30+ MGD Recycled Water by 2030 for Hawaiʻi

Overcoming Barriers to Expanded Water Reuse

prepared for

HAWAIʻI COMMUNITY FOUNDATION
Amplify the Power of Giving

August 2019

prepared by

Bahman Sheikh, PhD, PE
Water Reuse Consultant

This Photo by Unknown Author is licensed under CC BY-NC-ND
This page is intentionally blank
30+ MGD RECYCLED WATER BY 2030
Overcoming Barriers to Expanded Water Reuse in Hawai‘i

August 2019

Bahman Sheikh, PhD, PE
Water Reuse Consultant
San Francisco, California
DISCLAIMER

The views, opinions, findings and recommendations contained in this report are those of Bahman Sheikh, PhD PE, Water Reuse Consultant. They should not be construed as an official position, policy, or decision of Hawai‘i Community Foundation unless so designated by other official documentation.
August 1, 2019

Dr. Dana Okano, Program Director
Hawai‘i Community Foundation
827 Fort Street Mall
Honolulu HI 96813

Dear Dr. Okano,

It is a pleasure to submit the final report of our project “Barriers and Solutions to Scaling Water Reuse in Hawai‘i”. The process of working with you and other stakeholders throughout the water cycle agencies of Hawai‘i has been highly rewarding, informative, and useful to completing this project. The insight gained from participating in Water Reuse Task Force meetings and from a series of interviews with Hawaiian officials, in the context of water reuse in the mainland states and in select countries abroad resulted in a series of conclusions and recommendations.

The recommendations offered in the attached report are aimed directly at achieving the Freshwater Council’s goal of 30 million gallons per day of additional recycled water by the year 2030. I believe this goal is attainable and—when achieved—will provide statewide ancillary benefits in the long-term, including increased local food production on the islands, protection of the coastal aquifers against the future impacts of climate change and seawater rise, and overall sustainability and security of the state’s water supply.

I remain available to you as you work to increase water recycling in Hawai‘i with legislative and regulatory initiatives and with your collaborations with the state’s utilities and the development community.

Thank you for the opportunity to serve the Hawai‘i Community Foundation in this interesting and rewarding project.

Regards,

Bahman Sheikh, PhD, PE
Water Reuse Consultant
San Francisco California
ACKNOWLEDGMENTS

Hawai'i Community Foundation sponsored a study in furtherance of the Hawai'i Fresh Water—Wai Maoli—Initiative. This report is the final product of that study.

Dr. Bahman Sheikh, Water Reuse Consultant of San Francisco was retained by Hawai'i Community Foundation to provide specialized water recycling expertise, make recommendations to inform and advance Wai Maoli, and to prepare this final report.

Many individuals assisted in the conduct of the study, including but not limited to the following. Omissions are regretful and inevitable, as many people were contacted and gave generous support and assistance with information, access, and suggestions:

- Dr. Dana Okano, Program Director, Hawai'i Community Foundation
- Ms. Christin Reynolds, Principal, One World One Water
- Ms. Sina Pruder, Manager, Wastewater Branch, Hawai'i Department of Health
- Dr. Bruce Anderson, Interim Director of Public Health
- Mr. Keith Kawaoka, Deputy Director of Environmental Health
- Mr. Daniel Chang, Environmental Health Specialist, Hawai'i Department of Health
- Environmental Management Division
- Mr. Jefferey Pearson, Deputy Director, Hawai'i Department of Land and Natural Resources | Commission on Water Resource Management
- Ms. Lenore Ohye, Hydrologic Planning Program Manager, Hawai'i Department of Land and Natural Resources | Commission on Water Resource Management
- Mr. Neal Fujii, State Drought and Water Conservation Coordinator, Hawai'i Department of Land and Natural Resources | Commission on Water Resource Management
- Mr. Jeremy Kimura, Hydrologist, Hawai'i Department of Land and Natural Resources | Commission on Water Resource Management
- Mr. Barry Usagawa, Program Administrator, Water Resources Division, Honolulu Board of Water Supply
- Ms. Lorna Heller, Water Resources Division, Honolulu Board of Water Supply
- Ms. Lori Kahikina, Director, Department of Environmental Services, City and County of Honolulu
- Mr. Timothy Houghton, Deputy Director, Department of Environmental Services, City and County of Honolulu
- Mr. Michael Miyamoto, Deputy Director of Environmental Management, County of Maui
- Mr. Scott Rollins, Planning Section, Wastewater Reclamation Division, County of Maui
- Mr. Albert Hahn, Project Manager, Wastewater Reclamation Division, County of Maui
- Mr. William Kucharski, Director, Department of Environmental Management, County of Hawai'i
- Dr. Richard Bennett, Chair, County of Hawai'i’s Environmental Management Commission
Mr. James Nakatani, Executive Director, Agribusiness Development Corporation of Hawai‘i Department of Agriculture
Ms. Denise Albano, Agribusiness Development Corporation of Hawai‘i Department of Agriculture
Ms. Myra Kaichi, Agribusiness Development Corporation of Hawai‘i Department of Agriculture
Mr. Todd Low, Manager, Special Projects, Hawai‘i Department of Agriculture
Ms. Stephanie Whalen, Executive Director, Hawai‘i Agricultural Research Center
Mr. Alfred Layi, Project Manager, Honouliuli Water Recycling Facility
Ms. Catherine Soriano, Assistant Project Manager, Honouliuli Water Recycling Facility
Mr. Gregg Serikaku, Executive Director, Plumbing and Mechanical Contractors Association of Hawai‘i
Mr. Reginald Castanares, Former Business Manager and Financial Secretary, Plumbers and Fitters
Mr. Lance Sokugami, Grounds Manager, Maui Nui Golf Club
Mr. Lief Smith, Director of Golf, Maui Nui Golf Club
Mr. Steven Parabicoli, Independent Water Resources Consultant
Mr. Elson Gushiken, Vice President, ITC Water Management, Inc.
Mr. Peter Ono, Senior Associate, Brown and Caldwell
Ms. Kathy Whang Inouye, Senior Advisor, Kobayashi Group
Dr. Lawrence Lombardi, Natural Energy Laboratory of Hawai‘i Authority (NELHA)
Ms. Melanie Holmer, Brown and Caldwell (contributor of Figure 3 in this report)
# TABLE OF CONTENTS

LETTER OF TRANSMITTAL........................................................................................................i
ACKNOWLEDGMENTS............................................................................................................... iii
LIST OF FIGURES.................................................................................................................. vi
LIST OF TABLES..................................................................................................................... vi
EXECUTIVE SUMMARY......................................................................................................... 1
1. BACKGROUND .................................................................................................................. 3
2. INTRODUCTION: WATER REUSE 101 ......................................................................... 4
   Municipal Water Reuse Practices on the Mainland and Abroad ........................................ 4
   On-Site Use of Recycled Water ......................................................................................... 4
   Graywater Reuse ............................................................................................................... 5
   Current Use of Recycled Water in Hawai‘i ........................................................................ 5
3. IMPEDIMENTS TO INCREASED USE OF RECYCLED WATER ................................... 8
   Sources of Insight for Hawai‘i-Specific Challenges to Water Reuse ................................. 8
   Recent Trends in Water Reuse in Hawai‘i ................................................................. 9
   Impediments to Increased Use of Recycled Water in Hawai‘i ....................................... 10
      Financial Constraints ................................................................................................. 11
      Regulatory Obstacles ................................................................................................ 11
      Institutional Impediments ......................................................................................... 12
      Infrastructure Inadequacies ...................................................................................... 12
      Social Attitudes ........................................................................................................ 12
4. OPPORTUNITIES, PROSPECTS FOR INCREASED USE OF RECYCLED WATER .... 13
   Lessons from Other States, Regions, and Other Nations ............................................... 13
      California .................................................................................................................... 14
      Florida ........................................................................................................................ 16
      New York City ........................................................................................................... 16
      City of San Francisco ................................................................................................ 17
      City of San Jose .......................................................................................................... 18
      West Basin Municipal Water District ........................................................................ 18
      Orange County Water District (OCWD) ..................................................................... 19
      Australia ..................................................................................................................... 19
      Japan .......................................................................................................................... 20
   Prospects for Large-Scale Expansion of Water Reuse .................................................... 20
      Agricultural Use of Recycled Water ........................................................................... 20
      Decentralized Reuse Opportunities ........................................................................... 21
      Groundwater Recharge with Recycled Water ............................................................ 22
      Potable Reuse ............................................................................................................. 22
5. STRATEGIES FOR MEETING STATEWIDE WATER REUSE OBJECTIVES ............ 23
   Legislative Initiatives ...................................................................................................... 24
Regulatory Updates .................................................................................................................. 25
Financial Incentives and Assistance ....................................................................................... 26
  Federal Support ..................................................................................................................... 26
  State Subsidies ..................................................................................................................... 27
Water Utilities Investment ........................................................................................................ 27
Wastewater Utilities Investment ................................................................................................ 27
Demonstration Projects ........................................................................................................... 28
Public Outreach and Education ............................................................................................... 28
  Public Outreach Messages .................................................................................................... 29
  Stakeholders ........................................................................................................................ 30
  Public Education Approaches ............................................................................................... 30
6. CONCLUSIONS AND RECOMMENDATIONS .................................................................. 31
  Conclusions .......................................................................................................................... 31
  Recommendations ............................................................................................................... 31
APPENDICES .......................................................................................................................... 35
APPENDIX A - REFERENCES .................................................................................................. 37
APPENDIX B - California Statement of Support for Water Reuse ........................................ 41
APPENDIX C - Florida Statement of Support for Water Reuse .............................................. 43
APPENDIX D - Washington State’s Statement of Support for Water Reuse .......................... 45
APPENDIX E Summary of Interviews with Stakeholders ......................................................... 47

LIST OF FIGURES

Figure 1  Categories of Recycled Water Use in Hawai‘i ........................................................... 6
Figure 2  Historical Trends in Water Recycling in Hawai‘i ....................................................... 10
Figure 3  Status of progress on potable reuse regulations in various states as of July 2019 .22
Figure 4  Past Trends and Future Projection of Hawai‘i Water Reuse ...................................... 23
Figure 5  Energy Usage by Various Sources of Water ............................................................... 29

LIST OF TABLES

Table 1 Hawai‘i Water Reuse in MGD by Year and by County .............................................. 6
Table 2 Use of Recycled Water for Agriculture in Hawai‘i ..................................................... 7
Table 3 Perceived Challenges to Increased Use of Recycled Water in Hawai‘i ....................... 8
Table 4 Summary of Topic Raised by Interviewed Stakeholders ............................................. 48
OVERCOMING BARRIERS TO EXPANDED WATER REUSE IN HAWAI‘I

EXECUTIVE SUMMARY

Hawai‘i has historically received ample precipitation to support its natural habitats and the built environment in harmonic balance. That balance is at risk of tilting in the direction of water shortages in the future because of increasing demand for water and projected decreasing supply from rainfall.

