

**APPROPRIATE COASTAL DEVELOPMENT:  
STRATEGIES FOR HAWAII'S WATER FUTURE**

Presented by:  
Lauren C. Roth Venu  
Roth Ecological Design Int. LLC  
lauren@rothecological.com

# REDI'S `OHANA

*ROTH ECOLOGICAL DESIGN INT.'S (REDI) MISSION IS TO CONNECT DEVELOPMENTS TO SUSTAINABLE WATER MANAGEMENT PRACTICES THAT REFLECT THE SITE'S ECOLOGY, CULTURE AND NATURAL HYDROLOGY.*





# CLIMATE CHANGE



# Hurricane Irma is now the strongest hurricane ever recorded in the Atlantic

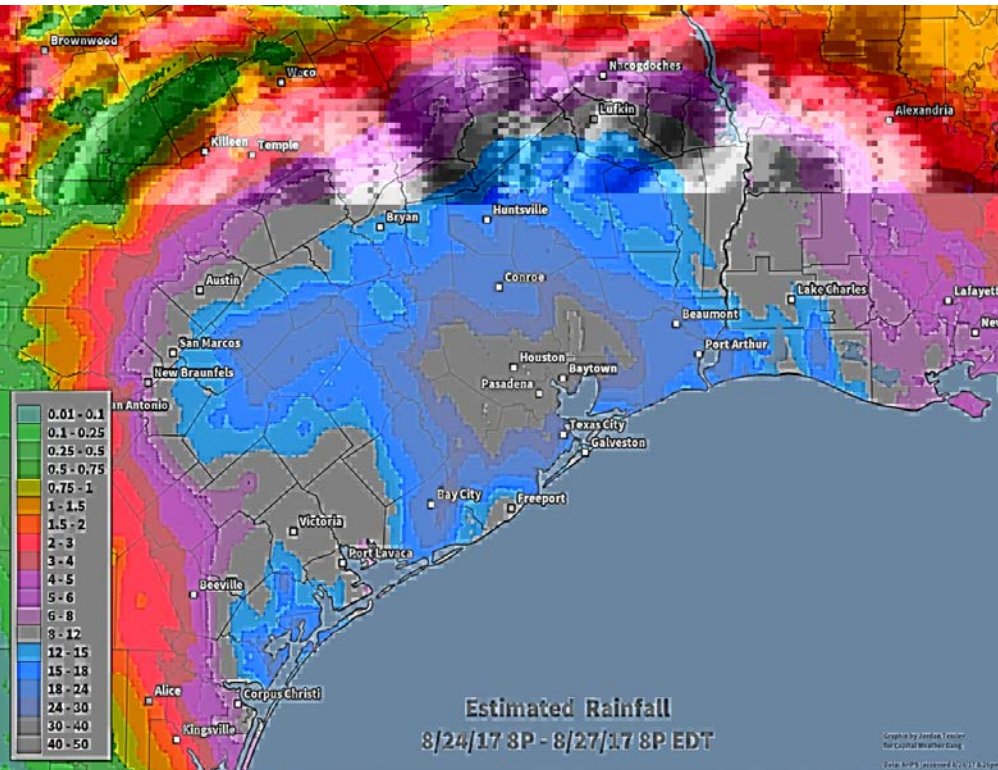


Hurricane Irma has already reached the Caribbean, and will possibly hit Florida by the end of the week. The storm grew fast and furiously. In...

Katherine Ellen Foley | September 06, 2017



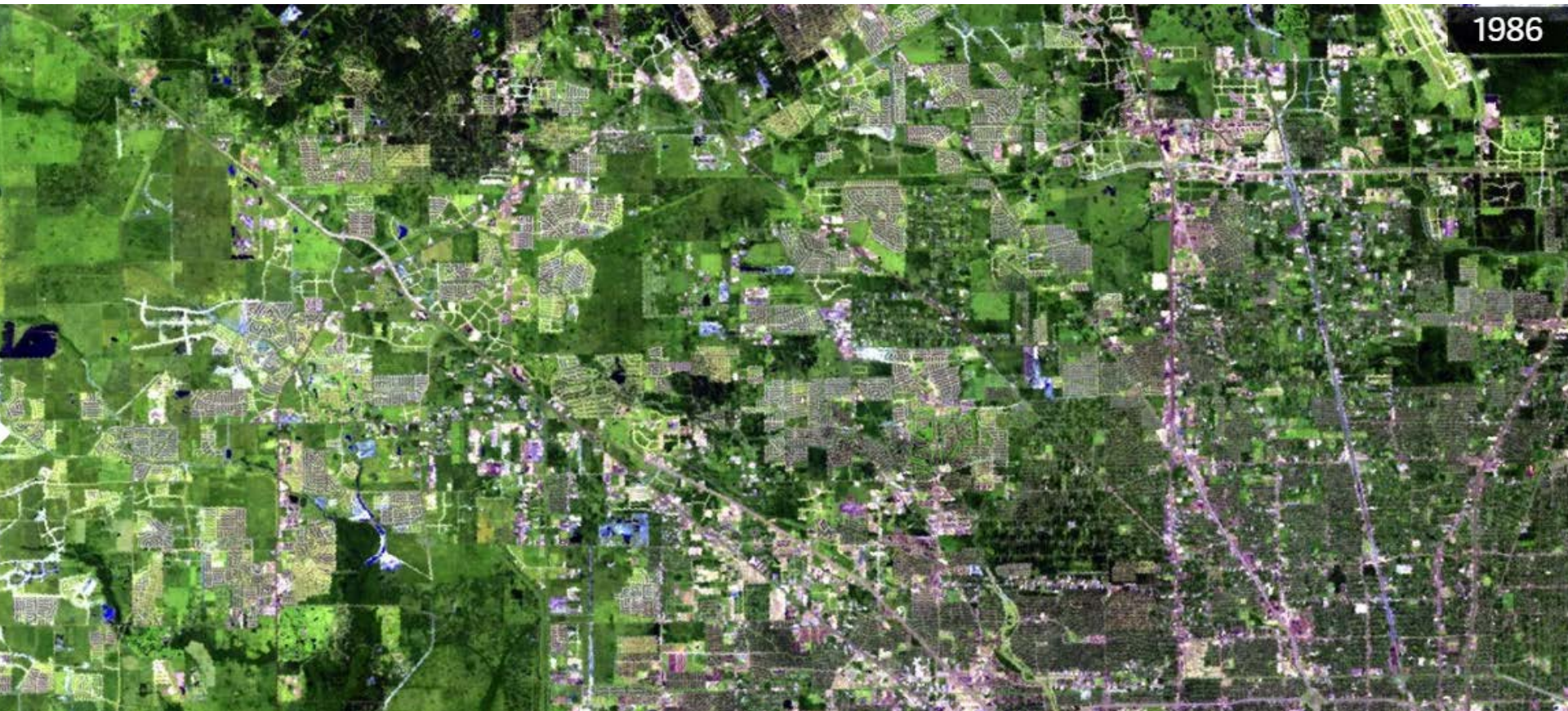
# HARVEY & HOUSTON: CLIMATE PREPAREDNESS?



