30-Year Infrastructure Investment Plan

SUMMARY

Board of Water Supply
City and County of Honolulu

Water for Life, Ka Wai Ola

MARCH 2018

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Board of Water Supply
City and County of Honolulu

This is a summary of the 30-Year Infrastructure Investment Plan prepared by the City and County of Honolulu Board of Water Supply in March 2018. The full plan and its companion publications – a Water Master Plan and a Long Range Financial Plan – are available on the Board of Water Supply web site.

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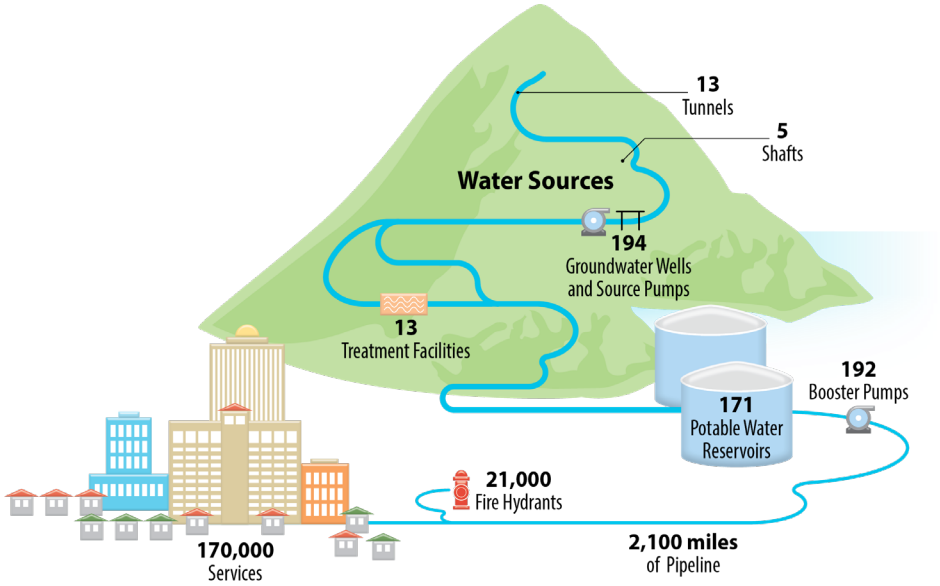
The **Value** of an **Infrastructure Investment Plan**

The Board of Water Supply (BWS) water system is extensive and complex. It's one of the largest water systems in the nation. Each and every day, BWS delivers an average of 145 million gallons of high-quality water that supports the health, safety, and economic vitality of Oahu's communities. The potable (drinking) water system on Oahu has been built over the course of 100+ years with a current replacement value of $16 billion.

As is typical of large municipal water systems, some of the pipes, pumps, reservoirs, wells, and other components of Oahu's water infrastructure are in need of attention. This leads to the questions of where and how to focus attention and resources. The answers have been developed through a trio of plans that BWS has prepared over the past several years.



"Honolulu has risen to these challenges (of water sustainability) by preparing a comprehensive Water Master Plan and a strategic plan, as well as eight regional watershed management plans providing greater detail for each land use district on the island. The Water Master Plan provides a comprehensive understanding of Oahu's water supplies and needs as well as the water storage and distribution systems, giving BWS a road map to meet future needs, establish priorities, and adopt sustainable financing strategies."

American Water Works Association *Journal*, February 2018

The Water Master Plan (WMP), adopted in 2016, provides a road map for decision-making to help sustain a healthy water system for Oahu. The plan assessed the condition of the water system's components, estimated future water demands, and outlined necessary actions to address wear, age, growth, and supply sustainability. The WMP sets a planning horizon at 30 years, a full generation longer than is typical for water master plans.

The 30-Year Infrastructure Investment Plan (IIP) was developed to put the WMP into action. The IIP provides an analysis-based strategy for when specific water infrastructure projects should be implemented and prioritizes renewal and replacement of portions of the water system, based on risk.

The Long Range Financial Plan (LRFP) balances affordability with continuing stewardship of water system resources. It establishes financing strategies to effectively fund the IIP, with consideration to community values and affordability.

These intertwined plans establish a foundation for BWS policy makers, managers and technical staff to sustain Oahu's water system and assure ample, quality fresh water for generations into the future.

