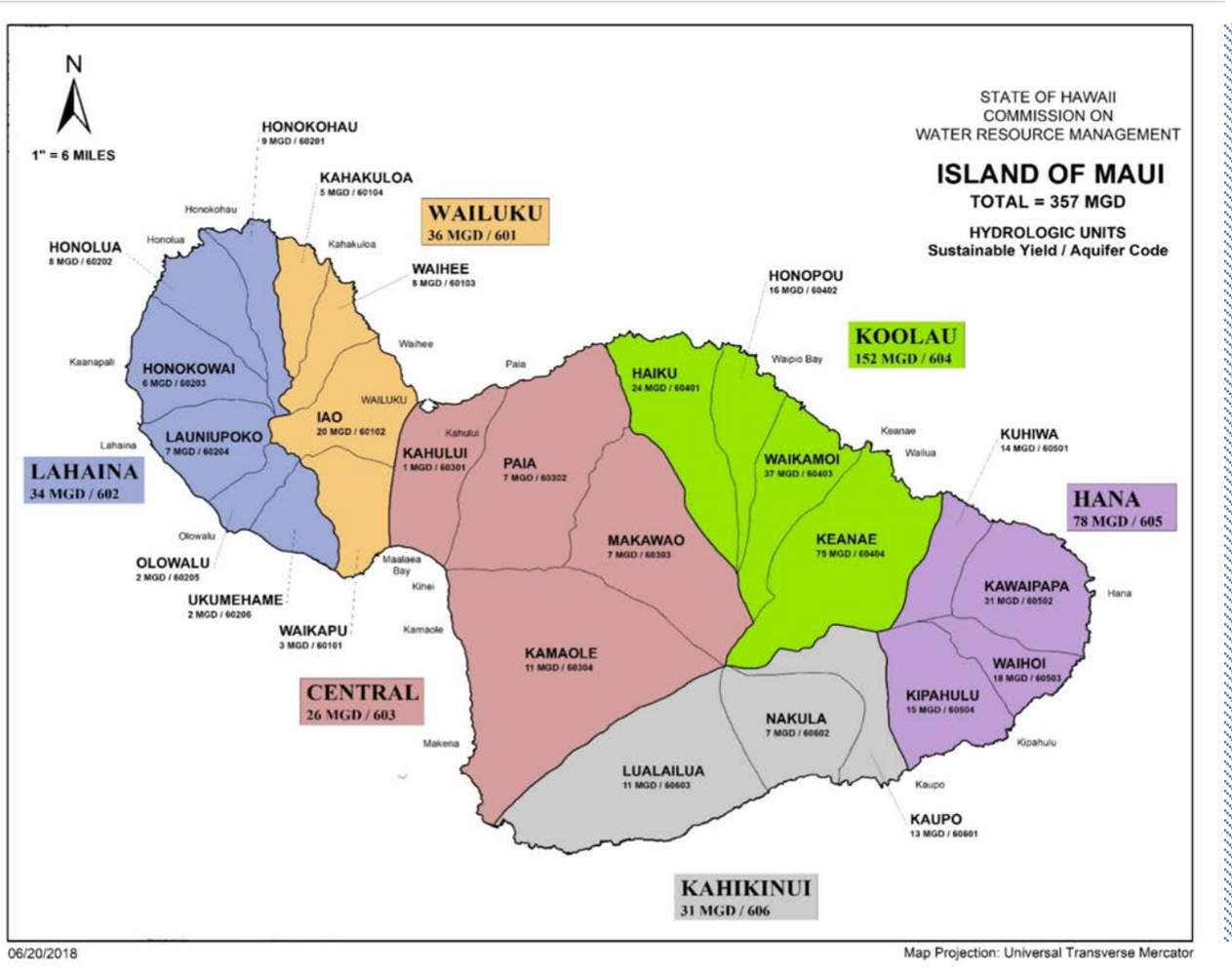
Source: East Maui Waters, Watershed, and Water System, H2O Roundtable, Lucienne de Naie, red is WUDP, CWRM database, 1989 Declarations of Water Use and reported diversions from EMI and ML&P, Ko`olau WUDP

EAST MAUI IRRIGATION (EMI) DIVERSION SYSTEM



Source: https://pubs.usgs.gov/of/2012/1115/of2012-1115_appendix.pdf | https://pubs.usgs.gov/of/2012/1115/of2012-1115

GROUND WATER HYDROLOGIC UNITS AND 2019 SUSTAINABLE YIELDS



http://files.hawaii.gov/dlnr/cwrm/maps/gwhu_maui.pdf

EAST MAUI INTERIM INFLOW STREAM STANDARDS

- **Hawai`i Administrative Rules, Section 13-169-46, "Interim Instream Flow Standard for all streams on Hawai`i, as adopted by the commission on water resource management on June 15, 1988, shall be that amount of water flowing in each stream on the effective date of this standard, and as that flow may naturally vary throughout the year and from year to year without further amounts of water being diverted off stream through new or expanded diversions, and under the stream conditions existing on the effective date of the standard…"**
- **June 2001**- Native Hawaiian Legal Corporation (NHLC) filed a Petition to Amend the Interim Instream Flow Standard for each of 27 streams in East Maui.
- **July 2001**- NHLC asked the Commission on Water Resources to focus its efforts on seven priority streams.
- **March 2002** - U.S. Geological Survey (USGS), in cooperation with various partners, initiated a study to assess stream flow in East Maui and impacts of restoration to native stream organisms.
- **January 2006** - USGS released the second of two studies on the Effects of Surface-Water Diversions on Habitat Availability for Native Macrofauna, Northeast Maui, Hawaii.
- **Five priority hydrologic units**: Honopou, Hanehoi, Piinaau, Waiokamilo, Wailuanui.
- **June 2018** - CWRM decision to return free flowing water, with no upstream diversions, to all streams which have historically supported significant kalo cultivation (Honopu, Huelo, Hanehoi, Pi'ina'au, Palauhulu, Ohia (Waianui), Waiokamilo, Kualani, Wailuanui, Makapipi). **The majority of these streams had been diverted for over 100 years.**
- CWRM decision for Honomanū, Waikamoi East Wailuaiki, Kopiliula, Punalau/Kōlea, Waiohue, West Wailuaiki to have **limited or no water diversions in order to foster improved habitat for native fish and other stream animals.**

CWRM, Ecology, Restoration, and Management of Hawaiian Stream and Riparian Systems May 20-22, 2008, CWRM Findings of Fact, Decision & Order, June 2018

SUMMARY OF MAJOR DIVERSIONS: LUPI ROAD SECTOR

EMI system was designed and constructed to take full advantage of the gravity flow of water from higher to lower elevations, thus minimizing pumping and the additional consumption of electrical power.

- **Wailoa Ditch:** HC&S attempts to divert the maximum possible amount of water into the EMI system at the Wailoa Ditch, which has a capacity of 195 Mil gallons per day.
- **Honopou Stream:** On the northeastern slope of Haleakala volcano in eastern Maui. The stream is approximately 5 miles in length, heading at an elevation near 2200 feet on the flanks of a small secondary cone called Ulalena, and entering the sea between Puniawa Point and Honopou Point. Future: no diversion and planned to be restored 100%.
- **Hoolawa Stream** — On the northeastern slope of Haleakala and is approximately 6 miles in length, heading at an elevation near 2800 feet, upslope and to the east of a small secondary cone called Ulalena, and entering the sea between at Hoolawa Bay. The catchment has two major branches, the Hoolawanui to the west, which is by far the longer, and the Hoolawaliiilii to the east. Declarations of Water Use: 133,307 gallons per year (1989), 22 diversions
- **Hanehoi Stream** —On the northern slope of Haleakala and is less than 3 miles in length, heading at an elevation of approximately 1800 feet on the broad slopes east of the secondary summit of Ulalena, and entering the sea via a terminal waterfall at Hoalua Bay. The Hanehoi system has a major western tributary, Huelo Stream, which heads at elevations mostly below the alignment of the EMI ditch system, and its confluence with the Hanehoi occurs downslope of the Hana Highway. Due to this difference in the elevation of the headwaters, the main stem Hanehoi has points of diversion at all 4 of the EMI ditches (Haiku, Lowrie, New Hamakua and Wailoa), whereas the Huelo is diverted only at the Haiku and Lowrie ditches. Future: no diversion and planned to be restored 100%.

Source: Field Survey Report, East Maui Irrigation Ditch System, East Maui, Hawaii - Stream Diversion Abandonments, Dan A. Polhemus, US Fish & Wildlife Service, October 2019

SUMMARY OF MAJOR DIVERSIONS: WAILUAIKI ROAD SECTOR

IoTask

EMI SYSTEM DIVERSIONS CONTINUED…

- **Wailuanui Stream** —On the northeastern slope of Haleakala immediately to the east of the Koolau Gap, and approximately 7.5 miles in length, heading at an elevation of approximately 8000 feet near the rim of Haleakala crater, and entering the sea via a low gradient terminal reach at Wailua Nui Bay. The Wailuanui system has two major branches, the West Wailuanui, which is much longer and carries a higher discharge volume, and the East Wailuanui, which heads at an elevation near 2200 feet and therefore has a smaller catchment and lower discharge volume. Both stream branches, and their associated tributaries, are diverted by EMI's Koolau Ditch, which runs at an elevation near 1250 feet. Future: no diversion and planned to be restored 100%.
- **Waiokamilo Stream** —On the northeastern slope of Haleakala, running along the east side of the Koolau Gap and approximately 5.3 miles in length. The stream heads at about 3600 feet elevation on the slopes above the gap, and flows for about 3 miles before cascading over the east wall of the gap, after which it follows a much lower gradient across the floor of the gap before entering the sea via Waiokilo Falls. In its upper course the stream has a channel incised in the Kula lava series, while its lower course in the Koolau Gap runs over later Hana lava flows of Pleistocene age, in which the channel is only weakly incised. The EMI Koolau Ditch system formerly had 18 points of diversion arrayed along the south wall of the gap where small springs drain down to the main Waiakamilo Stream channel far below, but all of these appear to have been inactivated around 2007, and as far as can be determined from current EMI records, there are no active diversions remaining in the Waiokamilo System. Future: no diversion and planned to be restored 100%.

Source: Field Survey Report, East Maui Irrigation Ditch System, East Maui, Hawaii - Stream Diversion Abandonments, Dan A. Polhemus, US Fish & Wildlife Service, October 2019

TYPES OF BUILT COMPONENTS – DAMS AND BRIDGES

DAMS

Dams are built in the streambed to impound water in order to draw water into ditches. Dams are typically of concrete or masonry (lava rock with concrete mortar) construction. They are typically built with lava cobbles that are laid uncoursed, or are of poured concrete. Some dams are built of faced, uncoursed, irregular lava rock, and some are quarry-faced rectangular blocks laid in courses with concrete mortar. Dams have sluice gates to regulate the amount of water impounded and to allow the stream to flow when no water is needed for the associated intake. Contrast dams with weirs are designed to have water flow over them. Most dams are less than 6' high, however some in larger streambeds can be up to 14' in height.

Figure 7: Dam at Wailuanui West Stream diversion impounds stream water for intake. (Source: MAI, 2018)

BRIDGES

Bridges are used along the trail route that provides access to the ditches and their features. Bridges span gulches and streams. They are typically concrete slab construction with either curbs at their edges or solid concrete parapets. Some are inscribed with the year built.

Figure 6: Bridge at Banana Intake stream diversion carries an access trail over the stream. (Source: MAI, 2018)

TYPES OF BUILT COMPONENTS – DITCHES AND TUNNELS

DITCHES

Ditches carry the collected water along a gently sloping grade across the terrain and deliver it to planted fields. They can be built of varying dimensions, from about 2' wide to over 1O' wide and can be unlined or lined with concrete or masonry.

Figure 8: Koolau Ditch near Waiohue Stream diversion. View Facing S. (Source: MAI, 2018)

TUNNELS

Tunnels are built to carry the ditch through the steep terrain of the watershed. Tunnels make up a large portion of the EMI Aqueduct System in East Maui, comprising about two-thirds of the length of the system. Tunnels were dug on a gently sloping grade similar to the standard grade of a ditch. (Most intakes at stream diversions that were visited during field work for this report fed their collected water into a tunneled portion of ditch.)

Figure 13: Tunnel near Kopiliula stream diversion carries water underground at ditch gradient. View facing SE. (Source: MAI, 2018.)

TYPES OF BUILT COMPONENTS – FLUMES AND SIPHONS

Figure 9: Flume at Koolau Ditch near Waiohue Stream diversion. View Facing N. (Source: MAI, 2018)

FLUMES

Flumes are used to carry water across a gulch or depressed area of terrain by remaining at ditch gradient. They have the same gentle slope as ditch sections . Historic flumes are typically cast concrete construction with a rectangular cross section and vertical sides that are between 4" and 8" thick. Concrete flumes often have transverse concrete braces across their open tops.