- 51” rain fell (11 trillion gallons) US record
- 56,000 9-11- calls
- 13M people were under flood warning/watch
- 3,400 water rescues
- 30,000 people needed temp shelter
- 450K victims will ask FEMA for assistance

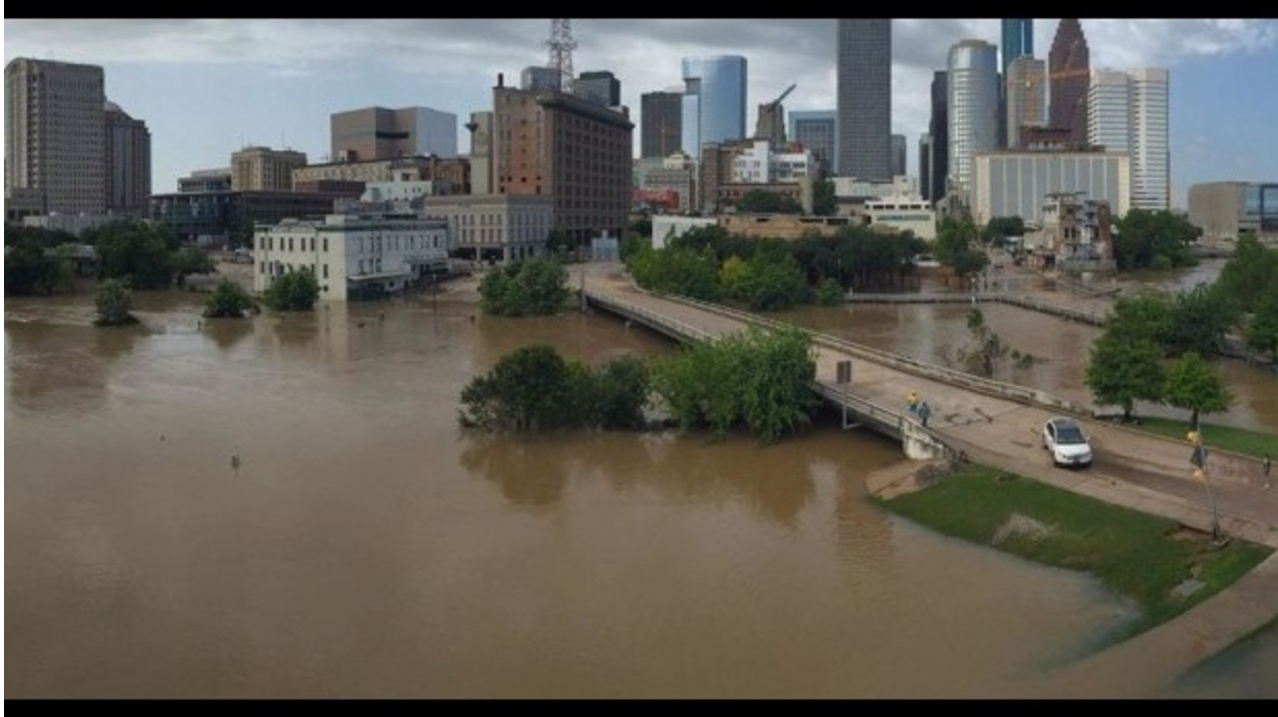


# APPROPRIATE DEVELOPMENT?





# IMPERVIOUS SURFACE + HIGH GROUNDWATER = FLOODING





## NEWS RELEASE UNIVERSITY OF HAWAII SYSTEM

### Study finds heavy rainfall events becoming more frequent on Hawai'i Island

University of Hawai'i at Mānoa

Contact: [Pao-Shin Chu](#), (808) 956-2567

Professor, Atmospheric Sciences, School of Ocean and Earth Science and Technology

[Marcie Grabowski](#), (808) 956-3151

Outreach Coordinator, School of Ocean and Earth Science and Technology

Posted: Feb 4, 2015

#### News Releases

[News release archive](#)

[PR contacts](#)

[Submit a news item](#)

[RSS feeds](#)

[UH in the News](#)

[System news home](#)

**20yr storm is now every 3-5yrs!**



**THIS IS WHAT OAHU'S WAIMEA BAY LOOKED LIKE AFTER TROPICAL STORM DARBY HIT**





Storm drains  
backing up at  
high tide.

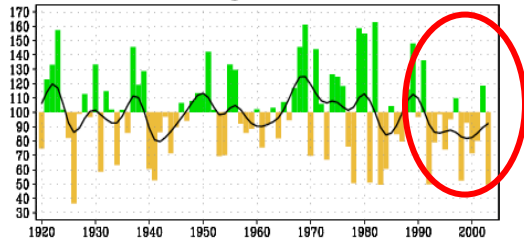




**DROUGHT**



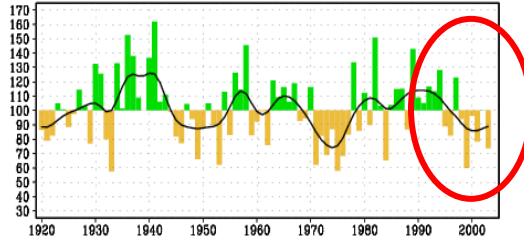
November to April



-Downward overall trend  
(-18%) over last 30 yrs.

Percent of Normal

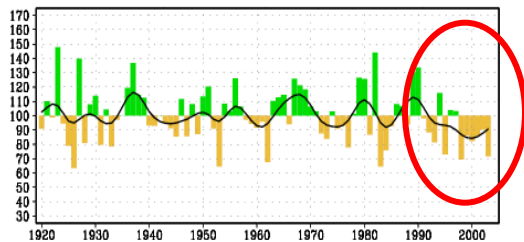
May to October



-1/3 of the State being the most of affected

- Windward sides least affected

Annual



-Projected another 20-50% decrease in overall rain over next 50 years (SOEST)

# WATER DEMANDS

HAWAII'S POPULATION UP 2X SINCE STATEHOOD & IS EXPECTED TO DOUBLE AGAIN IN THE NEXT 60 YRS!

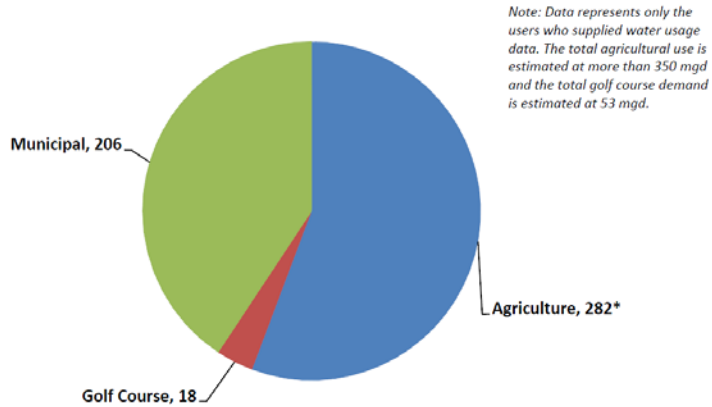
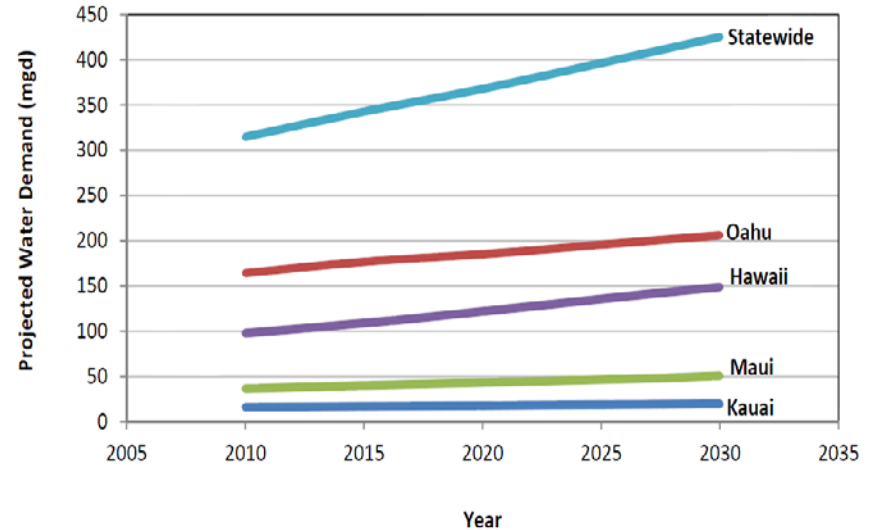