Water recycling is one of the ways in which the historic water resource balance can be restored and maintained. The potential to achieve the needed increase in water reuse is great because the identified barriers are amenable to removal with legislative initiatives, regulatory reforms, and attitudinal changes. Such remedies have been shown to be successful in other states and their experiences can serve as useful models to emulate for Hawai‘i.

Top water cycle managers in Hawai‘i have recognized the impact of climate change and future population increase on the state’s water supply. Facilitated by Hawai‘i Community Foundation, the Freshwater Council set a goal of adding 100 million gallons per day (MGD) of new water supply by the year 2030—from water reuse, conservation, and groundwater recharge. Water reuse is expected to provide over 30 MGD of the total by 2030.

Currently, most water recycling in Hawai‘i occurs on the islands of Oahu and Maui, and most of the recycled water produced is used for golf course irrigation. Other users of recycled water are industries, agriculture, and landscapes. Barriers to expanding water reuse in Hawai‘i include economic/financial constraints, regulatory obstacles, institutional impediments, infrastructure inadequacies, and social attitudes. All of these challenges are amenable to being overcome, as shown with examples from several other states and overseas.

Opportunities for future expansion of water reuse in Hawai‘i lie in several new arenas. A major opportunity for scaling water reuse lies in agricultural irrigation with R-2 and R-1 recycled waters. Agriculture is very important to Hawaii’s economy and consumes a large fraction of the total water used by all sectors. Furthermore, recycled water can be used for irrigation of food crops over currently fallowed lands that formerly produced sugarcane and pineapple. Use of recycled water in agriculture will help meet the state’s goal of increasing local production of food crops.

Decentralized water reuse, in new developments, especially in high-rise buildings provides another arena for pushing water reuse forward. On-site water reuse—another term of art for
“decentralized reuse”—is an especially effective water conservation measure in densely populated residential and commercial districts in urban areas such as Honolulu, resulting in 40 to 80 percent less demand for the building’s water requirement from the municipal network. Feasibility and economic viability of on-site reuse has been demonstrated in major metropolitan areas, including New York City, San Francisco, Sydney, and Melbourne.

Another promising arena, in terms of volume and in the long-term vision, is groundwater replenishment with recycled water. Managed aquifer recharge, using recycled water, has been a long-standing practice with an unblemished record of safety in California, Arizona, and Texas. This use of recycled water for groundwater replenishment is currently not included in the allowed categories listed in the water reuse guidelines administered by the Hawai‘i Department of Health, Wastewater Division. Adoption of specific guidelines and regulations, defining the required water quality and the recharge process is necessary to open this use of recycled water in order to combat future overdraft of coastal aquifers and consequent intrusion of seawater into the groundwater supplies.

Several strategies are offered for accomplishment of the 30+ MGD by 2030 goal, including legislative initiatives, regulatory updates, financial support and subsidy, demonstration projects, and public outreach and education.

Accomplishment of the 30 MGD by 2030 goal is feasible—much larger goals have been accomplished in other states when the need for new water supplies was broadly recognized. Recommendations for specific actions are offered to guide the path to arrive at—and possibly even exceed—that goal over the coming decade. The most effective first steps toward accomplishing the 30-by-2030 goal are: (a) legislation, (b) master planning, (c) demonstration projects coupled with public outreach and education, (d) financing, (e) market studies, (f) regulatory updates, and (g) progress toward implementation of projects leading to delivery of recycled water to customers.
1. BACKGROUND

Hawaiian Islands have unique hydrological characteristics (Lau & Mink, 2006) that significantly influence the availability of water resources for human consumption, agricultural irrigation, industrial applications, other urban needs, and numerous other uses. Water resources of Hawai‘i have been stretched to their limits with increasing population levels and future supply uncertainties. These trends are expected to continue and possibly accelerate, compounded with the effects of global climate change and warming ocean waters. Rising sea levels will cause intrusion of seawater into coastal aquifers (Lau & Mink, 2006, Jiao & Post, 2019). The resulting increase in the salinity of near-shore groundwater resources of the state will render them unfit for human consumption and agricultural irrigation. These trends, taken together, will widen the gap between water supply and demand.

The Hawai‘i Fresh Water Initiative—Wai Maoli—is a blueprint for action, with the goal of ensuring the availability of adequate water supplies for the economic, social, and environmental health of the State (HCF, 2015). The Hawai‘i Community Foundation convened a high-level council, composed of a diverse group of experts from across the State—farmers, landowners, scientists, conservationists, and government officials. After a two-year process, the Council unanimously agreed that to achieve water security, Hawai‘i needs to create 100 million gallons a day of additional, reliable water supply by 2030.

To achieve this goal, the Fresh Water Council identified three quantitative targets to be met by 2030:

**Water Conservation:** Increasing water use efficiency such that per-capita water demand is reduced by an average of 15 percent would free up at least 40 million gallons per day of potable water.

**Groundwater Recharge:** More rainwater can be captured, stormwater retention can be improved, and the additional water could be recharged into the state’s aquifers. This component would add 30 million gallons per day of water.

**Water Reuse:** Subject of this report, water reuse involves increased reclamation of wastewater throughout the state and its beneficial reuse in place of potable water, thus freeing up an additional 30 million gallons per day of potable water. This component also includes use of gray water in residential settings, on-site water reuse in new developments, and reuse of other waters currently wasted to the ocean.
2. INTRODUCTION: WATER REUSE 101

Municipal Water Reuse Practices on the Mainland and Abroad

Use of untreated wastewater is common throughout the world. In fact, only about 10 percent of all wastewater is treated globally (Jiminez and Asano., 2008). Irrigation of agricultural crops with raw wastewater is widespread in China, India, parts of South America and Africa. Use of properly treated municipal wastewater, with due regard for public health and safety, has been on the rise over the past several decades, particularly in the industrialized nations of the world.

The state of Israel is a pioneer in regulated use of recycled water, currently utilizing 86 percent of its treated wastewater, mostly for agricultural irrigation (Israel Water Authority, 2015). Australia developed major water reuse projects during its eleven-year Millennial drought and continues to increase recycled water production and reuse (Bureau of Meteorology, 2018). In the United States, mainland states with major water reuse projects include Florida, California, Arizona, Texas, Colorado, Nevada, and Idaho (WateReuse, 2019). Even some of the states in the northern tier, with plenty of rainfall, have implemented water reuse projects, primarily for environmental reasons. New York, North Carolina, Georgia, Washington, and Oregon have a variety of active water recycling programs. Lessons learned from the successes of these water reuse projects are relevant to future expansion of water reuse in Hawai‘i. Some of those lessons are further summarized in Section 4 of this report.

On-Site Use of Recycled Water

An important contribution to water reuse in the state can come from on-site reclamation of wastewater and its reuse within the same development or a group of structures. In recent years, water recycling systems built into new high-rise development projects have become commonplace in some major metropolitan regions, such as New York, San Francisco, Melbourne, Tokyo, etc. Success of these projects is due in large part to the fact that on-site water reuse provides huge savings in water demand, wastewater flow and energy use within high-rise structures. These savings have significant economic value to the developers in addition to their recognition as sustainable green-building structures, such as Leadership in
Environmental and Energy Design, or LEED (Krishnamurti, 2012). Commercial and residential high-rise buildings with LEED certification command rental rates that are up to 8 percent higher than comparable buildings without sustainability features (Stanley and Wang, 2017).

**Graywater Reuse**

While graywater reuse is not expected to be a major contributor to the adopted water reuse goals, its importance to the individual user and its impact on public perception of water reuse cannot be over-stated (Sheikh, 2010). The Hawai‘i State Department of Health Wastewater Branch published “Guidelines for the Reuse of Gray Water” (DOH, 2009). The Department of Health defines gray water as wastewater discharged from showers and bathtubs, hand-washing basins, wastewater that has not contacted toilet waste, sinks (not used for disposal of hazardous, toxic materials, food preparation, or food disposal) and clothes-washing machines (excluding wash water with human excreta e.g., diapers).

Gray water from sinks, tub/shower drains, and clothes washers are estimated to be 50 to 80 percent of the total residential wastewater generated (Gross 2007). This wastewater stream may be reused to meet part of the freshwater demand for landscaping. Diverting this wastewater stream to a subsurface irrigation system also reduces the amount of wastewater entering the individual wastewater system (septic tank systems, cesspits, etc.). Nitrogen, phosphorus, and potassium are the top three essential nutrients—also called macro-nutrients—in graywater that plants need to survive.

An objection to on-site water reuse (including graywater reuse) is the potential for clogging of sewers with reduced liquids in the lines from onsite reuse or scalping. The situation only becomes problematic if (a) a large majority of residences implement on-site reuse and graywater reuse in a given wastewater collection zone, and (b) sewers are laid on very shallow slopes. Neither of these conditions are expected to apply in any of the Hawaiian communities—and are less likely to occur at the same time.

**Current Use of Recycled Water in Hawai‘i**

Water recycling in Hawai‘i is regulated by the Department of Health, Wastewater Branch, which provides guidelines and standards for both municipal water reuse (DOH, 2016) and for graywater reuse in individual residences (DPH, 2009). Currently, data about use of recycled
water is available for municipal water reuse. It is fair to assume that a certain amount of on-site reuse and graywater use is also occurring, but there is no quantitative accounting for such use of treated or untreated wastewaters.

According to the Hawai‘i Department of Health, a total of 18.8 MGD of municipal recycled water was utilized in Hawai‘i in 2018 (DOH, 2018). Breakdown of water reuse in Hawai‘i in recent years by County is shown in Table 1.

**Table 1 Hawai‘i Water Reuse in MGD by Year and by County**

<table>
<thead>
<tr>
<th>No table of</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oahu</td>
<td>9</td>
<td>9.8</td>
<td>11.2</td>
<td>12.1</td>
</tr>
<tr>
<td>Maui</td>
<td>3.7</td>
<td>4</td>
<td>3.9</td>
<td>3.1</td>
</tr>
<tr>
<td>Kauai</td>
<td>2.4</td>
<td>2.2</td>
<td>2.1</td>
<td>2.7</td>
</tr>
<tr>
<td>Hawai‘i</td>
<td>1.2</td>
<td>1.3</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Statewide Total</td>
<td>16.3</td>
<td>17.2</td>
<td>18.3</td>
<td>18.8</td>
</tr>
</tbody>
</table>

Source: Hawai‘i Department of Health¹, Wastewater Branch, 2019

Oahu County accounts for 64 percent of the total recycled water use in the state, in line with its proportion of the state population (69%), followed by Maui County with 16 percent. However, on a per-capita basis, Maui County ranks first, with 18.6 gallons per capita per day compared to Oahu’s 12.2 gpcpd². Most of the recycled water in Hawai‘i is used for irrigation of golf courses, as shown in Figure 1.

