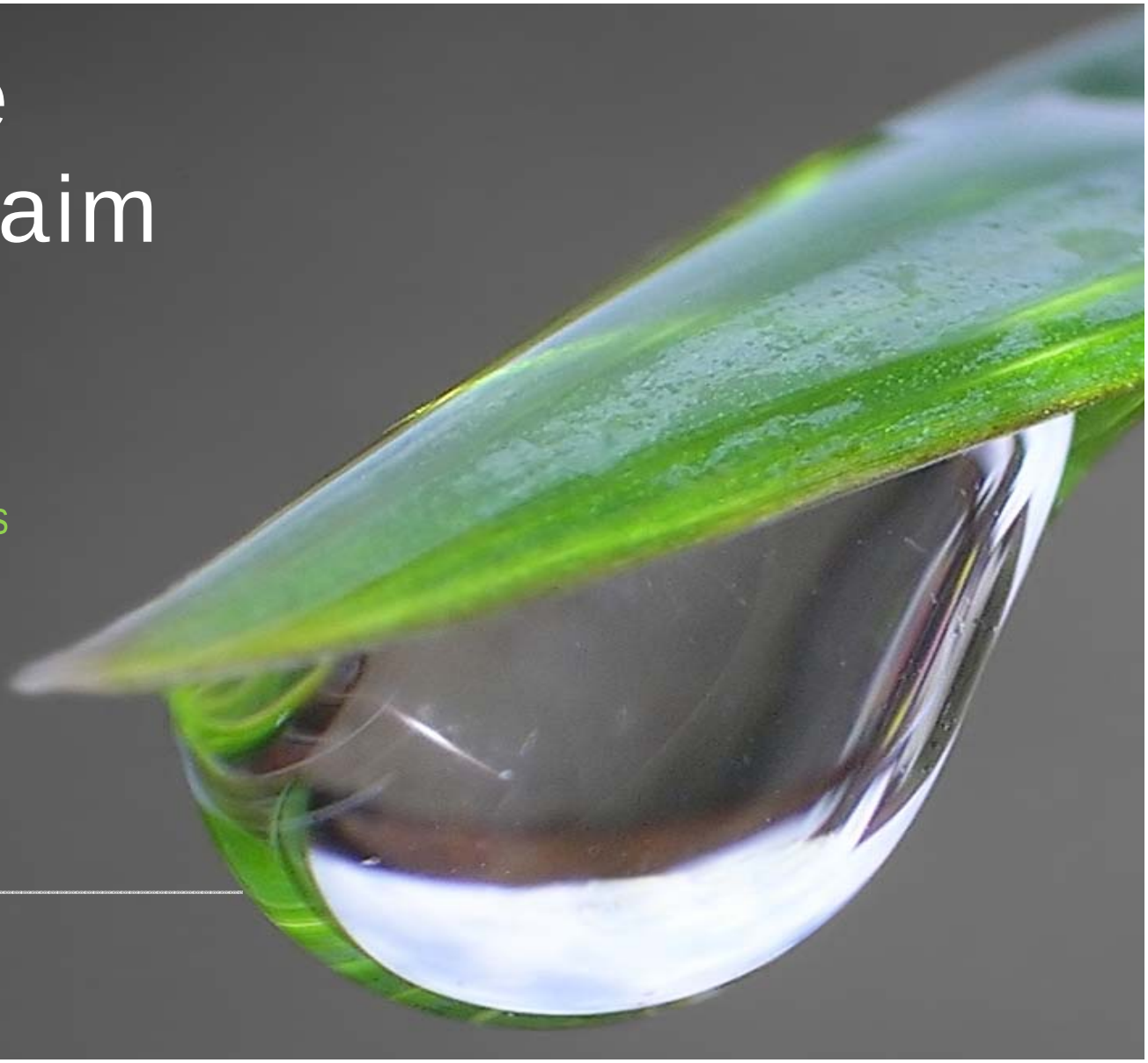
Sustainable Water Reclaim Systems:

