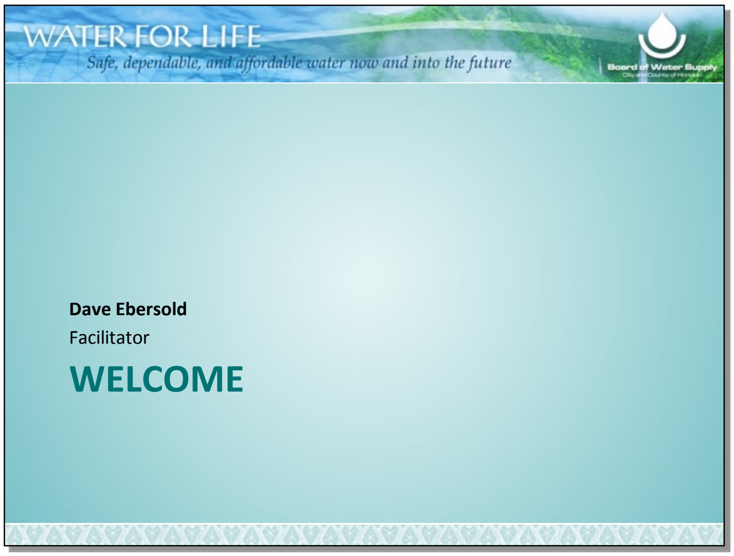
Slide 2


WATER FOR LIFE
Safe, dependable, and affordable water now and into the future
Board of Water Supply
Dave Ebersold
Facilitator
WELCOME

Slide 3


WATER FOR LIFE
Safe, dependable, and affordable water now and into the future
Board of Water Supply
Public Comments on Agenda Items

Slide 4


WATER FOR LIFE
Safe, dependable, and affordable water now and into the future
Board of Water Supply
Hālawa Shaft and Xeriscape Garden Tour
Sat Feb 20, 2016

Slide 5

WATER FOR LIFE

Safe, dependable, and affordable water now and into the future

Board of Water Supply

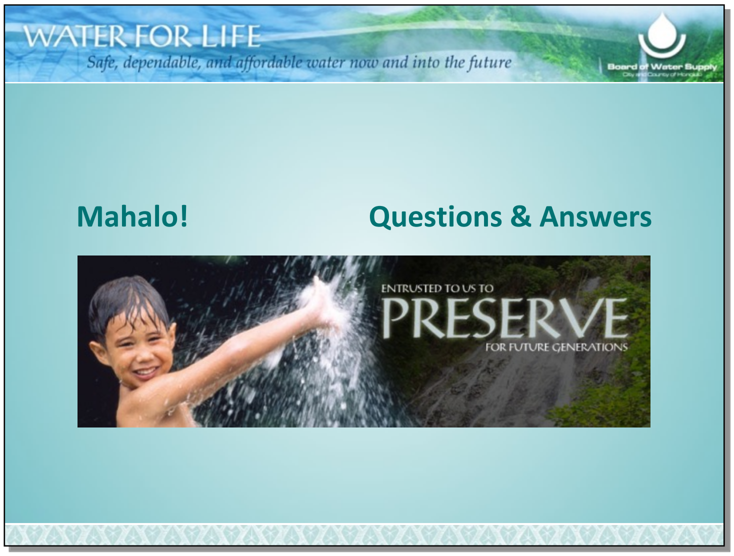
Meeting Objectives

- Hear important news regarding the BWS
- Complete refinement of the Water Master Plan objectives
- Learn about the results of the Water Master Plan system analysis

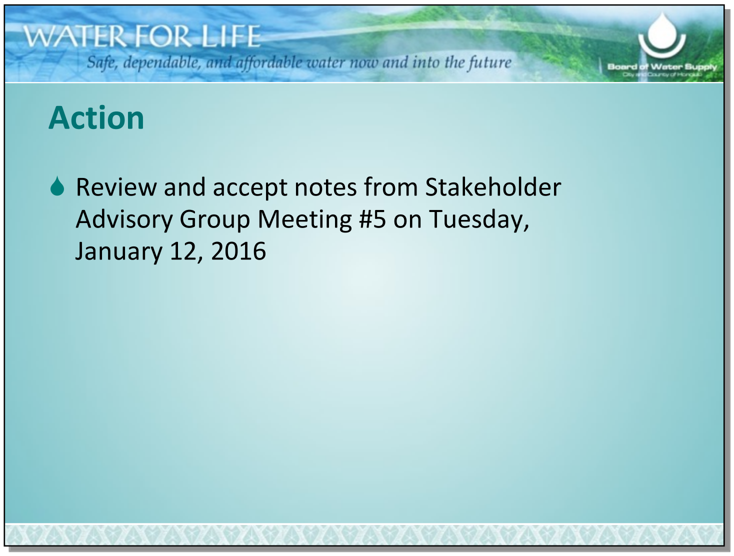
Slide 6


WATER FOR LIFE
Safe, dependable, and affordable water now and into the future
Board of Water Supply
Ellen Kitamura, P.E.
BWS Deputy Manager and Chief Engineer
BWS UPDATES

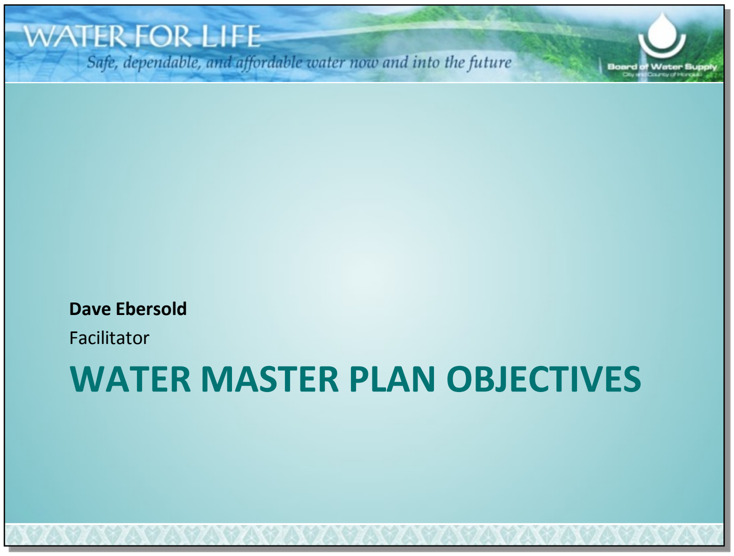
Slide 7


WATER FOR LIFE
Safe, dependable, and affordable water now and into the future
Board of Water Supply
Mahalo!
Questions & Answers
ENTRUSTED TO US TO
PRESERVE
FOR FUTURE GENERATIONS

Slide 8


WATER FOR LIFE
Safe, dependable, and affordable water now and into the future
Board of Water Supply
Action
Review and accept notes from Stakeholder Advisory Group Meeting #5 on Tuesday, January 12, 2016

Slide 9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Safe, dependable, and affordable water now and into the future
Board of Water Supply
Dave Ebersold
Facilitator
WATER MASTER PLAN OBJECTIVES

Slide 10

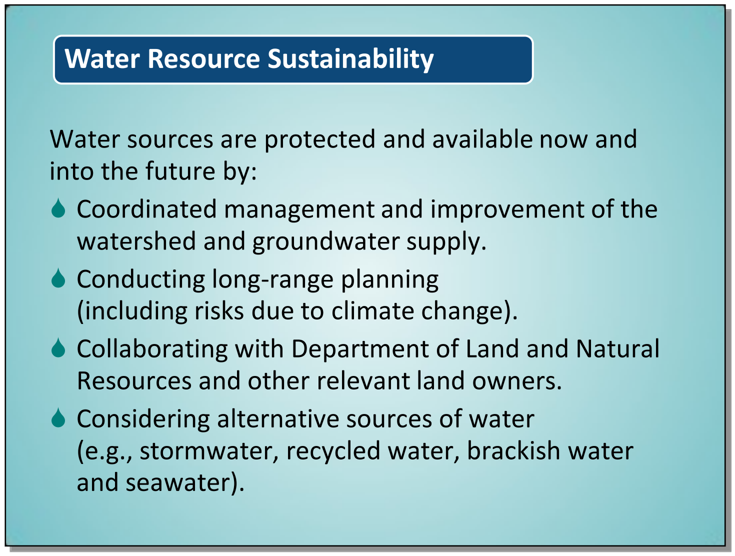
We began this process in Meeting 2, focusing on framing objectives that articulate where we want to be in terms of 5 critical areas you had prioritized in our first meeting and the preceding interviews and discussions.

We continued discussing this during Meetings 3, 4, and 5, and believe we've achieved consensus on the first four.

Slide 11

Today we will turn our attention to the last remaining objective.

Slide 12



Stakeholder Advisory Group members were asked to review, discuss, and refine the proposed definition of the draft objective for Water Resource Sustainability, previously discussed in Meeting 2. The draft objective was edited during Meeting 6 and will be discussed further in Meeting 7. The discussion and edits will be documented in the notes for Meeting 6, which will be posted on the BWS website when accepted by the Stakeholder Advisory Group (anticipated May 2016).

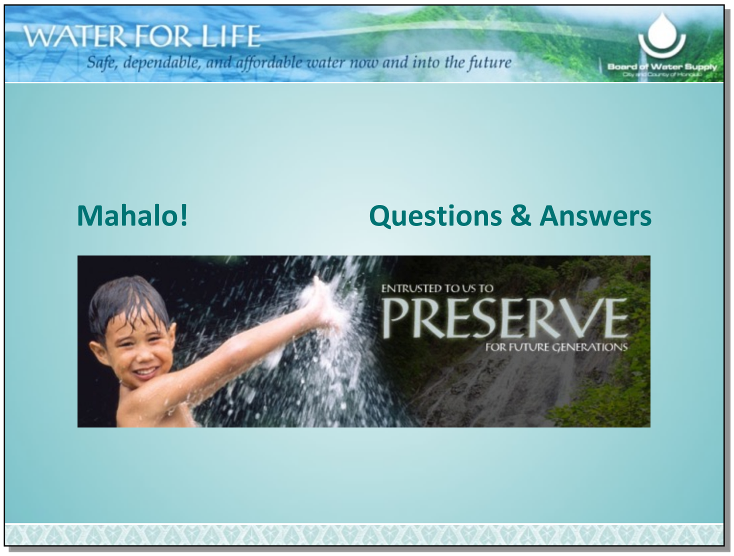
Slide 13

Draft Preamble to Objectives

The Honolulu Board of Water Supply (BWS) Stakeholder Advisory Group has developed the following objectives for the BWS Water Master Plan using a consensus-based process. These objectives cover five major areas that support the BWS's water resource planning efforts and the ahupuaʻa model of sustainable resource management. In establishing these objectives, the Stakeholder Advisory Group recognizes that, in a world of limited resources, not all objectives will be fully attainable and some objectives may directly compete with others. For this reason, the Stakeholder Advisory Group emphasizes the guiding principle that meeting these objectives will require balance, a sensitivity and shared kuleana.