![Figure 1 Categories of Recycled Water Use in Hawai‘i](image)

Industry and agriculture account for just ten and nine percent of the total recycled water use in the state, respectively. Landscape irrigation accounts for six percent and other uses two percent. Agricultural use of recycled water is further detailed in Table 2.

---


² Per capita figures were calculated using 2018 population data for Oahu County (98,865) and Maui County (16,260), respectively.
Table 2 Use of Recycled Water for Agriculture in Hawai’i

<table>
<thead>
<tr>
<th>Farm</th>
<th>Ares, Acres</th>
<th>Recycled Water Category</th>
<th>Estimated Flow, Gallons Per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laie</td>
<td>17</td>
<td>R-1</td>
<td>57,500</td>
</tr>
<tr>
<td>Waikele</td>
<td>2,800</td>
<td>R-1</td>
<td>1,007,000</td>
</tr>
<tr>
<td>Kunia WA</td>
<td>2,700</td>
<td>R-1</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Kunia Loa Ridge</td>
<td>50</td>
<td>R-1</td>
<td>5,000</td>
</tr>
<tr>
<td>Dole</td>
<td>18,000</td>
<td>R-2</td>
<td>573,000</td>
</tr>
<tr>
<td>Waiawa Correctional</td>
<td>10</td>
<td>R-2</td>
<td>56,000</td>
</tr>
<tr>
<td>Monsanto-Maui</td>
<td>65</td>
<td>R-1</td>
<td>234,135</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>23,832</strong></td>
<td><strong>--</strong></td>
<td><strong>~ 3 MGD</strong></td>
</tr>
</tbody>
</table>

Source: Hawai’i Department of Health, Wastewater Branch, 2019

Purple is the common (nearly universal) color designating recycled water piping and related equipment.
3. IMPEDIMENTS TO INCREASED USE OF RECYCLED WATER

Sources of Insight for Hawai‘i-Specific Challenges to Water Reuse

A primary source of information for this project was the interview process in which stakeholders provided their own assessment of what it would take to increase water reuse in Hawai‘i. A summary of insights derived from these interviews is presented in Appendix E. The interviewees were chosen to represent the water cycle management community, including municipal water supply, wastewater collection and treatment, public health, agriculture, builders, plumbers, and landscape irrigation managers. A summary of the perceived challenges to increased use of recycled water in Hawai‘i, based on the interview process is presented in Table 3.

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Rate of Occurrence</th>
<th>Cost of Treatment, Pipeline (Financial)</th>
<th>Regulatory Constraints (Regulatory)</th>
<th>Interruptions in Supply (Infrastructure)</th>
<th>Public Acceptance Issues (Social)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plentiful Water Perception (Social)</td>
<td>Low</td>
<td>High</td>
<td>Very High</td>
<td>Very Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Cost of Treatment, Pipeline (Financial)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulatory Constraints (Regulatory)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interruptions in Supply (Infrastructure)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Acceptance Issues (Social)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cost of treatment and distribution of recycled water was almost uniformly acknowledged as a major barrier to implementation of water reuse projects, especially since construction costs are generally much higher in Hawai‘i than in most other states. Furthermore, it was widely agreed that pipe laying in lava rock formations is extremely difficult and costly.

An analysis of the record of interviews reveals two counter-intuitive phenomena: First, while only a few interviewees mentioned “plentiful water perception” as an impediment, it is in fact the most powerful challenge. Allocation of funding for additional water reuse depends on public perception (hence the elected officials’ vote) for the need for more water and funding the necessary projects. Second, nearly all interviewees mentioned “regulatory constraints” as an important barrier to additional water reuse in Hawai‘i. The foundations of the established regulations are sound, but the interpretation and pattern of enforcement of some of the regulations are creating barriers to increased reuse and could be alleviated. Interviews with stakeholders indicated a level of difficulty in the interpretation of water reuse guidelines and their enforcement by the DOH staff. However, a comparison of the Hawai‘i water reuse guidelines and standards with those of California and Florida shows that Hawai‘i’s regulations are not unreasonably restrictive. In fact, the 2016 update of the regulations was inspired by...
California’s Title 22—Water Recycling Criteria—and Florida Department of Environmental Protection’s Water Reuse Guidelines (Peter Ono, 2018).

Many of the regulatory restrictions enumerated by interviewees are in fact due to provisions that protect the environment against pollution with nutrients in recycled water. While these nutrients are beneficial for irrigation, they can contaminate water supplies in three ways: (1) deep seepage of irrigation water past the root zone can penetrate into the groundwater, (2) release of excess effluent into waterways and the ocean can contaminate surface waters and cause eutrophication, and (3) storage of off-season recycled water in surface lakes and reservoirs can render those reservoirs unfit for potable water use.

One specific way in which the regulations are correctly identified as obstacles is in the way those regulations are sometimes implemented and enforced. Several interviewees indicated that the DOH personnel were uninterested in the challenges that the customers faced and unwilling to work with them to resolve their challenges while meeting the spirit of the guidelines.

**Recent Trends in Water Reuse in Hawai‘i**

Recycled water usage in Hawai‘i experienced a period of relatively rapid growth in the 1990s (HDLNRCWRM, 2013) as shown in Figure 2 Historical Trends in Water Recycling in Hawai‘i. However, after the year 2000, that growth stagnated and reversed into a slow reduction in total volume of recycled water produced in the State. While water supply has been the main driver for water recycling in the past, it is anticipated that in the future additional drivers—such as environmental considerations, discharge limitations, green building certification, and sustainability motivations—will play a larger role in pushing water reuse projects forward.

Opportunities and prospects for increased use of recycled water in Hawai‘i are explored in Section 4. Lessons learned from other regions with successful implementation of water reuse programs are provided in Section 5. Recommendations for policies and actions to increase recycled water in Hawai‘i are presented in Section 6.
Impediments to Increased Use of Recycled Water in Hawai‘i

The trends shown in Figure 2 raise the question “what are the barriers to increased use of recycled water, especially in the last ten years?” Interviews with stakeholders and experts in Hawai‘i resulted in the following generalized categories of impediments working against rapid expansion of this resource:

- Financial
- Regulatory
- Institutional
- Infrastructure
- Social

Proven remedies for overcoming these challenges, based on the experience in other states and other countries, are presented in Section 5. In the following sections, the impediments identified by stakeholders are described as they apply to conditions in Hawai‘i.
Financial Constraints

The economics of water reuse are in favor of project implementation in most circumstances, assuming that all the benefits that accrue to various beneficiaries are accounted for (Sheikh, 2002). However, the necessary up-front costs can appear prohibitive and intimidating. Initiation of a new water recycling enterprise involves large investments of public funds for municipal projects and significant private investment for on-site water reuse systems. Such funds and assets are not readily available, unless a sense of crisis happens to prevail—usually during a prolonged drought, or as the result of recognition of future water shortages due to climate change, population increase, groundwater depletion, etc. Priority of water supply security is generally an effective motivation for allocation of the necessary resources in order to initiate a water reuse project. Availability of inexpensive freshwater and the common perception of plentiful water supplies is another impediment in the category of financial barriers (as well as in the social category), necessitating subsidization of recycled water projects.

Regulatory Obstacles

The Hawai‘i regulations for water reuse are some of the more user-friendly standards in the nation. Nonetheless, the regulated community (users of recycled water) generally perceives the regulations as prohibitive or restrictive. The restrictions imposed by regulation are intended to protect the public health and the environment under all conceivable circumstances. Therefore, a common understanding of the rationale for these regulations and a deep appreciation of their intent usually helps water reuse customers appreciate the need for and comply with the applicable regulations. It is also imperative that the regulatory community exercise flexibility and understanding in the way they implement, interpret, and enforce the guidelines and regulations. Training of staffs—both regulators’ and customers’—is critically important in ensuring that the regulations do not become a bottleneck to water reuse projects.

An important regulatory barrier is unavailability of adequate resources at the Hawai‘i Department of Health dedicated to water reuse regulation, permitting, supervision, and enforcement. States with robust water reuse programs have recognized the importance of providing the necessary expertise, funds, and personnel in their respective regulatory offices.

Are water reuse rules too restrictive?

The common perception among users and producers of recycled water is that the rules are too restrictive. However, further analysis reveals that it is the interpretation and implementation of the rules by regulatory staff that are unnecessarily restrictive.
**Institutional Impediments**

Water recycling requires the collaboration of at least two institutions—the water utility and the wastewater utility. In many situations, these two functions (water and wastewater) are managed by separate and independent entities. Cost sharing, division of responsibilities, allocation of revenues, and assignment of liabilities between the two entities can be a complicated process requiring negotiations, compromises, letters of agreement, and binding legal contracts. Such agreements and contracts are time-consuming and difficult to attain, sometimes necessitating intervention from the legislative branch and infusion of incentives from higher levels of government. The recent trend in consolidation of water cycle responsibilities—known as the “one-water” concept—is a welcome development for regions facing future water scarcity, especially helpful for implementation of water reuse projects.

Direct quote from one of the water supply stakeholders interviewed:

“We are far from the “one-water” situation that would facilitate water reuse. Implementation of the one-water concept can help advance water reuse.”

**Infrastructure Inadequacies**

Water recycling infrastructure involves a great deal of construction for treatment works, storage reservoirs, transmission pipelines, and distribution systems. Construction in Hawai‘i is more costly than in most other states. This is due to the need for importation of equipment and construction materials, scarcity of skilled labor, and difficulty of construction—especially for pipelines—in the lava rock base.

Another infrastructure impediment is inflow of saline groundwater into coastal sewers, resulting in high salt content in the effluent of treatment plants. This problem will be exacerbated in the future as a result of seawater rise due to global climate change.

**Social Attitudes**

Individuals who are unfamiliar with recycled water in their community tend to be initially skeptical about its safety, connecting recycled water with its history (as sewage) rather than with its quality. Social scientists recognize this all-too-human tendency as “contagion,” and recommend ways to frame the water out of its historical context. Use of stigmatizing language in describing recycled water (terms such as “reclaimed wastewater”) reinforce the stigma in the mind of the general public.

