Sustainable Water Reclalm Systems:
Designing within Regulatory Challenges
JON GRAY, CPD
PRINCIPAL

• Specializes in water conservation and sustainable plumbing system design
• **40+ years** in the contracting and engineering industry
• Plumbing design of 100+ LEED buildings and several Net-Zero buildings
• **8 years** as Chairman of the Board, State of Oregon Plumbing Board
LEGISLATIVE CHANGES
AND THE ADVOCACY PROCESS
Water Uses
Water Saving with Rainwater
Alternate Methods

Rainwater approved uses

- Irrigation/garden hose bibs
- Toilet / urinal flushing
- Clothes washing
- Heating, ventilation & air conditioning (HVAC)

Apartments, daycares and schools are now eligible for alternate methods.
Water Saving with Greywater
Alternate Methods

Water Conservation Approved Uses:

- Toilet / urinal flushing
House Bill 2080
Greywater Reuse and Disposal

**TYPE 1**
is untreated or has passed through a physical process to remove solids, fats, oils and grease.

**Uses:**
- subsurface irrigation

**TYPE 2**
is treated by a chemical or biological process to reduce total suspended solids and organic matter concentrations.

**Uses:**
- drip irrigation / landscape ponds

**TYPE 3**
is treated to Type 2 standards and disinfected to reduce bacteria and other potential pathogens.

**Uses:**
- sprinkler irrigation / dust control.
Oregon Road Map
For Oregon, we have made the following possible through our alternative method process:

- Drink your rainwater at home
- Drink rainwater commercially complying with state drinking water division standards
- Reclaim greywater for non-potable uses in commercial projects
CALCULATING RAINWATER CAPTURE
## RAINWATER CALCULATOR

### Occupancy

<table>
<thead>
<tr>
<th>User Group</th>
<th>Group Name</th>
<th>10 Group Names</th>
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### Watershed Area

<table>
<thead>
<tr>
<th>Area Name</th>
<th>Area 1</th>
<th>Area 2</th>
<th>Area 3</th>
<th>Area 4</th>
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### Deviation From Original Fill Graph

Select water usage schemes as "Chris and Blackwater".

### Tank Information

- **Tank Size, Initial Fill, and Overflow Designation**
  - Tank 1: Size = 2700, Initial Fill = 2200, Overflow = 500
  - Tank 2: Size = 2700, Initial Fill = 2200, Overflow = 500

### Selection of Destination

- **Water Use Sectors**
  - Rainwater
  - Greywater
  - Blackwater

### Potable Treatment System

- **Black Water Treatment**
  - Tank 1: Size = 2700, Initial Fill = 2200, Overflow = 500
## Rainwater Calculator

### Occupant Water Use Inputs

<table>
<thead>
<tr>
<th>Future Type</th>
<th>Particular Description</th>
<th>Input Method</th>
<th>Gallons per Minute</th>
<th>Minutes per Use</th>
<th>Gallons per Use</th>
<th>Result</th>
<th>User per Use</th>
<th>Gender</th>
<th>Connected Users</th>
<th>Water Consumed per Day (Gallons)</th>
<th>Water Produced per Day (Gallons)</th>
<th>Water Quality</th>
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### Consumption and Production per Person per Day

<table>
<thead>
<tr>
<th>Future Type</th>
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<th>Input Method</th>
<th>Gallons per Minute</th>
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### Occupancy Profile

<table>
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<tr>
<th>Days of Week/Operation</th>
<th>%</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
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### Visitor Consumption and Production per Person per Day

<table>
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<tr>
<th>Future Type</th>
<th>Particular Description</th>
<th>Input Method</th>
<th>Gallons per Minute</th>
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</tbody>
</table>

| Instructions | Input Dashboard | Occupant Water Use Input | Precipitation Input | 30 day input | < Inputs, Calculations | Calculator | 30 day calc | Precip calc | inactive | Mech |
## User Group 1: FTE

<table>
<thead>
<tr>
<th>Water Consumed per Occupant per Day (gallons)</th>
<th>Water Consumed by Group per Day (gallons)</th>
<th>Average Water Consumption per Day (gallons)</th>
<th>Water Production per Occupant per Day (gallons)</th>
<th>Water Produced by Group per Day (gallons)</th>
<th>Average Water Production per Day (gallons)</th>
<th>Total Equivalent Days in a Year</th>
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</thead>
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<tr>
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<td>29.4</td>
<td>0.06</td>
<td>0.56</td>
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<td>29.7</td>
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### User Group 1: Occupancy Profile

![Occupancy Profile](image1.png)

Note: Day 0 is the first day of the simulation. Therefore, if the simulation starts on March 1, the report runs from March 1 to March 8.