Stakeholder Advisory Group members were asked to review, discuss, and refine the proposed definition of the draft preamble to the WMP objectives. The draft preamble was edited during Meeting 6 and will be discussed further in Meeting 7. The discussion and edits will be documented in the notes for Meeting 6, which will be posted on the BWS website when accepted by the Stakeholder Advisory Group (anticipated May 2016).

Slide 14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Slide 15

WATER FOR LIFE

Safe, dependable, and affordable water now and into the future

Board of Water Supply

Barry Usagawa, P.E.

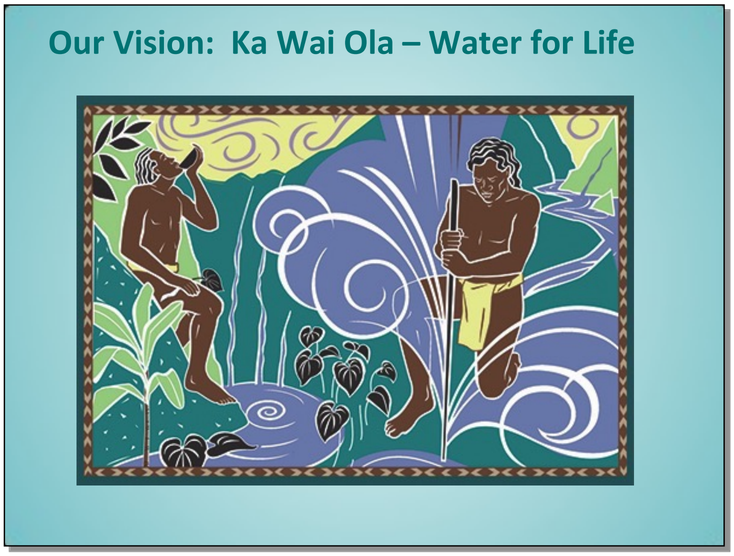
Board of Water Supply Water Resources Program Administrator

James Kim, P.E.

Consultant Lead Modeler for the Water Master Plan

WATER SYSTEM ANALYSIS

Slide 16



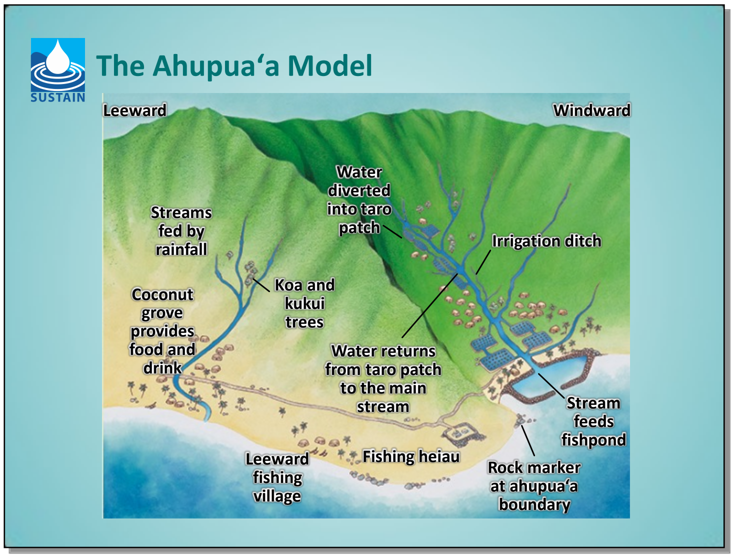
The Board of Water Supply (the BWS)'s vision expresses the critical need for water; that water is the basis of life.

Water in Hawaiʻi is a public trust and central to everything we do.

The way we sustain, capture and deliver water for our customers is with this trust in mind.

The BWS is a steward of this precious resource, and we have a duty to manage our water resources for present and future generations.

Slide 17

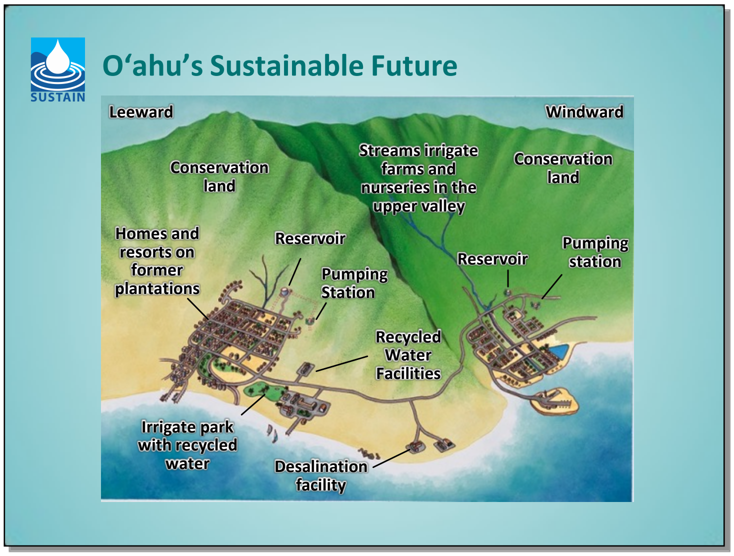


We also discussed the ahupuaʻa model for watershed management.

In pre-contact Hawaiʻi, the land was divided into ahupuaʻa that mirrored the lines of natural watersheds and ecosystems. Their boundaries extended from the mountains, through upland forests, streams and lowlands, and to the coral reefs. There was access to upland forests for timber, stream water for drinking, agricultural lands for crops and the ocean for fishing and travel by sea.

The ahupuaʻa model is more than a division of land. It also embodies resource management through a balance of environmental, economic and social/cultural values.

Slide 18

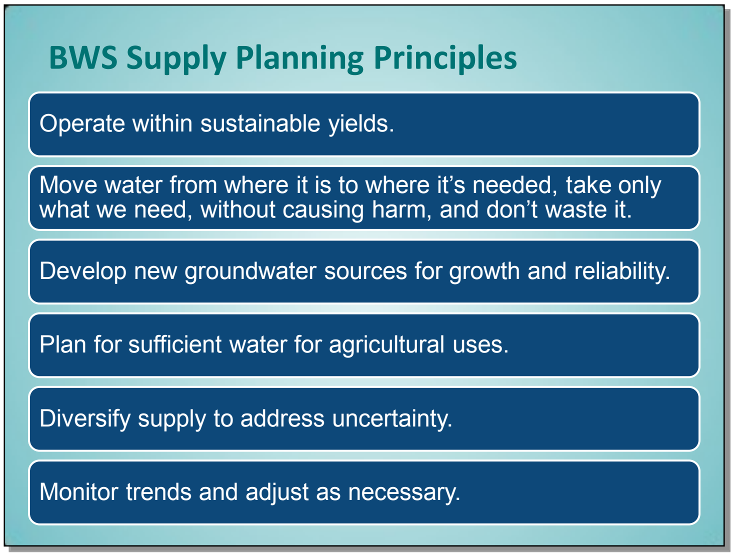


As we were developing our watershed management plans through community outreach, we were searching for a watershed-based model that was environmentally holistic, community based and economically viable. A watershed model that balanced the protection of natural resources and rights with managed water use and development.

What resonated with the community was the ahupua‘a model that sustained Hawaiians for centuries. Using the ahupua‘a model as a guide, we have a vision of O‘ahu’s Sustainable Future: a future where forested watersheds are healthy, streams flow and provide water for agriculture to grow our own food and to provide high quality drinking water for people.

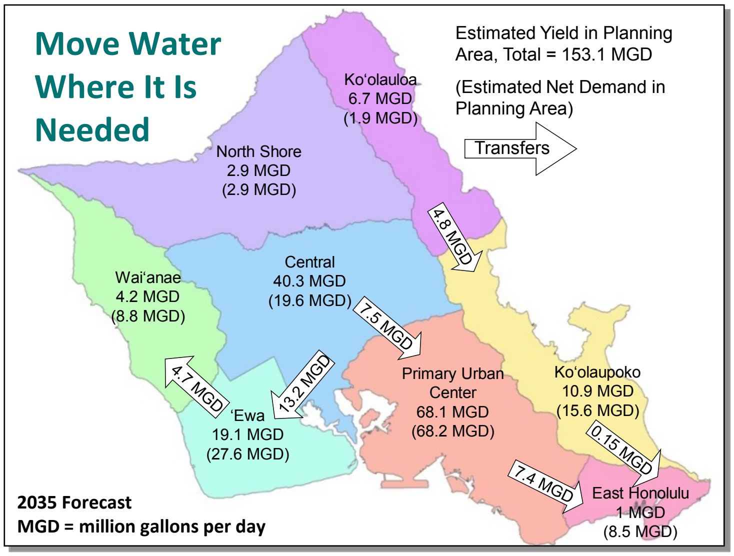
Ahupua‘a provides a model of sustainability that balances environmental, economic and social/cultural values in the modern context.

Slide 19



Building upon the BWS's vision and ahupuʻa model, the BWS follows these water supply planning principles.