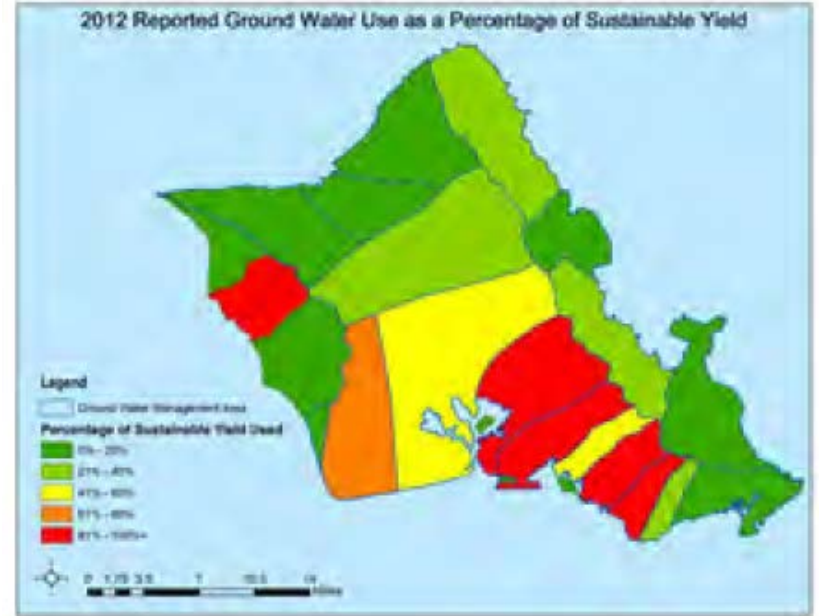
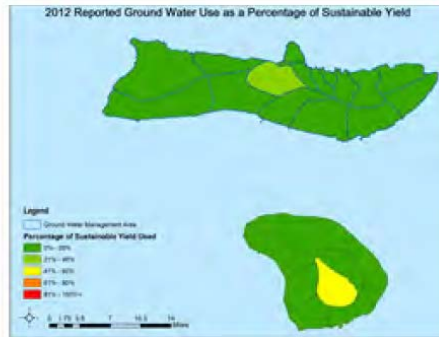
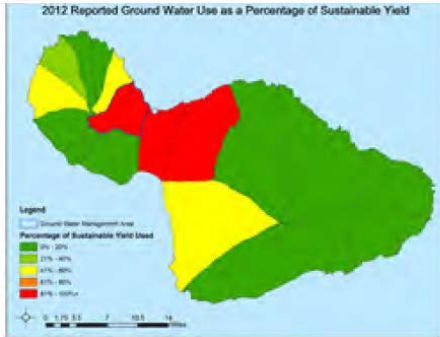
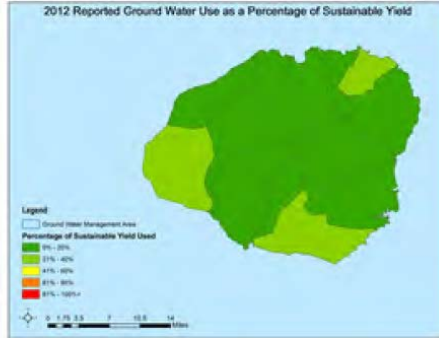
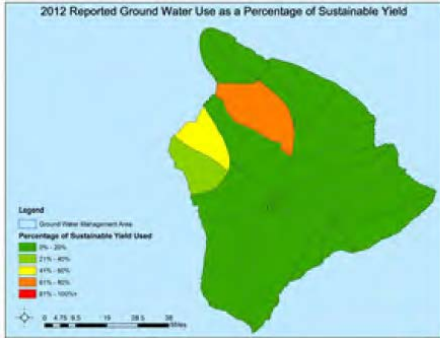
FIGURE 4-1  
Statewide Reported Water Usage In million gallons per day  
\*Agricultural uses includes surface water and some brackish ground water

Hawaii Water Conservation Plan, 2013



Wilson Okamoto Corporation, 2008

# 2012 GROUNDWATER SUSTAINABLE YIELD



Hawaii Commission of Water Resource Management







**“YOU CAN’T SOLVE PROBLEMS USING THE SAME MINDSET USED TO CREATE THEM.” (ALBERT EINSTEIN)**



# HAWAI'I FRESH WATER INITIATIVE: CREATE AN ADDITIONAL 100 MGD OF WATER BY 2030



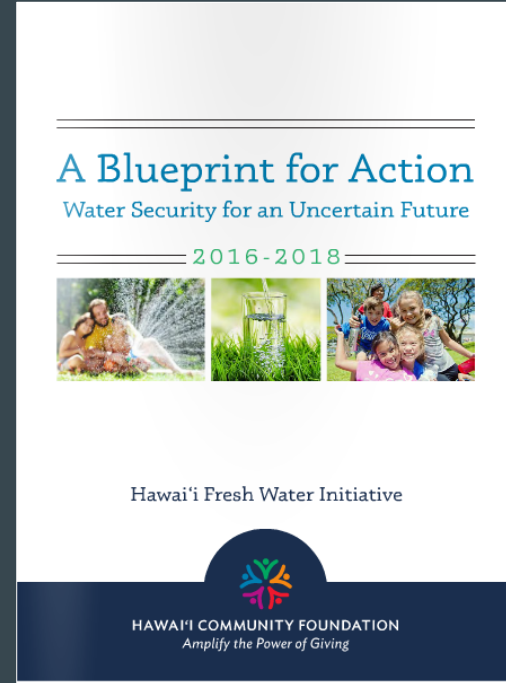
**Conservation** – Increase Water Efficiency (e.g. reduce residential use per capita by 25 gallons per day)



**Reuse** – Double the volume of reuse



**Recharge** – Stormwater back into the ground (30 million gallons per day)







# CONSERVATION



- WATER EFFICIENCY: Increase by 8% by 2030

# CONSERVATION: INCREASE H<sub>2</sub>O EFFICIENCY



PRE-1980s TOILET	HIGH-EFFICIENCY TOILET TODAY
 <p><b>5.0+</b> gallons per flush</p>	 <p><b>1.28</b> gallons per flush</p>

## REPLACING FAUCETS AND AERATORS

 <p>with <b>WATERSENSE MODELS</b> can save <b>700 GALLONS</b> per year</p>	 <p>EQUAL TO <b>40 SHOWERS</b> worth of water</p>
--	--