In addition to its wastewater origin, recycled water is often associated with higher levels of salts and nutrients. Presence of heavy metals—a significant issue in biosolids reuse—is sometimes raised as a concern in recycled water proposals. Also, recent recognition of the
persistence of pharmaceuticals, personal care products, hormonal compounds, etc. in wastewater has prompted questions about their presence and significance in recycled water. Research about the significance of these constituents provides a strong basis for water professionals to respond to such concerns with confidence (WateReuse, 2011). Another concern raised about recycled water is the impact of the Food Safety Modernization Act (FSMA) on growers using recycled water. The fact that FSMA’s microbial water quality standards for irrigation water (FSMA, 2016) are 100 times less stringent than those of R-1 water should help allay these concerns.

4. OPPORTUNITIES, PROSPECTS FOR INCREASED USE OF RECYCLED WATER

Water reuse has already played a significant role in the integrated water resources management of numerous arid and semi-arid regions of the world, notably in Israel, Australia, Singapore, and parts of the United States—Florida, California, Arizona, Texas, and Hawai‘i. In every instance, the initial push to implement water reuse was met by seemingly insurmountable challenges. After all, the raw material for water reuse is human waste, not the most pristine source and not the low-hanging fruit to be picked with ease. In most cases, vision, perseverance, and the efforts of a champion were the ingredients that helped implement water reuse projects and expand water reuse to current levels.

Water reuse professionals’ first and foremost objective is to protect the health and safety of the public against microbial and chemical contaminants in raw wastewater and against droughts and water scarcity caused by gaps in the supply and demand equation. Achieving this dual objective involves a balancing act, played out in the regulatory and technological arenas. The regulator typically tends to require enough barriers to achieve near-zero risk while the technologist aims toward the most efficient solution (least cost for adequate protectiveness).

This balancing act can become prohibitive to water reuse or result in unacceptable risk to the public health. The State of Florida’s regulatory landscape is probably the most user-friendly among the U.S. states for maximizing water reuse, without compromising public health and safety. In the course of research for this project, numerous opportunities for increased use of recycled water were identified by the stakeholders and evaluated. Despite the barriers enumerated in Section 3, these opportunities can be realized with persistent and dedicated efforts of utility managers—mainly water and wastewater utilities—to overcome those barriers.

Lessons from Other States, Regions, and Other Nations

While Hawai‘i is unique in many ways, there are many similarities in the ways in which recycled water projects have been implemented here to those on the mainland and in other
countries. Therefore, it is illustrative and instructive to review a sampling of efforts in other regions to ramp up water reuse in relatively short periods of time. In the following sections, some of these experiences are summarized as object lessons for possible emulation.

**California**

California has experienced periods of severe drought over the past century. Each drought period stimulated public discussion of water supply shortages and the need to increase water conservation and recycling. Many communities in California planned and constructed extensive water reuse infrastructure and supplied non-potable demand (irrigation, industry, wash-downs, etc.) with recycled water, thus freeing up potable water for its most important use for domestic water supply.

California’s legislators, prompted by WateReuse Association advocacy, established statewide goals for additional recycled water, and provided subsidies to water and wastewater utilities to accomplish these goals (SWRCB, 2018). Although some progress was made in the last few decades toward these goals, it became clear that achievement of these goals would not be possible without also allowing potable reuse. Thus, a well-financed research initiative—funded mostly by water and wastewater utilities—was undertaken to establish the criteria for safe use of recycled water for drinking. The regulatory framework implementing these criteria is expected to be adopted in 2023 (Assembly Bill (AB) 574 (Chapter 528, Statutes of 2017)).

Examples of California’s push to increase water recycling, as possible models for Hawai‘i, are enumerated below:

- In the past 30 years, over 100 legislative bills were passed and signed into law to facilitate implementation of water reuse and to provide for a more flexible regulatory environment.
- In order to gain public support for recycled water, a statement of support was drafted and signed by state and federal agencies (Appendix B).
- Several bond issues were approved by California voters, providing for significant public subsidies to supplement federal subsidies to public agencies to implement their water reuse projects.
- An association of water cycle professionals was established: it gradually expanded its scope nationally (WateReuse Association); it is providing technical support to its members; it engages in legislative and regulatory advocacy to improve the playing field for water reuse.
- A water reuse research foundation was established to fund scholarly studies that answered questions raised by the public about the safety of use of recycled water.
- The state moved regulation authority on water reuse from the Department of Health to the State Water Resources Control Board, Division of Drinking Water, thus integrating control of all water resources, including recycled water, under one regulatory umbrella.
• Graywater reuse was legalized, and its use was facilitated by adoption of plumbing code provisions for simple and complex graywater reuse systems.
• Groundwater replenishment regulations were adopted as a means of (indirect) potable reuse, in addition to seawater intrusion barriers and rapid infiltration basins already in existence.
• In July 2019, the Board of Trustees of WateReuse California issued "California WateReuse Action Plan", a blueprint for doubling the annual volume of recycled water production in the state by the year 2030. The action plan includes the following components:
  1. Complete Research to Advance Water Recycling and Potable Reuse
  2. Develop and Streamline Recycled Water Regulation and Permitting
  3. Perform Integrated Regional Planning to Advance Recycled Water Use
  4. Increase Grant and Loan Opportunities to Expand Recycled Water Infrastructure

• As of this writing, a rule-making process is underway for development of direct potable reuse regulations, anticipated to be formally adopted by 2023.

### Lessons for Hawai‘i from California

- Legislation in favor of water reuse reflects the state’s political will
- Bond issues for subsidization of water reuse are fair means of spreading their costs over a wide range of beneficiaries of recycled water
- Water cycle utilities can be the best champions for moving water reuse projects forward
- User-friendly regulations and enforcement are key to rapid development and expansion of recycled water
  
  One possible way to promote water reuse while regulating it is by transporting the state’s water reuse regulatory function from the Department of Health to the Commission on Water Resource Management.
- Groundwater replenishment with recycled water is feasible and can result in large volumes of new water into the water supply mix
**Florida**

The state of Florida is number one in terms of annual reclaimed water production (Florida DEP, 2016). The primary driver for water reuse in Florida is avoidance of discharge of nutrient-laden effluent in surface waters. In order to gain public support for recycled water, a statement of support was issued, endorsed by a dozen state and federal agencies (Appendix C) As a result, many communities have established extensive networks of reclaimed water distribution systems. According to its 2016 water reuse inventory of the Florida Department of Environmental Protection 397,750 residences, 574 golf courses, 1,053 parks, and 381 schools used reclaimed water for irrigation. While such extensive networks for reclaimed water distribution are unique to Florida, the lesson of feasibility of use of recycled water at many individual residences is an important one for Hawai‘i communities.

---

**Lesson for Hawai‘i from Florida**

- Effluent discharge requirements can provide a powerful driver for initiation of water reuse projects—diverting the flow from receiving waters to beneficial reuse applications.
  
  In Hawai‘i, there are several opportunities where effluent discharge limitations, cesspit discontinuation deadlines, and consent decrees provide similar drivers for implementation of water reuse projects.

---

**New York City**

A 92-acre area, located at the southeast tip of Manhattan in New York City, called Battery Park City, was developed over a landfill in an urban redevelopment program over the past 30 years. The Battery Park City Authority championed sustainable urban development for this area, including water reuse objectives that were more advanced than those of

---

3 “Reclaimed water” is the term of art in Florida, used exclusively to denote recycled water.

4 Also, see Appendix D, containing Washington State’s support declaration for water reuse.
the LEED\textsuperscript{5} standards. Five residential water reuse systems in this area service six buildings: The Solaire, Tribeca Green, Millennium Tower, The Visionaire, Riverhouse, and The Verdesian\textsuperscript{6}. The first project to incorporate water reuse was the Solaire Building, which recycles 25,000 gallons of treated wastewater per day. The treated water is reused for flushing toilets in the 293-unit apartment building, cooling tower make-up water, laundry and garden irrigation. It has consistently achieved a 48\% water consumption reduction and a 56\% reduction in wastewater discharge (compared to similar base residential buildings in NYC). These water and wastewater savings are the result of wastewater reuse and water conservation.

\begin{center}
\textbf{Lesson for Hawai‘i from New York City}
\begin{quote}
New development zones provide excellent opportunities for incorporating sustainability features, including on-site water reuse.
\end{quote}
\end{center}

\textbf{City of San Francisco}

The Public Utilities Commission of the City of San Francisco (SFPUC) has developed an extensive program for promotion of on-site water reuse in new high-rise buildings within the City, starting with its new headquarters building. The program has advanced from single buildings in 2012 to district-scale buildings in 2013 to mandatory requirement for projects over 250,000 square feet of space in 2015. In some cases, graywater and rainwater are captured, treated, and reused. In others, blackwater, condensate, and foundation drainage water are treated and recycled. These projects are resulting in many millions of gallons of potable water offset.

\begin{center}
\textsuperscript{5} LEED = Leadership in Energy and Environmental Design
\textsuperscript{6} A private consultancy (NSU) designed, built and currently operates the wastewater and rainwater recycling systems within these LEED-certified buildings.
\end{center}
In collaboration with water utilities in several other cities across the United States, SFPUC helped develop a comprehensive guidance document (SFPUC, 2014) for on-site water reuse and a model regulatory framework (SFPUC, 2017) for adoption by other jurisdictions.

**Lesson for Hawai‘i from San Francisco**

In densely built urban areas, the best opportunity for water reuse may be on-site reuse, especially for new high-rise buildings.

Mandates established at the county or state levels would provide a level playing field for developers of new commercial and residential projects incorporating on-site water reuse.

**City of San Jose**

As a solution to a regulatory dilemma faced by the City about its effluent discharges to the southern end of San Francisco Bay, the City decided to reduce those discharges by implementing a water reuse program, named South Bay Water Recycling. With federal support about $100 million, a network of over 150 miles of purple-pipe was established serving over 800 customers with disinfected tertiary recycled water (similar to Hawai‘i’s R-1 water in quality) for landscape irrigation, industrial uses, and agriculture. This program was rapidly implemented over a period of about 15 years.

**Lesson for Hawai‘i from the City of San Jose**

Long-distance pipeline networks for delivery of recycled water are costly and complex, but also necessary and feasible.