Figure 11: Malika siphon, unknown date. (Source: EMI archives)

SIPHONS

Siphons' enclosed tubes that carry ditch water across a gulch or depressed area of terrain. Unlike flumes, siphons dip down to follow the depression and then ascend on the opposite side of the gulch . (There are 13 siphons but none were seen during the field work for this report.)

TYPES OF BUILT COMPONENTS – INTAKES AND DIVERSIONS

INTAKES

Intakes are located at stream diversions. They are channels that stream water flows through to be carried from the stream to the ditch. Intakes can have sluice gates at their apertures to control the amount of water taken in, or they can be without a gate. Some intake channels have throw-out sluice gates in their side walls that can be opened to discharge incoming water back out to the stream bed.

Figure 10: Intake at Hanawi Stream diversion. View Facing S. (Source: MAI, 2018)

STREAM DIVERSIONS

Stream diversions are features built into a streambed that allow stream water to be taken into a ditch. They generally have a dam or weir to impound a pool of water that is routed into an intake. Stream diversions are masonry or concrete construction, with some metal components such as sluice gates, trash grates, and walkways.

Figure 12: Honomanu Stream diversion. View facing E. (Source: MAI, 2018.)

TYPES OF BUILT COMPONENTS – WEIRS AND WALKWAYS

WEIRS

Weirs are low dams built across a stream to impound water on their upstream side. They are intended to have water flowing over them during times of normal water level and are not high enough to totally obstruct the flow of a stream. Weirs are typically concrete construction or masonry of lava rock and concrete mortar. Some weirs are built with a shallow "v" depression along their top edge to keep the flowing water better channelized in the center of the stream bed.

Figure 15: Wailuanui West Stream diversion. View facing SW. (Source: MAI, 2018.)

WALKWAYS

Walkways are used to cross gulches above some stream diversions. All of the walkways observed on the field visit for this report are of fairly recent construction of galvanized steel, aluminum , and plastic tread.)

Figure 14: Walkway above Makapipi Stream diversion. View facing S. (Source : MAI, 2018.)

SUMMARY CHARACTERISTICS OF DITCHES IN EMI

Name	(New) Haiku***	Spreckels**	Lowrie	Manuel Luis	Center	Kauhikoa	New Hamakua	Wailoa	Koolau
Capacity	70 MGD*,		70 MGD*				100 MGD*	195 MGD*,	
Approx Elevation	400-500 ft	300-1200 ft	600-800 ft	500 ft	500 ft	400-900 ft	1000-1200 ft	1000-1200 ft	1250 ft
Length	9.68 miles	4.62 miles	12.41 miles	1.79 miles	2.2 miles	4.96 miles	8.05 miles	9.56 miles total	10.2 miles
Characteristics	9.3 miles tunnel, .38 lined	2.42 miles tunnel, .02 lined, 1.31 partially lined, .86 lined	4.61 miles tunnel, .21 lined, .13 partially lined, 7.46 unlined	.97 miles tunnel, .06 partially lined, .76 unlined	1.51 miles tunnel, .11 lined, .04 partially lined, .54 unlined	4.78 miles tunnel, .16 lined, .02 partially lined	5.61 miles tunnel, .13 lined, .86 partially lined, 1.44 unlined	9.49 miles tunnel, .07 lined Wailoa & Koolau are sections of same ditch	7.7 miles tunnel, 2.47 lined, .02 partially lined Wailoa & Koolau are sections of same ditch
How much in Lease area?	None	Portions	A lot is outside of lease area	Portions	Portions	None	Almost all is inside lease area	Primary source of water in lease area	Primary source of water in lease area
Claimed Land Ownership	Primarily EMI/Mahi Pono	Combination EMI/Mahi Pono & State	Combination EMI/Mahi Pono & State	Combination EMI/Mahi Pono & State	Combination EMI/Mahi Pono & State	EMI/Mahi Pono Only	Combination EMI/Mahi Pono & State	Combination EMI/Mahi Pono & State	Combination, mostly State
Comments		Joins several streams, Ko'olau and Lowrie Ditch		Joins Lowrie	Joins Lowrie	Joins New Hamakua			Joins Wailoa

Per Draft Water Use & Development Plan, Koolau, ** also referred to as "Old Haiku", *** Replaced portions of Old Haiku-Spreckels Ditch

SUMMARY CHARACTERISTICS OF 6 MAJOR DAMS/RESERVOIRS IN EMI

IoTask

Name	Haiku Reservoir	Kapala'alalea Reservoir	Kaupakaulua Reservoir	Papa'aea Reservoir	Pauwela Reservoir	Peahi Reservoir
Type	Earthen	Earthen	Earthen	Earthen	Earthen	Earthen
Purpose	Irrigation	Irrigation	Irrigation	Irrigation	Irrigation	Irrigation
Date/Age	1904/1979	1885	1885	1902	1904	1924
Height	37 ft	48 ft	57 ft	37 ft	47 ft	35 ft
Length	1,700 ft	230 ft	400 ft	820 ft	270 ft	170 ft
Drainage area	0.82 sq. miles / 525 acres	0.89 sq. miles / 570 acres	2.90 sq. miles / 1,856 acres	0.49 sq. miles / 314 acres	1.19 sq. miles / 762 acres	0.78 sq. miles / 499 acres
Max Storage	266 ac-ft / 87 MG	197 ac-ft / 64 MG	210 ac-ft / 68 MG	154 ac-ft / 50 MG	142 ac-ft / 46 MG	72 ac-ft / 23 MG
Hazard	High	High	High	High	High	High
Location (Nearest Town)	Haiku (.4 mi.)	Huelo (2.2 mi.)	Haiku (1.7 mi.)	Kailua (0.7 mi.)	Haiku (0.4 mi.)	Ulumalu (1.2 mi.)

Source: Prof. Andrew Whittle, Massachusetts Institute of Technology (MIT), State of Hawaii, Dam Inventory System http://dams.hawaii.gov/

TYPES OF STREAM DIVERSIONS

IoTask

Type A Stream Diversion Intakes Water by Closing the Sluice Gate

- Most common type.
- Operates using a dam across the stream bed that is equipped with a sluice gate.
- When sluice gate is closed, water is impounded in a pool above the dam.
- As water rises in pool, reaches the level of a ditch intake aperture and is able to flow out of impounded pool, through aperture, into ditch.
- With sluice gate in dam open, stream water flows through gate and is not impounded sufficiently by dam to reach level of intake.
- Uses either a ratchet or geared type of sluice gate to control water going through dam.

Variation Includes a stilling wall and/or sluice gate at intake

- Stilling wall is built to a level slightly below that of the top of the dam.
- When dam sluice gate is closed and water backs up in the impounded pool, it flows over the top of the stilling wall and reaches intake aperture.
- Stilling wall is designed to reduce turbulence of water that reaches intake aperture from compounded pool.
- Some stilling walls constructed with perforations to allow water to flow through as well as over them.
- Another variation is a second spice gate at intake aperture. This sluice gate would need to be open to allow collected water to flow into the intake.

Historical Structure Assessment, Draft EIS

TYPES OF STREAM DIVERSIONS (CONTINUED)

Type B Stream Diversion Intakes Water by Opening the Sluice Gate

- Operates using a weir across the stream to impound water to a level that reaches intake aperture.
- Sluice gate that is installed at the aperture is opened when the intake and the stream water flows over the weir out of the impound and continues down the stream bed.
- Uses board adjusted sluice gates at the intake apertures and has additional throw-out sluice gates located on the intake channels downstream of the intake apertures, which discharge excess water back into the stream bed when opened.

Type C Stream Diversion Intakes Water by Closing a Throw-Out Sluice Gate

- Uses a weir and impounded pool to feed stream water into an intake aperture that is not equipped with a sluice gate.
- Intake aperture of this type is always open.
- Amount of water fed into ditch is controlled by a throw-out sluice gate in the side wall of the intake channel, downstream of the aperture.
- The throw-out gate, when open, discharges the water flowing into the intake channel back to the stream bed below the weir.
- When sluice gate is closed, intake water is not discharged into the stream but continues down the intake channel into the ditch.
- Uses ratchet mechanism on the throw-out sluice.

TYPES OF STREAM DIVERSIONS (CONTINUED)

IoTask

Type D Ditch Water Throw-out

- Uses a Sluice Gate in the Ditch wall to discharge water.
- Not a stream diversion, designed to stop flow of water through the ditch.
- Two board-adjusted sluice gates: one straddles the ditch itself and a second upstream sluice gate is built into the sidewall of the ditch.
- Sluice gates serve to stop flow of water through ditch and discharges water into a gulch.

SLUICE GATES

Figure 23: Typical board adjusted type sluice gate mechanism, shown with the gate closed. This gate is located at EMI stream diversion at Waiohue, which is ordered to be a "Fully Restored" stream by CWRM. View facing SE. (Source: MAI, 2018.)

Figure 21: Typical sluice gate. Note the vertically sliding panel at the lower end that is operated by the mechanism above. This ratchet-operating gate is located at EMI stream diversion at Wailualki East, which is ordered to be restored as a "Habitat Stream" by CWRM. (Source: MAI, 2018.)

Figure 22: Typical configuration of sluice gates in a concrete dam. These sluice gates are located at EMI stream diversion at Kopiliula, which is ordered to be restored as a "Habitat Stream by CWRM. View facing N. (Source: MAI, 2018.)

RATCHET TYPES

Figure 24: This typical ratchet type sluice gate operating mechanism is located at EMI Hoolawaili Stream diversion, on a tributary of Hoolawa, which is ordered to be restored as a "Habitat Stream" by CWRM. View facing SE. (Source: MAI, 2018.)

Figure 25: This sluice gate mechanism is a ratchet type. The concrete pedestal and platform it is mounted on is typical of ratchet type gate mechanisms . This ratchet-operating gate is located at EMI stream diversion at Makapipi, which was fully restored in 2008. View facing SE. (Source: MAI, 2018.)

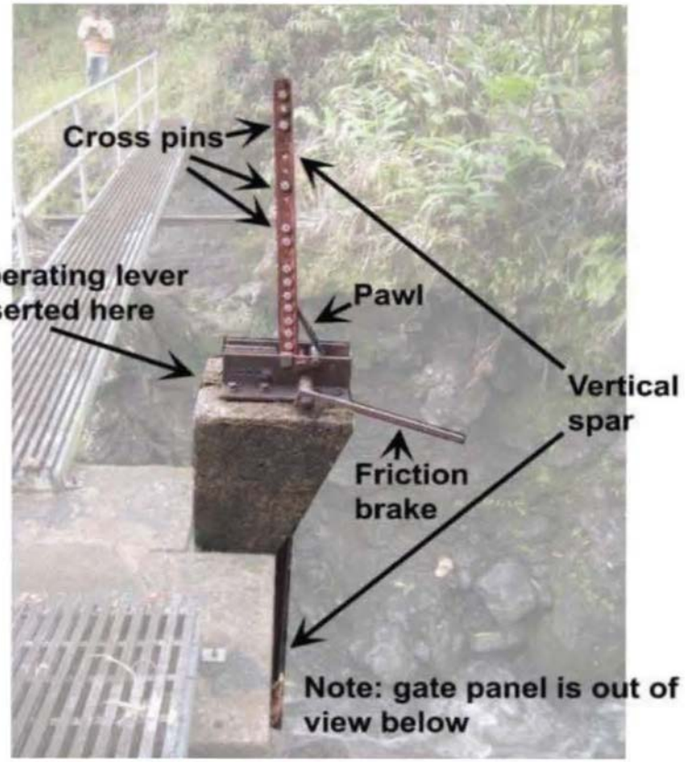


Figure 26 : This photo illustrates the parts of the sluice gate. Existing modifications to ratchet type sluice gates include the replacement of cross pins (sometimes with stainless steel pins), and placing a locked box over the operating lever area to prevent unauthorized gate adjustments. The integrity of this type of gate can also be affected by the removal of operating parts by EMI to disable the gate, and by corrosion , which can degrade parts and cause them to break or come loose. (Source: MAI, 2018.)

GEAR TYPES

Figure 27: This typical geared type sluice gate operating mechanism is located at EMI Honomanu Stream diversion , which is ordered to be restored as a "Habitat Stream" by CWRM. View facing SE. (Source: MAI, 2018.)

Figure 29: View of the same geared mechanism at right.

Figure 28: This sluice gate mechanism is a geared type. It operates by attaching a crank to the shaft of the small pinion gear. Revolving the crank operates the geared mechanism and advances the gear rack, to raise or lower the gates . This geared-operating gate is located at EMI stream diversion at Kopiliula, which is ordered to be restored as a "Habitat Stream" by CWRM. View facing E. (Source: MAI, 2018.)