Designing within Regulatory Challenges

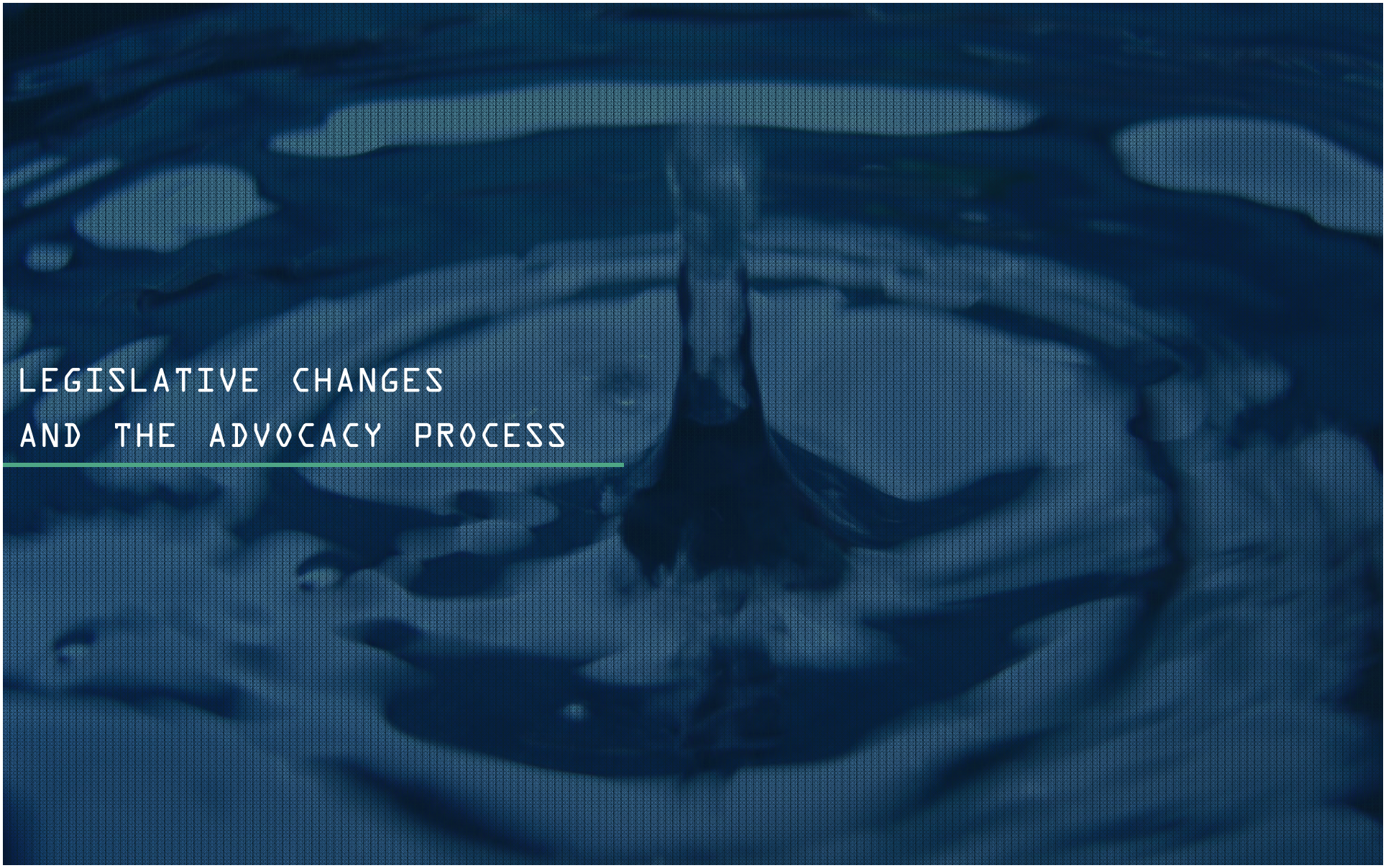


JON GRAY CPD
PRINCIPAL

INTERFACE ENGINEERING

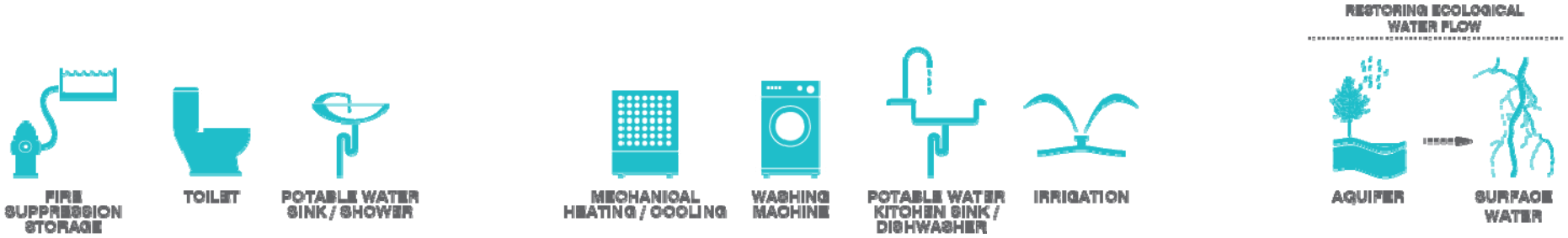
JON GRAY, CPD
PRINCIPAL

- 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 or Oregon Plumbing Board



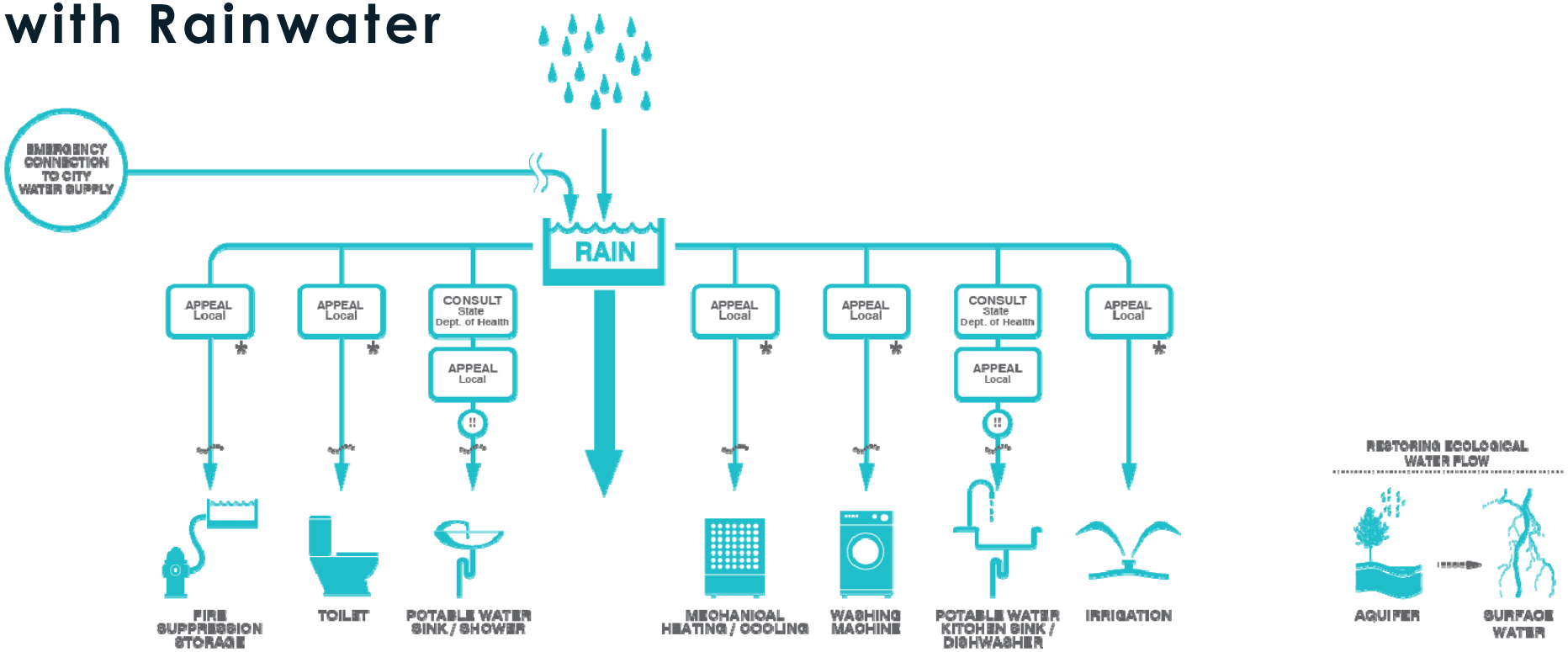
LEGISLATIVE CHANGES AND THE ADVOCACY PROCESS

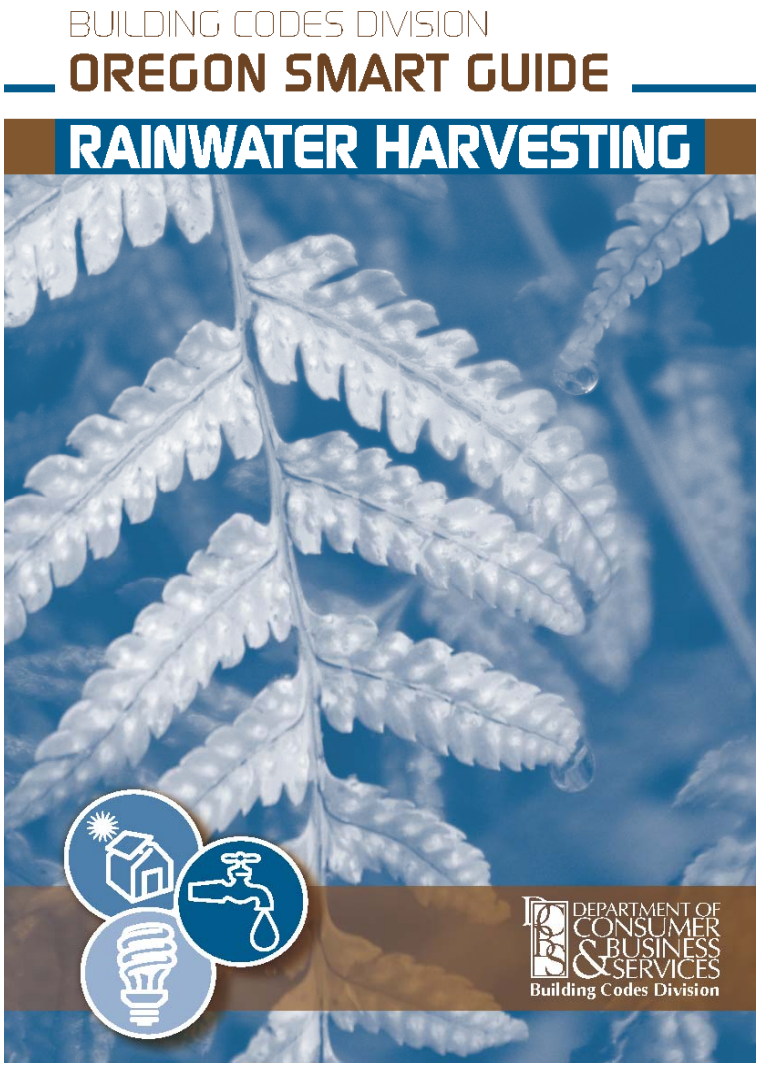
Water Uses


FIRE SUPPRESSION STORAGE
TOILET
POTABLE WATER SINK / SHOWER
MECHANICAL HEATING / COOLING
WASHING MACHINE
POTABLE WATER KITCHEN SINK / DISHWASHER
IRRIGATION
RESTORING ECOLOGICAL WATER FLOW
AQUIFER
SURFACE WATER