## RECHARGE

- INCREASE  
STORMWATER  
RECHARGE WITHIN KEY  
WATERSHEDS
- GOAL OF **30 MGD**  
INCREASE IN  
GROUNDWATER



## REUSE

- **DOUBLE** THE VOLUME  
OF REUSE BY 2030
- GREYWATER
- RECYCLED WATER



# GREEN INFRASTRUCTURE



# SUSTAINING & BUILDING WATER CAPITAL

## Conservation

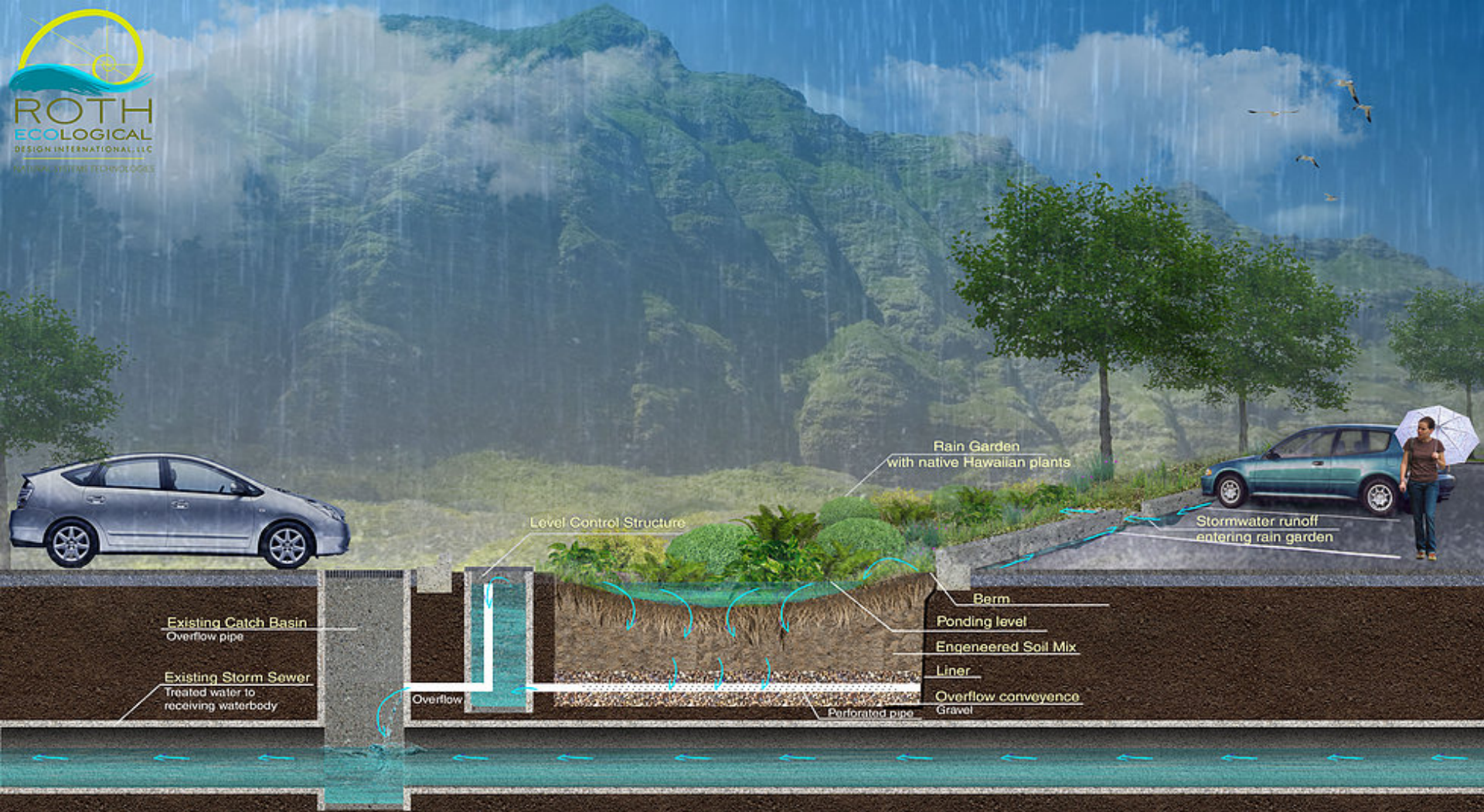


*Roth Ecological Design Int.*

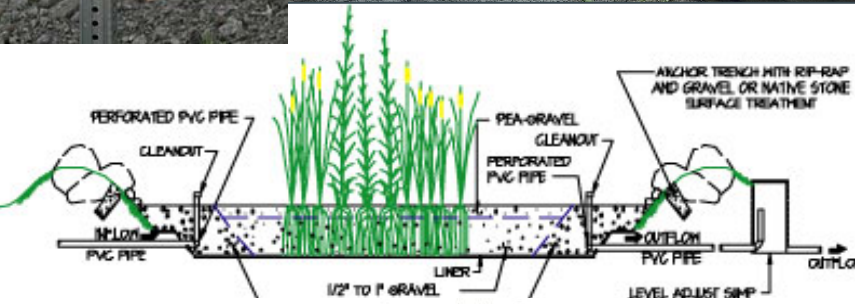
## Regeneration



*Picture by: The Daily Kos*











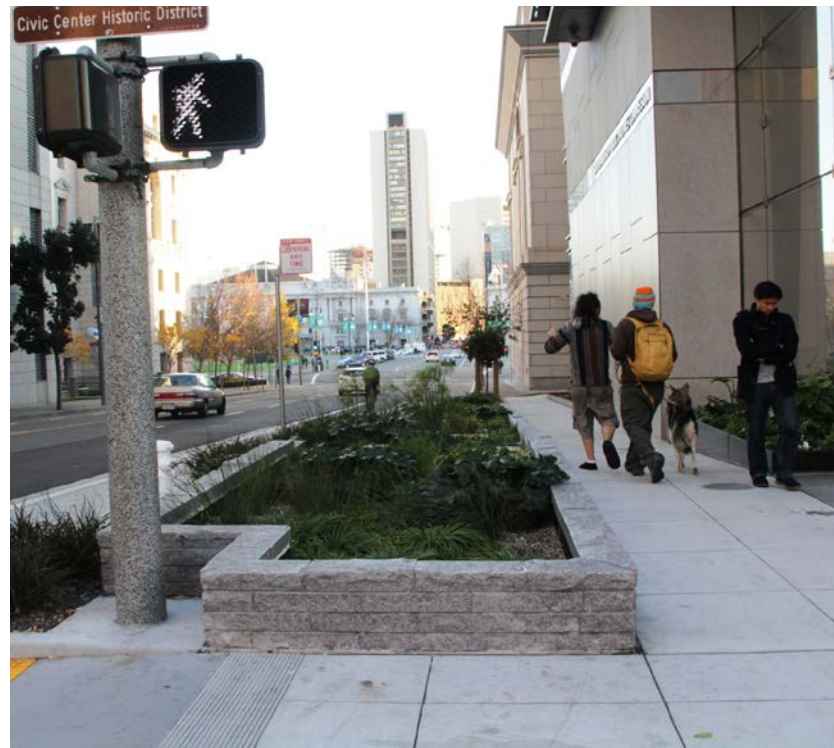
# DISTRIBUTED INFRASTRUCTURE & WATER RESILIENCY

= *Balancing a development's annual water demand through efficient use, capture, reuse and recharge of water resources*