BOARD ADJUSTED TYPES

Figure 30: This typical board adjusted type sluice gate operating mechanism is located at EMI Kolea Power House stream diversion on Kolea, a tributary of Punalau, which is ordered to be restored as a "Habitat Stream" by CWRM. View facing SW. (Source: MAI, 2018.)

Figure 32: Board adjusted sluice gate with plastic boards installed . Boards are in the closed position , preventing water from passing through the gate. At about 2'-6" wide, this gate is typica l width for board adjusted gates seen at EMI during the field survey. This board adjusted gate is located at EMI stream diversion at Waiohue , which is ordered to be a "Fully Restored" stream by CWRM . View facing SE. (Source: MAI, 2018.)

Figure 31: Board adjusted sluice gate with no boards installed. Note that this gate is about 5'wide in total, with three vertical spaces for boards . This board adjusted gate is located at EMI throw-out gate at Piinaau, which is ordered to be a "Fully Restored " stream by CWRM. View facing NE. (Source : MAI, 2018.)

THREADED SHAFT TYPE

Figure 33: This threaded shaft type sluice gate operating mechanism is located along an irrigation ditch on the Big Island. It is very similar to the threaded shaft mechanism observed at EMI Kolea Power House stream diversion, on Kolea, a tributary of Punalau , which is ordered to be restored as a "Habitat Stream" by CWRM. The single example surveyed was too damaged to properly illustrate its configuration. (Photo: MAI, 2017.)

Figure 34: The sluice gate mechanism is a threaded shaft type that is inoperable due to corroded and missing parts. The gate once operated by turning a handwheel that advanced the formerly threaded vertical steel shaft up and down, moving the metal panel. The handwheel is missing and corrosion has destroyed the threads on the steel shaft. Some of these mechanisms have become inoperable due to lack of use. When necessary, however, they can be serviced to make the adjustments. This threaded shaft gate is located at EMI stream diversion at Kolea Power House, on Kolea, a tributary of Punalau, which is ordered to be restored as a "Habitat Stream " by CWRM . View facing S. (Source: MAI, 2018 .)

Figure 35: Another view of the threaded shaft gate mechanism at left. This gate is paired with a ratchet type gate. (Source: MAI, 2018.)

CURRENT STATE OF PRACTICE: MANAGEMENT

EMI had 25 to 30 employees to manage the ditch system in the 1950's. Every section of ditch in the more complicated areas had a "ditch man" who lived nearby and was responsible for the upkeep of a mile or so of ditch. The ditch men would likely rotate out, and another ditch man take up residence. It is important to understand that the EMI system is really set up to need that level of care.

In the early 1990's EMI had 19 employees. At the time of the 2007-2008 CWRM reports on the 25 East maui streams, EMI was listed as having 17 employees.

By the 2015 CWRM East Maui hearings, the number quoted was about 15. After sugar closed down, the word was that there were 12 employees, dropping to 9.

Rumor has it that Mahi Pono has hired some folks back in the last year or so.

STAKEHOLDER DEPENDENCE ON EMI WATER: HC&S

IoTask

HC&S sugar plantation consisted of approximately 43,300 acres of land.

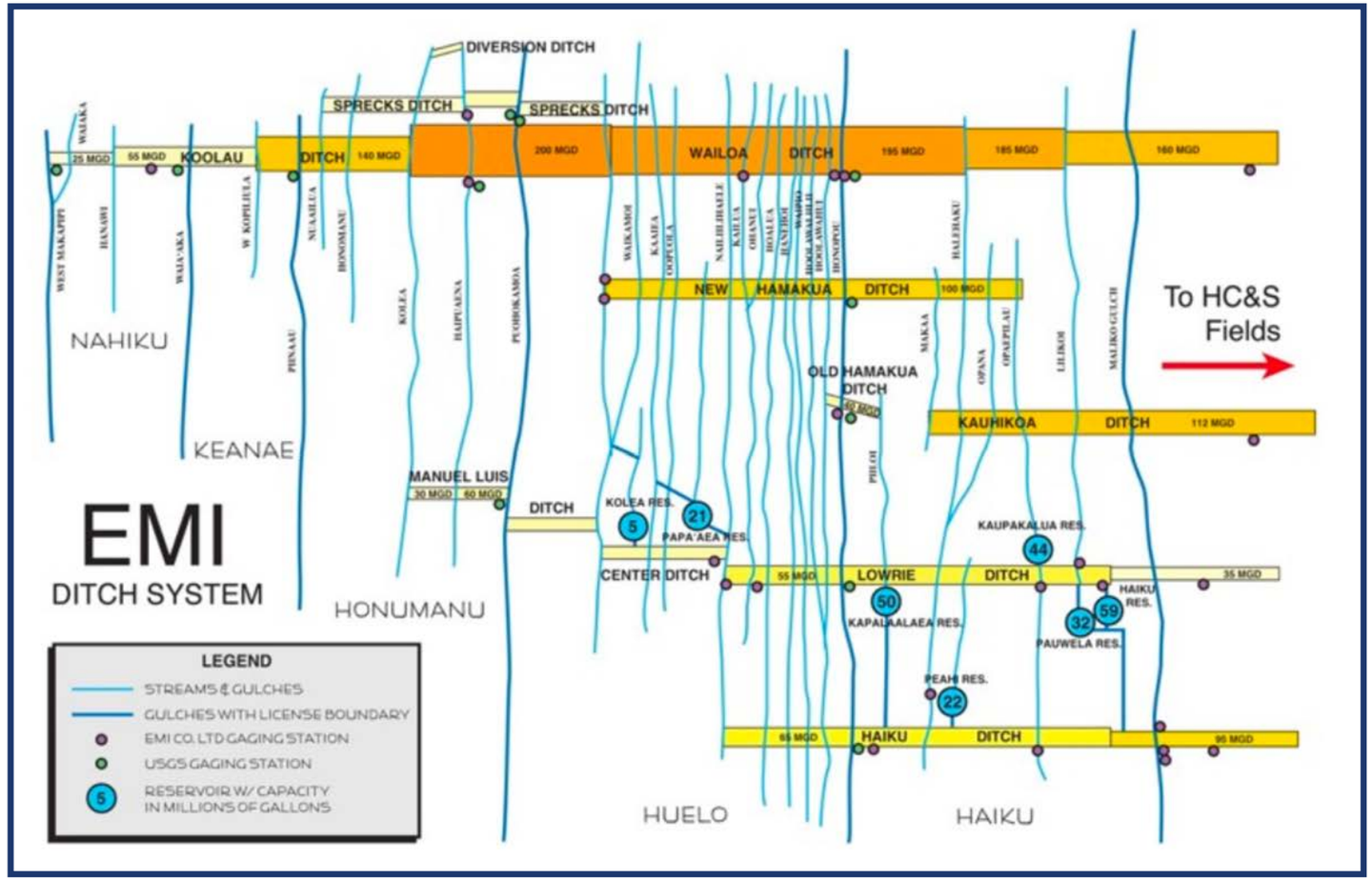
- Sugar was cultivated on roughly 35,100 acres.
- Balance was leased to third parties, was not suitable for cultivation.
- Approximately 30,000 acres were irrigated with water delivered by EMI.
  - 5,000 acres irrigated solely with EMI water.
  - 25,000 acres irrigated with a mix of EMI water and supplemental ground water pumped by HC&S.
- From 2002 to 2004, HC&S received 71 percent of its water supply from EMI (surface water), while the remaining 29 percent was supplemental ground water.

HC&S needs from EMI varied largely with weather and seasonal conditions.

- Low of 134 Mil gallons per day in the winter months.
- High of 268 Mil gallons per day during peak usage in the months of May to October.

CURRENT STATE OF PRACTICE: MEASUREMENT

- Transparent measurement of diversions is limited
- 11 Public gauges, of which, only three (3) are “active”
- West Wailuaiki Stream near Keanae, Maui, HI
- Hanawi Stream near Nahiku, Maui, HI
- Honopou Stream near Huelo, Maui, HI
- Gauge is planned for Naili’iliha’ele stream



CURRENT STATE OF PRACTICE: MANAGEMENT

Water management is the control and movement of water resources to minimize damage to life and property and to maximize efficient beneficial use.

Good water management of dams and levees reduces the risk of harm due to flooding. Irrigation water management systems make the most efficient use of limited water supplies for agriculture.

Drainage management involves water budgeting and analysis of surface and sub-surface drainage systems. Sometimes water management involves changing practices, such as groundwater withdrawal rates, or allocation of water to different purposes.

JOBS & GDP DEPENDENCE ON EMI

IoTask

Agriculture-related jobs on Maui

- HC&S employed approximately 800 full-time workers.
- EMI employed an additional 17 workers.
- 650 agricultural jobs were eliminated on Maui - HC&S plantation closed 2016.

Agribusiness GDP on Maui

- HC&S agribusiness saw a revenue increase of 3 percent, or $4.2 Mil, in 2006 over the previous year.

  - Increase was attributed to higher revenues in repair services and trucking, higher-power sales, higher equipment rentals and soil sales, and higher specialty sugar and molasses sales.

  - Lower revenues were reported in the bulk sugar sales.

In 2017, there were 365 farms hiring

- 14 of which hired migrant workers.
- A total of 1,174 residents worked 150 days or more, and 36 migrant workers worked 150 days or more.

Source: Department of Business, Economic Development & Tourism [DBEDT], 2007, A&B, 2007, Maui County Databook 2018

CURRENT STATE HYDRO-ELECTRICITY INCLUDES 3 HYDRO-ELECTRIC PLANTS

IoTask

- Hawaiian Commercial and Sugar Co. (HC&S) had three hydro-electric plants utilizing EMI water.
- Paia Hydro was built in 1912 with 800 kw capacity. In 1923, the penstock was extended to a higher elevation, increasing capacity to 100 kw.
- HC&S built 4000 kw hydroplane in Kaheka in 1924, with a design capacity of 4.5 MWe. It has 3 unit(s).
- In 1982, 500 kw hydro-electric plant installed at Hamakua Ditch in Paia. This low head hydroplane takes water through a 36 inch pipe and discharges it into the Hamakua Ditch.
- As of 1980, Paia was producing 3.0 gwh annually and Kaheka 18.0 gwh annually.

Sugar Water, Hawaii's Plantation Ditches, Carol Wilcox, 1996, Maui - Hydroelectric 1981 study | https://www.osti.gov/servlets/purl/6603444

SEC AGREEMENT PROVIDES ADDITIONAL COVENANTS RELATED TO HYDROELECTRIC POWER AND DISTRIBUTION

IoTask

- **Specific terms of SEC agreement require continued provision of power to mill property.**
  - "The Puunene Mill property contains certain electrical transmission, switching and associated equipment used in connection with the hydroelectric power and 12KV distribution system located at the Real Property and the EMI Land.
  - After Closing the parties shall cooperate reasonably to develop a plan and timeline for Buyer's removal and relocation of such equipment from the Puunene Mill property.
  - Such relocation shall be completed when reasonably practicable after Closing, taking into account both Seller's redevelopment plans and, where applicable, any work by MECO that is a necessary precondition to Buyer's relocation of such equipment.
  - Until Buyer completes the disconnection of such equipment from the Puunene Mill property, Buyer shall continue to deliver hydroelectric power to the Puunene Mill property, as available after all of Buyer's power needs are met and on an as-needed basis consistent with past practice, without charge to Seller to the extent Buyer produces excess hydroelectric power."