**West Basin Municipal Water District**

This water utility is located within Los Angeles County. During the drought period of the early 1990s, the District negotiated the purchase of secondary effluent form its neighbor, the City of Los Angeles at $7.00 per acre-ft (~$0.57/m³). Over a period of about ten years, the District built a treatment plant, upgrading the secondary effluent to five distinct types of recycled water, each with a water quality fit for its intended customer. The diverse customer types included landscape and golf course irrigation, industrial cooling towers, low-pressure boiler feed, high-pressure boiler feed, and seawater barrier and groundwater replenishment.
Orange County Water District (OCWD)

A pioneer in water reuse in California, OCWD and its next-door neighbor Orange County Sanitation District formed a historic partnership that has borne immense fruit with the most advanced and largest potable reuse project in the nation. After a 30-year “experimental” project (Water Factory 21), proof of concept was accomplished and documented with several scientific research projects. As a result, a 100-MGD Groundwater Replenishment project is now recharging a potable aquifer serving a large part of Orange County. The Districts are now on track to expand the project to a capacity of 130 MGD (OCWD, 20).

Lesson for Hawai‘i from OCWD

Collaboration between the water utility and the wastewater agency is essential for success of water reuse.

Australia

During the eleven-year (1997-2009) Millennial Drought (SEACI, 2011) that gripped the continent, every state and territory in Australia implemented water reuse projects at a rapid pace, some with significant support from the federal government. Other water reuse projects were sponsored by the private sector. A major potable reuse project in Queensland was completed at a cost of over $1 billion only to be aborted when a heavy rainy season broke the long drought in 2010-2011. Public opposition against the concept also played a part in preventing the potable reuse scheme from realization once the drought-induced water shortage crisis had passed.

Lesson for Hawai‘i from Australia

- Rapid development of water recycling projects is feasible with federal assistance and a sense of urgency.
- Public investment on water reuse is readily justified during prolonged droughts.
- Public support for water reuse can wax and wane with droughts and floods. Extended drought periods provide for prioritization of water reuse projects by the public and their elected representatives.
**Japan**

Japan is endowed with more than adequate rainfall for its water supply needs. Nonetheless, new high-rise developments in Tokyo and other major cities are required by law to include on-site wastewater treatment and reuse in order to avoid further burdening the Cities’ wastewater collection and treatment systems. These in-building water reuse systems have provided a model establishing the economic and environmental feasibility of on-site reuse and have led to emulation of the systems in Melbourne, New York, and San Francisco, to name just a few prominent examples. Some systems capture graywater, while others, such as the Tokyo Metropolitan Government Center buildings, capture all blackwater for treatment and on-site reuse.

---

**Lesson for Hawai‘i from Japan**

On-site water reuse in high-rise buildings is economically feasible, especially at the initial construction stage.

---

**Prospects for Large-Scale Expansion of Water Reuse**

**Agricultural Use of Recycled Water**

In 2017, Hawai‘i Governor Ige set an aspirational goal of doubling Hawai‘i’s local food production by 2020 with a long-term view toward eventual self-sufficiency in food production for the state. Challenges to meeting this goal are farmers’ access to financing, and the availability of irrigation water and agricultural labor. To accomplish this vitally important goal, irrigation water will be needed in large volumes. Recycled water, with R-1, R-2, and even R-3 treatment levels—depending on crop type and irrigation method—is suitable for this purpose and can avoid further tapping the groundwater resources of the state. This food crop production goal provides an ideal opportunity to also meet the state’s water reuse goal and possibly exceed that goal by a wide margin.

Hawai‘i Guidelines for water reuse allow unrestricted use of R-1 recycled water for irrigation of all crops, irrespective of method of irrigation. All crops include fruits, vegetables, leafy greens, and other crops normally consumed raw, without further processing, or cooking.

Irrigation with R-2 recycled water is restricted to crop whose edible portions do not come in contact with the irrigation water. Use of subsurface or surface drip irrigation is required to prevent exposure of humans to R-2 water. Allowed crops for irrigation with R-2 recycled water include fruit trees, non-edible vegetation, sod farms, ornamental plants, fodder, fiber, seed crops, timber, and non-bearing food crops. Spray irrigation with R-2 water is generally prohibited, but it can be allowed with an adequate buffer between the area being irrigated and the adjacent residential of publicly accessible area. R-3 recycled water is allowed to be used...
only with subsurface drip irrigation of non-edible vegetation in areas with limited public access, fodder, fiber, seed crops, timber, and trees not bearing food crops.

The Water Research Foundation (2019) published a comprehensive report relating to the impediments to use of recycled water in agriculture and ways to overcome the challenges. A geospatial analysis was performed to match wastewater treatment plants in the United States having significant potential for recycled water production with farmlands of large acreages of production in proximity to those WWTPs. While Hawai‘i (and other non-contiguous States) were not specifically covered by the report, many of the general findings are applicable to Hawai‘i and have been drawn upon in Section 6.

**Decentralized Reuse Opportunities**

Decentralized water reuse is gaining favor in (a) isolated areas where access to a centralized water reuse system is not available, and (b) densely populated metropolitan regions where obtaining recycled water from a central water reuse system would be impractical due to the congested utility corridors and capacity limitations at the central treatment plants. Versions of decentralized water reuse are:

- In-building black-water or graywater on-site collection and treatment and recycling for non-potable uses within the building
- District-scale water reuse, with several neighboring buildings sharing raw material, treatment and use of the collective recycled water
- Sewer mining upstream of existing wastewater treatment plants for on-site treatment and reuse
- Graywater reuse for landscape irrigation in residential households, usually without treatment
- Stormwater capture at the household or district level for storage and use in dry periods
- Capture and reuse of foundation groundwater, air-conditioning condensate, and other unconventional water sources, with or without treatment

Experience in localities that have adopted on-site water reuse indicates that the total amount of water thus saved on the regional level is relatively small. However, for the individual systems, the impact can be great, reducing water demand of the building from 40 to 90 percent compared with conventional systems relying entirely on potable water.

Beyond adoption of the latest plumbing code, it will also be necessary to establish treatment standards that would ensure public safety and at the same time gain and maintain public support for such systems. Such standards can be developed from those of New York City’s Battery Park Development and San Francisco’s more recent on-site systems with incentives and mandates (SFPUC, 2017).
Groundwater Recharge with Recycled Water

An important opportunity to increase the use of recycled water in Hawai‘i is by replenishment of groundwater aquifers with highly treated recycled water. This use of recycled water would be especially beneficial in Oahu and Maui where reliance on groundwater is paramount. Groundwater replenishment with recycled water can provide for sustained maintenance of high levels of water in the aquifers against the potential for seawater intrusion. The combined effect of future overdraft and seawater rise threatens to salinize groundwaters in coastal aquifers. Anticipating the threat is the first step to preventing it. Groundwater replenishment with recycled water can operate year-round and utilize the relatively constant supply of the raw material. Because of the high levels of treatment needed, groundwater recharge can also help improve the mineral quality of water in the aquifer over the long-term.

Potable Reuse

Potable reuse may be pre-mature for Hawai‘i at this time. However, it is rapidly gaining favor in a number of states with planning underway for a variety of systems to come on-line in the coming years, as shown below in Figure 3. The greatest advantage of potable reuse is that, unlike non-potable reuse, it does not require a separate distribution network. Also, with the extremely high quality of the finished water, the multi-barrier treatment, and real-time on-line monitoring of treatment performance, water from a potable reuse system will be far superior to conventional sources of water for any use, including drinking, bathing, cooking, etc. In the long-term, potable reuse will play a part in many water-short regions of the world, including some parts of Hawai‘i.

Figure 3 Status of progress on potable reuse regulations in various states as of July 2019

Source: Courtesy of Brown and Caldwell and WateReuse Association, from webcast on July 10, 2019
5. STRATEGIES FOR MEETING STATEWIDE WATER REUSE OBJECTIVES

Figure 4, below, shows the past record and future (desired) trends of water reuse in Hawai‘i. The following trends are noteworthy:

- Initial rapid water reuse growth phase in the 1990s
- Period of relatively constant water reuse volume in the 2000s
- A declining phase of water reuse volumes from 2009 to 2015
- The most recent phase (2015 to 2018) of growth in water reuse
- Projection of the necessary growth in volume of water reuse in the coming years if the goal of 30+ MGD by the year 2030 is to be achieved

**Figure 4  Past Trends and Future Projection of Hawai‘i Water Reuse**

The initial rapid phase of development of water reuse and the most recent increasing trend are encouraging indications that achieving the established goal of 30+ additional water reuse by 2030 is a distinct possibility. What is needed is a champion to push on several fronts and motivate the water cycle stakeholders to make the necessary investments in producing and distributing recycled water to customers with non-potable use applications—agricultural irrigation, landscape, industry, urban uses, groundwater recharge, etc.

Some of the most immediately effective strategies for scaling water reuse in Hawai‘i are discussed in the following sections.
Legislative Initiatives

State laws are expressions of the general public’s serious intent to accomplish certain ends in the interest of the common good. The Hawai‘i legislature has already signaled its support for water reuse with enactment of House Concurrent Resolution 86, in which “the Department of Health is requested to convene a Task Force to identify barriers and solutions to expanded water reuse in the state…”. Already, one piece of legislation has been introduced to request the Department of Health to adopt on-site water reuse regulations based on the National Blue-Ribbon Commission for Onsite Nonpotable Water Systems’ “A guide for Developing and Implementing Regulations for Onsite Non-Potable Water Systems”. This legislative bill was approved by both houses in April, 2019 and signed into law by the Governor as Act 202.

Aside from the current legislative initiative(s), the following are possible future concepts for consideration:

- Laws to provide adequate resources for the Department of Health Wastewater Division to expand its regulation and permitting of water reuse in the state, to monitor compliance, and to maintain and update water reuse projects throughout the state.

- Increased use of state matching funds (e.g., from State Revolving Funds) and other subsidies to Counties for construction of treatment and distribution systems for recycled water service to agriculture, industry, and other non-potable water demand customers.

- Laws to provide both a requirement and a source of funds for re-alignment of coastal sewers to avoid future inundation due to seawater rise, while also avoiding intrusion of seawater into the sewers.

- Laws to require new developments to provide dual plumbing for recycled water distribution systems for non-potable applications throughout their residential, commercial, and industrial structures and to connect to source(s) of recycled water from centralized reclaimed water centers.