INTERFACE ENGINEERING

Water Saving with Rainwater





Alternate Methods

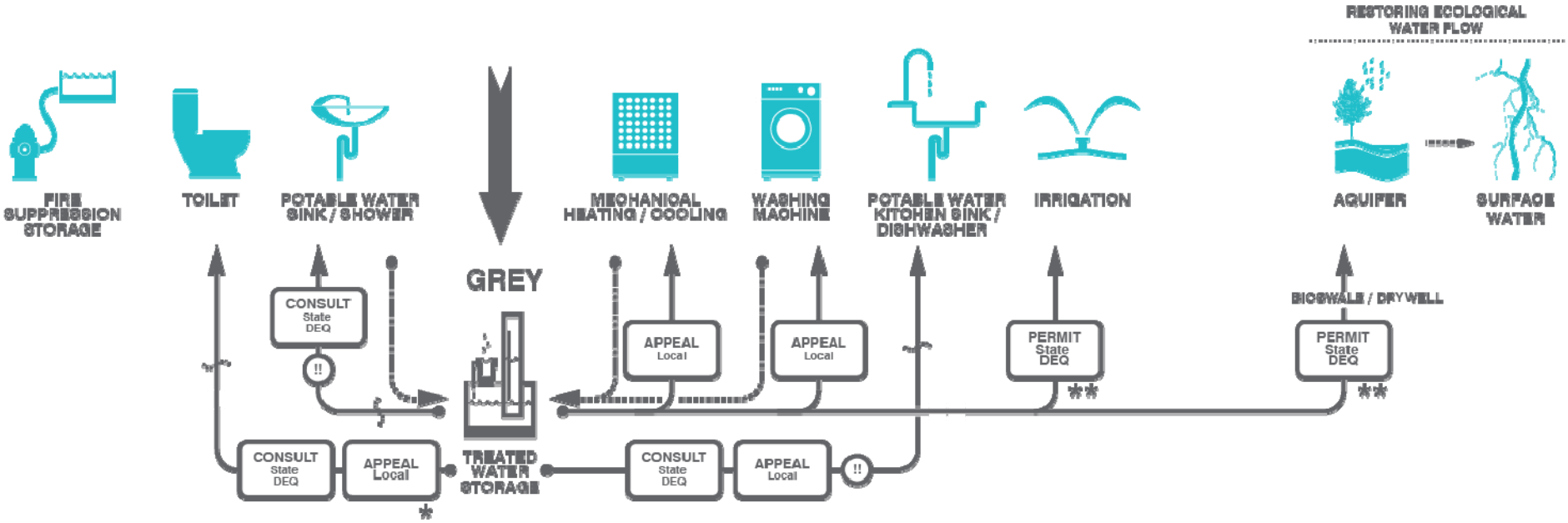
Rainwater approved uses

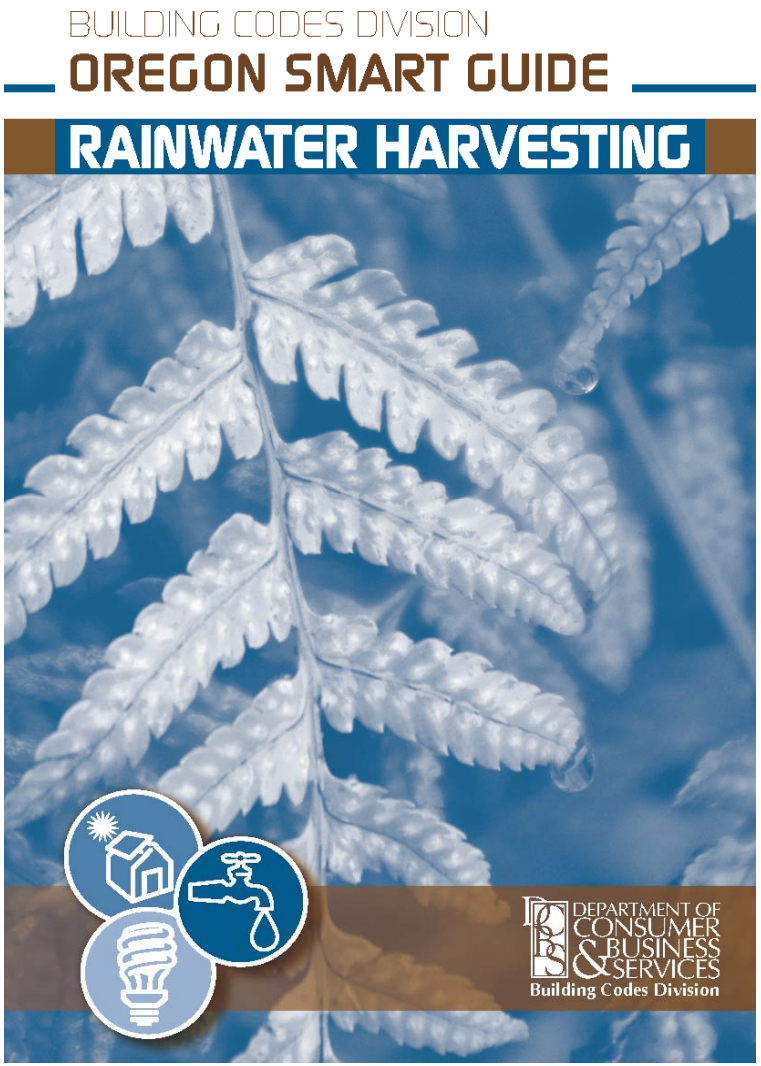
- Irrigation/garden hose bibs
- Toilet / urinal flushing
- Clothes washing
- Heating, ventilation & air conditioning (HVAC)