CURRENT STATE ASSESSMENT CONCLUSION

- **Ko‘olau Mountains watershed on Oahu**
  - Economic analysis showed an estimated Net Present Value (NPV) of $7.44 billion to $14 billion.
  - East Maui is estimated to have a higher value than the Ko`olau watershed.
- **The EMI aqueduct system is impacting the integrity and value of the East Maui Watershed and is not adequately serving the Public Trust, which requires protection and maximum reasonable beneficial use of water**
- **A repurposed and optimized EMI aqueduct system in sustainable relation with the East Maui watershed can have significant potential to fully meet diverse stakeholder needs (including flora, fauna, and human users), as well as providing additional research, educational, and substantially increased economic benefits.**
- **Because the true condition of the water distribution system and the cost of optimizing it in the context of 21st century technological innovations and ecological knowledge is unavailable, even though 70% of the system is situated on state lease lands, it is imperative that a comprehensive assessment of the system and watershed be completed as soon as possible.**

Source: University of Hawai‘I, Natural resource valuation of the Ko‘olau Mountains watershed on Oahu. Case Study of the Honopou Stream prepared by CWRM’s Ecology, Restoration, and Management of Hawaiian Stream and Riparian Systems Report of 2008,

LEGAL SITUATION ASSESSMENT

KEY FACTS RELATED TO LEGAL SITUATION

IoTask

- **Alexander & Baldwin (A&B)**
  - A large land-owner in Maui for the past one hundred years.
  - Acquired land and water rights at a minimum cost, below fair market value without compensation to indigenous owners.
  - Built ditches, dams, and irrigation system, collectively referred to as EMI (East Maui Irrigation system)
    - Delivers water mostly for A&B's plantation land, with 20 percent or so of water to other adjacent land-owners and local Maui farmers.
    - Since 1878, A&B has been diverting water from public lands at an extremely cheap water price, which has not been adjusted since.
    - There was no comprehensive review on the environmental impact of EMI's stream diversion and water usage.
- **In 2016, A&B sold 41,000 acres of former sugar land to Mahi Pono, but it retains several thousand acres on Maui**
  - Mahi Pono and A&B each owns 50 percent of EMI.
  - Terms are contingent upon A&B delivering water rights.
  - Price difference is nearly 62 million USD.
- **A&B and its successor, Mahi Pono, want a 30-year state lease for 33,000 acres of East Maui watershed**
  - claims that allowing EMI to resume diversion of 80 million gallons per day or more of public stream water will have no impact.

Source: Maui Tomorrow Foundation is a not-for-profit environmental advocacy organization with focus includes sustainable planning, reef and shoreline protection, sustainable energy development, water conservation and reuse, and stream restoration. Website: https://maui-tomorrow.org/

KEY FACTS RELATED TO LEGAL SITUATION: CURRENT LITIGATION

- **Carmichael v. Board of Land & Natural Resources, Alexander & Baldwin, County of Maui.**
  - The Native Hawaiian Legal Corp (NHLC) representing plaintiff says diversion of water should not continue until an environmental assessment is completed, the very first step in the environmental review process required under Hawaii Environmental Policy Act (HEPA).
  - Question whether State's Board of Land and Natural Resources (BLNR) has the statutory right to require A&B to conduct an Environmental Impact Statement (EIS) as a condition precedent to the renewal of the water leases. The BLNR sought a declaratory judgment against A&B, declaring its water license null and void absent of the environmental assessment.
  - 2015 Circuit Court decision ruled in favor of Hawaiian Kalo farmers in East Maui invalidated the BLNR's renewal of temporary revocable water permits for large diverters. A&B appealed, and successfully pushed the 2016 legislative session to allow revocable permits for three years.
  - In June 2019, the appellate court (Hawaii Intermediate Court of Appeals, abbr. ICA) ruled for A&B. The Kalo farmers now have appealed the ICA decision and the case is pending decision at the Hawaii Supreme Court, which heard the case in May 2020. Mahi Pono joined as a party in the lawsuit.
- **Sierra Club vs. Board of Land and Natural Resources (BLNR), Dept of Land and Natural Resources, Suzanne Case, Chairperson of BLNR, Alexander & Baldwin, EMI.**
  - State board is trustee of these state/Kingdom lands, waters, and native flora and fauna and the suit challenges the state land board for not upholding its Public Trust responsibilities.
  - Alleges BLNR and public has not been provided with:
    - Adequate information on the impact of the continued diversions of the 13 East Maui streams that have had no studies on stream flows or native flora & fauna needs.
    - Sufficient information on what the diverted water is actually being used for.

Source: https://www.civilbeat.org/2020/05/hawaii-supreme-court-hears-maui-water-case-in-a-historic-online-session/

COUNTY CAN PLAY A MORE ACTIVE ROLE IN TRANSFORMING EMI THROUGH APPROPRIATE LEGAL AND POLITICAL PROCESS

- County has **general powers** to levy fees and taxes, issues bonds.
- County has the **power of eminent** domain, "to provide by ordinance assessments for the improvement or maintenance of districts; to construct, lease, and otherwise acquire waterworks and "other conduits for distributing water to the public" and to establish and maintain waterworks.
- Currently, the Maui Board of Water Supply(BWS) only has **advisory power** to the mayor and the county.
- County may, through **appropriate legal and political process**, revise ordinance and the charter of BWS to delegate it with more decision-making powers.

THE COUNTY CAN:

- Pass ordinance or through charter amendment to create a decision making body.
- Restore the former power of the Board of Water Supply prior to the 2002 amendment) to manage water systems, adopt regulations, assess and adjust water rates, have eminent domain power, and borrow and issue bonds on its own.
- Create a special improvement district or implement other legal tools, including eminent domain and condemnation when necessary.

THREE OPTIONS SUGGESTED BY LOCAL ATTORNEYS:

- County purchases the water rights from the private parties.
- County acquires EMI, through condemnation of EMI (based on the statutory rights), establish a non-profit utility corporation and take over the management of the EMI system.
- County establishes a special improvement/assessment district and assesses fees on the parties/require the private parties to pay for upgrades and investment of irrigation improvements.

Source: Lincoln-IoTask analysis with perspective of local attorneys 2020

CURRENT POWERS OF MAUI DEPARTMENT OF WATER SUPPLY (DWS)

IoTask

- **Maui Department of Water Supply (DWS) has power to manage all water systems owned by county**
  - Administering daily operations, preparing capital improvement plans for enactment by the Council via ordinance.
  - Recommending water rates for mayor's approval and the enactment of an ordinance by the council.
- **DWS cannot borrow directly and cannot conduct eminent domain on its own**
  - The county has the power of eminent domain, "to provide by ordinance assessments for the improvement or maintenance of districts; to construct, lease, and otherwise acquire waterworks and "other conduits for distributing water to the public" and to establish and maintain waterworks. HRS §46-1.5(6), (9), (19) & (23).
  - Art. VII, §12 requires approval from the county council for issuance of all bonds.
  - County council must authorize "issuance of special purpose revenue bonds for each single project or multi-project program of each special purpose entity, provided that it is in the public interest" and by a two-thirds vote.
- **Special purpose revenue bonds to assist "special purpose entities" that may be, "utilities serving the general public" and "agricultural enterprises"**

Source: HRS chapter 39 A governs the state's issuance of special purpose revenue bonds.

SETTING UP A SPECIAL IMPROVEMENT DISTRICT (SAD/SID)

IoTask

- **A special improvement district assesses an additional tax on the full value of a property.**
  - Paid by property owners within a defined special improvement district that will benefit from specific public improvement(s).
  - Used to finance major infrastructure upgrades (such as public transport), build roads, and install water and sewer systems.
- **In order to issue special improvement district bonds.**
  - A majority of owners must agree to a self-assessment.
  - Special assessment is not a tax.
  - Generally levied under the municipality's taxing power or police power.
  - Mandatory statutory procedures must be followed.
- **Hawaiian law allows counties to set up an improvement district, in some cases requires an ordinance.**

Source: HRS §§ 46-80, 80.1, 80.5, and 54-1.

SETTING UP A PUBLIC UTILITY AUTHORITY/COMPANY

IoTask

- **Maui county and BWS currently do not have the power to set up a public utility company.**
- **Maui county cannot create a public corporation unless authorized by the state Constitution or State legislature.**
  - The Hawaii constitution does not have a home rule provision.
  - The State Constitution confers upon the state the power to charter corporations and grant franchises, and those powers are not conferred on the counties.
- **A work-around can be done.**
  - A private entity can register a corporation to provide a public service.
  - A nonprofit doing public works is regulated by the state Public Utilities Commission.
  - If the county registers a private non-profit corporation, with its board members appointed by the mayor and the council, then this non-profit corporation can manage utility assets, borrow and issue corporate bonds, and make investment.

CURRENT EAST MAUI WATER LICENSE FEE STRUCTURE IS EXTRAORDINARILY BENEFICIAL TO EMI

IoTask

HISTORIC LEASE RATES

- Originally low to offset ditch construction costs
- Lease rates based upon sugar prices in past
- A&B/EMI required at one time to pay for fixed amount of water on an annual basis, regardless of use

CURRENT PERMIT RATES

- Most recent one-year revocable permit (10/12/19) for the four lease areas approved unanimously by the 6-member Board of Land & Natural Resources: $19,622.05 per month for 45 mgd
- Assuming 5 mgd to the state and DWS, 40 mgd @$654.07/day = 1.6 cents per 1,000 gallons

A&B/EMI AND MAUI COUNTY

- A&B/EMI bills Maui county for water delivered to County treatment plants (6 cents per 1,000 gallons since 1973).
- DWS charges $1.10 per 1,000 gallons for upcountry agricultural use (over 15,000 gallons per month).
- Maui agricultural users who use less than 15,000 gallons per month pay residential rates.
  - 0-5,000 gallons per month - $2.05 per 1,000 gallons
  - 5-15,000 gallons per month - $3.90 per 1,000 gallons
  - Domestic rates for more than 15,000 gallons range from $5.85 to $11.45 per 1,000 gallons, depending on pipe size

Sources: East Maui Waters, Watershed, and Water System, H2O Roundtable, Lucienne de Naie, https://www.mauinews.com/news/local-news/2019/10/state-board-oks-more-water-for-mahi-pono/, Maui County Water Department website: https://www.mauicounty.gov/216/Water-Charges

STATE LEGISLATURE EXTENSION OF LEASE PERMITS

- **Hawaii Legislature approved a three-year extension of A&B's four permits in 2017.**
- **In 2019, State House Bill 1326 failed in Committee when legislators deadlocked on whether to again extend the water permits and whether to include A&B along with several utility companies, farmers and ranchers that also tap into state waters.**
  - HB 1326 was opposed by environmental groups, taro farmers and many Native Hawaiians who believe it favored A&B and violated the public trust on water use.
  - It was supported by ranchers, farmers and utilities who want to divert water for their respective enterprises.
  - The amended version of bill specified that the authorization for the issuance of holdover permits does not apply to holdovers or pending lease applications that concern a use or disposition of water rights that is otherwise legally prohibited or invalidated by a court of law.
  - That language specifically impacted A&B because a state Circuit Court ruling in January 2016 prohibited the company from using four revocable permits to authorize permanent diversions of stream water in East Maui. The ruling, which is on appeal, led to legislation that year that allowed the company to use the permits until 2019.

Source: https://www.civilbeat.org/2019/04/water-rights-bill-goes-down-the-drain-in-historic-vote/

CURRENT LEASE APPLICATION PROCESS REQUIRES WATER USE AND CONSULTATIONS

APPLICATION INCLUDES RIGHT TO DIVERT WATER FOR A SPECIFIC CHARACTER OF USE, PLUS RIGHT TO MAINTAIN OR REPLACE PHYSICAL INFRASTRUCTURE ON STATE LAND (ESSENTIALLY AN EASEMENT)

1. **Confirm proposed water use and amount**
   - Water is a Public Trust Resource.
   - Leases under stewardship of Board of Land & Natural Resources, which regulates water from a proprietary perspective.
   - BLNR manages Dept of Land & Natural Resources, which manages unencumbered state land, including surface water and ground water.
   - Commission on Water Use Management (also within DLNR) manages water from resource management perspective and determines Interim Instream Flow Standards which establish how much water must be left in stream to ensure healthy stream environment, sustainability of resource, thereby capping maximum amount of lease.
2. **Develop water reservation with Dept of Hawaiian Homelands (DHHL)**
   - DHHL receives 30% of lease revenues.
   - Office of Hawaiian Affairs receives 20% of lease revenues.
   - DHHL has first right of use for future development so all leases must take DHHL reservations into consideration.
3. **Written consultation with the Office of Conservation and Coastal Lands**
4. **Comply with Chapter 343, HRS (EA/EIS/Exemption)**
   - EMI currently in EIS review process.

Source: Dept of Land & Natural Resources, Ian Horikawa public presentation to the Board of Water Supply

CURRENT LEASE APPLICATION PROCESS ALSO REQUIRES A WATERSHED PLAN AND PUBLIC AUCTION

IoTask

5. **Development/implement a Watershed Management Plan**
   - BLNR/DLNR still working out process, thinking about utilizing existing plans, and requiring applicant to contribute in an equitable way.

6. **Appraisal of water rights to determine upset rent**
   - BLNR has yet to determine appraisal process. Although water is a public trust, need to determine fair market value of water, traditionally been a big challenge; fair market value is upset rent.
   - BLNR/DLNR do not want water to be a commodity, or to encourage speculation/buying up water rights.

7. **Public Auction**
   - Only qualified bidders can bid. Must have ability to operate the whole system (which is currently physical located on state/private land, and EMI/Mahi Pono land).
   - Has to be a legitimate qualified agricultural operator (or domestic use provider or other trust use).
   - Must have relevant experience (could be a power producer).
   - BLNR would not necessarily outright prohibit sub-leases, but lease will require use of water under character reviews, must meet IIFS, must stay consistent with use.
   - If East Maui taro farmers wanted to bid, they would have to be allowed to operate the system.
   - If the County were the owner and wanted to bid, the public auction process would likely be changed.
   - Once signed, lease terms cannot be amended.