- Laws to mandate use of recycled water for specific applications where the quality and cost of recycled water are acceptable for the end use of the water. Examples of uses that may be mandated include the following:
  - Street cleaning and washdown of land surfaces
  - Landscape (including golf course) irrigation in proximity to recycled water networks
  - Toilet flushing in high-rise commercial buildings, hotels, and condominiums

POSSIBLE CHAMPIONS:

- Individual legislator(s)
- Philanthropic Organizations
- Nonprofit, nongovernmental organizations
- Water cycle utilities
o Agricultural irrigation
o Industrial applications

- Laws to convert existing cesspools to decentralized water reuse systems. This recommendation can dovetail well with the State requirement for cesspools in to be gradually eliminated by 2050 (Act 132 of SLH 2018)

- Laws to limit or prohibit ocean discharges and deep injection of wastewater effluents under certain conditions where ocean water quality is protected against pollution while the effluent is reclaimed and made available for recycling and beneficial reuse.

**Regulatory Updates**

The Hawai‘i regulations for water reuse and for graywater use are protective of the public health while also being user-friendly—comparable to those of California and Florida. Continuous vigilance is needed to keep the regulations updated and to ensure they are supportive of expanded water reuse and encouraging to new projects coming online. Some of the improvements that need to be considered are listed below, based on experience in other states and based on the outcome of interviews with water reuse stakeholders in Hawai‘i:

- Uniform interpretation and enforcement of the existing regulations

- Expansion of list of “Suitable Uses” of recycled water of various qualities (RO, R-1, R-2, R-3, etc.). This recommendation would provide for a more comprehensive list of allowed uses of recycled water under different conditions. Examples of additional uses—beyond the 14 specifically enumerated in the 2016 Reuse Guidelines—are listed below:
  - Commercial laundries
  - Commercial car washes
  - Priming drain traps

- Adoption of regulations specifically for groundwater replenishment with recycled water

- Waiver of the daily coliform monitoring requirement for certain on-site treatment systems that meet specific reliability and resiliency requirements using continuous recording of treatment performance parameters (e.g., turbidity, pH, disinfectant residual, etc.)

**POSSIBLE CHAMPIONS:**
- Hawai‘i Department of Health
- Philanthropic Organizations
- Nonprofit, nongovernmental organizations
• Setting higher volume limits on discharges of R-1 recycled water that are treated as a violation—for example, set 50,000 gallons of R-1 or RO water spilled instead of 1,000 gallons.

• Allow use of recycled water for irrigation of landscaping in individual residences

• Allow daytime spray irrigation with R-1 recycled water when site supervisor is present

• Adoption of the 2018 Plumbing code by each County

Financial Incentives and Assistance

Expanding water reuse requires expansion of the existing water reuse infrastructure and construction of additional treatment and distribution facilities. These facilities cost millions of dollars in land acquisition, buildings, equipment, pipelines, storage facilities, and retrofits at the use sites. Funds necessary for these facilities can come from a combination of sources, including:

• Federal grants and low-interest loans

• State subsidies

• Individual water utilities

• Wastewater utilities in each county

Federal Support

Federal assistance for water reuse is currently available through Title XVI of the Bureau of Reclamation.

In addition, the federal Water Infrastructure Finance and Innovation (WIFIA) is another source of funding, providing long-term loans at extremely low interest rates for a variety of types of water projects—specifically including water recycling projects. Eligible activities include development phase, construction, real property acquisition, and other carrying costs during construction (USEPA, 2019).
State Subsidies

State support of water recycling is essential for meeting the established goal. It provides some of the funding to get projects underway, but—more importantly—it conveys the important message that the state’s populace is behind water reuse as another resource for the future water supply in the state. At the present time, there are no state programs funded specifically to support development of water recycling projects, although the State Revolving Fund for clean water projects can be (and has been) tapped for this purpose.

Some of the ways in which other states have established subsidization programs for water reuse include voter-authorized bond issues in which the state obligates itself to pay back the bonds over a period of several decades at an interest rate that would be attractive in the bond market. Because of the stability of the state and its financial health, investors would purchase the bonds and provide some of the up-front funding necessary for construction of the needed facilities. Once a water reuse support fund is established, a state agency can administer its grants and/or collection of loan repayments. The Commission on Water Resources Management (Hawai‘i CWRM) would be the logical agency to administer the state funds and any matching funds from the federal government.

Water Utilities Investment

Water utilities are in the best position to market recycled water because of their existing networks, knowledge of demand demography, and ability to expand their existing networks into new areas and introduce a new water supply. Introduction of recycled water into the mix is challenging at first, but it saves existing water customers from the possibility of future supply shortfalls, rationing, and steep cost increases. Furthermore, in some areas water supply utilities enjoy a legal monopoly for distribution of water within their established service area. Thus, a first step in creation of a new recycled water project would be a collaboration agreement between the water utility and the wastewater utility serving the same population service zone. Passing the additional cost of recycled water service to potable water customers can be justified by the benefits to the water customers and the populace as a whole, including (a) avoidance of future shortages, (b) greater reliability of water supply, (c) food production, (d) jobs creation, (e) economic stimulation, and (f) increased environmental sustainability of water service.

Wastewater Utilities Investment

Wastewater utilities benefit from water reuse projects in two important ways: (a) reduced discharge to the environment and possible relief from some discharge requirements and their costs, and (b) revenue from sale of recycled water to the partner water utility with responsibility for distributing the water to end users. On the other hand, the burden of planning and construction of a new water reuse infrastructure—if not all its costs—usually, but not always, falls upon the wastewater utility. Cost sharing with the water utility and
subsidies from state and federal governments can bring local costs to a level where the project can be justified and undertaken.

**Demonstration Projects**

The common expression “seeing is believing” applies to water reuse when the public can see for themselves the processes involved in taking the pollutants out of wastewater and produce a safe finished water that is suitable for a variety of beneficial uses. A number of potential demonstration projects have been proposed in the course of the research being reported here. Some of the conceptual project sites, as candidates for demonstration, are listed below:

- Honokohau Harbor—Hawai‘i Island
- Waimanalo wastewater treatment plant—Oahu
- Kealakehe Wastewater Treatment Plant—Hawai‘i Island
- A potential water recycling project at Natural Energy Laboratory of Hawai‘i Authority (NELHA)—Hawai‘i Island
- Lahaina Wastewater Treatment Plant—Maui
- Wailea (100% Reuse)—Maui
- Expand Honouliuli Recycled Water Network into Hoopili Development—Oahu
- Wahiawa Wastewater Treatment Plant—Oahu
- Kunia Storage Basin (14 MG Capacity)—Oahu
- Mililani 1 MGD capacity scalping plant for irrigation of recreational areas and agriculture
- Cesspit Districts Conversion to Decentralized Water Recycling Centers—statewide

**Public Outreach and Education**

Public support—at a minimum, public acquiescence—is essential for success of water reuse expansion in Hawai‘i, especially as that expansion moves into more intimate uses of recycled water, such as groundwater replenishment. Conversely, opposition to recycled water, even from a small but vocal minority can derail proposed projects. There are numerous examples of individual opponents derailing and delaying water reuse projects by expressing fear-based and misinformed scenarios at public
hearings. To avoid such possibilities, a series of public outreach efforts are necessary at the local level, supplemented with state-wide public education campaigns. It is advisable to recruit the services of public relations firms with experience in recycled water communication strategies.

**Public Outreach Messages**

Key outreach messages that should be conveyed include:

- All water is recycled water
- Nature continuously recycles water through the hydrological cycle
- The amount of water on earth is essentially the same as it has ever been and will be for the foreseeable future
- Recycled water is safe, reliable, and drought-resistant
- Recycled water is a sustainable source of local water supply and good for the environment
- Using recycled water conserves potable water for drinking
- Water reuse is economical when all its benefits are accounted for
- Recycled water use saves energy, as shown in Figure 5, below. This message is true and important, even if desalination and potable reuse are not now on the planning horizon for Hawai‘i.

![Figure 5: Energy Usage by Various Sources of Water](source)

Source: Equinox Project, 2010, based on San Diego County’s water sources
Stakeholders
Stakeholders are groups with vested interest in a proposed water reuse project. Approach to each stakeholder group must be tailored to their specific needs and concerns. Typical stakeholders with interest in water reuse projects include:

- The general public
- Elected and appointed public officials
- Journalists (reporters, television anchors, etc.)
- Utility staff members
- Business community, including chambers of commerce, and local businesses
- Government agencies
- Recycled water customers

Public Education Approaches
The following are proven and established approaches that have borne fruit for successful water reuse projects—especially when implemented early in the planning stages:

- Demonstration water reuse projects, serving as examples for future projects to emulate
- Tours of demonstration projects and wastewater treatment facilities for school children, civic groups, and the general public
- Showcase models of treatment systems to elucidate the entire treatment process for the lay public\(^7\)
- Videos, fact sheets, and brochures presenting the need for water reuse, its safety, and examples of ongoing water reuse projects in Hawai‘i and other states
- Speakers bureaus with active engagement for presentations at service clubs, schools, and other opportune occasions
- Meetings with community opinion leaders, including elected officials, ministers of faith communities, leaders of political parties, and others to discuss the need for water reuse and its appropriateness for the state of Hawai‘i
- Avoidance of stigmatizing language when referring to recycled water

---

\(^7\) An example is at the Honoluluui Wastewater Treatment Plant

Public Perception of Recycled Water

“Water should not be judged by its history, but by its quality”
- Dr. Louis van Vuuren, National Institute of Water Research South Africa, 2005
6. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The 30+ MGD recycled water goal for Hawai‘i is achievable by 2030 and can even be exceeded within that time frame. This conclusion is based on experience in other localities where a decision to expand recycled water over a decade's time period resulted in high gains in the volume of recycled water generated, distributed, and beneficially reused. A great example is the West Basin Municipal Water District in Los Angeles County, California, where over the period 1990 to 2000, the District constructed the necessary infrastructure to deliver 20 MGD of recycled water to five different customer types within its service area (WBMWD, 2019). Another reason for this optimistic projection is that Hawai‘i already has a robust water reuse baseline, especially in Oahu and Maui Counties. Furthermore, the available flow of wastewater that is now disposed of to the ocean is over 400 percent of the 30-MGD goal and only a fraction of it needs to be recycled by 2030.

However, accomplishing the goal will require a concerted effort to push forward the initiatives recommended herein. First and foremost, a dedicated champion is needed (possibly one in each county) to lead the way, prioritize specific projects with a master plan for the state, initiate a facilities planning process for specifically identified water reuse projects, and launch each project into its implementation phase.

Coordination and collaboration between water and wastewater utilities is a critical component of recycled water projects initiation and completion. Because of their independence and their respective responsibilities to their service populations, there may be some hesitation for the water cycle agencies to come together.

Funding water reuse expansion in Hawai‘i is a challenge that can be met with a multi-pronged effort at federal, state, and local levels. Federal assistance requires “shovel-ready projects”, where the planning and environmental review have been completed and the necessary permits have been obtained. Expertise for performing the planning-related tasks is resident in Hawai‘i and working experience with federal agencies (USEPA, Bureau of Reclamation) is available in the numerous consulting organizations in the Islands.