Slide 20

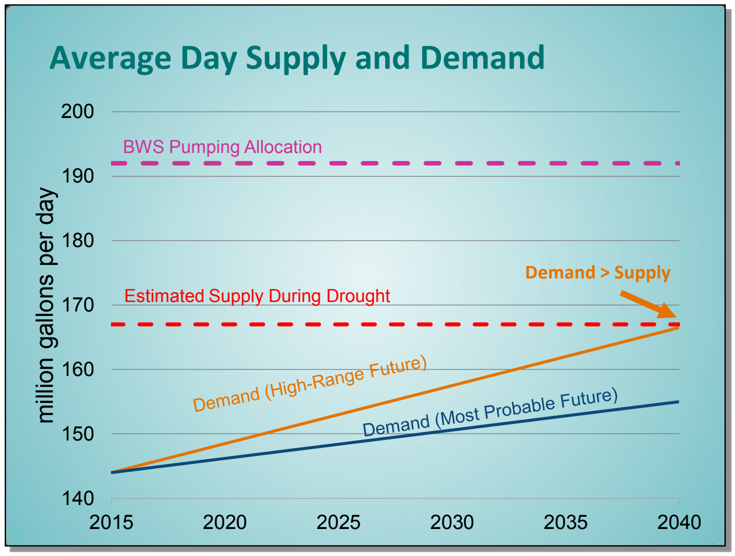


Even if we have enough water island-wide, the sources are not necessarily where the water is needed, so we have to move water from one area to another.

Arrows shown above indicate the 2035 forecast of water transfers between land use districts.

Included in the 2035 forecast is 2.0 million gallons per day of water from a future desalination facility proposed to be located in ‘Ewa.

Slide 21



We look at supply and demand from a variety of perspectives:

- For an average day, we project "High-Range Future" as well as "Most Probable Future" demands.
- We also compare that range of demands for water to the estimated supply during normal as well as drought conditions.

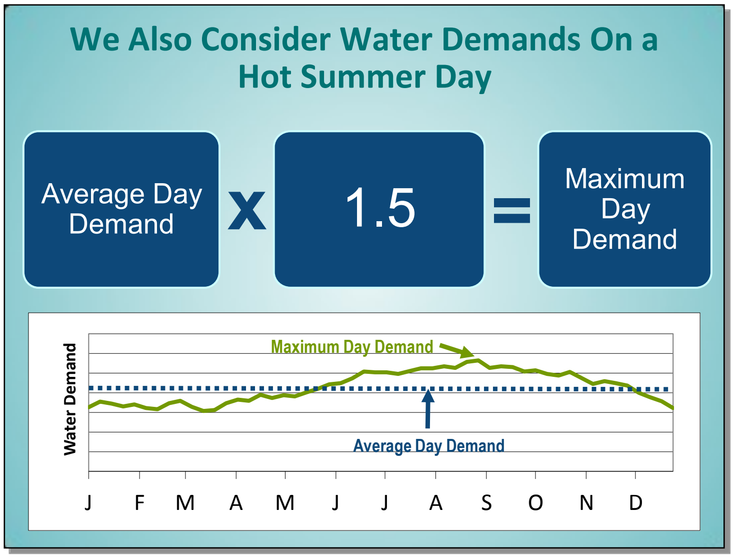
In the chart above, the Estimated Supply During Drought is shown as 167 million gallons per day. That amount is based on experience from previous multi-year droughts, and is less than the permitted pumping allocation.

The BWS Pumping Allocation (supply) shown above as 192 million gallons per day is largely the State Permitted Use. There are a few wells for which the State has not established permitted yields, however. The BWS assessed the yield of those few wells, and included that in the 192 million gallons per day amount.

The forecast shows that Average Day Demand gets close to exceeding the estimated supply during drought at the end of the 30-year Water Master Plan planning period. Just because the demand isn't forecasted to exceed supply, that doesn't mean we should not be concerned.

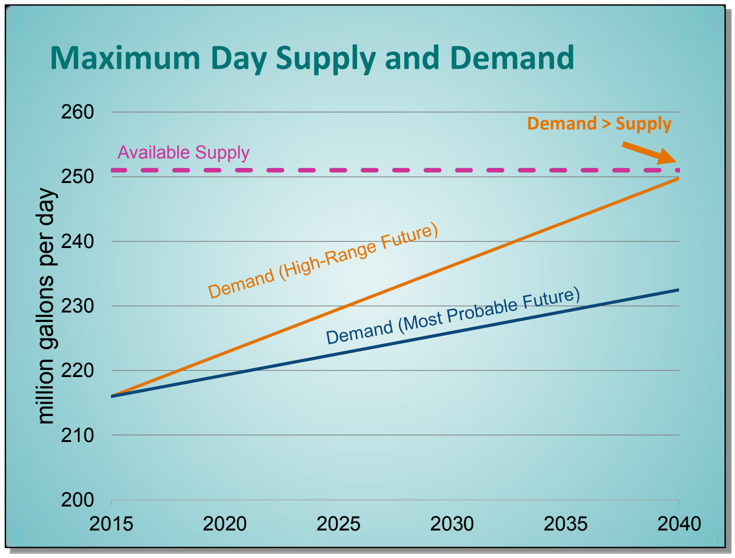
That means we should continue monitoring supplies and demands, and updating this forecast over time.

Slide 22



In addition to analyzing the system under Average Day Demand conditions, we also look at Maximum Day Demand conditions to simulate high water use on a hot summer day.

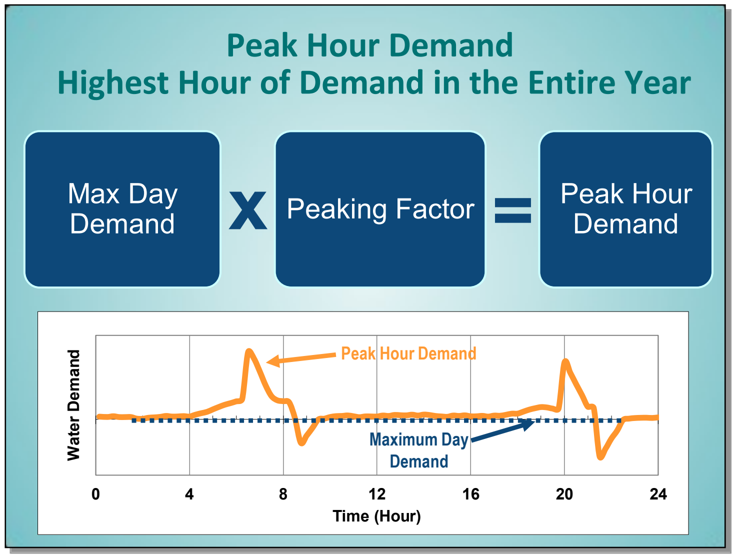
Slide 23



These are the Maximum Day Demand projections through 2040.

Just like for the Average Day Demand, this forecast shows the Maximum Day Demand getting very close to exceeding the estimated available supply. We will continue monitoring supplies and demands and updating this forecast over time.

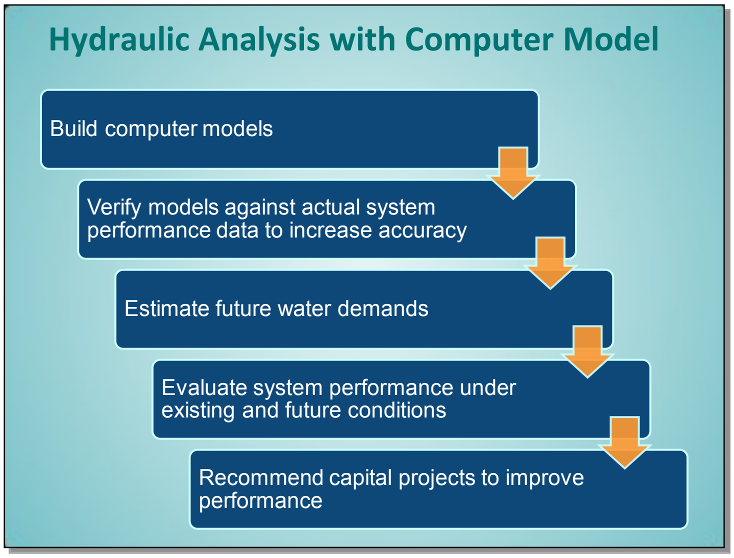
Slide 24



We also look at Peak Hour Demand to simulate demand during the single hour of highest water use on a hot summer day – which usually occurs in the morning before people leave for work, or in the evening when they return.

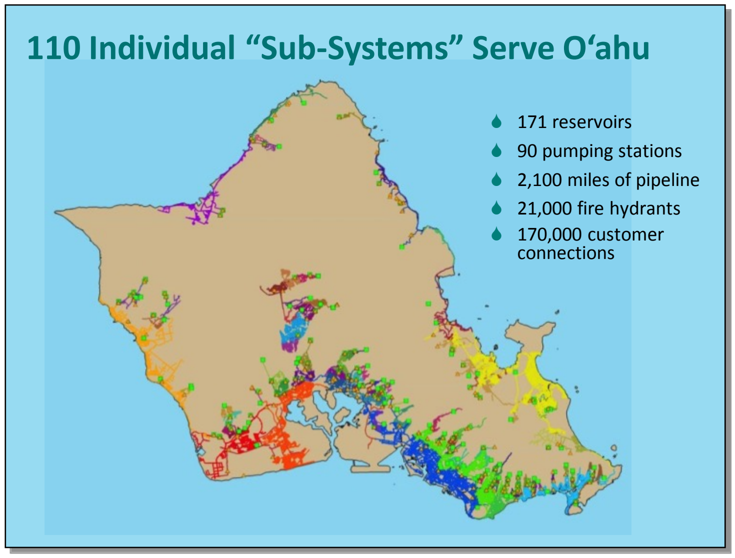
The following slides provide more details on our water system analysis.