Components of **Infrastructure Investment** Planning

The 30-Year IIP represents BWS's best look into the future using currently available information coupled with educated projections based on trends and knowledge. There's no doubt that conditions will change as time passes. Recognizing this inherent uncertainty, BWS has adopted a multi-layered approach to infrastructure investment planning. As illustrated to the right, each layer references a different timeframe and feeds into the tier below.

The process begins with development of the 30-year IIP, a prioritized schedule of projects designed to meet the water system's needs as identified in the WMP. Placeholders are used in instances where, due to the long planning horizon, a need has been identified but a specific solution has not. From the 30-year IIP, shorter horizon plans are developed, each with greater detail as the project moves from conceptualization into the planning and design process.

When a project enters the 10-year IIP, it is further defined and scored for risk. In this application, risk is defined as the likelihood of failure multiplied by the consequence of failure. Risk ratings consider impacts on the public, findings of the WMP condition assessments, historic performance, resource sustainability, and engineering judgement. Risk prioritization provides for the highest degree of overall system reliability at the most affordable cost.

At 6 years, a complete scope and cost estimate are developed and the project is prepared for planning and design. The 1-year IIP has projects expected to be contracted in the coming fiscal year.

30-Year IIP
- Long range; updated every 10 years
- Timeframe considers facilities' end of service life
- Place holders for emerging projects

10-Year IIP
- Medium range; updated every 3 to 5 years
- Details added to projects
- Place holders for emerging projects
- Basis for the 6-year IIP

6-Year IIP
- Short range; updated annually for budget forecast
- Complete project scope developed
- Projects prepared for planning and design
- Used for rate setting

1-Year IIP
- Current; developed annually for budgeting
- Anticipates contracting in the coming fiscal year (FY)
- Planning and design for projects starts in the coming FY

A Snapshot of BWS's Infrastructure

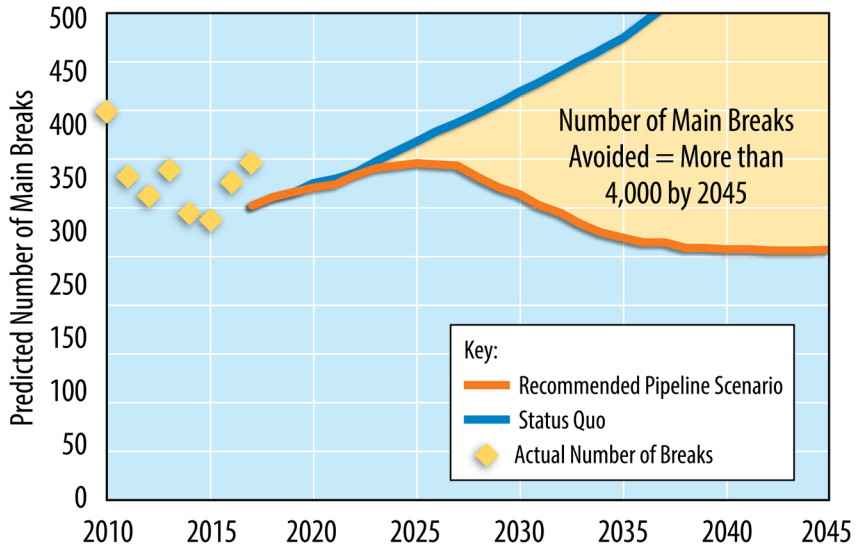
Infrastructure Type	Current Value (in 2016 $)	Anticipated Lifespan (years)	Percent of Total
Sources	$1,333,000,000	150	8%
Pumps	$387,000,000	40	2%
Treatment	$293,000,000	40	2%
Storage	$1,250,000	100	0%
Pipelines	$12,298,000,000	100	75%
Nonpotable*	$387,000,000	50	2%
Facilities	$517,000,000	60	3%
TOTAL	$16,465,000,000	–	100%**

* Potable is drinking water. Nonpotable is recycled or brackish water.