Recommendations

The following recommendations are based on the insights gained from interviews with the water cycle stakeholders in Hawai‘i. They are also inspired by the successes in water reuse expansion in recent years in California, Florida and other regions. Strategies listed in Section 5 are major options for increasing water reuse significantly over a short period of time. The recommendations for implementation of those strategies are listed below in an approximate hierarchy of priority and chronological order of implementation:
1. **Enact laws to provide for use mandates, funding, and promotion of water reuse**

   Sponsorship for consideration of these laws can come from individual legislators, supported by legislative advocacy from nonprofit or philanthropic organizations, water cycle utilities and professional associations.

   a. Mandate use of recycled water, where available, for agricultural and landscape irrigation, industrial applications, toilet flushing, air conditioning, and other urban uses.

   b. Allocate state funds to incentivize water reuse by providing subsidies to local projects

   c. Apply for federal cost-share from USBR's Title XVI and USEPA's WIFIA programs and provide local-share funding

2. **Update Hawaii's regulations and guidelines for water reuse**

   Regulatory updates can be promoted by professional water associations and would need to be implemented by the Department of Health. The following are recommendations for changes and additions to the existing water reuse regulations and guidelines:

   a. Expansion of list of “Suitable Uses” of recycled water of various qualities (RO, R-1, R-2, R-3, etc.). This recommendation would provide for a more comprehensive list of allowed uses of recycled water under different conditions. Examples of additional uses—beyond the 14 specifically enumerated in the 2016 Reuse Guidelines—are listed below:

      i. Commercial laundries

      ii. Commercial car washes

      iii. Priming drain traps

   b. Adoption of regulations specifically for groundwater replenishment with recycled water, using the example of the recently adopted California regulations for groundwater recharge with recycled water.

   c. Waiver of the daily coliform monitoring requirement for certain on-site treatment systems that meet specific reliability and resiliency requirements using continuous recording of treatment performance parameters (e.g., turbidity, pH, disinfectant residual, etc.)

   d. Setting higher volume limits on discharges of R-1 recycled water that are treated as a violation
e. Allowing use of recycled water for irrigation of landscaping in individual residences

f. Adoption of the 2018 Plumbing code by each County

Aside from revisions of the existing regulations, a change is needed in the interpretation, enforcement, and supervision of permitted water reuse projects, including a positive and friendly attitude toward such projects. As part of this change, the following specific changes are recommended:

a. Uniform interpretation and enforcement of the existing regulations

b. Allowing daytime spray irrigation with R-1 recycled water when a site supervisor is present

c. Allowing use of graywater from simple systems (such as clothes washing machine effluent used for landscape irrigation) without a permit if certain conditions are met

d. Provision of training programs for staff to encourage a balance of firm but friendly enforcement of water reuse regulations

3. **Establish an office of water recycling**

A dedicated office of water recycling can act as a statewide advocate, record-keeper, promoter, and coordinator of water reuse initiatives. The office can be set up possibly within the Hawai‘i Commission on Water Resource Management to manage, advocate, plan, and help secured funds for future water reuse projects. Eventually, this entity may be delegated the responsibility of regulating water reuse in Hawai‘i.

4. **Commission a state-wide master plan for water reuse**

A detailed planning effort is needed prioritizing specific projects by their potential to contribute to meeting the 30+MGD by 2030 goal. The plan would be commissioned at the state level, possibly by the Commission on Water Resource Management, and conducted by a local engineering firm with knowledge and experience of the water cycle entities in Hawai‘i. The master plan can include a market study to identify potential users of recycled water for each prioritized project. Preparation of detailed facilities plans would be the next step for each of the identified projects.

5. **Establish demonstration water reuse projects on each island**

An initial list of potential demonstration sites is presented in Section 5. These projects can be sponsored by the local environmental services of each county and used for public outreach and promotion of the concept of water reuse.
6. **Discontinue declining block rates for agricultural water**

Declining block rate were originally introduced to encourage greater use of water and to enhance revenue for the water suppliers. Those eras of abundance of water supplies have long passed. Therefore, new rates, possibly *increasing* block rates are necessary to encourage water conservation, except where recycled water is used.

7. **Initiate a public outreach and education campaign**

Communities that are unfamiliar with water reuse generally tend to be skeptical about its safety and may oppose its introduction. Therefore, it is necessary to promote the image, necessity, and importance of recycled water in the overall water resources portfolio of the state. The outreach effort can be undertaken at the state level or at each county by the respective water cycle utilities—or by the aforementioned office of water recycling when one is established.

8. **Promote and require on-site water reuse in new construction**

As new development projects come up for permits, especially for high-rise buildings, an opportunity opens for provision of dual plumbing for use of recycled water for nonpotable applications and for on-site water reuse. Such systems could be mandated if the first recommendation, above, has been adopted and implemented.

---

Photo Credit: Bahman Sheikh

Ewa Beach Golf Club, irrigated with R-1 recycled water
APPENDICES

A  References
B  California Statement of Support for Water Reuse
C  Florida Statement of Support for Water Reuse
D  Washington State’s Statement of Support for Water Reuse
E  Summary of Interviews with Stakeholders

Graywater Reuse for Toilet Flushing, Common in Japan

Photo Credit: Bahman Sheikh
APPENDIX A - REFERENCES


Lau, S. L., Mink, J. F. 2006 “Hydrology of the Hawai’ian Islands” University of Hawai’i Press | Honolulu


Ono, Peter, 2018, Personal Communication on 6/28/2018 (Brown & Caldwell assisted the DOH in preparing the 2016 update of Hawai’i’s Water Reuse Guidelines


WateReuse, 2009, National Water Reuse Database, accessible by WateReuse members at: https://nwrd.watereuse.org/default.aspx


This page is intentionally blank
APPENDIX B - California Statement of Support for Water Reuse

STATEMENT OF SUPPORT FOR WATER RECLAMATION

The United States Environmental Protection Agency (EPA), Region 9; the California Water Resources Control Board; the California Department of Water Resources; the California Department of Health Services; the California Conference of Directors of Environmental Health; the United States Bureau of Reclamation; and the WaterReuse Association of California adopt the following joint statement of support for water reclamation:

Whereas, water reclamation is defined as the beneficial use of treated wastewater for such planned uses as irrigation, industrial cooling, recreation, groundwater recharge, environmental enhancement, and other uses permitted under California law; and

Whereas, the Governor of California has made water reclamation an important element of California’s water supply policy; and

Whereas, the California State Legislature has adopted statewide goals for water reclamation providing 700,000 acre-feet by the year 2000; 1,000,000 acre-feet by the year 2010 so as to help the state meet its future water needs; and

Whereas, the Department of Water Resources estimates that California will need to increase its water supply by 3,000,000 to 5,000,000 acre-feet by 2050, which includes an assumption that 1,300,000 acre-feet of conservation will be achieved by then; and

Whereas, the Bureau of Reclamation is currently engaged in several water conservation and reuse projects and plans to help promote water saving throughout California and the West.

Whereas, the amount of water reclaimed in California has increased from 165,000 acre-feet per year in 1977 to over 380,000 acre-feet in 1993; and

Whereas, the WaterReuse Association of California’s 1993 survey reported that water reuse will continue to increase from 380,000 acre-feet per year in 1993 to a projected 1,000,000 acre-feet in 2000 and to a projected 1,300,000 acre-feet by 2010, and that the major constraints to achieving these levels of reuse appear to be funding, institutional and regulatory disincentives, the permitting process, and public acceptance; and

Whereas, California’s extensive experience with water reclamation provides reasonable assurance that the potential public health risks associated with water reclamation in California are minimal, provided all regulations pertaining to water quality, monitoring, reporting, and reliability are adhered to; and

Whereas, California law and regulations are fully protective of human health and require a specific level of water quality and treatment corresponding to each beneficial use of reclaimed water; and

Whereas, this set of laws and regulations also provides general requirements and provisions which reclaimed water purveyors and users must comply, including monitoring and reliability requirements to further assure that use of reclaimed water is safe; and

Whereas, Congress established pollution prevention as a “national objective” in the Pollution Prevention Act of 1990 and EPA has adopted pollution prevention as the new environmental ethic, and EPA’s definition of pollution prevention, pursuant to the Act, includes increased efficiency in the use of water.

Now, therefore, be it resolved on this first day of June 1994, the undersigned agencies support the pursuit and development of federal, state, and local water reclamation policies and regulations that will reduce constraints and promote water reclamation. Specifically, the agencies will work to overcome and reduce institutional and regulatory disincentives and funding constraints, and so promote public acceptance of water reclamation. The agencies will cooperate to develop specific policies and resource commitments that will enable the State of California to meet the Legislature’s water reclamation goals and to help satisfy the State’s overall water needs.

[Signatures of officials from various agencies]
This page is intentionally blank
APPENDIX C - Florida Statement of Support for Water Reuse

Statement of Support for Water Reuse

The Florida Department of Environmental Protection; the United States Environmental Protection Agency, Region 4; the Florida Department of Health; the Florida Public Service Commission; the Florida Department of Agriculture and Consumer Services; the Florida Department of Community Affairs; the Northwest Florida Water Management District; the South Florida Water Management District; the St. Johns River Water Management District; the Southwest Florida Water Management District; and the Suwannee River Water Management District (collectively “Participating Agencies”) adopt the following joint statement of support for water reuse:

Whereas, water reuse is defined as the beneficial use of reclaimed water (treated wastewater) for landscape and golf course irrigation; agricultural irrigation; industrial uses; toilet flushing; fire protection; decorative water features; ground water recharge; indirect potable reuse; wetlands creation, restoration, and enhancement; and other uses allowed by Florida’s reuse rules; and

Whereas, Florida Statutes establish the encouragement and promotion of water reuse as state objectives; and

Whereas, Florida’s Water Resource Implementation Rule advocates and directs that reuse of reclaimed water be established as an integral part of water and wastewater management programs in Florida; and

Whereas, water reuse provides an environmentally sound means for managing wastewater, while conserving water and replenishing valuable water supplies; and

Whereas, Florida law and regulations are fully protective of public health and environmental quality; and

Whereas, the capacity of water reuse systems in Florida exceeds one billion gallons per day; and

Whereas, Florida’s extensive experience with water reuse has demonstrated the viability and acceptability of water reuse practices; and

Whereas, the EPA has recognized Florida’s Water Reuse Program for excellence in 1993, 1996, and 1999; and

Whereas, the EPA encourages water reuse as a means for managing wastewater under the provisions of the Clean Water Act; and

Whereas, Florida Statutes require the Florida Public Service Commission to allow recovery of all prudent reuse costs in customer rates, which may be allocated among the utilities’ water, wastewater, or reuse customers, or any combination thereof; and

Whereas, the Florida Department of Environmental Protection and the water management districts have formally agreed to assist the Florida Public Service Commission in rate cases in the proper evaluation of reuse issues and the resulting costs, and promote customer acceptance of reuse through expert testimony at formal hearings, and at informal customer meetings; and

Whereas, Congress established pollution prevention as a national objective in the Pollution Prevention Act of 1990 and the EPA includes increased efficiency in the use of water as part of a new environmental ethic; and

Whereas, the EPA, the Florida Department of Environmental Protection, and the state’s water management districts have participated in the funding of water reuse systems in Florida and all Participating Agencies have encouraged and promoted the safe implementation of water reuse in Florida.