Source: Dept of Land & Natural Resources, Ian Horikawa public presentation to the Board of Water Supply

TECHNOLOGY ASSESSMENT

TECHNOLOGY FORMS THE FOUNDATION OF THE VISION FOR THE FUTURE

IoTask

MODEL OF SMART WATERSHED

DEFINITIONS:

- ***Crowdsourcing*** refers to the practice of obtaining information or input into a task or project by employing the services of a large number of people, typically via the Internet.
- ***Crowd2Cloud*** directly aggregates crowd-sourced data in the network cloud.
- ***IoT (Internet of Things)*** is about extending the power of the internet beyond computers and smartphones to a whole range of other things, processes, and environments. IoT systems are sensor-enabled software-defined systems that are a combination of product, application, analytics and the Internet/networking. They are scalable, upgradable, automated and future ready and are often also referred to as "Smart" technology.
- **ESG** stands for Environmental. Social and Governance, a commonly used term to refer to public good impact other than monetary.

Source: IoTask led visioning 2020

SMART TECHNOLOGY PROVIDES SOLUTIONS FOR MANY PROBLEMS THAT THE STAKEHOLDERS FACE TODAY

IoTask

- **Water and irrigation systems become smarter with IoT and satellite.**
- **IoT can also be used to connect with the Government systems.**
- **In a smart system, Smart Land, Water and Air can all interact with each other in a virtual cloud ecosystem.**
- **Smart Energy is a logical derivative from Land, Water and Air.**
- **Smart opens up the door to many new ways of doing business and thus new revenues through demand creation.**
- **All the above sit on the next generation of digital infrastructure that provides the basic connectivity and communication platforms.**

AREAS FOR TECHNOLOGY EXPLORATION FOR EAST MAUI SITUATION

IoTask

UTILITY	DEVELOPMENT	EDUCATION	INFRASTRUCTURE
Energy	Economic Development	Education Platforms	Open data
Water	Housing	Learning Formats	High-speed Internet
Waste	Local Government	Digital Skills	Connectivity Technology
Municipal	Land Use	Schools	
Street-Lights		Research Center	
Drainage			

EACH CATEGORY HAD MANY SUB APPLICATIONS

IoTask

UTILITIES

- Home energy consumption tracking; Distribution automation systems
- Water quality monitoring; Water level sensors for leak detection and control
- Optimization of waste collection routes
- Digital public records
- LED/efficient lights
- Rainwater harvesting
- Building automation systems; Smart streetlights; Home energy automation systems
- Real-time consumption tracking;
- Digital tracking and payment for waste disposal
- Data-driven building inspections; Virtual personal assistants
- Solar-powered lights
- Flooding detection
- Stream and water measurement
- Rainwater catchment
- Storm water reuse
- Desalination

DEVELOPMENT

- Digital business tax filling
- Peer-to-peer accommodation platforms for affordable community living options
- Local civic engagement applications
- Open cadastral (land) database
- Digital business licensing and permitting
- Data sharing of smart home sensor technologies to reduce expenses for security, heating, cooling, lighting, water
- Digital citizen services (e-Gov)
- Digital land-use and building permitting
- Automated Public offices
- Local connection platforms; Sensor enabled public spaces - parks, sidewalks, common areas
- Public technologies for watershed – rain gauges, invasive specie detection, fog catchers

EDUCATION

- Education analytics solutions
- Cognitive-based blended learning systems
- Adaptive learning systems with automated real-time analysis
- Online education curriculums; Real-time feedback on online courses
- Data-based measurement of potential student performance
- AI e-textbooks
- Local e-career centers
- Online retraining programs
- “Civic coding” programs
- Wi-fi access in public schools
- 1:1 laptop/tablet programs
- Integrated digital education platforms
- Smart irrigation controllers
- Energy-generating exercise equipment
- Interactive, software based play structures

INFRA-STRUCTURE

- Freedom of information; Individuals controlling their private data
- High levels of security and privacy using AI and blockchain technologies; Accessibility and sustainability
- Higher efficiency and interoperability across smart municipalities - regionally and globally (Open311)
- Help bridge the digital divide in cities; Charging stations; Emergency calls; Directory of services;
- Enable IoT based city services connected - street lighting, trash bins, smart parking, smart building, smart water, etc.
- Location based services for individuals; Broadband experience everywhere and anytime
- Free city wide Wi-Fi/LPWAN coverage
- City wide 4G/Broadband coverage
- Free city/country wide Broadband coverage

MAUI IS WELL POSITIONED TO BE A CENTER FOR SMART IOT APPLICATIONS

IoTask

- **Maui is highly diverse and international.**
  - Socially and ethnically global in culture.
  - Progressive and willing to innovate.
- **Maui is relatively small and contained in area.**
  - Far more akin to cities than rural in terms of distance challenges.
- **Maui County is made of discrete power, transportation and telecommunications grids.**
  - Water distribution systems are also isolated.
  - Geographic advantage in deploying new innovations in an isolated real-world environment that is fully grid integrated with limited impact from outside variables.
- **Maui County can provide valuable research opportunities with regard to climate change and biodiversity.**
  - The state of Hawaii has 10 of the world's 14 climate zones.
  - The Hawaiian Islands are the most isolated populated land mass on the planet.
  - Hawaii is home to a large number of endemic mammal, fish, bird, insect, and plant species, many of which are endangered.
  - Cloud forests of East Maui may be the most sensitive and vulnerable to climate change.

BUT THE WATER SYSTEMS IN EAST MAUI IRRIGATION ARE FAR MORE RUDIMENTARY TODAY

IoTask

- **The water systems in East Maui are far more rudimentary and require a far earlier stage of implementation**
  - Basic infrastructure needs to be also upgraded
  - Transparency on measurement and gauges need to be added to the EMI systems
  - Non-operational dams/reservoirs need to be made operational
  - Transparent monitoring of EMI systems is long overdue

WATER TECHNOLOGY INCLUDES SOLUTIONS FOR MEASUREMENT, MONITORING, MANAGEMENT, DISTRIBUTION AND ANCILLARY FUNCTIONALITY

IoTask

Water management is the control and movement of water resources to minimize damage to life and property and to maximize efficient beneficial use.

Water Measurement → Water Monitoring → Water Management → Water Distribution → Water Ancillary Revenues

Water Source

- Streams
- Wells
- Rivers
- Springs
- Rain & fog

- ACCESSIBILITY
- VOLUME
- CAPACITY
- RELIABILITY

Monitoring

- Measurement for leaks, usage etc.
- Indicators: pressure, flow speed, level measurement, environmental etc
- Additional: invasive species, flooding, wildfires

- TRANSPARENCY
- ACCOUNTABILITY

Storage

- Stored in tanks for distribution, reliability
- Indicators: pressure, temperature, flow speed, level measurement, environmental etc.

- SUSTAINABILITY

Treatment

- Distribution
- Indicators: PH, pressure, temperature, flow speed, level measurement, environmental etc.

- PRIORITY
- PARTICIPATION

USE (Home, Agriculture…)

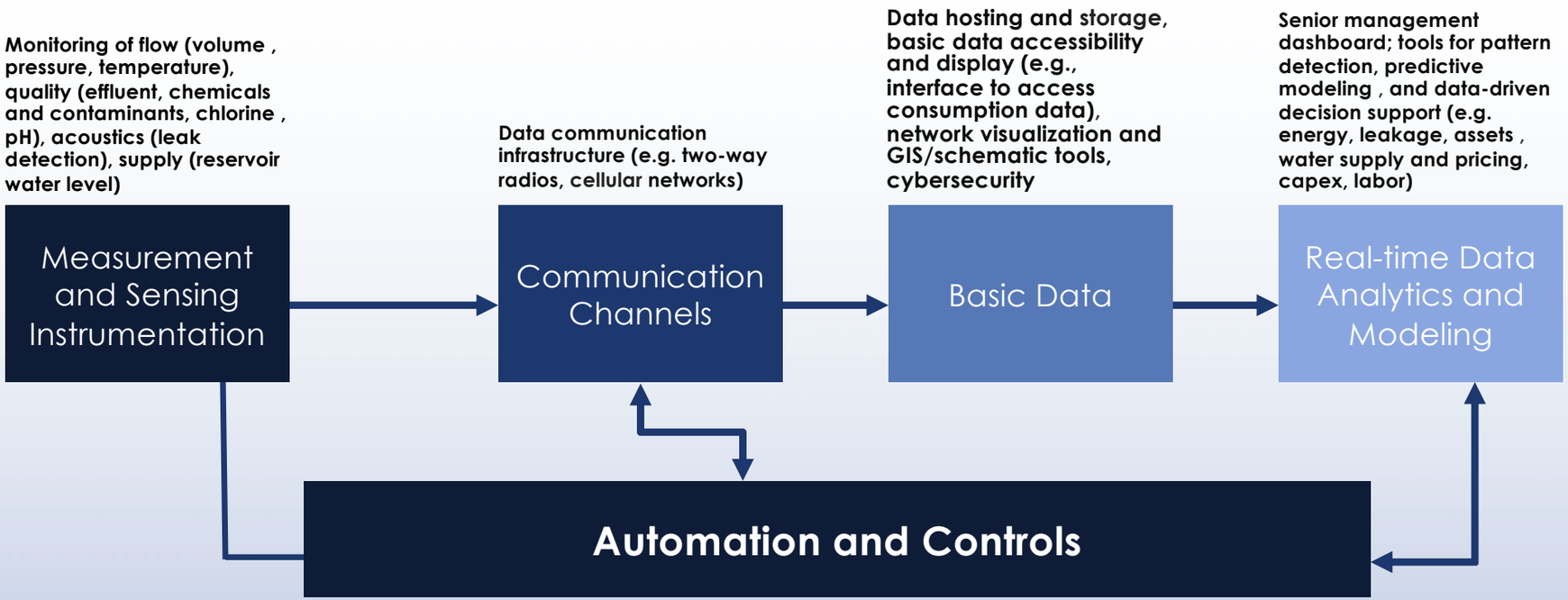
- Standard users: home, agriculture
- Electricity
- Recreational
- Information

- ECONOMICS
- SERVICE LEVELS

CERTAIN TYPES OF INFRASTRUCTURE ARE REQUIRED IN ALL SMART WATER SYSTEMS

Physical infrastructure (E.G., Pumps, pipes, valves)

Software and Services (e.g., data infrastructure and hardware, software, professional and managed services)



Automated physical network infrastructure (e.g. pumps and valves) and software to manage pressure , quality, flow, shutoff , etc.

WATER TECHNOLOGY FOR SMART WATER IMPLEMENTATIONS

IoTask

Water Measurement

- Sensors
  - Pressure Measurements
  - Flow levels
  - Flow meters
  - Acoustic emission
  - Temperature
  - Chemical measurements
  - PH
  - Microbial
- Networks – real time
- Drones
- Geospatial - GIS
- Satellite
- Gauges
- Photo-voltaics

Water Monitoring

- Water Monitoring Systems
- Leak Detection Systems
- Networks – real time
- Drones
- Geospatial - GIS
- Satellite
- Gauges
- Photo-voltaics

Water Management

- Locks
- Meters
- Pumps
- Towers
- Leak detection
- Smart water networks
- Escalation management
- Hydrographic management
- Simulations
- Corrosion tech
- Data analytics
- Automation/control

Water Distribution

- Blockchain
- Water meters
- ESG Tokens

Water Ancillary Revenues

- Hydroelectric
- Recreational apps
- Informational apps
- Micro-hydro electric
- Mobile apps

LANDSCAPE OF TECHNOLOGY COMPANIES THAT PROVIDE COMPONENTS FOR SMART WATER SOLUTIONS

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- Flexim Instruments Ltd.
- Sandhurst Instruments
- Swan Analytical Instruments
- Gill Sensors and Controls
- Utilis
- Lovibond
- Metasphere
- Langham Industrial Controls Ltd.
- South West Sensor
- Sensorex
- Process Instruments (Pi)
- ANB Sensors
- ABB Group
- Evoqua Water Technologies Corp.
- 3M
- Dow Water and Process Solutions

- Flexim Instruments Ltd.
- Pure Tech Ltd.
- Echologics LLC
- Swan Analytical Instruments
- Aganova
- Utilis
- Hydrosave
- Metasphere
- Idrica/Go Aigua
- HWM Global
- ABB Group
- Muller Water Products
- KROHNE
- Modern Water Inc.