** Does not add up to 100% due to rounding.

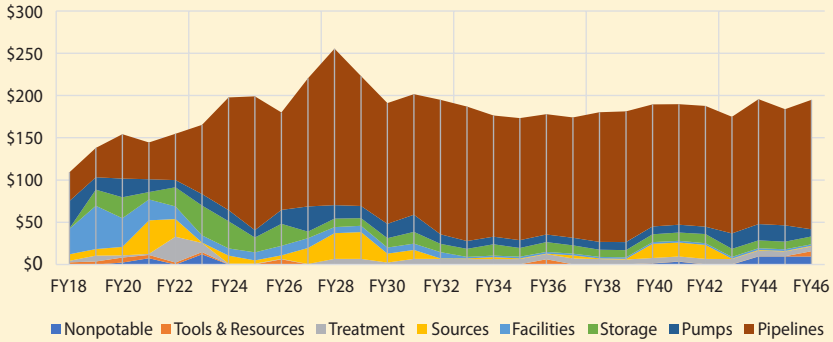
Risk is a key component in developing the 30-Year IIP. Affordability and level of service are other strong drivers for BWS's investment and prioritization decisions. A compelling example relates to replacing pipelines to reduce the number of main breaks. The multiple options for the speed of pipeline replacement takes costs and benefits in vastly different directions. BWS could slowly ramp up to the desired 21 miles of pipeline replaced per year. While costs would be lower, the number of water main breaks would continue to rise. Alternatively, BWS could more rapidly ramp up pipeline replacement. Near-term costs would be higher, but thousands of water main breaks could be prevented.

An extensive analysis was conducted to assess customer tolerances for an increased number of main breaks balanced with the added cost for more aggressive pipeline renewal and replacement. The results led to BWS's decision to significantly ramp up pipeline replacement, increasing from 6 miles per year in 2017 to 21 miles per year over a 10-year period.



This investment in replacing high-risk, aging pipelines can potentially reduce main breaks to less than 300 per year, and prevent 4,000 water main breaks by 2045.

Over the next 30 years, BWS will invest in more than 800 infrastructure projects island-wide, with total costs over $5.3 billion. These are 2017 dollars and are not adjusted for inflation.



Funding Level by Asset - *This graph visually lays out BWS's 30-year strategy for infrastructure investment, distributed by type of facility. This graph includes all three project types and it clearly illustrates that pipeline replacement is by far the primary component.*

30-Year Infrastructure Investment Plan by Project Type

Asset Type	Renewal & Replacement	Capacity Expansion	Research & Development
Number of Projects	736	69	35
Total Cost of Projects (in 2016 $)	$4,286,000,000	$931,000,000	$80,000,000

To facilitate Infrastructure Investment Plan management and tracking, projects are grouped into three categories, shown above.

These categories are detailed in the following pages, including example projects that are part of the 30-Year Infrastructure Investment Plan.