Slide 25



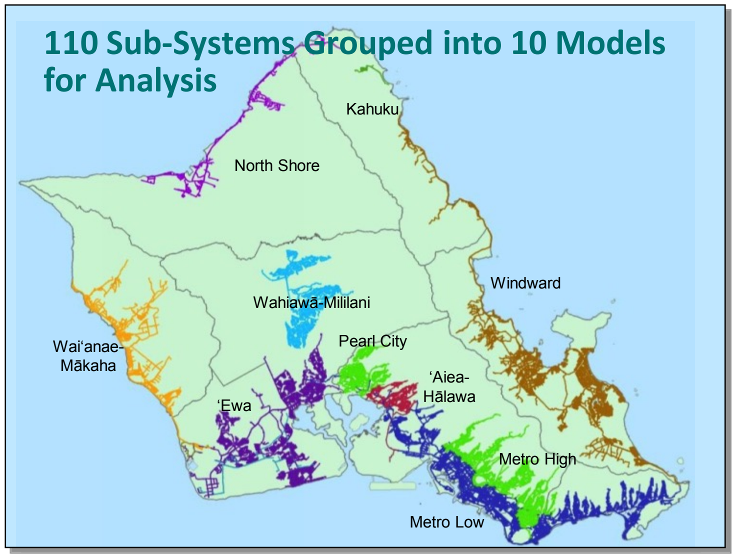
Hydraulic Analysis with Computer Model
Build computer models
Verify models against actual system performance data to increase accuracy
Estimate future water demands
Evaluate system performance under existing and future conditions
Recommend capital projects to improve performance

Slide 26



This is a view of the pipelines and facilities of the BWS system.

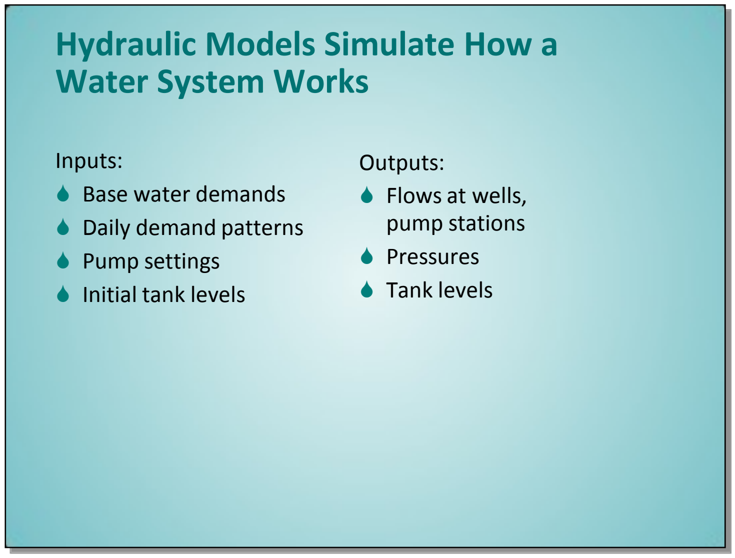
Slide 27



110 sub-systems were grouped into 10 different models for analysis. The 10 models are represented by the different colors shown above.

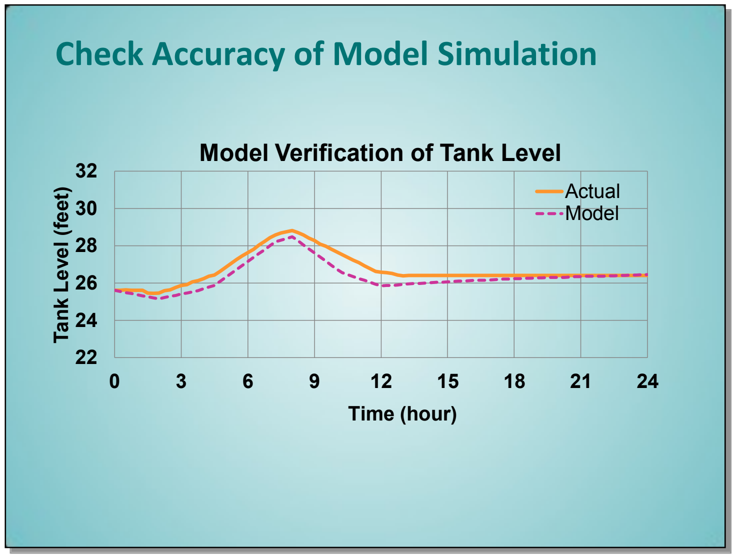
Hydraulic models are used to analyze the system for flows, pressures, and tank-refill cycles. We analyzed for what will happen in the future as the population grows, to help determine how best to meet projected demands.

Slide 28



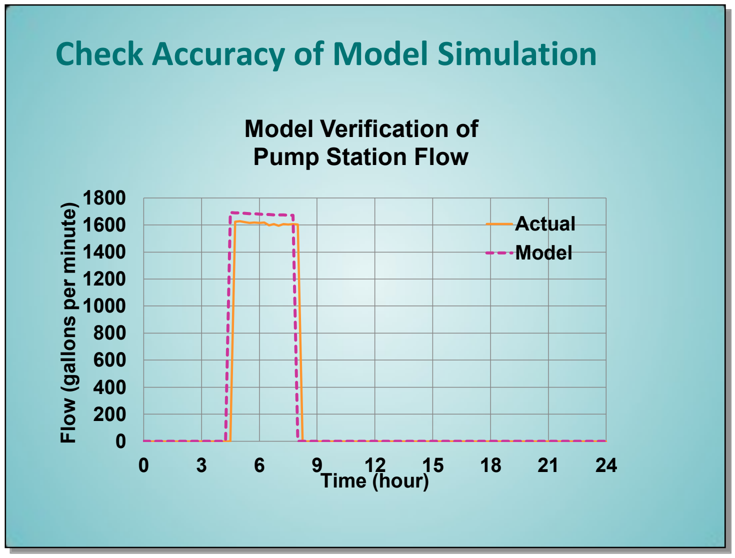
When we input data like projected water demands, daily water use (demand) patterns, pump settings and tank levels, the hydraulic models give us important information (output) that we use in planning, like flows at wells and pump stations, water pressures in the pipelines, and tank levels.

Slide 29



We check the accuracy of our hydraulic model by comparing computer results with real-world data. The actual levels recorded in a tank is the orange line, and the model output is the dashed purple line. You can see how closely the two lines compare in the chart above, which tells us that this hydraulic model is very accurate.

Slide 30



The previous slide showed the hydraulic model accuracy check for a particular reservoir. This one shows accuracy verification for one of the BWS's pump stations. The actual flow recorded for a pump is shown as the orange line, and the model output is the dashed purple line.

The hydraulic model was checked for accuracy of water levels at BWS's 170 reservoirs, and accuracy of pressures and flows at their 90 pump stations,. Being this thorough ensured that the model represents actual, existing conditions of the entire water system and that the information it provides about future conditions can be trusted.

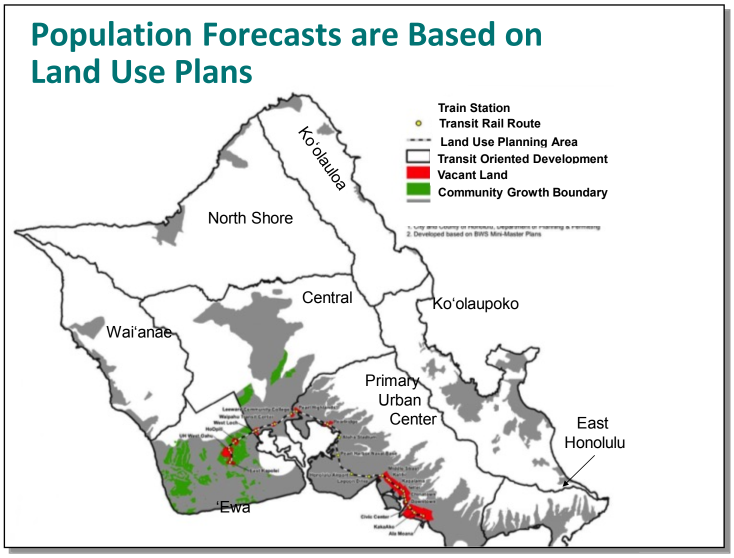
Slide 31

Water Demand Is a Key Input to the Models

- Existing Demands
  - Based on actual usage data
- Forecast Future Water Demand

BWS Population Served X **Use per Person** = **Total Water Demand**

Slide 32

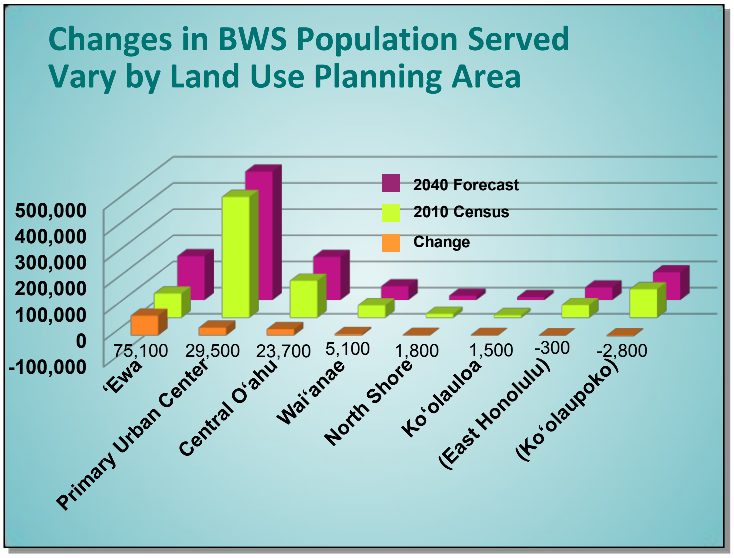


This map shows where population growth is expected to occur in the future, based upon land use plans.

Major development will occur at planned Transit Oriented Developments (TODs, shown in red) and at County Master Plan areas (shown in green) which are primarily in ʻEwa. These are the areas on Oʻahu that will experience the greatest increases in population growth, with corresponding greatest increases in water demand in the future.

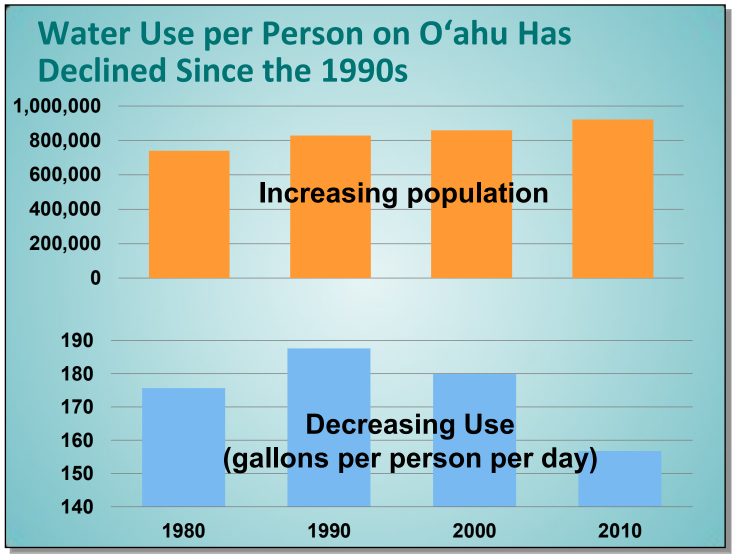
The hydraulic model enables us to determine whether or not the existing water system can meet those future demands, and if not, how much and where the deficiencies will be.