# NET-ZERO WATER: PUBLIC UTILITIES COMMISSION, SAN FRANCISCO, CA



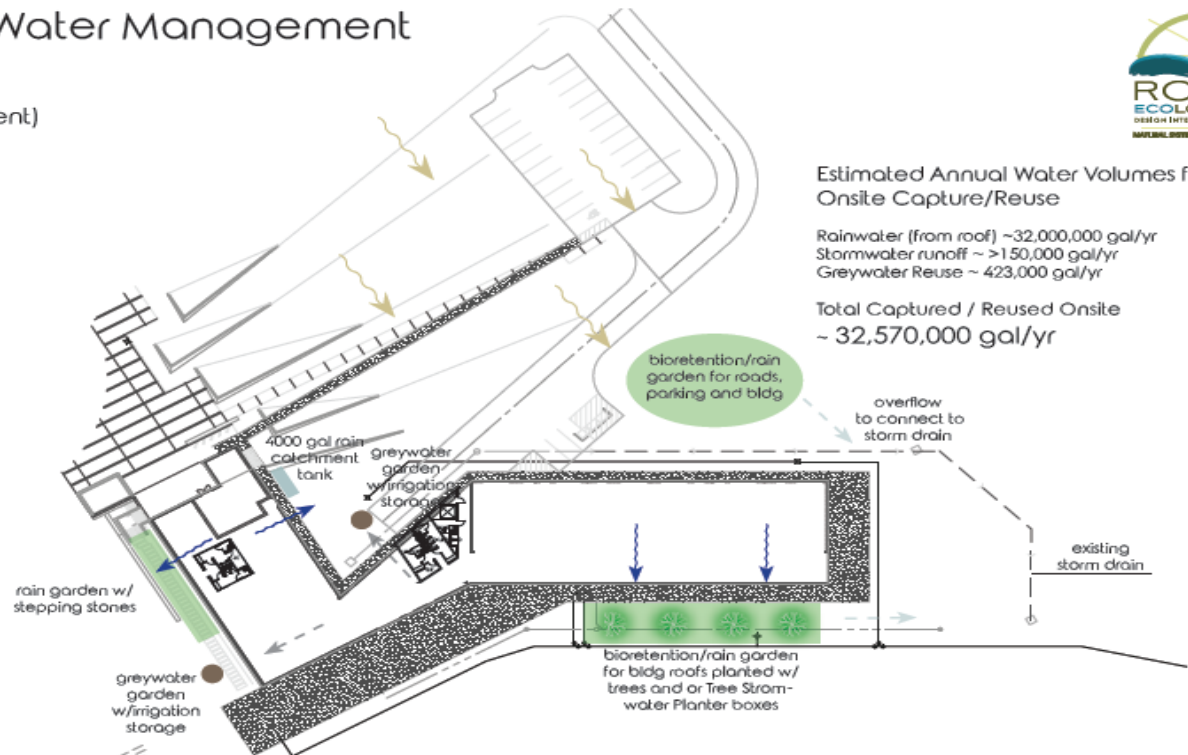
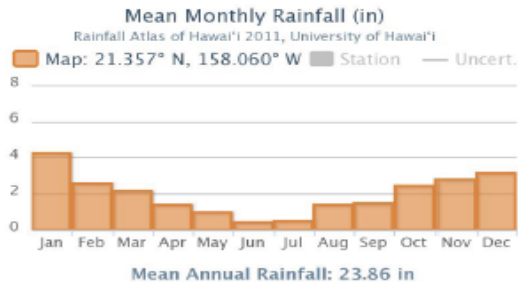


# UH WEST OAHU ADMINISTRATION & ALLIED HEALTH BUILDING



## UHWOC: Comprehensive Water Management (Net-Zero Water)

- Stormwater (raingarden, rainwater catchment)
- Greywater (from bathroom sinks)
- Rainwater
- Stormwater drainage direction
- Rainwater direction
- Greywater (from sinks) direction
- Filtered stormwater



### Estimated Annual Water Volumes for Onsite Capture/Reuse

Rainwater (from roof) ~32,000,000 gal/yr  
Stormwater runoff ~ >150,000 gal/yr  
Greywater Reuse ~ 423,000 gal/yr

**Total Captured / Reused Onsite ~ 32,570,000 gal/yr**



# BUILDING RESILIENCY:

## KAHALU'U MAKAI/REDEVELOPMENT, KAHALU'U, KONA, HI



Pohuehue



Akulikuli



Kupukupu



Ti



Taro



Carex



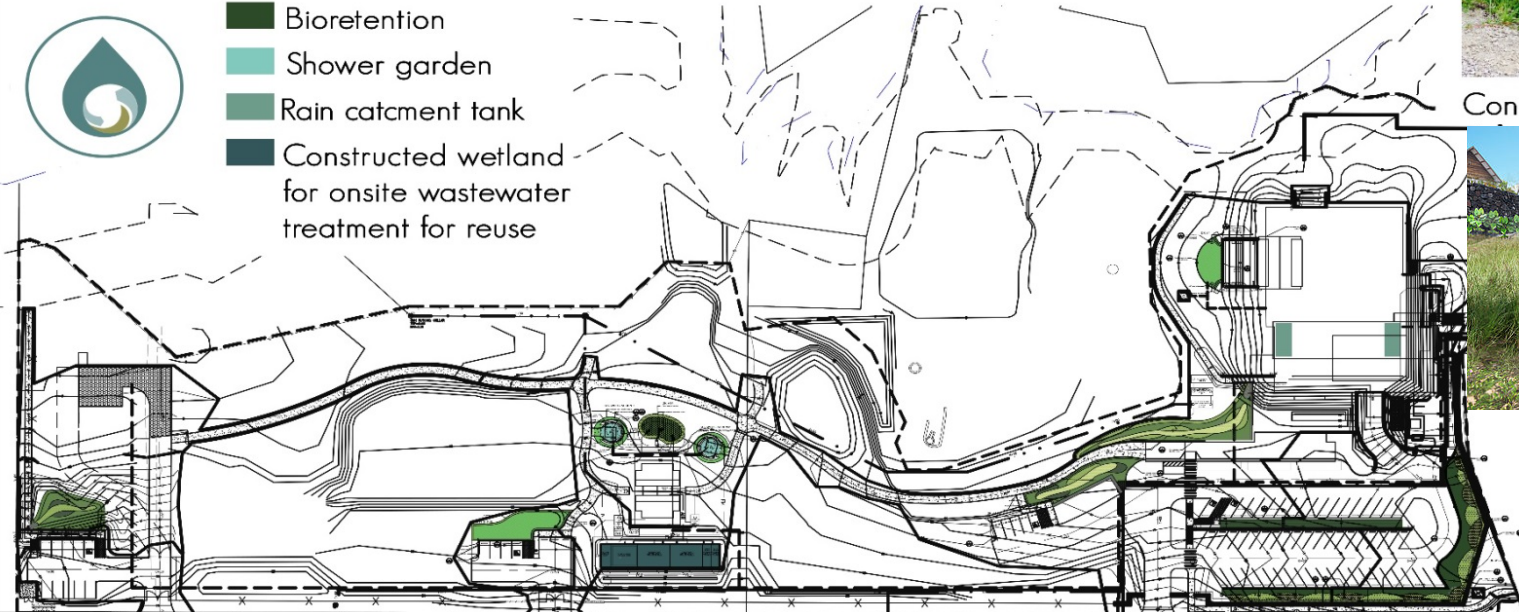
Ae'ae



Constructed wetlands



- Bioretention
- Shower garden
- Rain catchment tank
- Constructed wetland for onsite wastewater treatment for reuse



NATURAL SYSTEMS TECHNOLOGIES

# SCHOOLS BUILDING RESILIENCY & EDUCATION





**ECO-BLOCK/ECO-DISTRICT**



### **Hassalo on 8th<sup>3</sup>** **Portland, Oregon (block development)**

#### **Building facts:**

- (3) buildings in a block layout
- 657 residences (with commercial spaces on ground floor)
- 50,000 square feet

#### **Green building features:**

- Green roof (Eco-roof garden)
- Onsite wastewater treatment using trickling filters and constructed wetland technologies (45,000 gallons per day). Water is reused for flushing toilets, irrigation for the block's landscape, and feed for cooling tower.
- 60,000 gallon cistern collects rainwater. Collected stormwater used for the block's water feature.
- Over 1,000 bike parking stalls with access to bike valet and repair
- EV charging stations
- Composting
- Located next to Portland's light rail system

All images on this page, source: Biohabitats

3 Hassalo on 8th. Portland's Newest Neighborhood An Eco-Community Bringing Us Together, <http://hassalooneighth.com>. Accessed on August 16, 2017.

### **Emory University WaterHub<sup>4</sup>** **Atlanta, Georgia (neighborhood scale)**

#### **Building facts:**

- 631 acres (neighborhood scale)
- More than 70 buildings

#### **Green building features:**

- Stormwater capture and use (saves 800,000 gallons per year of potable water)
- Greywater reuse (saves 750,000 gallons per year of potable water)
- 400,000 gallons per day of wastewater "scalping" from main trunk line. Treatment includes moving bed bioreactor (MBBR) and constructed wetland technologies. Recycled water is used for cooling, toilet flushing, and steam plant (146,000,000 gallons per year of potable water savings).



Constructed wetland wastewater treatment plants at Hassalo act as part of a Natural Treatment Wetlands work using a tidal-flow (fill and drain) process to foster naturally occurring microbial organisms used to treat wastewater.