Apartments, daycares and schools are now eligible for alternate methods

INTERFACE ENGINEERING

Water Saving with Greywater





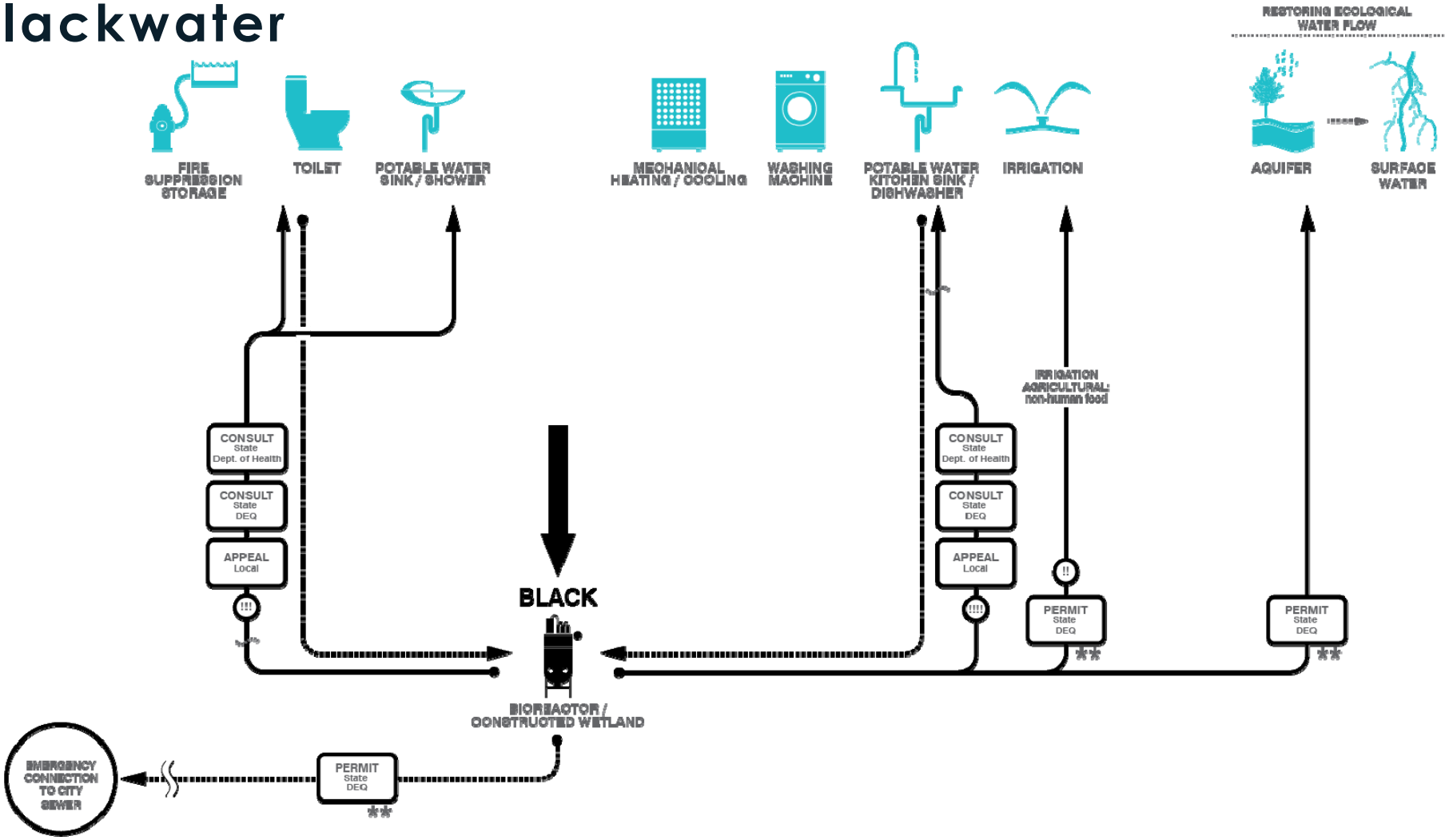
Alternate Methods

Water Conservation Approved Uses:

- Toilet / urinal flushing

INTERFACE ENGINEERING

Blackwater



House Bill 2080

Greywater Reuse and Disposal

State of Oregon Department of Environmental Quality

TYPE 1

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

TYPE 2

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

TYPE 3

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

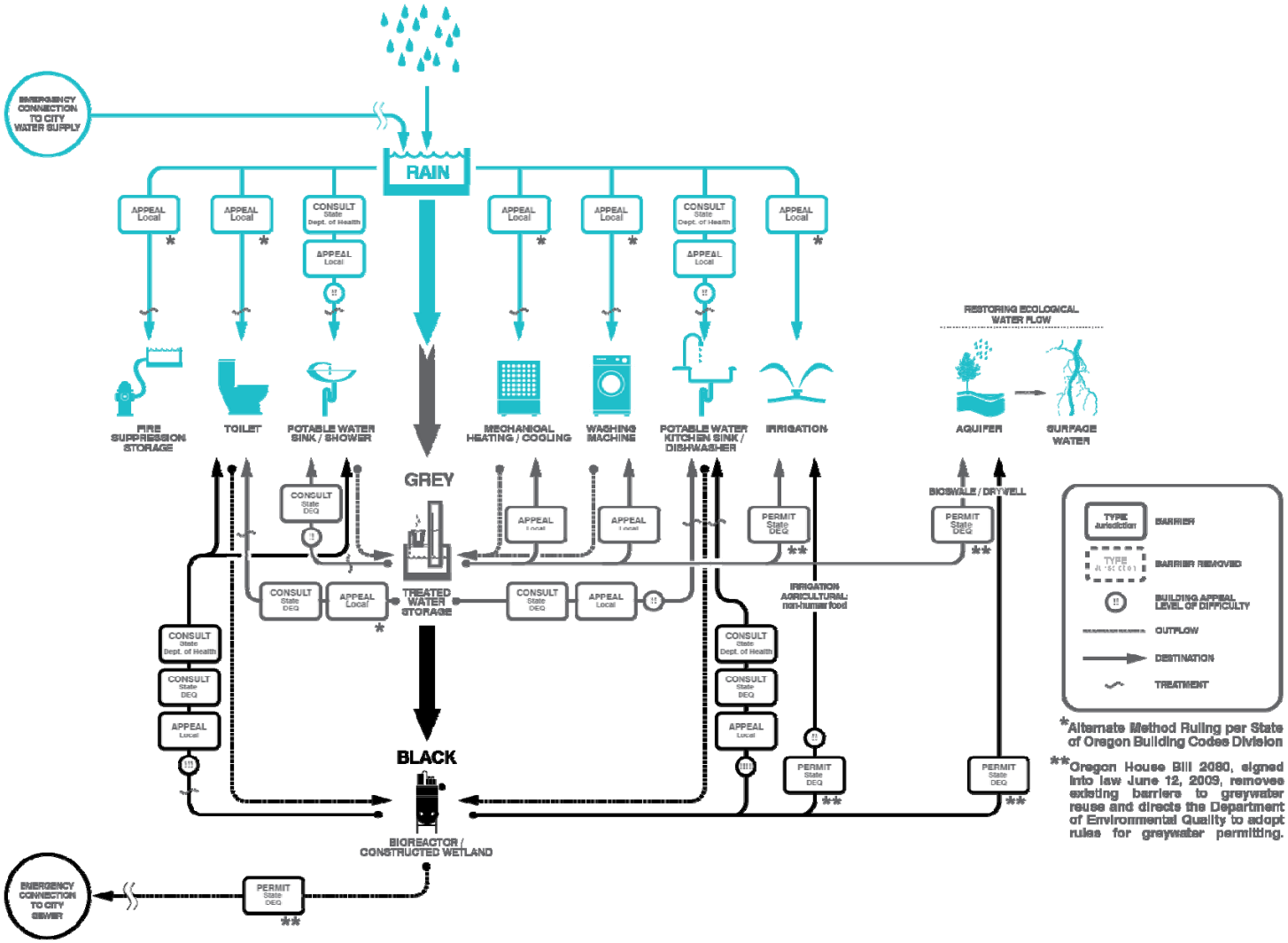
Uses:

subsurface irrigation

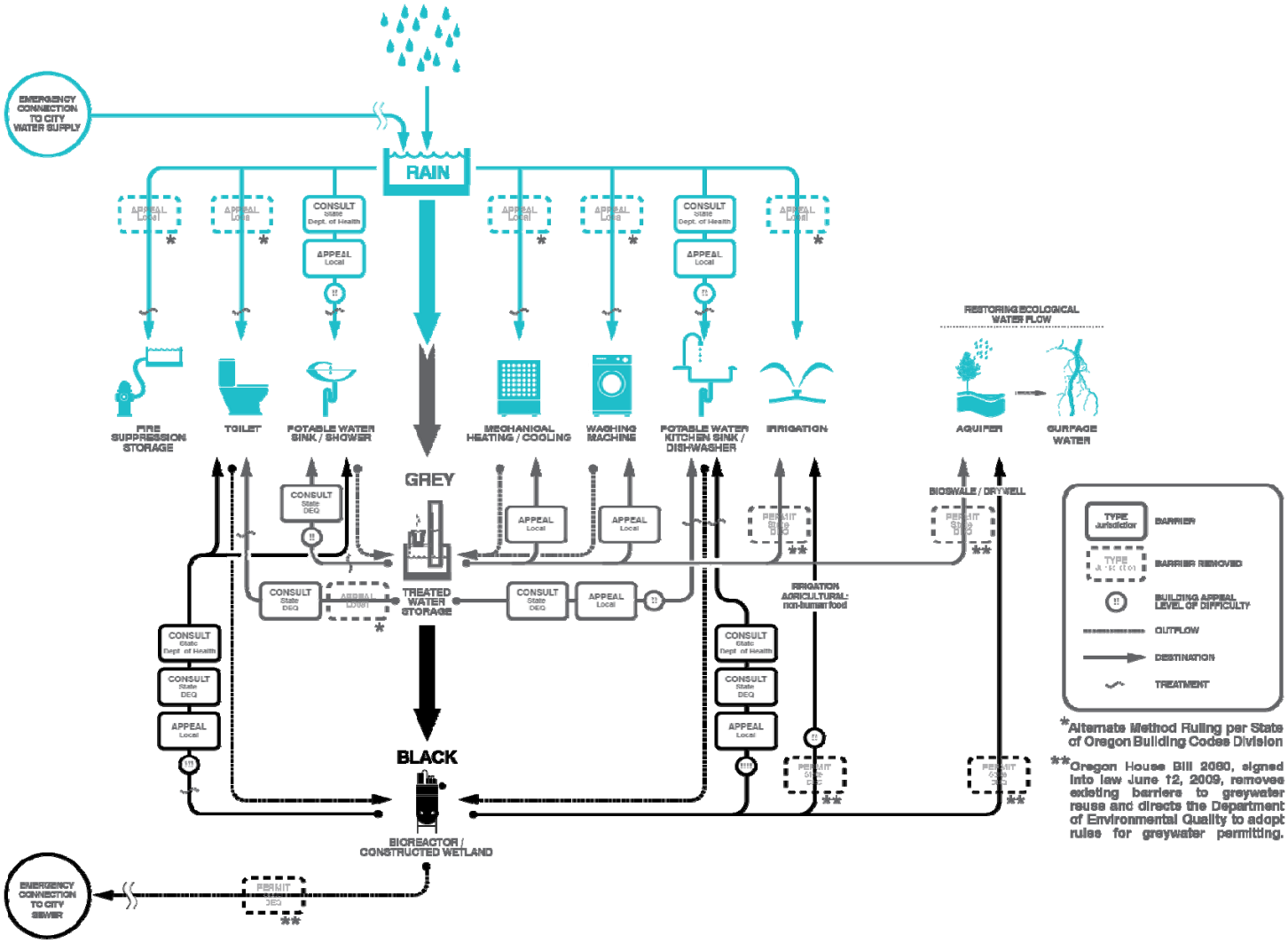
drip irrigation / landscape ponds

sprinkler irrigation / dust control.

Oregon Road Map



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

INTERFACE ENGINEERING

Project Name:	Oregon Sustainability Center		<- Data Input Required	Year 2	1944	23.26
Project Number:	2010-0659		<- cells populated by input	Year 3	1952	25.70
Location:	Portland, Oregon		<- cells populated by calcu	Year 4	1929	26.11
			Expand column M to position graphs =>	Year 5	1976	26.71

Occupancy

Rainfall Data Type: 5 Driest

User Group	Group Name	# Occupants
1	FTE	545
2	Visitor	230
3	College Student	2160
4	Retail Customer	600
5	Special Event	300
6		
7		
8		

Watershed Area

Area 1	Area Name:	Roof Area	
	Area (sq. ft):	26000	
		Well Accepted Defaults	<=Roof Material
		90%	<=co-efficient of loss
Area 2	Area Name:	Auditorium PV	
	Area (sq. ft):	3000	
		Well Accepted Defaults	<=Roof Material
		90%	co-efficient of loss
Area 3	Area Name:	Planted Cell	
	Area (sq. ft):	3500	
		Well Accepted Defaults	<=Roof Material
		90%	co-efficient of loss
Area 4	Area Name:		
	Area (sq. ft):		
		Well Accepted Defaults	<=Roof Material
		90%	co-efficient of loss

Month to Begin

January

The precipitation data is entered such that day 1 is Jan 1st. This cell shifts the simulation such that day 1 is the first day of the selected month. The simulation is looped. The last months of the 5th year are inserted

Mechanical Systems

Are cooling tower blow down and condensate being captured?	no	<= Currently disabled
Size of cooling system (tons)	20	DO NOT TURN ON

Deviation From Original Fill Graph

Select water reuse scheme => Grey and Black Reused

This input does not affect the simulation; it only affects the "Deviation from Original Fill" graph. This graph is not a part of the simulation. It is a tool for system sizing.

Place cursor over this cell to see general information about this graph

Place cursor over this cell to see information on how to read this graph

Tank Information

See the instruction's section on tanks and the flow diagram pdf.

Tank Size, Initial Fill, and Overflow Designation

"Overflow Designation" dictates where a tank will overflow. Only overflow into a lower quality tank is permitted.

The highest quality water is in tank 1, and the lowest is in tank 4.

	Tank Size (gal)	Initial Fill (gal)	Overflow Destination
Tank 1	2700	2700	Tank 2
Tank 2	205000	180000	Tank 4
Tank 3	5000	0	Tank 4
Tank 4	10000000000	0	Sewer
Black Water System	<= see black water treatment section below		

Selection of Destination

choose tank for which the following water sources will feed:

Rain Water	Tank 2
Mechanical Water	Sewer
Reclaimed Grey Water	Black Treatment
Treated Black Water	<= see black water treatment section below

Selection of Water Quality

Choose lowest quality tank acceptable for the following. (will pull from the lowest first until empty, then work up in quality)

Potable Water	Tank 1
Grey Water	Tank 3

Black Water Treatment

Treated Black Water Destination	Tank 3

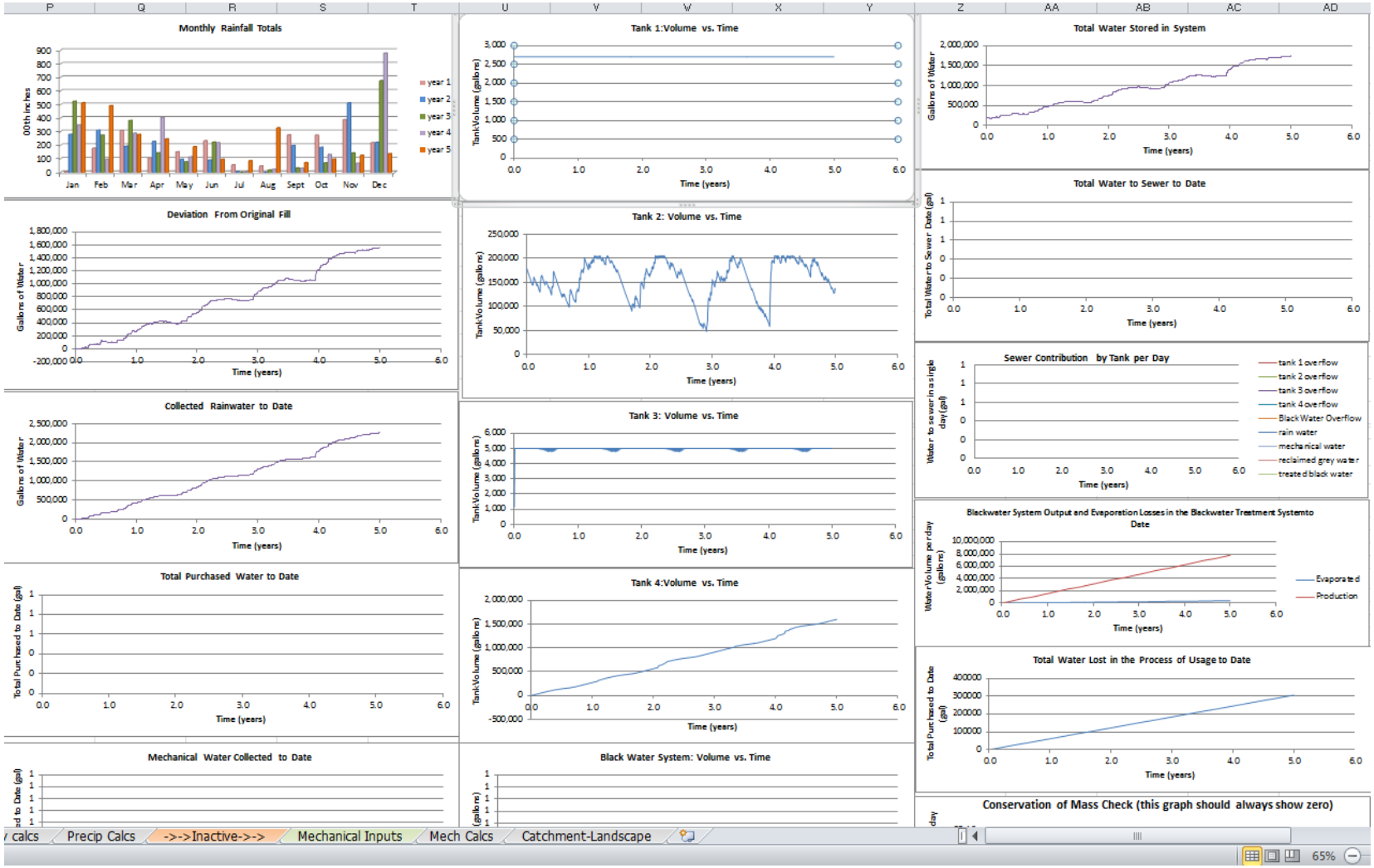
	Tank Size (gal)	Initial Fill (gal)	Overflow Destination
Black Water System Tank Size and Initial Fill (gallons)	12000	0	Sewer
Maximum Flow Rate (gallons per day)	7000	note: There is no choice regarding blackwater overflow, any blackwater overflow will go to the sewer system	
planted cell area (ft2)	3500		