## User Group 2: Visitor

<table>
<thead>
<tr>
<th>Water Consumed per Occupant per Day (gallons)</th>
<th>Water Consumed by Group per Year (gallons)</th>
<th>Average Water Consumption per Day (gallons)</th>
<th>Water Produced per Occupant per Day (gallons)</th>
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### User Group 2: Occupancy Profile

![Occupancy Profile](image2.png)
CASE STUDIES
Oregon Sustainability Center

Unbuilt due largely to regulatory challenges and the Portland City Council not approving funding, the Oregon Sustainability Center was a proposed high-rise designed to meet the Living Building Challenge.

Building stats:
- 100,000 sf
- Offices / Mixed-Use
- 7-9 stories
- Up to 1,400 FTE’s
Oregon Sustainability Center

Need to write any and all appeals to codes and statutes as well as SDC reductions

- 22,000 sf roof area provides 393,000 gallons per year
- Rainwater for potable uses
- Wastewater treatment system
CASE STUDY: OSC

Water
Savings

Water Usage Base Case

Low Flow Fixtures
Proposed Water Use Reduction

+ Blackwater Recycling
Proposed Water Use Reduction

+ Rainwater Collection
Proposed Water Use Reduction
Edith Green-Wendell Wyatt

Federal Building

Building stats:

- LEED Platinum Certified
- 437,000 sf
- Offices
- Renovation
- 18 stories
CASE STUDY: EDITH GREEN-WENDELL WYATT

Rainwater Reuse System

62% Potable Water Use Reduction

- Low-flow fixtures
- Rainwater collection & reuse
- Stormwater controls
CASE STUDY: EDITH GREEN-WENDELL WYATT

Water Savings

Water Usage Base Case
ARRA Goal = 20% Indoor Potable Water Reduction
50% Outdoor Potable Water Reduction

Low Flow Fixtures
Proposed Water Use Reduction

+Rainwater Collection
Proposed Water Use Reduction
CASE STUDY: EDITH GREEN-WENDELL WYATT

Road Map
Annual Water Use

- **CASE STUDY:** EDITH GREEN-WENDELL WYATT

- **WATER USAGE**
  - JAN: 126 K
  - FEB: 102 K
  - MAR: 81 K
  - APR: 57 K
  - MAY: 53 K
  - JUN: 37 K
  - JUL: 15 K
  - AUG: 25 K
  - SEP: 38 K
  - OCT: 67 K
  - NOV: 125 K
  - DEC: 109 K

- **RAINWATER COLLECTED**
  - JAN: 126 K
  - FEB: 90 K
  - MAR: 81 K
  - APR: 57 K
  - MAY: 53 K
  - JUN: 37 K
  - JUL: 15 K
  - AUG: 25 K
  - SEP: 38 K
  - OCT: 67 K
  - NOV: 125 K
  - DEC: 109 K

- **RAINWATER AVAILABLE**
  - 126 K
Annual Water Storage

Irrigation begins

Irrigation ends

WATER TANK
170,000 gallons
Chatham University

Eden Hall Campus

Building stats:
• LEED Platinum goal
• Net-Zero Energy goal
• Passive House goal
• Living Building goal
• 388 acre site, 110,000 sf
• Renovation
• 18 stories
CASE STUDY: CHATHAM UNIVERSITY

Site Plan
CASE STUDY: CHATHAM UNIVERSITY

Water Flow

NOTES:
Rain to potable uses. Treated sewage effluent (TSE) for non-potable.
Same for Grad Housing/Commons Building. Only use 40,000 gallon rainwater storage tank.
Chatham was to be the first campus built in the U.S. from the ground up to integrate sustainable development, living, and learning:

- Net zero water on an average across the campus (the campus, on an average rainfall year, would have utilized water from the Richland Township)
- Potable water would have been provided from the rainwater collection and filtration system
- Incorporated a constructed wetland to treat sewage, providing non-potable water to plumbing fixtures and irrigation
CASE STUDY: SAN YSIDRO US LAND PORT OF ENTRY