4 Emory University. Healthy Emory, Healthy Planet The Water-Hub at Emory University Moving from Feasibility to Project Execution, [https://smartandsustainable.umd.edu/sites/smartandsustainable.umd.edu/files/the\\_waterhub.pdf](https://smartandsustainable.umd.edu/sites/smartandsustainable.umd.edu/files/the_waterhub.pdf). Accessed on August 16, 2017.



Emory's campus wastewater is filtered and circulated among plant roots within and below a greenhouse, also providing a place for education and a botanical experience.



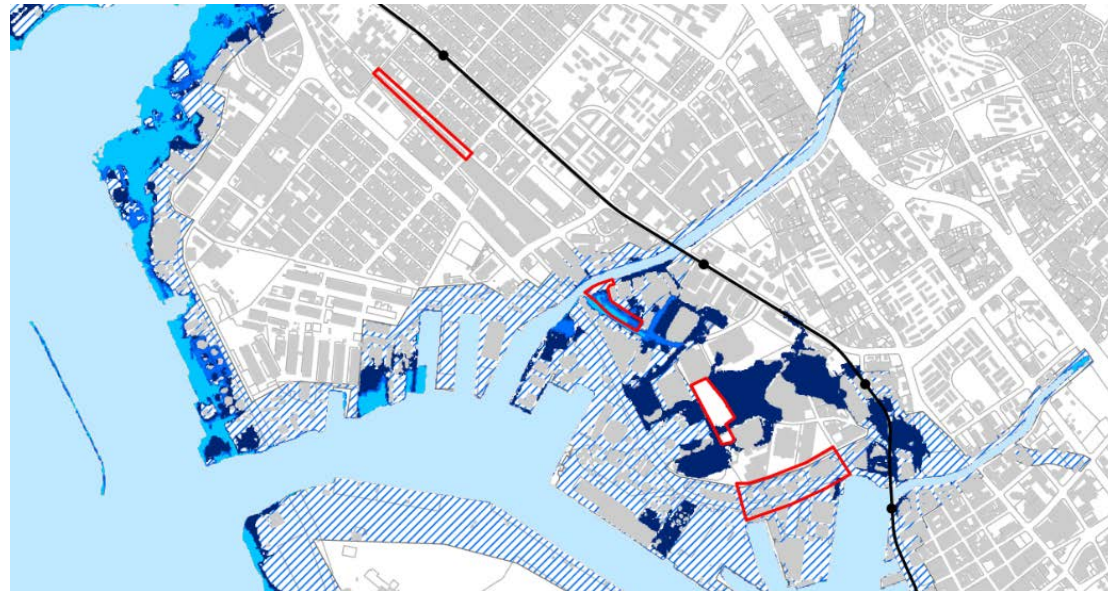
# EX: EPA GREENING AMERICA'S COMMUNITIES: IWILEI & KAPALAMA

## Local climatic conditions/Climate Change Consideration

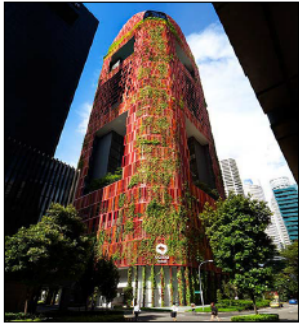
- Mean annual rainfall for the site ~ 30"/year.
- Decline of overall rainfall, increase in storm intensities, runoff and flash flooding
- Decline of available groundwater supplies

## Coastal/Ocean Influences

- King tides, storm surges, tsunamis, Sea level rise







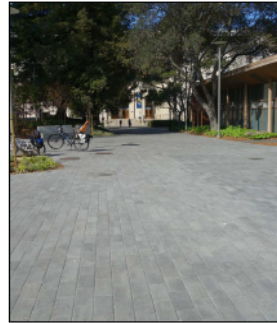
**INTEGRATED LANDSCAPE AND BUILDINGS**

Green screens, planters, and other elements can provide landscape on building facades, helping to cool buildings and the urban environment and increase biodiversity.



**ECO-BLOCK DEVELOPMENT**

Decentralized water and energy infrastructure while building community resiliency, and reducing the development's carbon and water footprints.



**PERMEABLE PAVER**

Stormwater runoff percolates through or around pavers to either infiltrate or be collected and directed to storm drain line. Added depth of subbase can retain stormwater.



**PERMEABLE CONCRETE/POROUS ASPHALT**

Stormwater percolates through pavement to either infiltrate or be collected and directed to storm drain line. Added depth of subbase can retain stormwater.



**BOARDWALK**

Allows stormwater to percolate through boards. Allow different look and provides structural support to bridge over green infrastructure or stormwater runoff storage areas.



**GREEN ROOF**

Provide cool roof and enhanced amenity to residents, employees, and visitors.



**DISCONNECTED DOWNSPOUT**

Collects and treats rainfall from rooftops.



**CONSTRUCTED WETLAND**

Engineered wetlands for stormwater or wastewater treatment and habitat restoration.



**BIORETENTION/GREEN INFRASTRUCTURE**

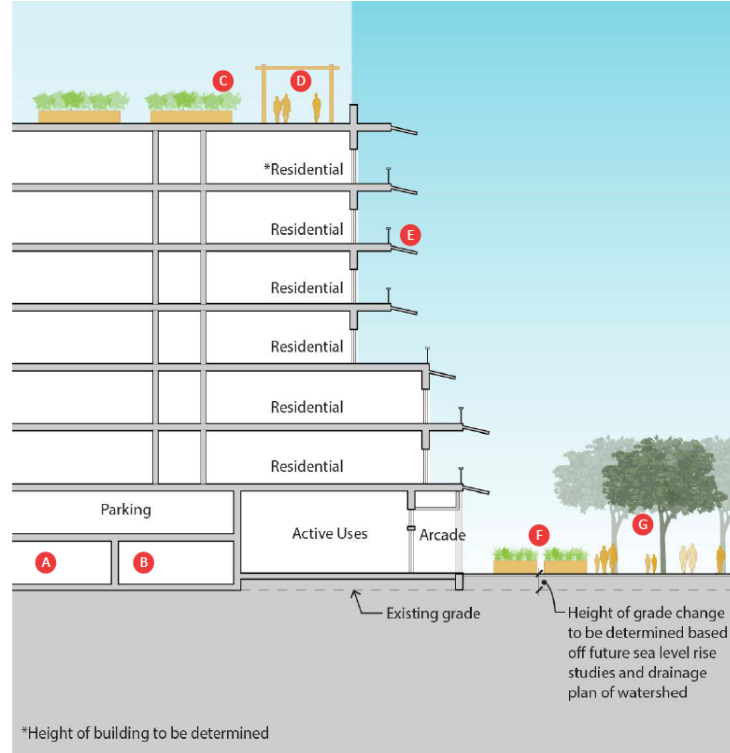
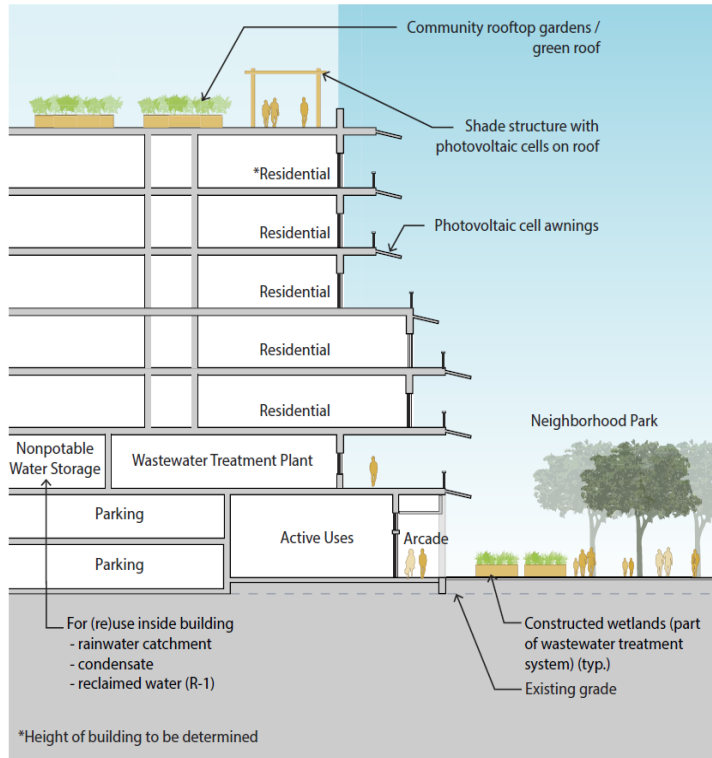
Captures and treats stormwater runoff with natural processes.