Potable Treatment System

Instructions | Input-Dashboard | Occupant Water Use Input | Precipitation Input | 30 day hourly input | <- Inputs, Calculations-> | Calculator | 30 day hou

RAINWATER CALCULATOR

INTERFACE ENGINEERING



RAINWATER CALCULATOR

INTERFACE ENGINEERING

Occupant Water Use Inputs

<- Data Input Required

<- cells populated by input in another cell. DO NOT OVERRIDE

<- cells populated by calculations. DO NOT OVERRIDE

Expand column R to position graphs =>

FTE

	% Female	% Male
Gender Breakdown=>	50%	50%

Consumption and Production per Person per Day

User

Fixture Type	Part #/ Description	Input Method	Gallons per Use	OR	Gallons per Minute	Minutes per Use	Gallons per Use Used in Subsequent Calculations	Uses per Day	Gender Corrected Uses Per Day	Water Consumed per Day (Gallons)	Lowest Consumable Water Quality	% Water Consumed which goes to Produced	Water Produced per Day (Gallons)	Water Quality Produced
watercloset (dualflush-low)		Gallons per Use					0		0	0		100%	0	black
urinal		Gallons per Use					0		0	0		100%	0	black
drinking water		Gallons per Use	0.125				0.125	3	N/A	0.375	potable	0%	0	
watercloset (dualflush-heavy)		Gallons per Use	1.6				1.6	1	N/A	1.6	grey	100%	1.6	black
watercloset (dualflush-low)		Gallons per Use	0.8				0.8	3	N/A	2.4	grey	100%	2.4	black
urinal		Gallons per Use	0.125				0.125	0	N/A	0	grey	100%	0	black
lavatory (metered)		Gallons per Use	0.125				0.125	4	N/A	0.5	potable	100%	0.5	grey
shower		GPM and Time per Use		OR	1.6	5	8	0.05	N/A	0.4	potable	100%	0.4	grey
kitchen sink (commercial)		GPM and Time per Use			1.8	0.25	0.45	1	N/A	0.45	potable	100%	0.45	black
dishwasher (commerical)		Gallons per Use	8				8	0.042	N/A	0.336	potable	100%	0.336	black
laundry washer		Gallons per Use							N/A			100%		
janitorial sink		GPM and Time per Use			2.5	1	2.5	0.06	N/A	0.15	potable	100%	0.15	black
									N/A			100%		
									N/A			100%		
										6.211	<= total		5.836	<= total

Occupancy Profile

		Sun	Mon	Tue	Wed	Thu	Fri	Sat
	Days of Week in Operation	25%	90%	90%	90%	90%	90%	30%

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
545	Months in Operation	100%	100%	100%	100%	100%	100%	100%	90%	100%	100%	93%	100%

Visitor

	% Female	% Male
Gender Breakdown=>	50%	50%

Consumption and Production per Person per Day

User

Fixture Type	Part #/ Description	Input Method	Gallons per Use	OR	Gallons per Minute	Minutes per Use	Gallons per Use Used in Subsequent Calculations	Uses per Day	Gender Corrected Uses Per Day	Water Consumed per Day (Gallons)	Lowest Consumable Water Quality	% Water Consumed which goes to Produced	Water Produced per Day (Gallons)	Water Quality Produced
watercloset (dualflush-low)		Gallons per Use					0		0	0		100%	0	black
urinal		Gallons per Use					0		0	0		100%	0	black
drinking water		Gallons per Use	0.125				0.125	0.3	N/A	0.0375	potable	0%	0	
watercloset (dualflush-heavy)		Gallons per Use	1.28				1.28	0.1	N/A	0.128	grey	100%	0.128	black
watercloset (dualflush-low)		Gallons per Use	0.8				0.8	0.3	N/A	0.24	grey	100%	0.24	black
urinal		Gallons per Use	0.125				0.125	0.3	N/A	0.0375	grey	100%	0.0375	black
lavatory (metered)		Gallons per Use	0.125				0.125	0.4	N/A	0.05	potable	100%	0.05	grey
shower		GPM and Time per Use		OR	1.6	5	8	0.01	N/A	0.08	potable	100%	0.08	grey
kitchen sink (commercial)		GPM and Time per Use			1.8	0.25	0.45	0	N/A	0	potable	100%	0	black
dishwasher (residential)		Gallons per Use	8				8	0	N/A	0	potable	100%	0	black
laundry washer		Gallons per Use						0	N/A			100%		
janitorial sink		GPM and Time per Use			2.5	1	2.5	0	N/A	0	potable	100%	0	black

Instructions | Input-Dashboard | Occupant Water Use Input | Precipitation Input | 30 day hourly input | <- Inputs, Calculations-> | Calculator | 30 day hourly calcs | Precip Calcs | ->->Inactive->-> | Mechanic

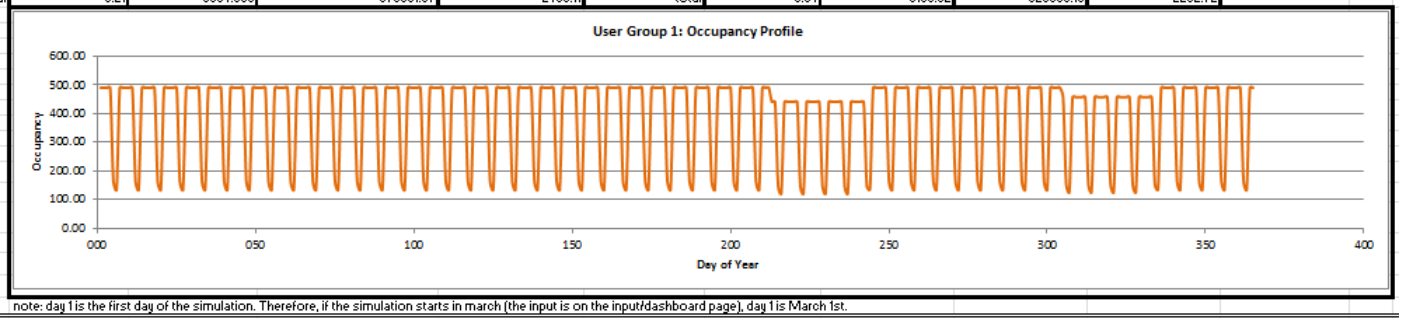
Ready Calculate

RAINWATER CALCULATOR

INTERFACE ENGINEERING

User Group 1 FTE

	Water Consumed per Occupant per Day (gallons)	Water Consumed by Group per Day (gallons)	Water Consumed by Group per Year (gallons) (based on equivalent days per year)	Average Water Consumption per Day (gallons)		Water Production per Occupant per Day (gallons)	Water Produced by Group per Day (gallons)	Water Produced by Group per Year (gallons) (based on equivalent days per year)	Average Water Production per Day (gallons)	Total Equivalent Days in a Year (days)
										259.7
potable uses	2.21	1204.995	312894.05	857.24	greywater	0.90	490.5	127365.28	348.95	
greywater uses	4.00	2180	566067.93	1550.87	blackwater	4.94	2690.12	698527.82	1913.77	
total	6.21	3384.995	878961.97	2408.11	total	5.84	3180.62	825893.10	2262.72	



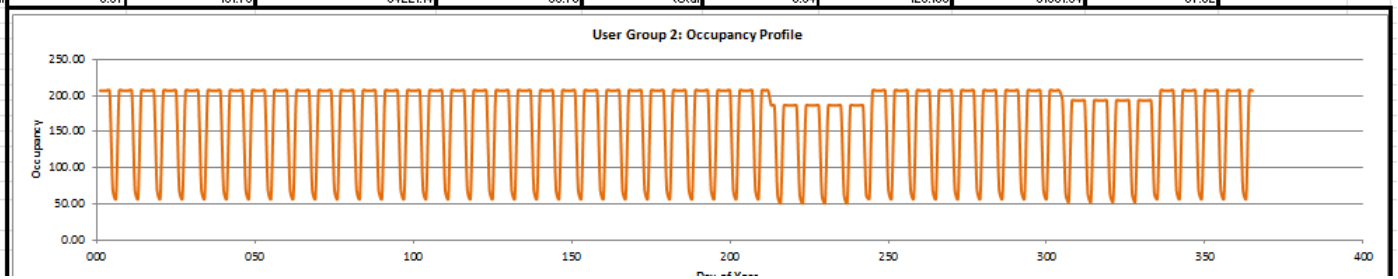
note: day 1 is the first day of the simulation. Therefore, if the simulation starts in march (the input is on the input/dashboard page), day 1 is March 1st.