Now, therefore, the Participating Agencies resolve to continue to encourage and promote water reuse, to work together to overcome institutional and regulatory disincentives and funding constraints, to ensure protection of public health and environmental quality, and to promote public acceptance of water reuse in Florida.
APPENDIX D - Washington State’s Statement of Support for Water Reuse

Declaration of Support for Reclaimed Water

We invite you to join in supporting the use of reclaimed water within the State of Washington. There will be an opportunity for you to sign this statement of support at this workshop.

Whereas, reclaimed water is an alternative water supply created from highly treated wastewater; and
Whereas, reliable and safe supplies of water are essential for meeting the existing and future needs of people, fish, farming, industry, and recreation; and
Whereas, the need for water in our state will likely grow as the result of population growth, economic development, and stream flow restoration; and
Whereas, according to peer-reviewed research from the University of Washington, global climate change is expected to result in the following impacts to the climate of the Pacific Northwest: reduced snow pack and associated strains on drinking water supplies, changes in winter flooding patterns, reduced summer stream flows for fish, and altered habitat for other wildlife; and
Whereas, reclaimed water is a safe alternative to drinking water (potable water) for approved uses such as irrigating golf courses and parks, fire fighting, toilet flushing, and industrial process cooling; and
Whereas, reclaimed water can also be used to create and repair wetlands, recharge groundwater, and augment stream flow, and thus enhance habitat for fish; and
Whereas, the more that reclaimed water is produced and used, the amount of wastewater that enters our water bodies, including Puget Sound, will decrease; and

Whereas, the Washington State Departments of Ecology and Health regulate reclaimed water under comprehensive standards for protection of public health and the environment; and
Whereas, the State of Washington has made it a policy since 1993 to encourage the use of reclaimed water to augment or replace the state’s available potable water supplies; and
Whereas, the Legislature in 2006 directed the Department of Ecology, with support from the Department of Health, to update the state’s reclaimed water standards by 2010 to reflect state-of-the-art technology and allow expanded uses of reclaimed water; and
Whereas, communities in Washington and other states, including California, Florida, Arizona, and Texas, have successfully used reclaimed water to supplement their water supplies without threatening existing water resources or public health; and
Whereas, local governments throughout the state are including expanded use of reclaimed water in their strategies for fish recovery and for meeting water quality goals; and
Whereas, use of reclaimed water is growing nationwide and around the world;

Now, therefore, we resolve to continue to encourage and promote the development and use of reclaimed water in the State of Washington, to work together to overcome barriers to its use, to ensure protection of public health and environmental quality, and to promote public acceptance of reclaimed water.

Jay Manning, Director
Washington State Department of Ecology

Gregg Grunenfelder, Assistant Secretary, Division of Environmental Health,
Washington State Department of Health

Ron Sims, King County Executive
Michael D. Strub, P.E., LOTT Alliance

Nancy Peterson, LOTT Alliance
Bonnie Mager, Spokane County Commissioner

Doug Mah, LOTT Alliance
Donald L.P. Miller, Lakehaven Utility District
The following individuals signed this declaration following the June 2007 Reclaimed Water: Tapping the New Resource workshop.

**FutureWise** (formerly 100 Friends of WA) 7-31-07

**Tom Agnew**, Liberty Lake Sewer & Water District
**Larry Curles**, Annapolis Water District, Karcher Creek Sewer District
**Mark Nelson**, Evergreen Valley Utilities
**Karla Fowler**, LOTT Alliance
**Ben McConkey**, LOTT Alliance
**Bob Swarner**, King County WTD
**John Kounis**, Washington Public Utility Association
**John Komorita**, King County WTD
**Ron Kohler**, King County WTD
**Richard Atwater**, WateReuse Association
**James Kelley**, City of Arlington
**Chris Kelsey**, Kennedy/Jenks
**Scott Redmond**, Puget Sound Action Team
**Geoff Reed**, King Conservation District

**People for Puget Sound** 7-31-07

**Rob Masonis**, American Rivers 7-31-07
**Larry Karns**, Shoreline 10-7-08
**Helen Meeker**, King County 10-18-08

**Ron Schultz**, Acting Director, Puget Sound Partnership 7-31-07
**Evan Lewis**, Seattle 2008
**G.J. Polson**, King County 10-18-08

**Washington Environmental Coalition** 7-31-07

**G.J. James**, King County Department of Natural Resources and Parks 6-2-08
**Rebecca Moore**, Auburn 2008

Updated October 27, 2008

Photo Credit: City of San Jose South Bay Water Recycling
APPENDIX E  Summary of Interviews with Stakeholders

At the beginning of this project, Bahman Sheikh held a series of interviews in person and by telephone with telephone calls and email follow-ups as needed. Table 4 below highlights the most frequently discussed challenges and opportunities brought up by the interviewees. There were multiple themes repeated, ranging from the salinity of recycled water to the impediment of public perception. Salinity was frequently discussed since seawater intrusion in corroded cast-iron sewer lines can result in salty recycled water with high sodium and chloride levels, and rising sea levels, which will only exacerbate this problem. Although salinity was repeatedly noted as a challenge, there were multiple interviewees (representing both golf courses and wastewater treatment plants) who shared that salinity was not a challenge for them. For public perception, although some interviewees expressed that the paradigm on recycled water has shifted, it was still noted as an obstacle that needs additional attention. The most recurrent theme in conversations however was the overly strict interpretation and enforcement of water reuse guidelines. The limited hours allowed for irrigation, for example, was noted as a prohibitive challenge.

The cost of water reuse was also highlighted by multiple stakeholders as a challenge, especially since construction costs are high in Hawaii and conventional sources of water are available at relatively low prices. The cost of constructing pipelines through volcanic rock, for example, can be as high as $1.8 million per mile. There is often a large distance between water production and recycled water user areas, making the construction cost particularly inhibitive. Decentralized reuse was noted as a potentially cheaper option that could eventually become a significant contributor to the water reuse goal. Currently R-1 quality water reuse at the individual building level requires an on-site operator, which is both cost and time intensive, resulting in water reuse being allowed at the municipal level only. Developers interviewed were interested in how other locations have dealt with high costs, and how reduced long-term water and wastewater costs could help offset costs at the building level.

Capital costs of infrastructure can potentially be financed with revenue bonds and paid by rate payers over time, along with operation and maintenance costs. State revolving funds and federal grants are also options for financing reuse projects.

Another impediment noted more than once was the lack of conversation between wastewater and water agencies. A more collaborative ‘one water’ approach to wastewater and freshwater management would help facilitate both the development and use of recycled water.

As for potential opportunities, groundwater replenishment with runoff is being considered and with high enough treatment levels, aquifers could also be recharged with recycled water in the future. As climate change and sea level rise threaten groundwater quality with saltwater intrusion, recharging with recycled water would be a practical and proven solution.

Demonstration projects were frequently listed as an opportunity for scaling water reuse- not only for increasing the public’s awareness on the safety of recycled water but also to highlight the feasibility and benefits. Interviewees were optimistic about the possibility of demonstration projects and ideas for different locations and projects were discussed. There is a great opportunity for pairing recycled water and agriculture, especially since the State has goals for both increasing water reuse and local food production. The challenges and opportunities noted in these interviews were critical to the development of this report and further
conversations should be held with key stakeholders as recommended strategies in this report are adopted and implemented.

Table 4 Summary of Topic Raised by Interviewed Stakeholders

<table>
<thead>
<tr>
<th>Impediments, Obstacles and Challenges to Increased Use of Recycled Water</th>
<th>Number of times topic was raised</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Overly strict interpretation and enforcement of water reuse guidelines, unfriendly attitude toward recycled water customers</td>
<td>20+</td>
</tr>
<tr>
<td>• Salinity of recycled water due to seawater infiltration into sewers • Public perception of recycled water is a possible impediment • Geographic constraints, distance, elevation from source of recycled water to customers • cost of construction in Hawaiʻi and cost of pipelines in volcanic rock</td>
<td>10+</td>
</tr>
<tr>
<td>• Low cost of freshwater • Uncertainty of the impact of the Food Safety Modernization Act on farmers using recycled water • Service interruptions in recycled water delivery result in problems for customers (golf courses in particular) • Separation of water utilities from wastewater utilities and a lack of ‘one water’ collaboration • Seasonal storage of recycled water is necessary but problematic • Difficulty in recruiting qualified personnel for water infrastructure • Water supply is not a problem • On-site reuse, graywater use, and scalping plants will reduce flow to central wastewater treatment plants and cause sewer clogging</td>
<td>1+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities for Overcoming Challenges and Increasing Recycled Water Use in Hawaiʻi</th>
<th>Number of times topic was raised</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Agricultural potential of recycled water use in the future is a big opportunity to achieve the water reuse goal</td>
<td>10+</td>
</tr>
<tr>
<td>• Lessons can be learned from other locations that are leaders in recycled water • Possibility of scalping plants to produce recycled water where needed • Potential for future restrictions on injection wells and outfalls can play a big role in the favor of water reuse • On-site water reuse in proposed new residential developments, subdivisions, and high-rise towers • Groundwater replenishment with recycled water • Demonstration projects would help convey the need for water reuse • State revolving funds (SRF) and US Bureau of Reclamation Title XVI funds can be tapped to build water reuse facilities • Over-pumping of coastal aquifer is beginning to produce seawater intrusion into the groundwater reservoirs • Honolulu’s mandated “reclaimed water zone” is a potential model for other areas of the state • Mandatory use ordinances can help advance water reuse • Elimination of septic tank and cesspit disposal practices offers an opportunity for on-site reuse and/or graywater use</td>
<td>1+</td>
</tr>
</tbody>
</table>