**STORMWATER TREE**

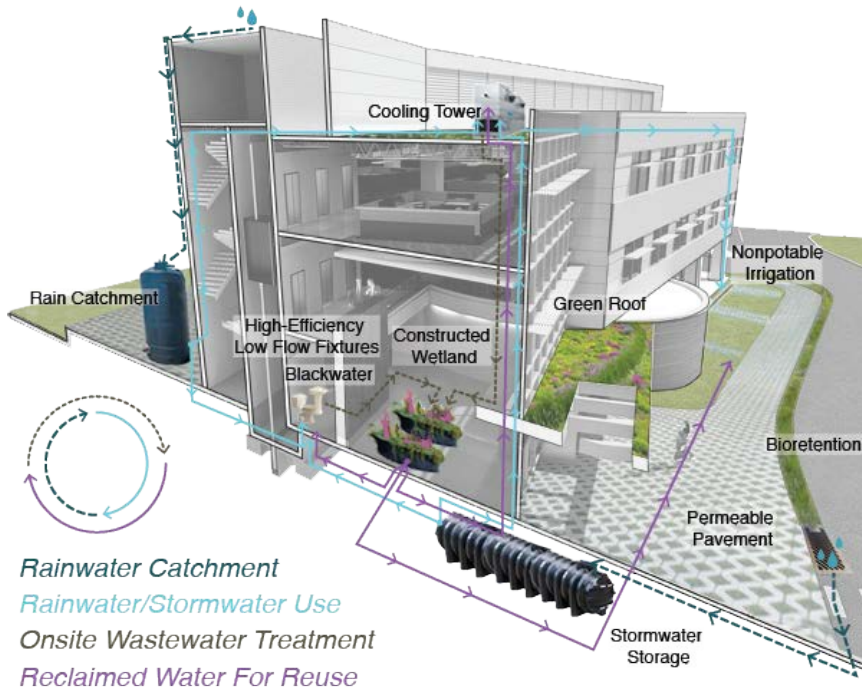
Captures and treats stormwater runoff with natural processes. May be "linked" to other trees for increased runoff storage.

# ECO-BLOCK/ECO-DISTRICT DESIGN CONCEPT

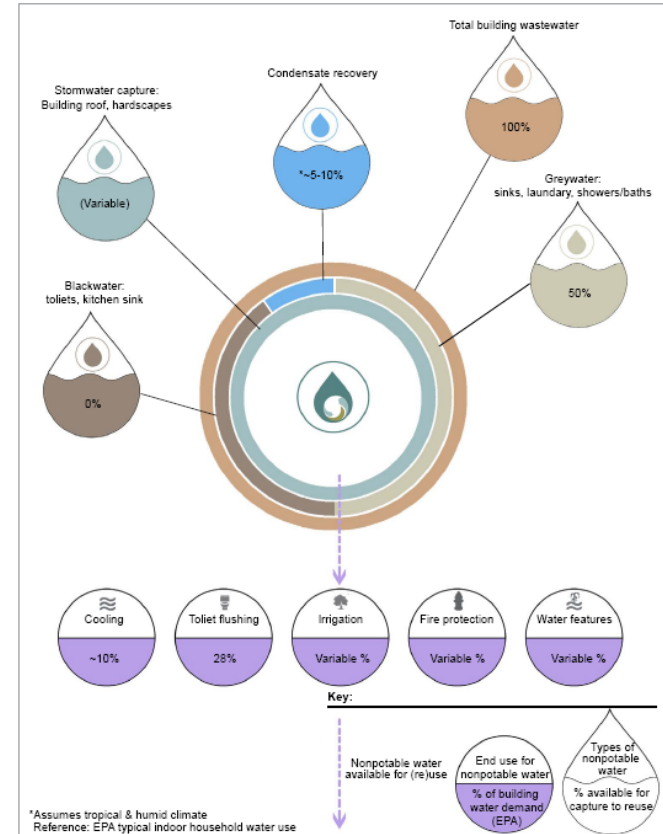


- A** Nonpotable water storage for (re)use inside building
- B** Wastewater treatment
- C** Community gardens and passive and active green roof space
- D** Shade structure with photovoltaic cells
- E** Photovoltaic cell awnings
- F** Constructed wetlands, as part of the wastewater treatment system
- G** Neighborhood park

# SITE 3: IWILEI ROAD AND PACIFIC STREET- ONSITE WATER MANAGEMENT STRATEGIES

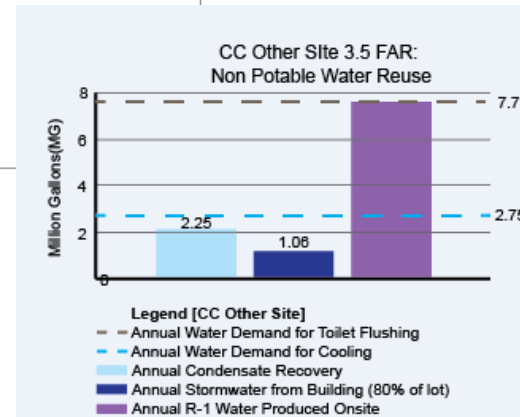
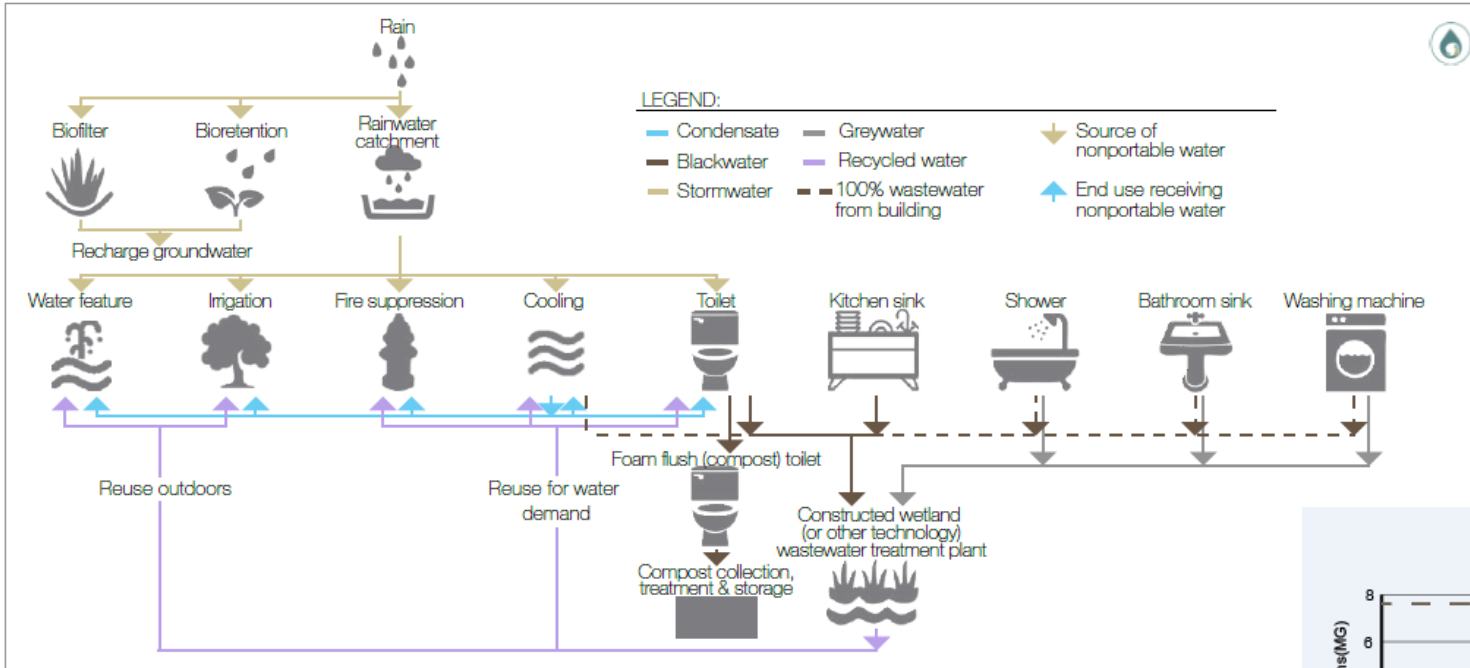