Slide 33



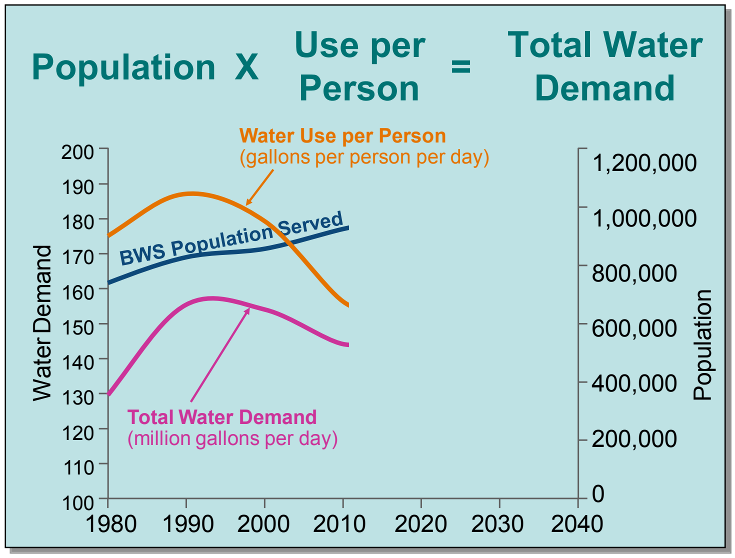
The area with the largest projected population change is ʻEwa. The second largest is the Primary Urban Center. Together, these two areas account for about three quarters of the total expected increase in population from the 2010 census to 2040. The populations of East Honolulu and Koʻolaupoko are both expected to decrease slightly by 2040.

Slide 34



Over time, as the population has increased (shown in the top chart), the water use per person has decreased (shown in the bottom chart). This is because of the effort of the people on O‘ahu to do their part to conserve.

Slide 35

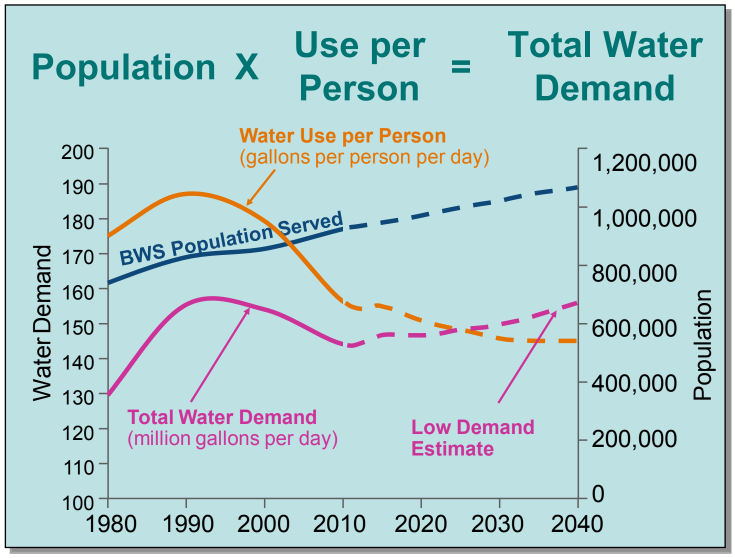


The orange line is the water use per person from 1980 to the present.

The blue line is the population served by the BWS from 1980 to the present.

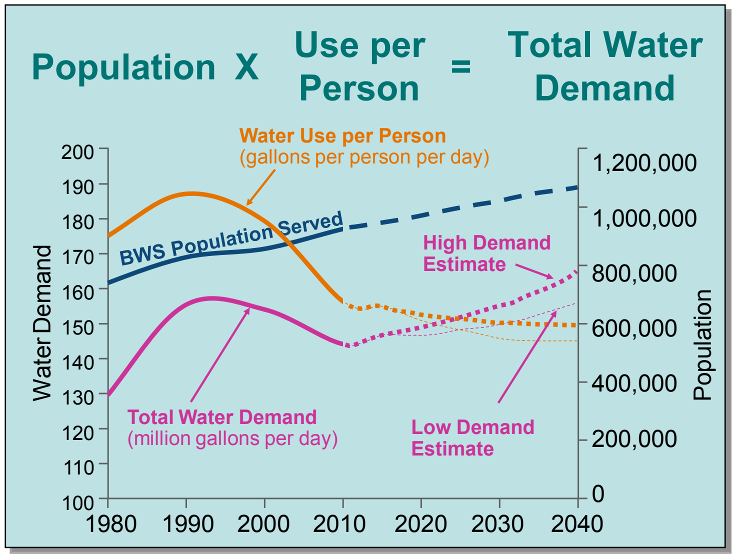
The purple line is the total water demand from 1980 to the present.

Slide 36



The purple dashed line shows the total water demand forecast from now through 2040.

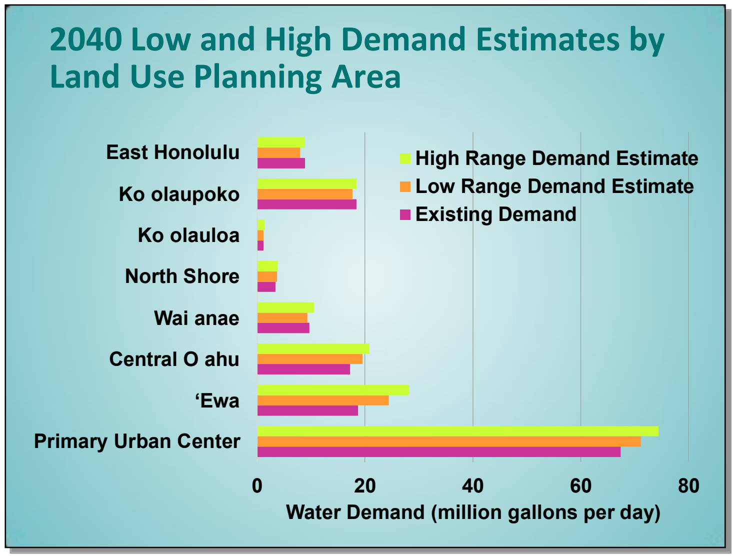
Slide 37



We took into account two scenarios about future water demand. In one, we used the “Low Demand Estimate”, which will occur if the trend of conserving more water continues on its downward path. We’ve also called this the “Most Probable Future Demand”.

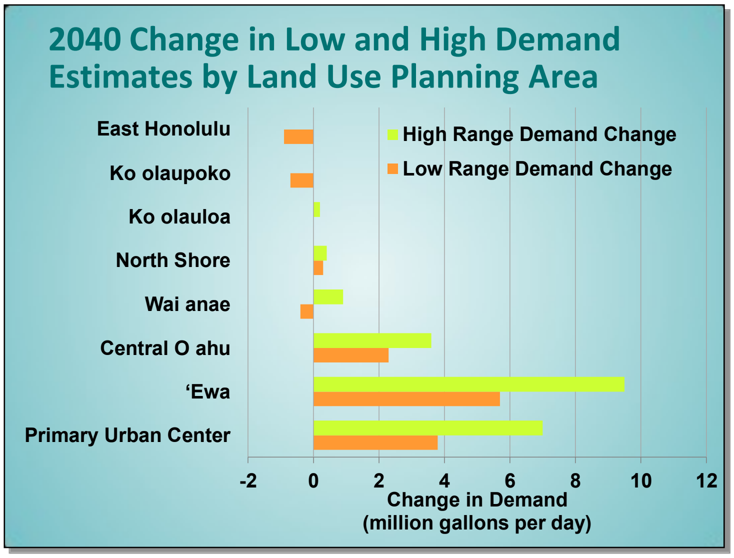
We also analyzed the water system using a more conservative “High Demand Estimate”, which would occur if the trend of conserving water flattens out, meaning that the downward trend of the “Low Demand Estimate” is not so steep.

Slide 38



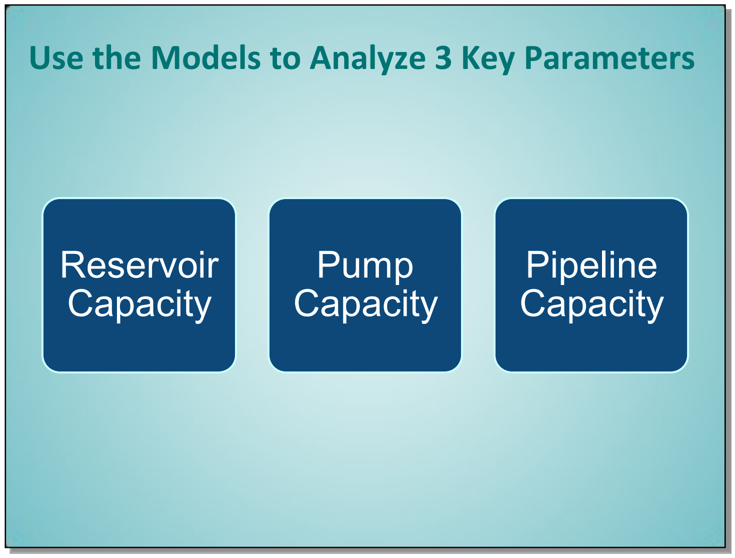
The land use planning areas of 'Ewa and the Primary Urban Center are where the largest amount of water demand is expected to occur in 2040. This is because these areas are where the greatest growth in population is expected based on planning data.

Slide 39



The previous slide showed the total estimated demand for 2040. This slide looks at the change in demand between 2010 and 2040. Again, the greatest changes in demand will occur in 'Ewa and the Primary Urban Center. We put these data in the model to help us analyze existing and future conditions of the water system.