- Flexim Instruments Ltd.
- Pure Tech Ltd.
- Echologics LLC
- Aganova
- Utilis
- Lovibond
- Hydrosave
- Idrica/Go Aigua
- ABB Group
- Muller Water Products
- KROHNE
- Ecodyne Limited
- BWA Water Additives
- Katz Water Technologies
- SafBon Water Technology, Inc.
- ClearBakk Water Solutions
- Cudd Energy Services

- Aganova
- Ingeniousware
- Xylem
- Muller Water Products
- Pentair
- Evoqua Water Technologies Corp.
- Breakwater Energy Partners

- Xylem
- Evoqua Water Technologies Corp.
- Dow Water and Process Solutions
- ABB Group
- SafBon Water Technology, Inc.

THE UTILITY SECTOR HAS SEVERAL LEVELS OF SMART-TECHNOLOGY CAPABILITIES

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UTILITIES – LEVELS OF MATURITY

CATEGORY	LEVEL 1	LEVEL 2	LEVEL 3
ENERGY	Home energy consumption tracking	Home energy / Commercial Buildings - automation systems	Renewable energy micro-grids; Peak-demand load balancing
WATER	Water quality monitoring; Water level sensors for leak detection and control	Real-time consumption tracking	Smart irrigation
WASTE	Optimization of waste collection routes	Digital tracking and payment for waste disposal	Autonomous waste collection vehicles/services
MUNICIPAL UTILITIES	Digital public records	Data-driven building inspections; Virtual personal assistants	Smart sustainable utilities
STREET LIGHTS	LED/efficient lights	Solar-powered lights	Micro-grid connected streetlights
DRAINAGE	Rainwater harvesting	Flooding detection	Sewage virus hotspot detection

THE DEVELOPMENT SECTOR HAS SEVERAL LEVELS OF SMART-TECHNOLOGY CAPABILITIES

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DEVELOPMENT – LEVELS OF MATURITY

CATEGORY	LEVEL 1	LEVEL 2	LEVEL 3
ECONOMIC DEVELOPMENT	Digital business tax filling, licensing and permitting	City-sponsored entrepreneurship accelerator programs	Smart economic zones, Frictionless transportation, 999 reliability
HOUSING	Accommodation platforms for affordable community living options	Data sharing of smart home sensors to optimize expenses for heating, cooling, lighting, water	Peak demand utility management systems, eHealthcare, Smart homes
LOCAL GOVERNMENT	Local civic engagement applications	Digital citizen services (e-Gov)	Automated Public offices, Smart water, Smart trash, Smart emergency services
LAND USE	Open cadastral database	Digital land-use and building permitting	Sensor enabled public spaces - parks, sidewalks, common areas, Blockchain based land records
AGRICULTURE	Practical cost effective methods for conserve water, reduce nutrients and pollution	Use of computer-based applications to enhance results	IoT, sensors and use of remote sensing technology combined with satellite, drone imagery

THE INFRASTRUCTURE SECTOR HAS SEVERAL LEVELS OF SMART-TECHNOLOGY CAPABILITIES

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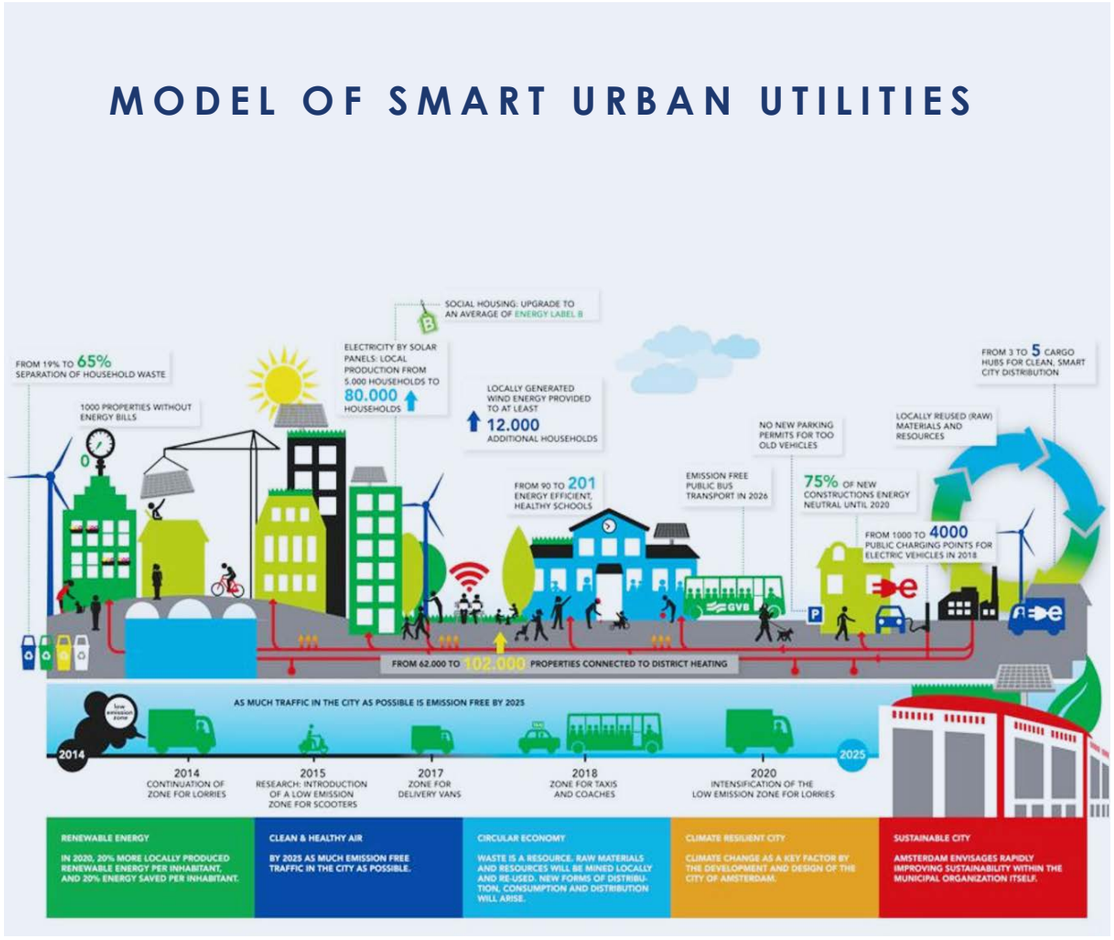
INFRASTRUCTURE – LEVELS OF MATURITY

CATEGORY	LEVEL 1	LEVEL 2	LEVEL 3
OPEN DATA	Freedom of information; Individuals controlling their private data	High levels of security and privacy using AI and blockchain technologies	Higher efficiency and interoperability across smart municipalities - regionally and globally (Open311)
HIGH-SPEED INTERNET	Bridge the digital divide in cities with public and city services - Charging stations; Emergency calls; Directory of services	Enable IoT based city services like connected - street lighting, trash bins, smart parking, smart building, smart water, etc.	Location based services for individuals; Broadband experience everywhere and anytime
CONNECTIVITY TECHNOLOGY	Free WiFi/LPWAN coverage	Municipality wide Broadband coverage	Free Broadband coverage

EXAMPLE OF A BEST PRACTICE SMART UTILTY SYSTEM: AMSTERDAM

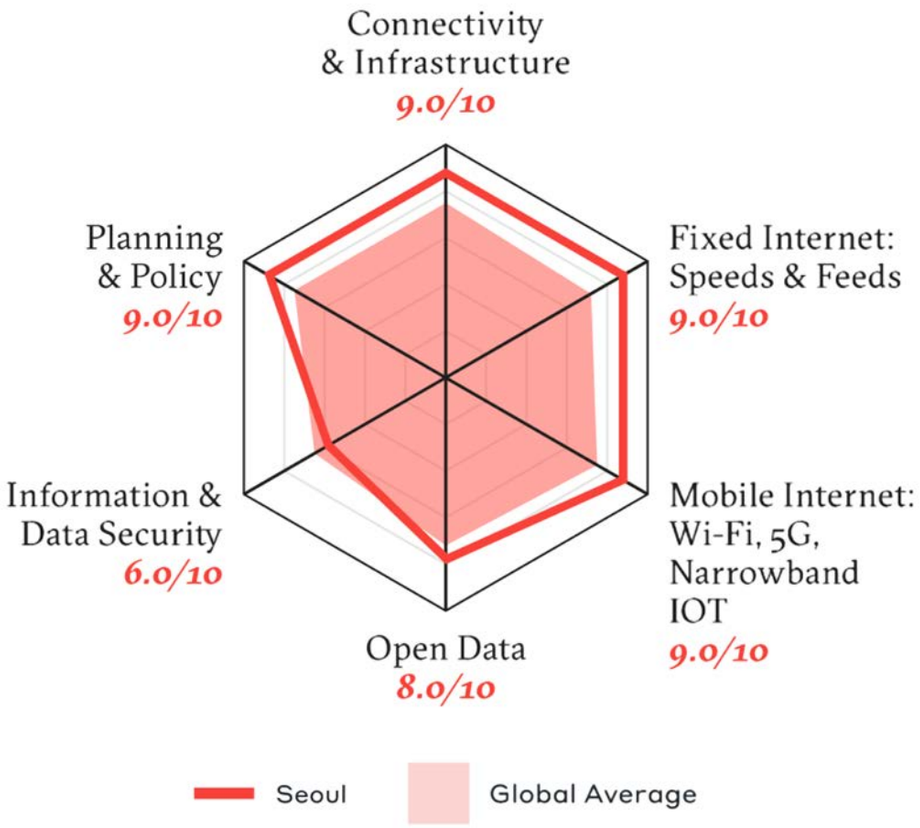


https://amsterdamsmartcity.com/themes/energy

SUSTAINABLE ENERGY PLAN

- Renewable Energy
- Intelligent Power Grid
- Real-time energy use monitoring
- Smart meters
- Connected Waste Management Systems
- Smart water quality and leakage monitoring
- Smart, solar street lights
- Residential retrofitting
- Sewer system heating collection
- Wastewater-based air cooling

EXAMPLE OF A BEST PRACTICE SMART INFRASTRUCTURE SYSTEM: SEOUL

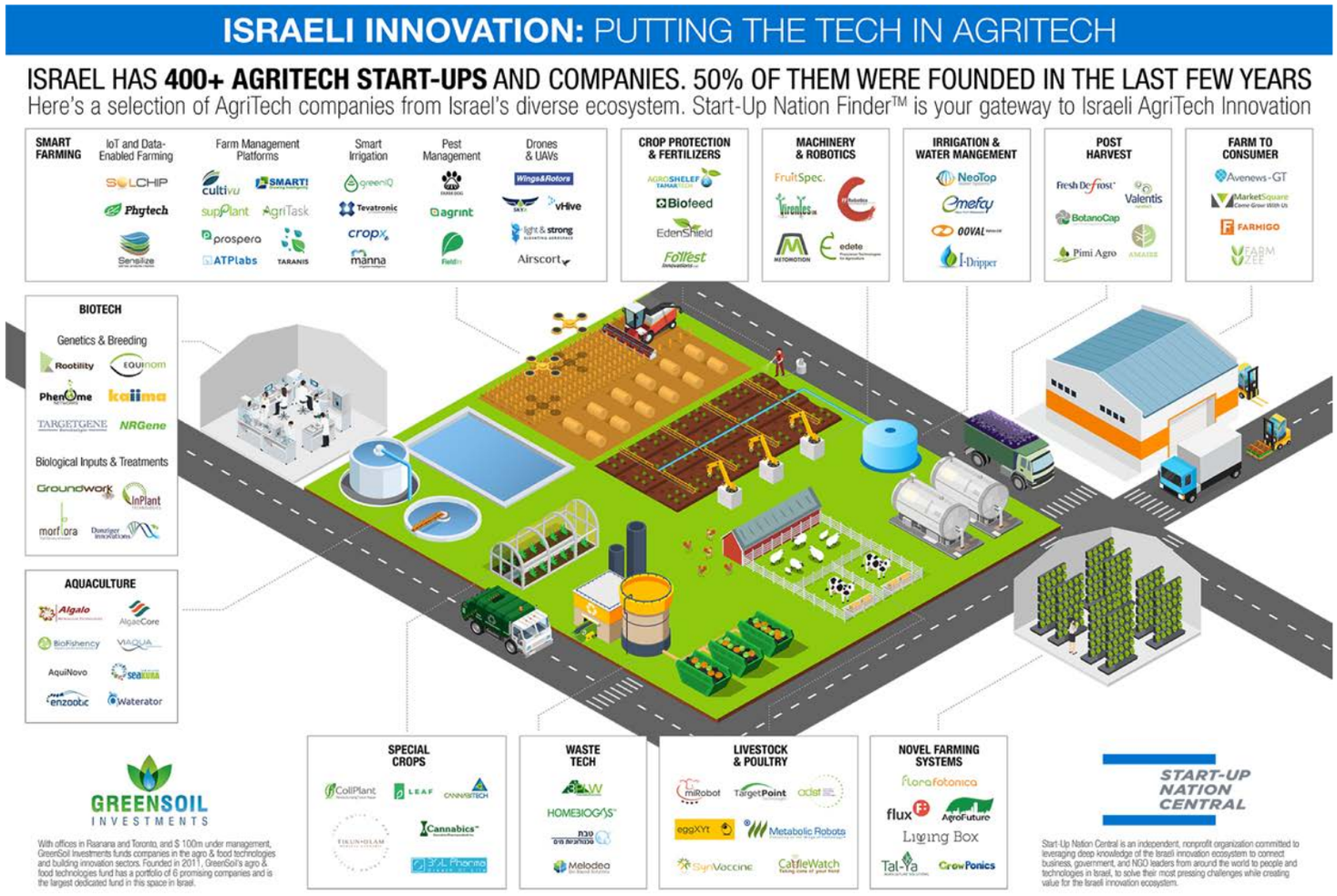


SMART MOBILITY 2030 - Intelligent Transport Systems (ITS) Master

- Broadband network
  - Ultra-fast speed
  - Ultra-low latency
  - Hyper-connectivity
- Advanced Driver Assistance Systems
  - Real-time traffic information updates
  - Vehicle-to-everything communication
- Cooperative Intelligent Transport Systems
  - Autonomous driving road infrastructure
  - Ultra-precision maps with centimeter-level accuracy