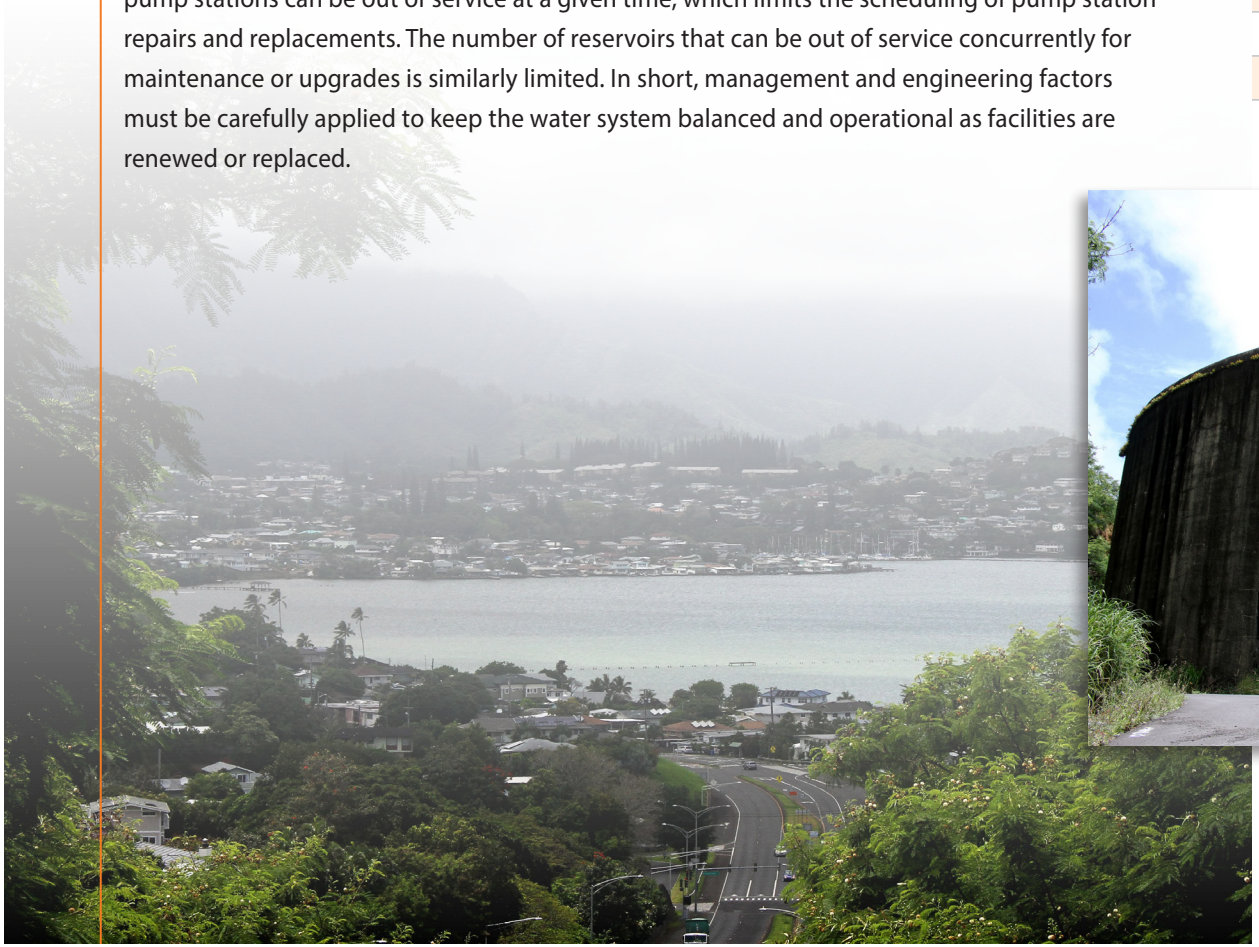
Renewal and Replacement Projects

Renewal and Replacement Projects (R&R) restore or change out worn or aging infrastructure. A few examples are: repairs on an existing well, improvements to an existing pump station, structural repairs or upgrades to reservoirs, and replacing aged pipelines.

Multiple methods were applied through the WMP to identify projects, among them: condition assessment, statistical analysis, capacity analysis, and management decisions. While risk is assessed for all R&R projects, further accuracy and consideration of special conditions may be necessary to properly prioritize individual projects. For example, only a small percentage of pump stations can be out of service at a given time, which limits the scheduling of pump station repairs and replacements. The number of reservoirs that can be out of service concurrently for maintenance or upgrades is similarly limited. In short, management and engineering factors must be carefully applied to keep the water system balanced and operational as facilities are renewed or replaced.

30-Year Infrastructure Investment Plan
RENEWAL and REPLACEMENT
Projects by Asset

Asset Type	Number of Projects	Total Cost (in 2016 $)
Pumps	89	$263,000,000
Reservoirs	48	$233,000,000
Pipelines	522	$3,382,000,000
Treatment	44	$162,000,000
Facilities	33	$246,000,000
TOTAL	**736**	**$4,286,000,000**



Kapa'a Reservoir Improvements - *Leaks have been discovered in the wall of this reservoir, built in 1957. To simplify installation and provide additional options for water system operation, this 2-million gallon reservoir will be replaced with two, 1-million gallon reservoirs.*

Emergency Generator Installation-Kalihi Yard and Shaft; Hālawa Shaft, Kunia Wells - *Strategically placed throughout the island, these new generators will work toward BWS's goal to supply total indoor water demands independent of central power in the event of a major natural disaster by 2030. Emergency generators will be installed in future projects at eight additional sites to meet this goal.*

Palolo Water System Improvements - *BWS will replace nearly 5 miles (25,400 feet) of 1930s-vintage pipe that is corroded and has reached the end of its useful life.*

Wai'alae Iki Booster - *To secure two major facilities away from a tsunami zone, BWS will abandon an existing booster pump and relocate another booster up a hill to the Wai'alae Iki Reservoir site.*

Capacity **Expansion** Projects

Capacity Expansion Projects (CapEx) are undertaken to meet growing water service demand resulting from shifting population distribution, population growth, or increased fire-flow requirements. These projects most often are associated with large infrastructure including wells, tunnels, treatment facilities, pipelines, pump stations, and reservoirs. CapEx projects also increase the reliability of the water system.