Slide 40



With the hydraulic model, we analyze 3 key parameters: reservoir capacity, pump capacity, and pipeline capacity.

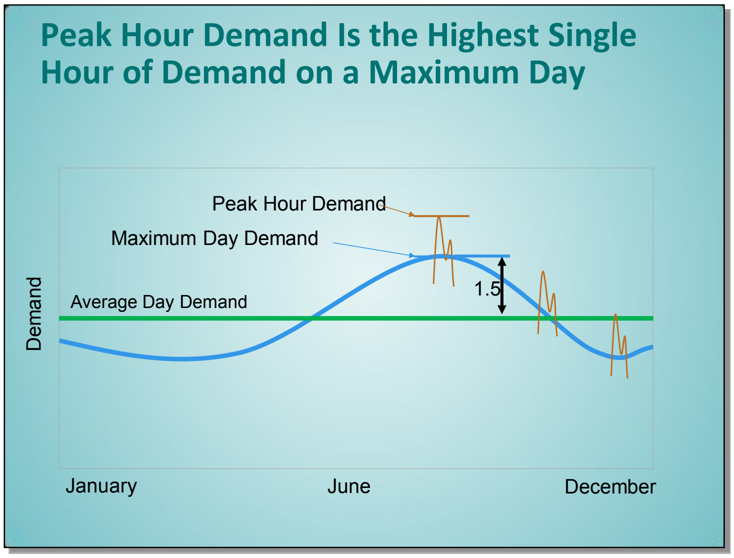
The hydraulic model evaluates the water system, identifies deficiencies, and helps define the capacity of infrastructure requirements needed to mitigate these deficiencies. The mitigations become projects that are included in the 30-year CIP.

Slide 41

Use Maximum Day Demand Simulation to Evaluate Pipelines and Reservoirs

- Identify pipelines that are too small or new pipelines needed to move water from the source to the reservoir
- Simulation confirms that
  - All 171 reservoirs can refill within 24 hours
  - Wells are pumping within limits

Slide 42



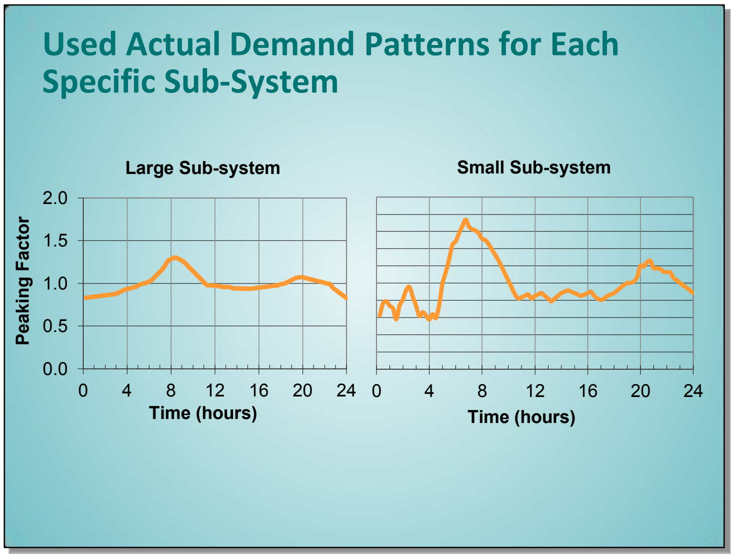
Water demands are generally lower in colder and wetter months, and higher in hotter and drier months.

The Maximum Day Demand is estimated as 1.5 x the demand on an Average Day.

The Peak Hour Demand is the highest single hour of demand in the entire year.

We use Maximum Day Demand and Peak Hour Demand simulations to evaluate adequacy of pipes and reservoirs. The simulation tells us whether or not the pipes are too small or new pipes are needed to move water from the source to where it's needed.

Slide 43



Day and night (diurnal) patterns were calculated for each zone or clusters of zones.
We were able to do that because of the extensive operational data collected by the BWS.

The ability to use actual data gives the BWS more accurate/realistic models. This is important because the model will replicate actual peak flow conditions (for example) and identify areas that may need improvement.

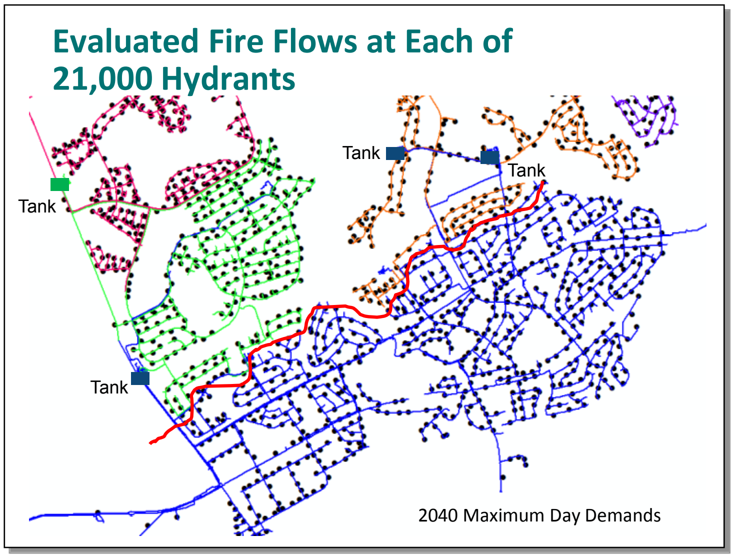
Also note that the peaking factor from Average Day to Maxium Day can be higher or lower than 1.5. The factor of 1.5 is specified for planning purposes in the State of Hawai'i's Water System Standards.

Slide 44

Peak Hour Demand Simulation Identifies Pipeline Limitations

- Areas where water pressures drop
- Areas where the speed of water moving through pipes is too high
- Opportunities for operational adjustments and system reconfiguration to provide higher water pressure
- Areas where larger pipes may be needed

Slide 45



This slide shows all fire hydrants in a sample area.

The hydraulic model evaluates for water pressure criteria at each hydrant, and at all demand nodes within the sample area (referred to as a "pressure zone").

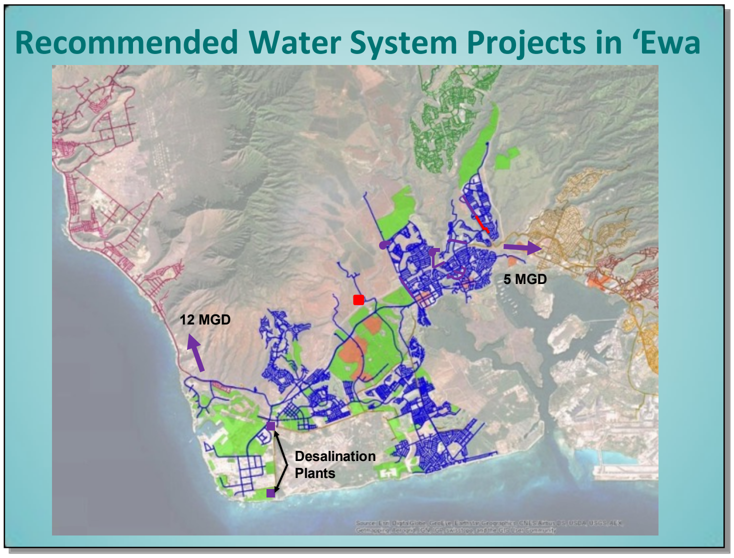
To look at effects of a specific hydrant, the hydraulic model analyzes the system with one hydrant on at a time. The model identifies which pipelines are being stressed due to that specific hydrant flow.

Slide 46

Fire Flow Criteria for O‘ahu

Land Use Category	Flow (gallons per minute)
Single Family	1,000
Multi-Family	1,500
Commercial	2,000
Industrial	4,000
	Pressure (pounds per square inch)
All Categories	20

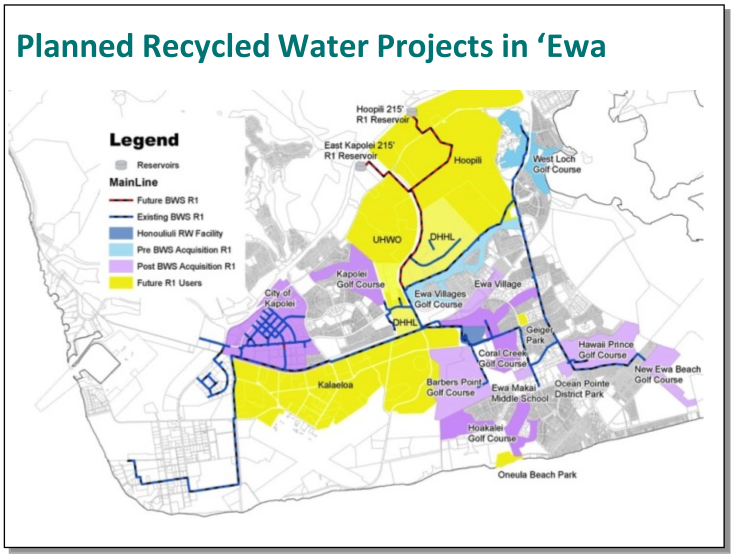
Slide 47



The water system analysis indicates that, under existing conditions, there is adequate infrastructure to meet the water needs in ‘Ewa.

Looking ahead to 2040, the hydraulic model indicated additional infrastructure and supply needs to serve the growing ‘Ewa population. We determined that these could be met with additional new pipelines, wells, and two new desalination plants. As a result, the modeling confirms that 12 million gallons of water per day would be available for transfer to the leeward side. Also, 5 million gallons per day would be available to export to Metro Low.

Slide 48



There is an existing recycled water system in ‘Ewa (represented by blue pipes) and it currently supplies recycled water to the areas shown in purple above. By expanding the recycled water system (shown in red pipes), the areas shown in yellow above would be accessible to recycled water supply. Future demands that can be met by the recycled water system reduce future demands for potable water.