https://wsp-futurecities.com/assets/pdf/en/seoul.pdf

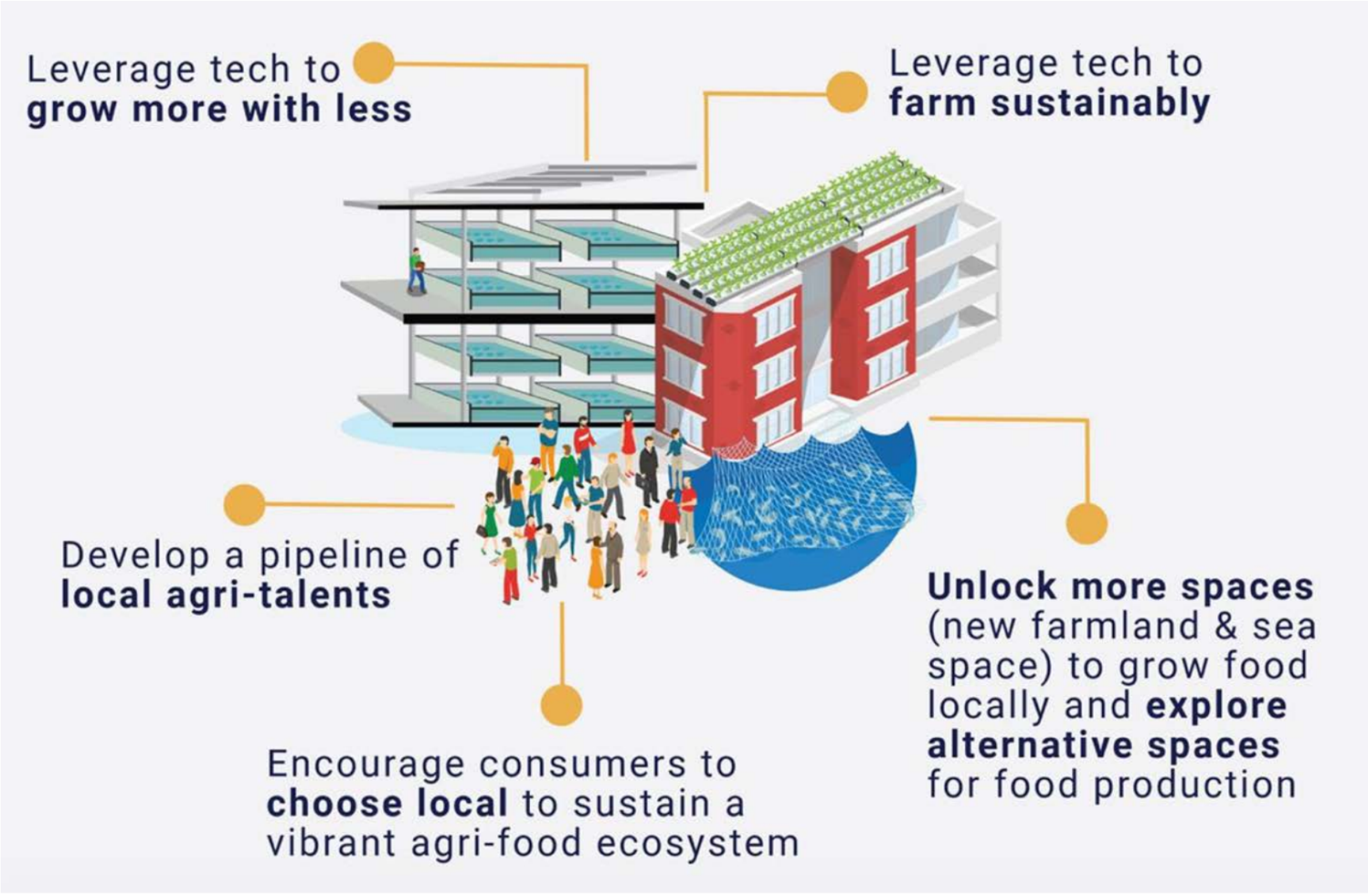
EXAMPLE OF A BEST PRACTICE SMART AGRICULTURE ECOSYSTEM: ISRAEL



SMART AGRI

- Analytic models
  - Farm & crop
  - Irrigation
  - Fertilizer
  - Weather
  - Climate
  - Disease
- Farm sensors & actuators
- Controllers
- Other sensing (or observation) technologies,
- Software applications
- Communication systems,
- Telematics and positioning technologies
- Drones & satellites
- Data analytics
- Hardware and software systems

EXAMPLE OF PACIFIC NATION INTEGRATING SMART AGRICULTURE TO REACH FOOD SECURITY



- Singapore currently imports 90% of its food.
- In April 2019, Singapore Food Agency (SFA) was formed to focus solely on securing the country's food security.
- Singapore aims to develop capability and capacity of its agri-food industry to produce 30% of Singapore's nutritional needs by 2030.
- Singapore does not have luxury of natural resources, ample land or water.
- Tech and innovation are key to addressing Singapore's natural and geographic limitations.

Source: https://www.facebook.com/SGFoodAgency/photos/pcb.2115014661908383/2115019418574574/?type=3&theater, https://www.channelnewsasia.com/news/singapore/covid19-coronavirus-singapore-food-security-stockpile-national-12563280

BEST OF BREED FOR UTILITIES WERE IDENTIFIED AS…

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ELEMENT	BEST CITY	SUMMARY
ENERGY	LONDON	https://www2.deloitte.com/insights/us/en/industry/power-and-utilities/smart-renewable-cities-wind-solar.html • London gets ~10.9% of all power from wind and solar and generates ~24.6% of energy as renewable energy • London has high energy performance new buildings along with 23000 smart street lights • London has a strong clean fuels and fueling infrastructure
WATER	AMSTERDAM	https://www.swan-forum.com/wp-content/uploads/sites/218/2016/05/fred_royan_smart_water_smart_city.pdf • Analyze water data across all "silos": levee sensors, water levels, water quality, pumping stations, locks & dams • Model weather events to predict floods and droughts
WASTE	SONGDO	https://www.smartcitiesdive.com/ex/sustainablecitiescollective/friday-fun-how-create-tomorrow-s-green-cities-today-s-garbage/1050616/ • All of Songdo's trash is sucked into underground pipes, and is automatically sorted and recycled, buried, or burned for fuel. These pipes connect all apartment buildings and offices; consequently, there are no street-corner trash pickups.
MUNICIPAL UTILITIES	AMSTERDAM	https://www.scottmadden.com/insight/the-smart-city-opportunity-for-utilities/ • Energy efficient retrofitting of 700 to 900 dwellings and connecting 10,000 dwellings to its intelligent electricity network • The grid operator can operate the medium-voltage grid remotely, permitting end-user transactions (such as sale of distributed solar energy) and ability to sell energy from battery storage into the market. It also enables virtual power plant capabilities • District heating and cooling with sustainable resources such as daylight collectors, sewer system heat, and cooling from surface water
STREET-LIGHTS	JAKARTA	https://www.smartcitiesworld.net/ebooks/connected-street-lighting-a-smart-city-starting-point • 90,000 street lights upgraded to energy-efficient LEDs and connecting them with remote management software in just seven months, all centrally controlled and managed by Interact City lighting asset management software • It is the largest smart street lighting project in Southeast Asia. enables operators to have access to the latest luminaire status updates, get automatic failure notifications and send repair crews only when and where needed, improving operational efficiency
DRAINAGE	BUENOS AIRES	https://www2.deloitte.com/content/dam/Deloitte/us/Documents/process-and-operations/us-cons-smart-cities-and-the-journey-to-the-cloud-whitepaper.pdf • The city now can predict flooding in certain areas using sensor data, such as weather reports and the speed, direction and level of water in sewer drains. These data are fed to city IT systems that set off an alarm if flooding is likely. The average time to resolve a complaint fell by 93 percent without additional spending, allowing the city to fix more problems in less time

BEST OF BREED FOR DEVELOPMENT WERE IDENTIFIED AS…

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ELEMENT	BEST CITY	SUMMARY
ECONOMIC DEVELOPMENT	SHENZHEN	https://www.dandc.eu/en/article/special-economic-zones-should-serve-purpose-smart-urbanisations-says-adb-economist • Shenzhen grew exponentially and its GDP per capita grew 24,569% from 1978 to 2014 • The zone had over 3 Mil registered businesses in 2017, which is the equivalent of one company for every four people • Shenzhen's economic productivity has increased by 200% in just six years
WATER	SINGAPORE	https://www.tnp.sg/news/singapore/smart-city-smart-homes-future • Singapore had 80% of it's population living in government housing with things like - smart lighting in common areas; smart pneumatic waste conveyance system • Singapore uses clean and renewable energy sources
WASTE	LONDON	https://static1.squarespace.com/static/5b3c517fec4eb767a04e73ff/t/5b513c57aa4a99f62d168e60/1532050650562/Eden-OXD_Top+50+Smart+City+Governments.pdf • Smart London 2.0 plan, fastest free Wi-Fi in all of UK • Digital Inclusion Strategy pilot projects to aid people in getting online and empowering them with basic digital skills
MUNICIPAL UTILITIES	SINGAPORE	https://www.smartcitiesdive.com/ex/sustainablecitiescollective/3-ways-land-use-planning-and-zoning-can-increase-urban-density/1096041/ • Incentive zoning allows density bonuses in exchange for public housing or other public benefits • All new construction has inclusionary zoning i.e. must have a certain number of affordable units • Land assembly consolidates smaller plots of land, and graduated density zoning encourages higher density buildings on large plots of land
AGRICULTURE	ISRAEL	https://agfundernews.com/israels-agritech-market-map-400-startups-putting-the-tech-in-agritech.htmlDrip Irrigation • 400 Agritech startups • Precision agriculture

BEST OF BREED FOR INFRASTRUCTURE WERE IDENTIFIED AS…

IoTask

ELEMENT	BEST CITY	SUMMARY
OPEN DATA	NEW YORK CITY	https://www1.nyc.gov/site/doitt/about/press-releases/annual-open-data-report-2018.page • Department of Health and Mental Hygiene (DOHMH) datasets on Rooftop Drinking Water Tank Inspections, Dog Licenses and MenuStat • Department of Transportation (DOT) street location information, including bus stop shelters, bike parking, newsstands, and parking meters
HIGH-SPEED INTERNET	AMSTERDAM	https://enterpriseiotinsights.com/20180709/channels/fundamentals/the-top-smart-cities-by-infrastructure-and-potential-tag40-tag99 • Transparency • Releasing social and commercial value • Participatory Governance
CONNECTIVITY TECHNOLOGY	SEOUL	https://www.easyparkgroup.com/smart-cities-index/ • World's fastest average internet connection speed; consistently ranked first in the UN ICT Development Index • Ubiquitous connectivity

CONCLUSION

CONCLUSION TO REPORT

IoTask

- The County of Maui and the community have a unique opportunity today to envision a different type of future over the next 10 years.
- Land, water and air are elemental building blocks in the fabric that should be balanced using the principles of Ahupua'a.
- Maui needs to start immediately, using the stimulus initiatives from the COVID-19 crisis to engender broad-based and lasting positive change.
- We have proposed a vision and roadmap with four workstreams to follow: Technology, Infrastructure, Legal & Governance and Economic workstreams to stage the achievement of the vision over 1,2,3,4,5 and 10 years.
- This vision should be considered a starting point to focus the communities' collaborative discussions on how to develop an ESG investment plan that supports the future they wish for the county.
- Maui is uniquely qualified to roll out many traditionally urban technologies in a rural setting due to its size, closed-grids, geographic characteristics and progressive temperament.