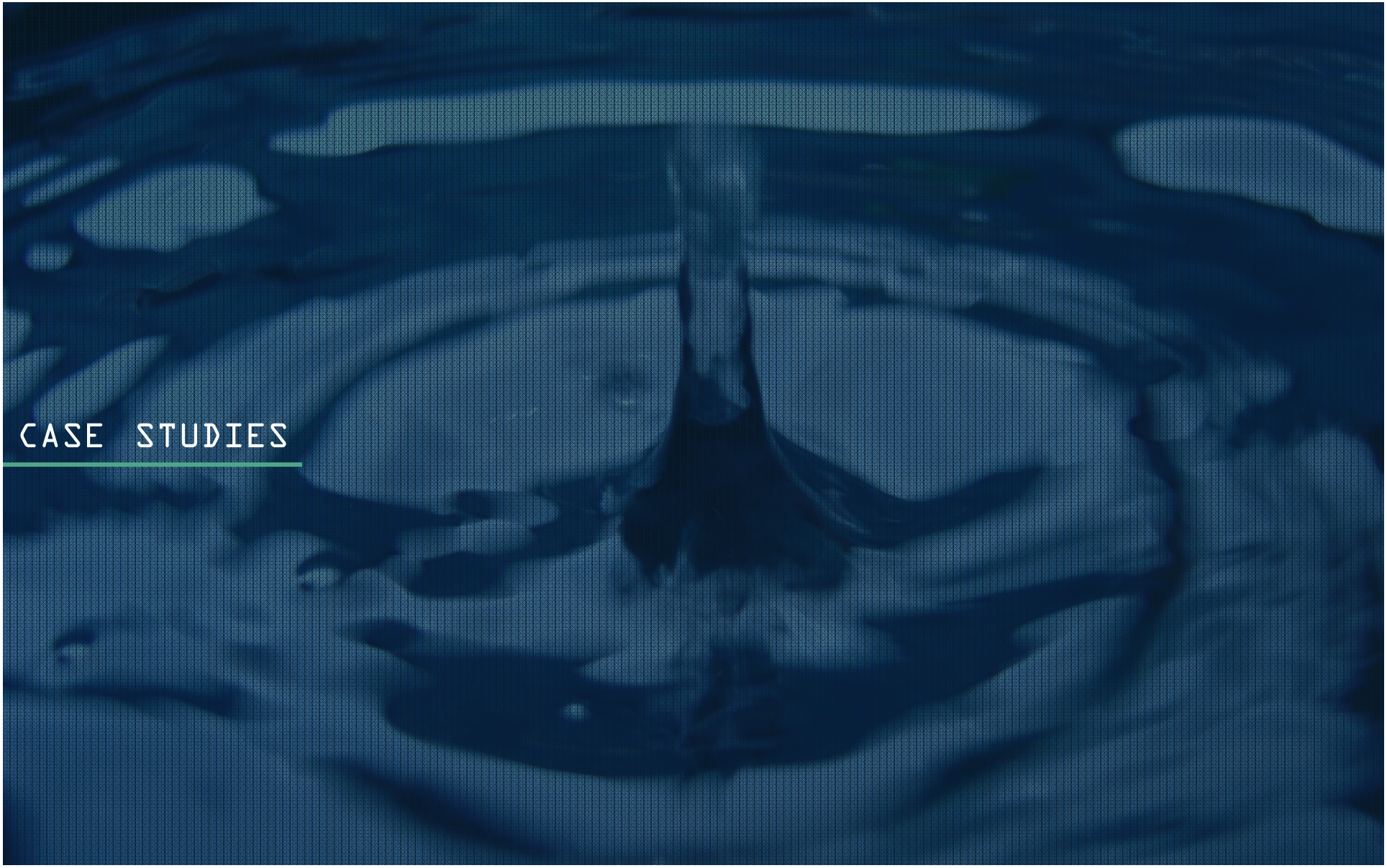
Male

50%

User Group 2 Visitor

	Water Consumed per Occupant per Day (gallons)	Water Consumed by Group per Day (gallons)	Water Consumed by Group per Year (gallons) (based on equivalent days per year)	Average Water Consumption per Day (gallons)		Water Production per Occupant per Day (gallons)	Water Produced by Group per Day (gallons)	Water Produced by Group per Year (gallons) (based on equivalent days per year)	Average Water Production per Day (gallons)	Total Equivalent Days in a Year (days)
										259.7
potable uses	0.17	38.525	10003.56	27.41	greywater	0.13	29.9	7763.96	21.27	
greywater uses	0.41	93.265	24217.58	66.35	blackwater	0.41	93.265	24217.58	66.35	
total	0.57	131.79	34221.14	93.76	total	0.54	123.165	31981.54	87.62	





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:

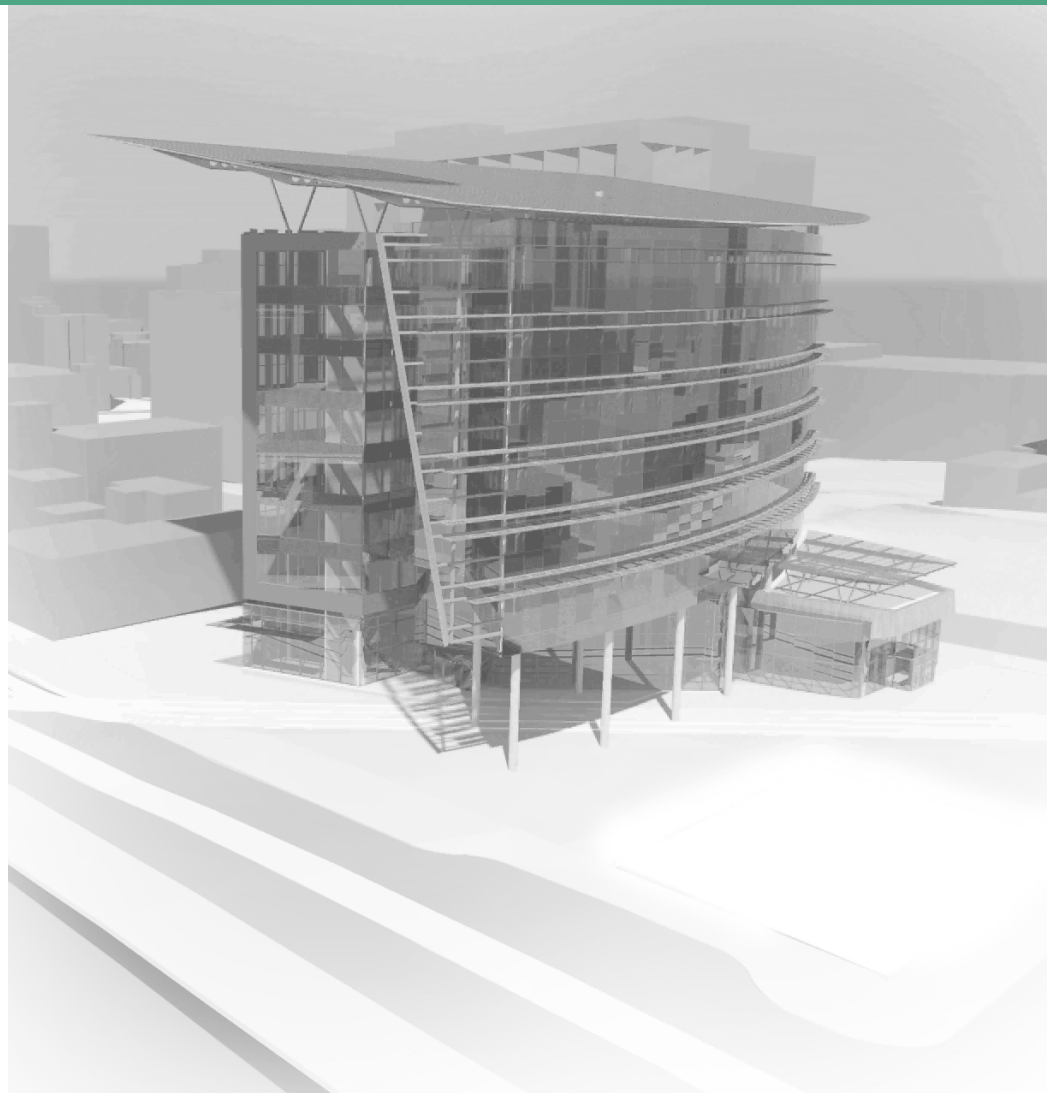
- 100,000 sf
- Offices / Mixed-Use
- 7- 9 stories
- Up to 1,400 FTE's