San Ysidro US Land Port of Entry

LEED Platinum, Design Excellence

Project stats:
• 102,000 people cross the border each day
• 200,000 sf
• Conserving water and energy
CASE STUDY: SAN YSIDRO US LAND PORT OF ENTRY

400,000 gallon cistern
Membrane Bioreactor System

Headhouse (HH)
**CASE STUDY: SAN YSIDRO US LAND PORT OF ENTRY**

**Water Conservation Strategies**

- Black water re-use from all connected fixtures for irrigation, mechanical makeup, toilet/urinals and wash-down
- Stormwater capture for irrigation and toilet flush
- Efficient fixtures
- Net-Zero stormwater discharge via green infrastructure (aquifer recharge)

28 MILLION GALLONS SAVED = 230 typical households per year
CASE STUDY: SAN YSIDRO US LAND PORT OF ENTRY

Water and Waste

40-YEAR COST SAVINGS: $3.6 MILLION
CASE STUDY: SAN YSIDRO US LAND PORT OF ENTRY

Water Saved

• 93% potable water use reduction
• 28 million gallons saved
University of Hawaii Mānoa

Infrastructure & Master Planning

- Net-Zero Water goal
- Net-Zero Energy goal
CASE STUDY: UHM INFRASTRUCTURE AND WATER MASTER PLAN

EXISTING CAMPUS CONDITIONS
MAUKA CAMPUS & MAKAI CAMPUS

CENTRAL CAMPUS
- Contains the majority of campus facilities;
- Receives majority of rain fall on campus;
- Generally wetter than the Makai Campus.

MAKAI CAMPUS
- Mostly athletic and residential facilities;
- Generally drier than the Central Campus;
- Contains large open spaces for play fields.
CASE STUDY: UHM INFRASTRUCTURE AND WATER MASTER PLAN

EXISTING CAMPUS CONDITIONS

MICROCLIMATES

UPPER CENTRAL
- Wettest Zone - Avg. Rainfall = 39”/year
- Approx. Elevation Range = 80’ to 150’

CENTRAL
- Moderate Zone - Avg. Rainfall = 31”/year
- Approx. Elevation Range = 60’ to 100’

MAKAI
- Driest Zone - Avg. Rainfall = 25”/year
- Approx. Elevation Range = 10’ to 20’
EXISTING CAMPUS CONDITIONS

FLOODING

2004 Flood - 25-yr flood event caused primarily by blockage at Woodlawn Bridge
- Flood Area
- Damaged Buildings

FEMA Flood Zone - 100-yr flood along Manoa Stream
- FEMA Flood Zone AE = 1% Annual Chance Flood
- FEMA Flood Zone X = 0.2% Annual Chance Flood
- FEMA Flood Zone A = 1% Annual Chance Flood

Makai Flood Basin
- Detention Basin
- 50-yr flood event
CASE STUDY: UHM INFRASTRUCTURE AND WATER MASTER PLAN

PROPOSED DESIGN CONCEPT
WATER BALANCE - RECOMMENDATION

Diagram shows the relationship between water supply and water demand.
PROPOSED DESIGN CONCEPT

SANITARY SEWER & RECYCLED WATER

- Relocation a portion of DPP Sanitary Sewer to align better with campus development;

- Central utility plant #1 to treat 600k gal wastewater daily from off-site flows for non-potable reuse;

- Recycled water distribution to follow trunk line routing and supply irrigation;

- Blending tanks will supply peak daily use;

- Any future increase in development in the Makai Campus will require a pump station upgrade or a new pump station.
PROPOSED DESIGN CONCEPT

WATER

OPTION 1: SEPARATE FIRE AND DOMESTIC LOOPS

- Life & Safety, additional fire-ready systems are not needed during domestic water maintenance;
- Less visible appurtenances;
- More linear feet of pipe;
- Meter & backflow DW connection to BWS;
- Backflow FW connections to BWS.

OPTION 2: COMBINED FIRE AND DOMESTIC LOOP

- Less infrastructure in the trunk line;
- May not pay for water during an emergency;
- More visible meters and backflows;
- Metered Connections to BWS;
- Sub-meters & backflows at service zones.
PROPOSED DESIGN CONCEPT

Conceptual Ideas Being Considered

Scale Jumping Sewage Thermal Recovery

Issue to resolve: Odors downstream
Any Questions?