TEAM BIOS

DR. GITANJALI SWAMY, MANAGING PARTNER, IOTASK

Gitanjali Swamy is a Managing Partner at IoTask, an "Innovation of Things" (IoT) company. Dr. Swamy has founded, built and served as a board director in successful entrepreneurial or intrapreneurial enterprises with over a dozen fundraisings and acquisitions under her tenure. Dr. Swamy has also worked on the sourcing, structuring, and transaction of many investments ranging in size from seed to over a Billion USD. She has held investment or professional roles in global leaders including The Carlyle Group and Booz Allen & Hamilton. She is currently a representative to the United Nations Equals Leadership Coalition, where she leads the working committee on Gender Equitable Investment, Founder/Advisor to the U.C. Berkeley's Witi@UC Women in Technology Initiative, Research Fellow and Director at the Private Capital Research Institute, Harvard Business School, and Board Advisor to several entrepreneurial ventures. Dr. Swamy is also currently advising State Senators and Representatives in multiple states on matters related to Private Capital Policy and Regulation. She is also currently involved in launching several public-private partnership efforts in innovative investment for sustainable and participative economic development.,

Previously, Dr. Swamy was an investment professional with The Carlyle Group. Prior to Carlyle, she consulted to Matrix Partners on investment strategy/portfolio incubation. Dr. Swamy was a management consultant at Booz Allen and Hamilton advising clients on strategy, innovation, and new business creation efforts. She has helped clients catalyze global innovative public and private sector entities such as MIT's Opencourseware, the Auto-ID Consortium, and the MIT Engine. Dr. Swamy has held product or line roles at Mentor Graphics, The Mathworks and senior management positions, including Chairman & CEO, while she led the companies from inception through fundraising, team recruitment to cross-border market development and acquisitions.

Dr. Swamy received her B. Tech in Electrical Engineering from the IIT Kanpur, where she was awarded Academic Proficiency Prizes, her Ph.D. in EECS at U.C. Berkeley, where she was an NSF Fellow & President of WICSE, and her MBA from Harvard Business School, where she served as CFO of HBS-SA. She is currently completing her J.D. in Law. She has nearly 25 publications and patents in the fields of data, algorithms, technology, and policy.

PROF. SANJAY SARMA OF MIT, MANAGING DIRECTOR, IOTASK

Sanjay Sarma is the Fred Fort Flowers (1941) and Daniel Fort Flowers (1941) Professor of Mechanical Engineering at MIT and the VP of Open learning. He co-founded the Auto-ID Center at MIT, which is considered to be the origin of the Internet of Things industry and where he developed many of the key technologies behind the EPC suite of RFID standards used worldwide. He was also the founder and CTO of OATSystems, which was acquired by Checkpoint Systems (NYSE: CKP) in 2008. He serves on the boards and advisory boards of GS1, EPCglobal and several startup companies including Senaya, ESSESS, TraceLink, Top Flight Technologies and IoTask. In all his endeavors, Professor Sarma has been at the forefront of technologies now known as the Internet of Things: RFID is a fore-runner to IoT, Senaya enables massive asset tracking, ESSESS focuses on infrared imaging and smart cities, TraceLink enables pharmaceutical applications, and MITx, which reports to Professor Sarma at MIT, delivers revolutionary Massive Open Online Courses (Courses) to millions of students around the world straight from the cloud. Over the years, Professor Sarma has been involved in other sectors as well: health care, energy (through his startups and work experience), automotive technologies, government (he is a designer of the Indian UID system) and financial technology.

Dr. Sarma received his Bachelors from the Indian Institute of Technology, his Masters from Carnegie Mellon University and his PhD from the University of California at Berkeley. Sarma also worked at Schlumberger Oilfield Services in Aberdeen, UK, and at the Lawrence Berkeley Laboratories in Berkeley, California. He has authored over 75 academic papers in Internet of Things, computational geometry, sensing, RFID, automation and CAD, and is the recipient of numerous awards for teaching and research including the MacVicar Fellowship, the Business Week eBiz Award and Information Week's Innovators and Influencers Award. He advises several national governments and global companies.

PROFESSOR PHILIP AUERSWALD OF GMU, AFFILIATE PARTNER, IOTASK

Phillip Auerswald is an Associate Professor of Public Policy at George Mason University and cofounder and coeditor of Innovations: Technology, Governance, and Globalization, a quarterly journal about entrepreneurial solutions to global challenges published by MIT Press. He leads the Global Entrepreneurship Research Network, an initiative of the Kauffman Foundation. His most recent book is The Coming Prosperity: How Entrepreneurs Are Transforming the Global Economy. From 2010 to 2013 he was an advisor to the Clinton Global Initiative, focusing on job creation and market-based solutions. Previously he co-led a multiyear study at the Kennedy School of Government, Harvard University, and George Mason University, on the topic of private and public sector coordination in disaster response; that project resulted in a co-edited book titled Seeds of Disaster, Roots of Response: How Private Action Can Reduce Public Vulnerability which was published by Cambridge Press in 2006. Professor Auerswald has published over twenty books and peer-reviewed research articles; has blogged and written op-eds for Harvard Business Review, Forbes, The International Herald Tribune, and The San Francisco Chronicle; and has been quoted in The Washington Post, The Wall Street Journal, The Boston Globe, and Slate.

He holds a Ph.D. in economics from the University of Washington and a B.A. (political science) from Yale University.

SHAY CHAN HODGES, AFFILIATE PARTNER, IOTASK & ORGANIZER RESPONSIBLE MARKETS

Shay Chan Hodges serves as lead organizer of Responsible Markets' Maui ESG Project and Ahupua'a Investment Summit, focusing on community engagement and grassroots investment education. She is an effective community builder who has worked on a variety of local issues, most recently working with local, state and national advocacy groups to support policies that meet the needs of women and families, including efforts to pass childcare and paid leave legislation. She is the author of Lean On and Lead, Mothering and Work in the 21st Century Economy which examines what it takes to participate in the 21st century economy while raising children, and introduces Family-Centered DesignSM thinking, a conceptual framework for designing society and the economy around the needs of families, rather than the other way around.

Shay served as the organizing Benefit Director of one the first Sustainable Business Corporations (SBC) in Hawaii, and had statutory authority to develop policies and protocols to ensure that social responsibility would be integrated into the board's corporate governance, and that specific accountability and transparency measures were designed to be part of the corporation's culture. She also provides technical and resource development consulting to nonprofit agencies in Hawaii, drawing on 25 years of experience in the local fundraising arena, with clients ranging from schools, community clinics, community development financial institutions, agencies addressing substance abuse, and arts organizations.

IAN CHAN HODGES, AFFILIATE PARTNER, IOTASK & ORGANIZER RESPONSIBLE MARKETS

Ian Chan Hodges founded Responsible Markets in 2000 and serves as managing member. Responsible Markets was created to leverage market imbalances profitably for long-term good. Responsible Markets focuses on intellectual property, clean energy, transportation, hospitality, healthcare, unions and community development finance. Recently, Ian served as the Hawaii lead in the development of the Hawaii State Clean Energy Innovation Strategic Plan and he was the lead consultant to Hawaii's Office of the Consumer Advocate on how Hawaii's economy can benefit from new models of corporate governance that incorporate local values and measurable community benefits with a robust framework for catalyzing the groundbreaking inventions necessary to meet the state's 100% renewable energy targets.

IMOGEN ROSE-SMITH, AFFILIATE PARTNER, IOTASK

Imogen Rose-Smith is an affiliate partner with IoTask specializing in investment policy projects. Most recently, Imogen has served as an investment fellow at the University of California in the Office of the Chief Investment Officer to the University of California Regents. She designed and oversaw the $120 billion asset owner's ESG and sustainable investment strategy. A former senior writer with Institutional Investor Magazine, Imogen Rose-Smith is an expert on public policy and governance of institutional asset owners, including defined benefit pension plans and sovereign wealth funds. At II Magazine Imogen pioneered the "Pension 40" an annual list of the most powerful people shaping the defined benefit pension industry. She has written extensively on pension reform and has profiled many of the world's largest asset owners. She founded and lead II Magazine's award-winning sustainable investment coverage.

In 2015, Ms. Rose-Smith was part of a delegation that worked successfully with the Obama White House and the Department of Labor to achieve changes to the DOL's guidance for corporate and union pension plans concerning the consideration of so-called ESG factors (the environment, social responsibility and corporate governance) in investment decision making. From 2012 to 2015 Imogen served as an advisor to the Robert F Kennedy Human Rights foundation on their program concerning institutional asset owners, ESG and human rights. Ms. Rose-Smith received her MA from Columbia University and her BA from University of East Anglia.

GEORGE W. MCCARTHY, PRESIDENT AND CHIEF EXECUTIVE OFFICER, LINCOLN INSTITUTE OF LAND POLICY

Dr. George "Mac" McCarthy is President and CEO of the Lincoln Institute of Land Policy in Cambridge, Massachusetts. The Lincoln Institute seeks to improve quality of life through the effective use, taxation, and stewardship of land. A nonprofit private operating foundation whose origins date to 1946, the Lincoln Institute researches and recommends creative approaches to land as a solution to economic, social, and environmental challenges. Before joining the Lincoln Institute in 2014, Mac directed Metropolitan Opportunity at the Ford Foundation which sought to provide disadvantaged people better access to good jobs and other opportunities for advancement by supporting regional planning, and coordinated transportation and housing development to alleviate poverty and reduce its concentration in metropolitan areas in the U.S. and developing countries in Asia, Africa, and Latin America. Before taking that position, Mac administered a program at Ford that focused on using homeownership to build assets for low-income families and their communities. Before joining Ford, Mac worked as a Senior Research Associate at the Center for Urban and Regional Studies at the University of North Carolina at Chapel Hill. Mac has worked as Professor of Economics at Bard College, Resident Scholar at the Jerome Levy Economics Institute, Visiting Scholar and Member of the High Table at King's College of Cambridge University, Visiting Scholar at the University of Naples, Italy, and Research Associate at the Centre for Social Research in St. Petersburg, Russia.

Mac received a B.A. in Economics and Mathematics at the University of Montana; an M.A. in Economics at Duke University; and, a Ph.D. in Economics at the University of North Carolina at Chapel Hill.

XINRUI SHI, CHIEF OF STAFF, OFFICE OF THE PRESIDENT, LINCOLN INSTITUTE OF LAND POLICY

Xinrui Shi: As chief of staff at the Lincoln Institute of Land Policy, Xinrui serves as the primary point of contact for the President, oversees strategic planning of the Institute, and provides advisory support to its research projects and activities with the special geographic focus on the Peking University-Lincoln Institute Center in Beijing and the International Center for Land Policy Studies and Training in Taipei. Xinrui is an experienced researcher in real estate finance and comparative urban planning laws and policies (U.S. and China). Her recent publications have examined housing finance, land use, and property tax legislations in China. She has authored several policy briefs and working papers for governmental think-tanks and agencies including the Development and Research Center of the State Council (DRC) and the Ministry of Natural Resources of the People's Republic of China. She has co-authored an International Monetary Fund (IMF) working paper on China's housing market. Xinrui has been invited to present her research internationally and has given lectures at the Central University of Finance and Economics in Beijing, China.

She earned her B.A. at University of Wisconsin-La Crosse and her J.D. at Emory University. She is also an attorney licensed to practice in the State of New York.

JIM HOLWAY, DIRECTOR, BABBITT CENTER FOR LAND AND WATER POLICY

Jim Holway is director of the Babbitt Center for Land and Water Policy at the Lincoln Institute of Land Policy. He has 35 years of experience on water and natural resources management. In November, 2016, Jim was re-elected to represent Maricopa County on the Board of the Central Arizona Water Conservation District and served as the board's vice president from 2017 to 2018. Jim previously directed the Western Lands and Communities joint program for the Sonoran Institute and the Lincoln Institute of Land Policy. Prior to joining the Sonoran Institute in 2009, Jim taught as a professor of practice in sustainability and served as the Arizona State University Coordinator for the Arizona Water Institute. He previously served as Assistant Director of the Arizona Department of Water Resources where he directed the implementation of Arizona's groundwater management programs.

Jim earned his B.A. in political science from Cornell University and both a Ph.D. and Masters of Regional Planning from the University of North Carolina. Jim was also inducted into the College of Fellows of the American Institute of Certified Planners in 2012.

A sincere thank you to the Lincoln Institute of Land Policy for funding and supporting this work

THANK YOU

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