Slide 49

Preview of Metro Low Results

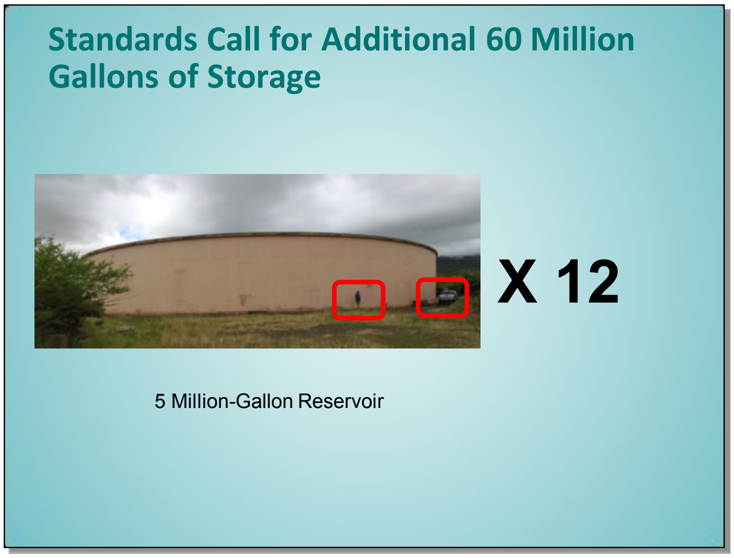
- Current
  - System provides adequate, reliable water service
- Future
  - Need for significant additional supplies
  - Need for significant additional reservoir storage

Slide 50

Planning for 27 Million Gallons per Day of Additional Supply for Metro Low

- Drivers
  - Growth
  - Used Maximum Day Demand = 1.5 x Average Day Demand for planning purposes
  - Protection of freshwater lens
- Potential solutions
  - New groundwater sources in Metro Low
  - Increase transfers
  - More aggressive conservation
  - Diversify supplies

Slide 51

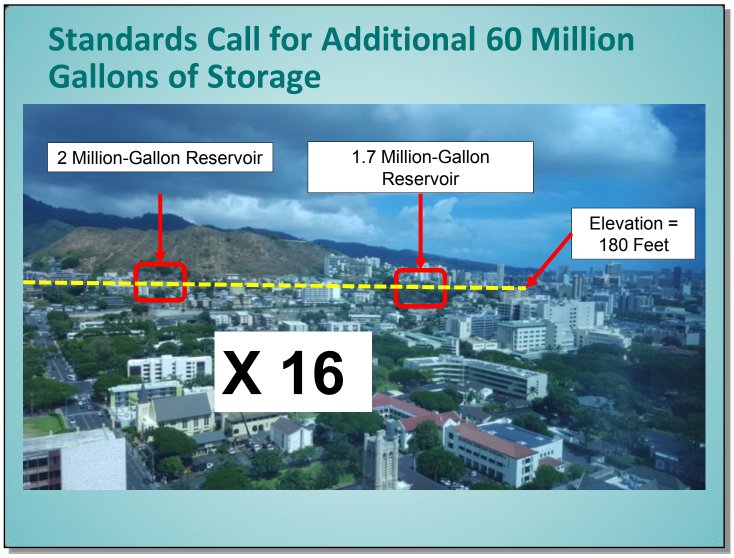


State standards require an additional 60 million gallons of storage to meet 2040 demands. How big is that?

It would be the equivalent of building 12 reservoirs this size.

(For scale, note the person and truck shown in the two red boxes.)

Slide 52



To maintain pressures, the new reservoirs would have to be built at 180 feet above sea level.

Shown in this slide are existing reservoirs at the 180-foot elevation.

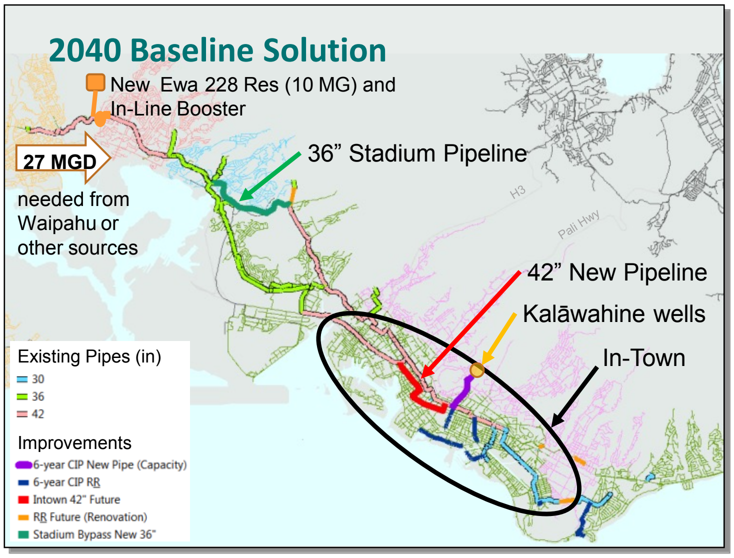
Providing 60 million gallons of storage would be the equivalent of duplicating these two reservoirs along this 180-foot elevation line 16 times.

Slide 53

Other Solutions are Possible

- Use pumping to meet peak hour demands
  - Wells with standby power
  - New tank and pumping with standby power
- Locations could vary (e.g. in-town, Central O‘ahu)
- Combination

Slide 54



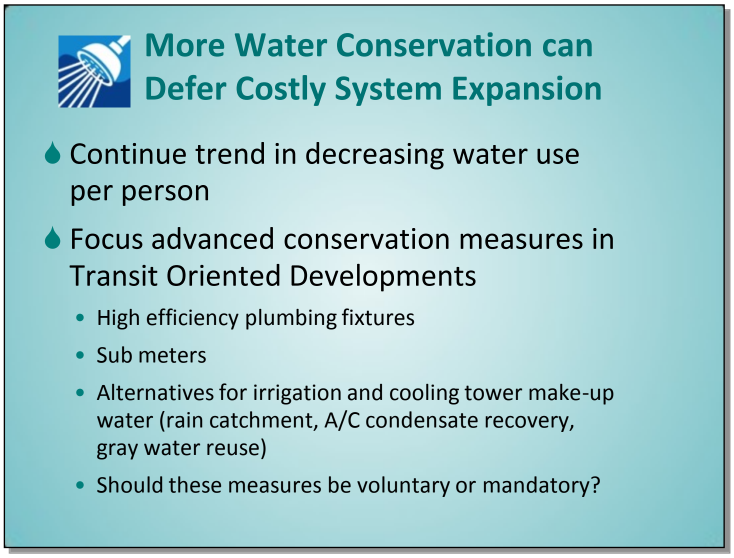
This slide shows a combination of infrastructure-based solutions to address just part of the demand needed for Metro Low in the future.

But solutions can also be "non-infrastructure", such as conservation, storm water capture, and others. We will discuss some of these solutions next.

Slide 55

One way that we can reduce the impacts or defer infrastructure-based projects further is to pursue the *Hawai'i Fresh Water Initiative, Blueprint For Action* strategies of conservation, recharge, and reuse.

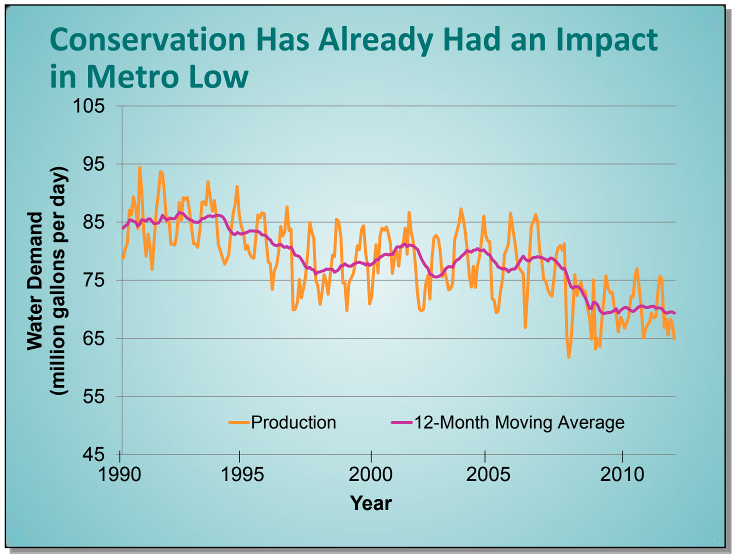
Slide 56



Conservation can save significant amounts of potable water and thus defer the expenses of building system expansions until later into the future.

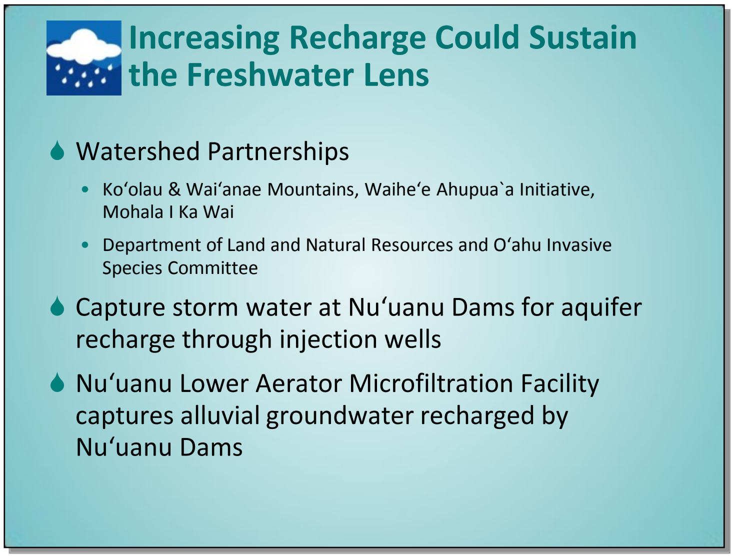
Some of the conservation programs that the BWS has been working on are focusing on Transit Oriented Developments, and other new developments in town. This list identifies some of those programs that are either in place or under consideration: high efficiency toilets, submeters that allow you to measure the water used, and reusing A/C condensate or graywater for irrigation and air cooling towers.