## Building Nonpotable Water Resources (Typical Residential)

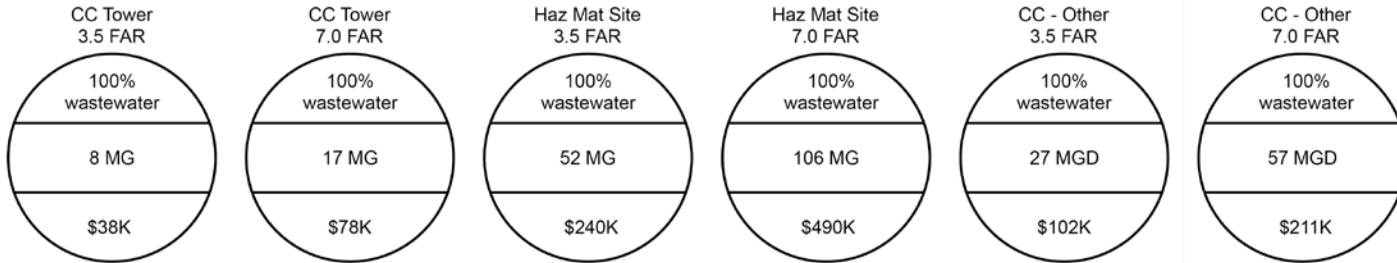




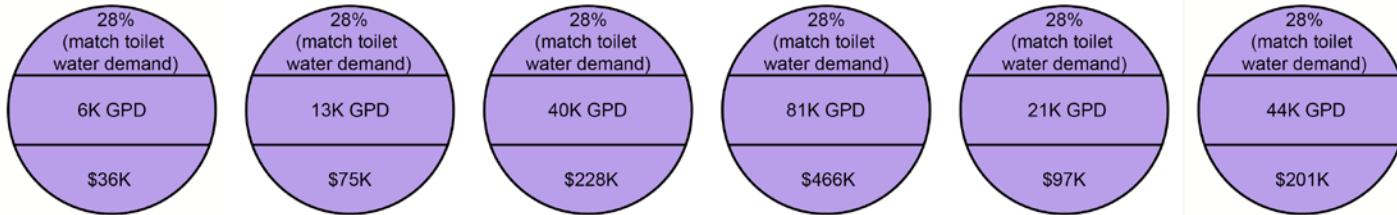
# Road Map for Nonpotable Water Capture and (Re)Use



 Estimated Annual Wastewater Volumes & Sewer Cost

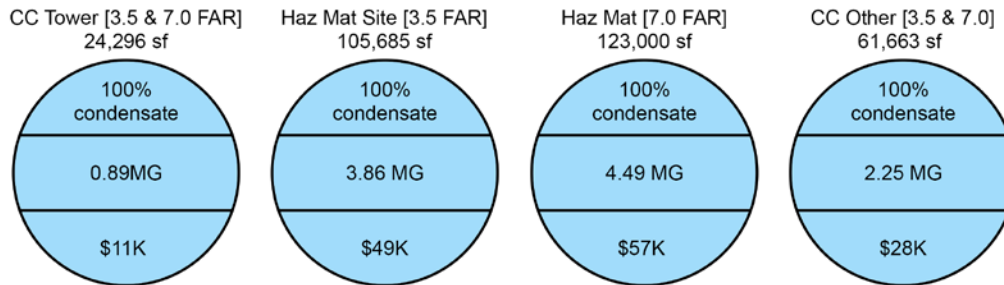


 Recommended Wastewater Volume for Onsite Treatment (to R-1) & Potential Annual Cost Savings



\*Cost Savings Includes Both Potable Water & Sewer Cost Savings

 Recommended Condensate Recovery Volumes for Onsite Reuse & Potential Annual Cost Savings



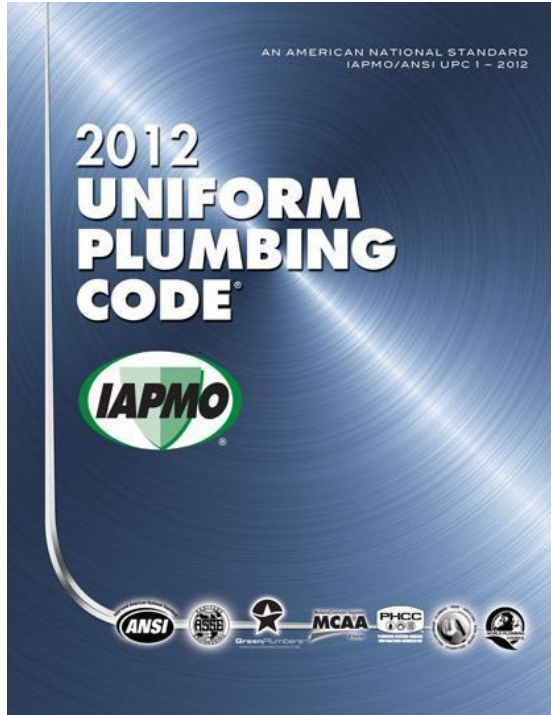
\*Cost Savings Includes Both Potable Water & Sewer Cost Savings

# POLICIES





# PLUMBING CODE UPDATES: GREEN CODES ARE THE NEW BASE CODE



- Water efficient fixtures
- Nonpotable reuse back inside buildings!
  - Rain water catchment
  - Stormwater reuse
  - Recycled water

# 2017 STATE OF HAWAII WATER LEGISLATION

HB 636 and SB 635 - Water Conservation Device Rebate

HB 637/SB 634. Expedite Plumbing Code Modernization

HB 100/SB 192 (Administration Budget). Strengthen Watershed Partnerships and Stewardship

SB 633. Dedicated Water Security Fund.

HB 630. Provides Funding Towards Drought Planning

HB 1244. Removal of Cesspools

# AN **ADAPTIVE CHALLENGE** FOR WATER RESILIENT FUTURE

1. When/How do we adapt and evolve existing infrastructure?
2. What opportunities are there?  
**NEW DEVELOPMENT!**
3. What regulation policies need to be updated or created?  
(FWI Ordinances/Water demand off sets)
4. What incentives are in place?
5. What are the costs and costs not to adapt?
6. Where are opportunities for partnerships/funding?



Picture By: ANDREW SHIMABUKU | The Honolulu Advertiser



# QUESTIONS?



Roth Ecological Design Int. LLC

[lauren@rothecological.com](mailto:lauren@rothecological.com)

[rothecological.com](http://rothecological.com)