CapEx projects were developed as part of a Water System Evaluation in the WMP. Evaluation techniques included hydraulic models of the entire BWS water system to determine future capacity needs. The table (at the right) shows the number and costs of different types of CapEx projects included in the 30-year IIP.

CapEx projects are prioritized so they are planned, designed, constructed, tested, and operational by the time they are needed. Growth projections are uncertain over decades. BWS regularly monitors actual conditions, then updates and refines its plans as needed thorough out the multi-year IIP process.

30-Year Infrastructure Investment Plan
CAPACITY EXPANSION
Projects by Asset

Asset Type	Number of Projects	Total Cost (in 2016 $)
Pumps	22	$293,000,000
Reservoirs	12	$164,000,000
Pipelines	22	$303,000,000
Treatment	2	$40,000,000
Facilities	11	$131,000,000
TOTAL	**69**	**$931,000,000**

Newtown Ridge and Royal Summit Reliability - *These two communities are served by a single reservoir and two high pressure water mains that stretch cross-country. Addition of a booster and reservoir on each ridge will make it possible to abandon the cross-country pipline, providing improved reliability and reduced risk.*

Kahuku Wells Capacity Expansion - *To enable BWS to meet its water commitments and sustain system reliability, a 1-million gallon-per-day pump will be added to augment capacity of the existing Kahuku Wells Station, in addition to an emergency generator and building improvements.*

New Reservoir in Kuwale - *A 4-million gallon reservoir will be built to complement the nearby Waianae reservoir, enhancing water system operations and increasing emergency storage.*

Salt Lake Boulevard 36-inch Main, Foster Village to Āliamanu - *Coordinated with the city Department of Design and Construction's Salt Lake Boulevard Improvements, this project will install 0.7 miles (3,700 feet) of 36-inch pipeline for additional water supply capacity and reliability into Honolulu.*

Research and **Development** (R&D) Projects

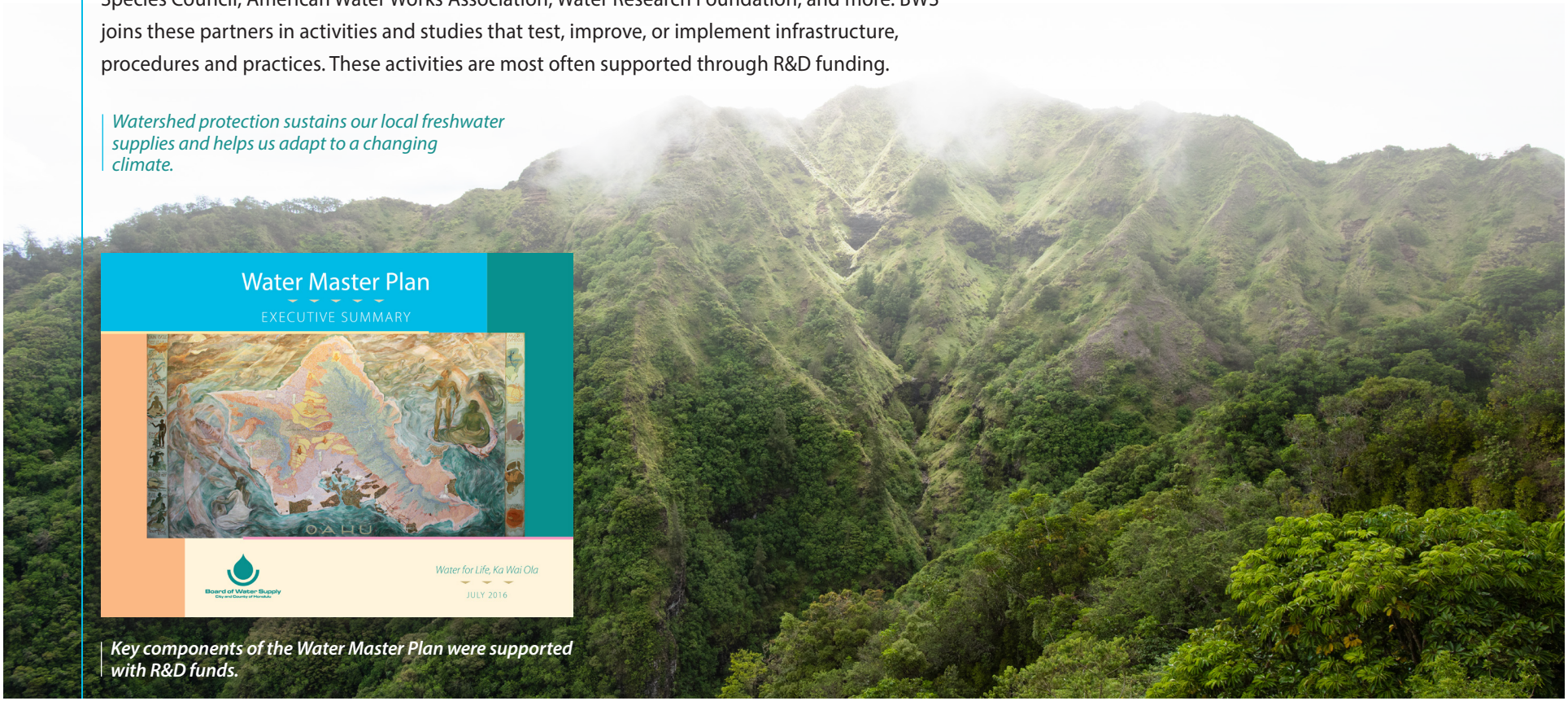
Research and Development Projects (R&D) are diverse in nature. They explore new technologies and pilot their impact and adoptability on Oahu, for example: a recent review of advanced water conservation mechanisms for households and businesses. This R&D project resulted in a new Board of Water Supply program that offers rebates for rain barrels, low water-use clothes washers, and weather based irrigation controls. R&D also includes feasibility studies, exploratory and monitoring wells, condition assessments, planning, and updates.