Slide 57



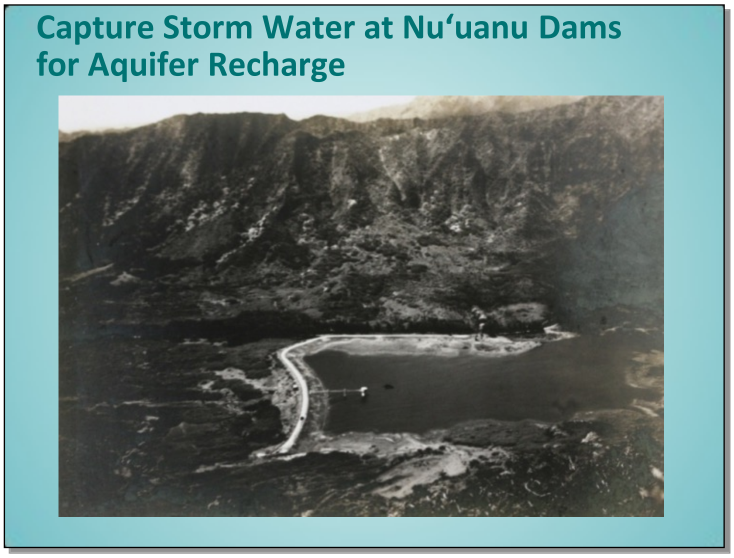
We've already seen major savings in Metro Low. This figure shows that we have saved 15 million gallons per day from 1990 to today. We still need the transmission pipelines and storage just described, but we are also interested in how much more we can conserve. The following slides show some of the projects and programs the BWS is working on.

Slide 58



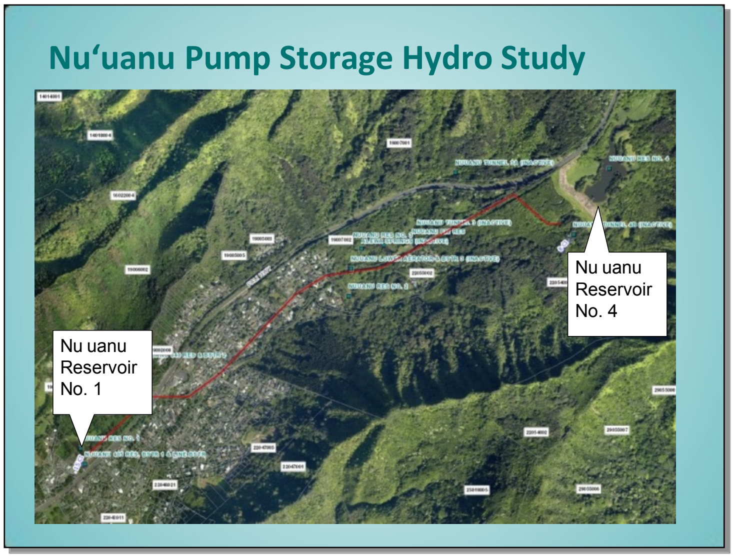
The projects and programs shown here are about sustaining the water resource.

Slide 59



With climate change, Oʻahu will have more intense storms in the future. We have opportunities to capture that rainwater and recharge aquifers. One of the locations to pursue this is at Nuʻuanu.

Slide 60



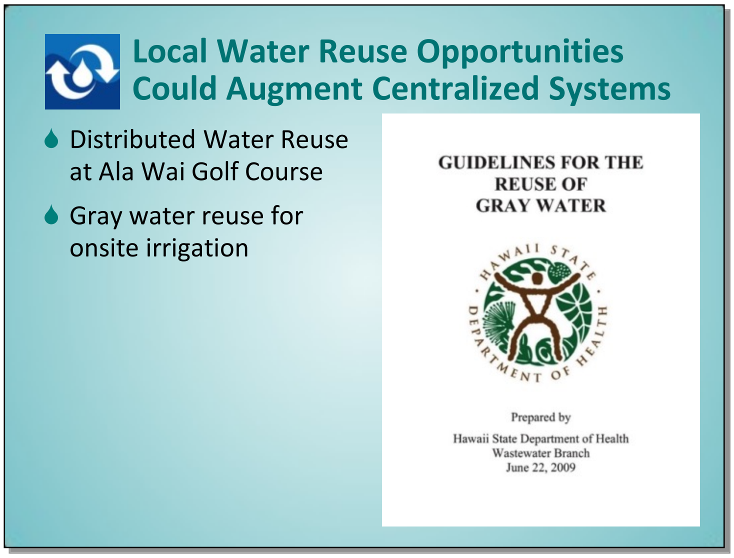
We are studying opportunities to diversify water sources at the Nu'uanu reservoirs and generating renewable energy.

If we were to raise the level of the Nu'uanu dams, tunnels below the dams will produce more water, which we could treat using microfiltration. This would be "diversification" of our water supply.

We are also looking into generating renewable energy by taking advantage of the elevation difference between Nu'uanu Reservoir 4 and Reservoir 1 shown above – an elevation drop of approximately 600 feet. We could potentially operate a hydroelectric system to meet peak energy needs.

The concept of using water from Nu'uanu to generate electricity is not new. The foundation of an old hydroelectric plant on Pali Highway still exists that once generated electricity from Nu'uanu reservoirs for downtown Honolulu.

Slide 61



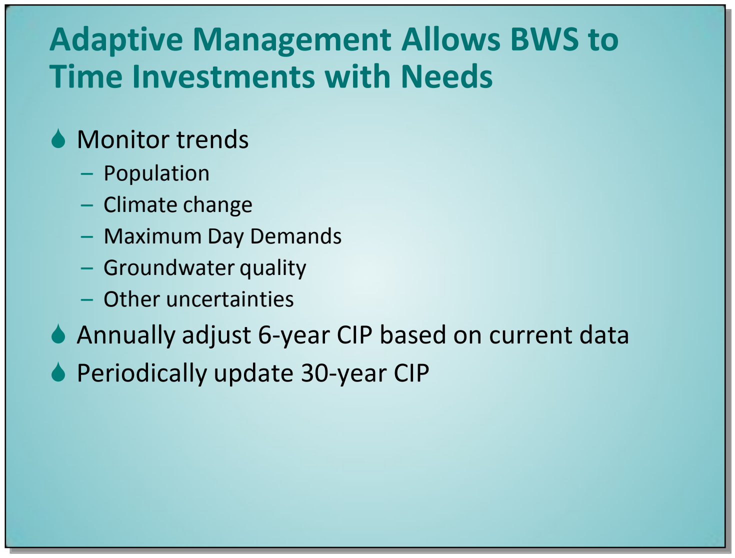
The BWS is working with the Ala Wai Golf Course on a distributed water system. In a feasibility study, we are looking into the potential for diverting some of the wastewater flowing through a 24-inch sewer pipeline, filtering it, and creating recycled water for golf course irrigation. That could be augmented by graywater reuse for onsite irrigation.

Slide 62

Ala Wai Golf Course Membrane Bioreactor

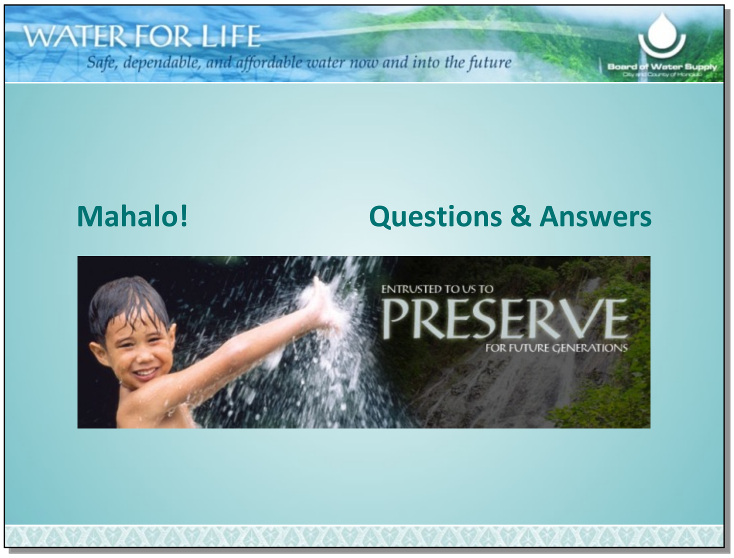
- Inter-Agency funding commitment (BWS-ENV-DES)
- Public-Private Partnership with Rockefeller RE.invest Green Infrastructure Initiative
- Cost incentive for golf course

Slide 63



Adaptive management allows the BWS to monitor conditions and adjust the scope and schedule of major projects so that they are implemented only if and when needed, rather than too early. The intent is that the users who benefit from the investments in infrastructure will also help pay for them. This will be accomplished through project prioritization and planning, as you will see in the Water Master Plan and 30-Year Capital Improvement Program.

Slide 64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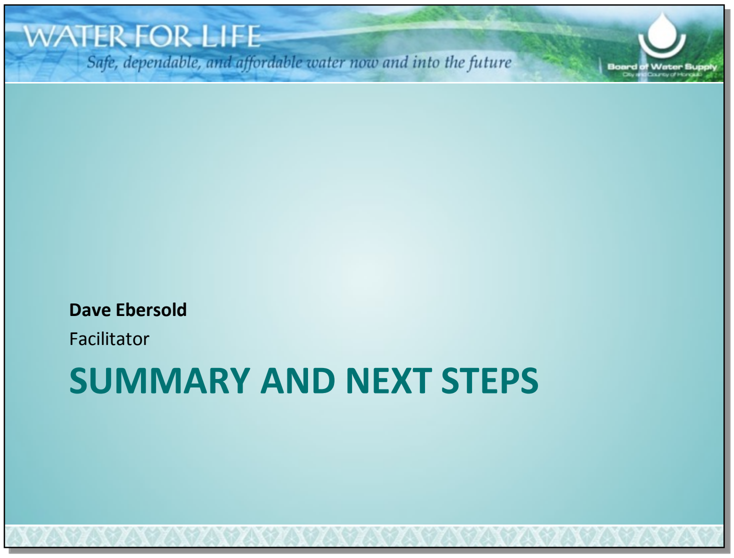
Slide 65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Board of Water Supply
Dave Ebersold
Facilitator
SUMMARY AND NEXT STEPS

Slide 66

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Board of Water Supply

Stakeholder Advisory Group Meeting 7

- Our first anniversary!
- Tuesday, May 17, 2016
- 4:00 pm to 6:30 pm
- Board of Water Supply Headquarters

Slide 67


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