In addition, R&D projects assure that the BWS remains out in front in its capabilities and practices. BWS is respected for its many high-value relationships both within Hawaii and beyond, for example, with the University of Hawaii, Hawaii Community Foundation, Koolau Mountains Watershed Partnership, Waianae Mountains Watershed Partnership, Oahu Invasive Species Council, American Water Works Association, Water Research Foundation, and more. BWS joins these partners in activities and studies that test, improve, or implement infrastructure, procedures and practices. These activities are most often supported through R&D funding.

30-Year Infrastructure Investment Plan
RESEARCH and DEVELOPMENT
Projects by Asset

Asset Type	Number of Projects	Total Cost (in 2016 $)
Pumps	10	$27,000,000
Reservoirs	5	$3,000,000
Pipelines	5	$14,000,000
Treatment	2	$2,000,000
Facilities	13	$34,000,000
TOTAL	**35**	**$80,000,000**

Watershed protection sustains our local freshwater supplies and helps us adapt to a changing climate.



Key components of the Water Master Plan were supported with R&D funds.

Nuuanu Hydro-Electric and Managed Aquifer Recharge Study and Environmental Assessment - *Climate change is expected to decrease rainfall and increase temperatures, diminishing groundwater availability on Oahu. This project will explore the potential to generate electricity and supplement groundwater supplies by injecting stormwater captured in two historic reservoirs in the Nuuanu Valley: one constructed in 1889 and the other in 1910.*

Ala Wai Membrane Bioreactor Facility - *This collaborative project between the Board of Water Supply and Department of Environment Services will explore feasibility to develop an alternative water source at this site. If successful, this would advance water conservation and provide a protective measure against climate change.*

Energy Savings Performance Contracting - *This project explores best options to reduce energy demand and costs, including photo-voltaic installations on reservoir roofs, replacing motors and motor starters with newer technologies, and upgrading lighting and HVAC (heating, ventilation and air conditioning) systems.*

About the Cover

Pure Water – Man's Greatest Need, 1958 - Juliette May Frasier

A large, richly colored mural spans the walls behind the customer service counter in the lobby of the Board of Water Supply (BWS) Public Service Building. According to a pamphlet describing architectural and artistic features on the BWS Beretania campus, the mural depicts agricultural activities on Oahu, from pre-contact to the 20th century. A section of the mural was selected to adorn the cover of this Infrastructure Investment Plan.

Juliette May Frasier was born in Honolulu in 1887. After graduating from Wellesley College with an arts degree, she returned to Hawaii to teach art.

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