INTERFACE ENGINEERING

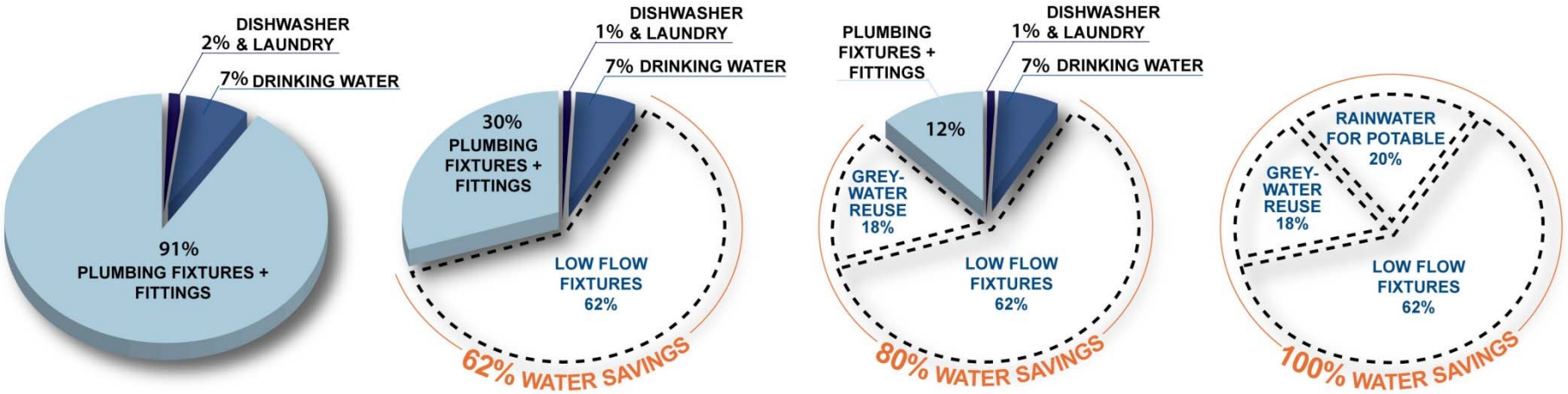
Oregon Sustainability Center

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



Water Savings



Water Usage Base Case

Low Flow Fixtures

Proposed Water Use Reduction

+ Blackwater Recycling

Proposed Water Use Reduction

+ Rainwater Collection

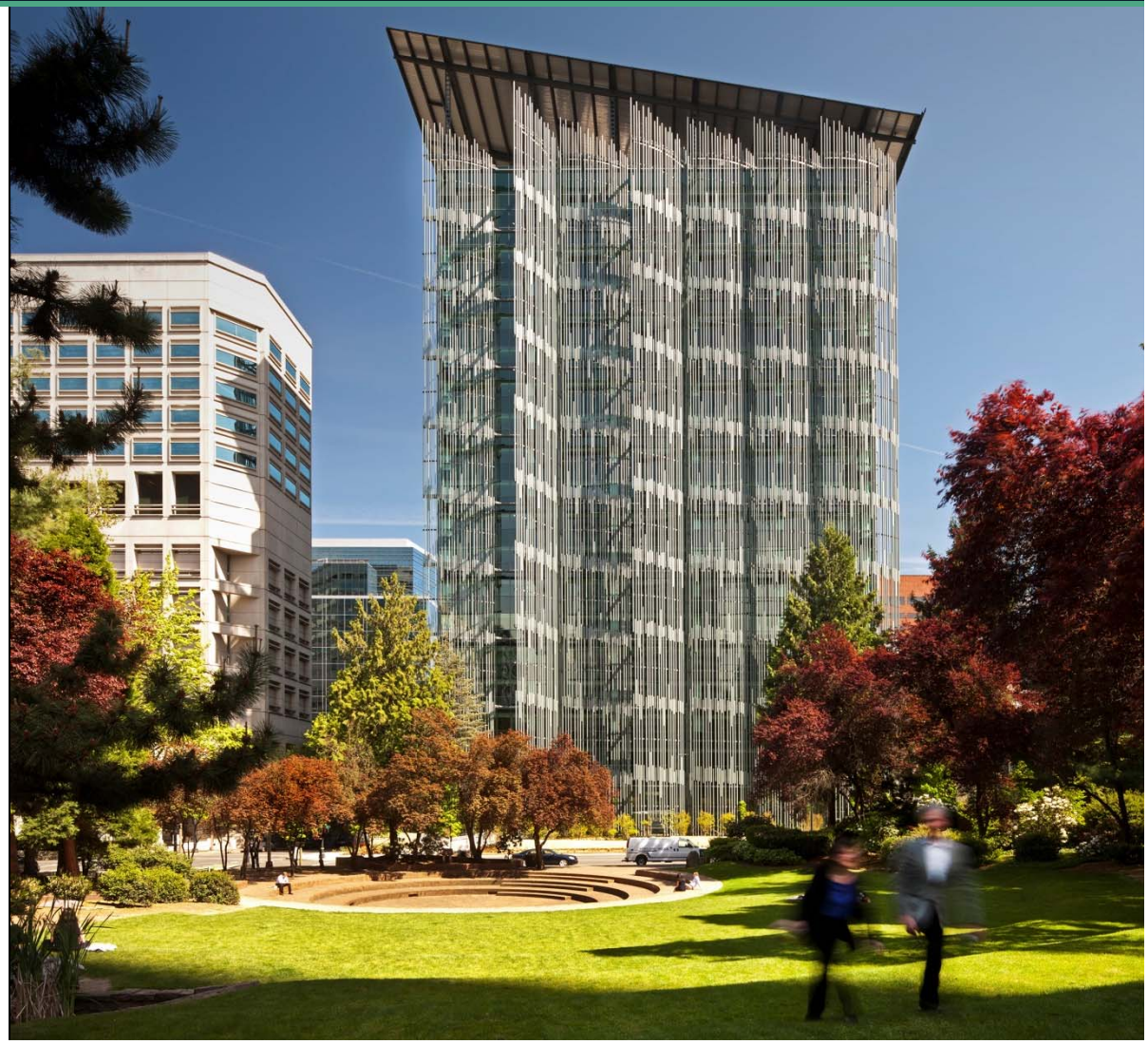
Proposed Water Use Reduction

Edith Green-Wendell Wyatt

Federal Building

Building stats:

- LEED Platinum Certified
- 437,000 sf
- Offices
- Renovation
- 18 stories

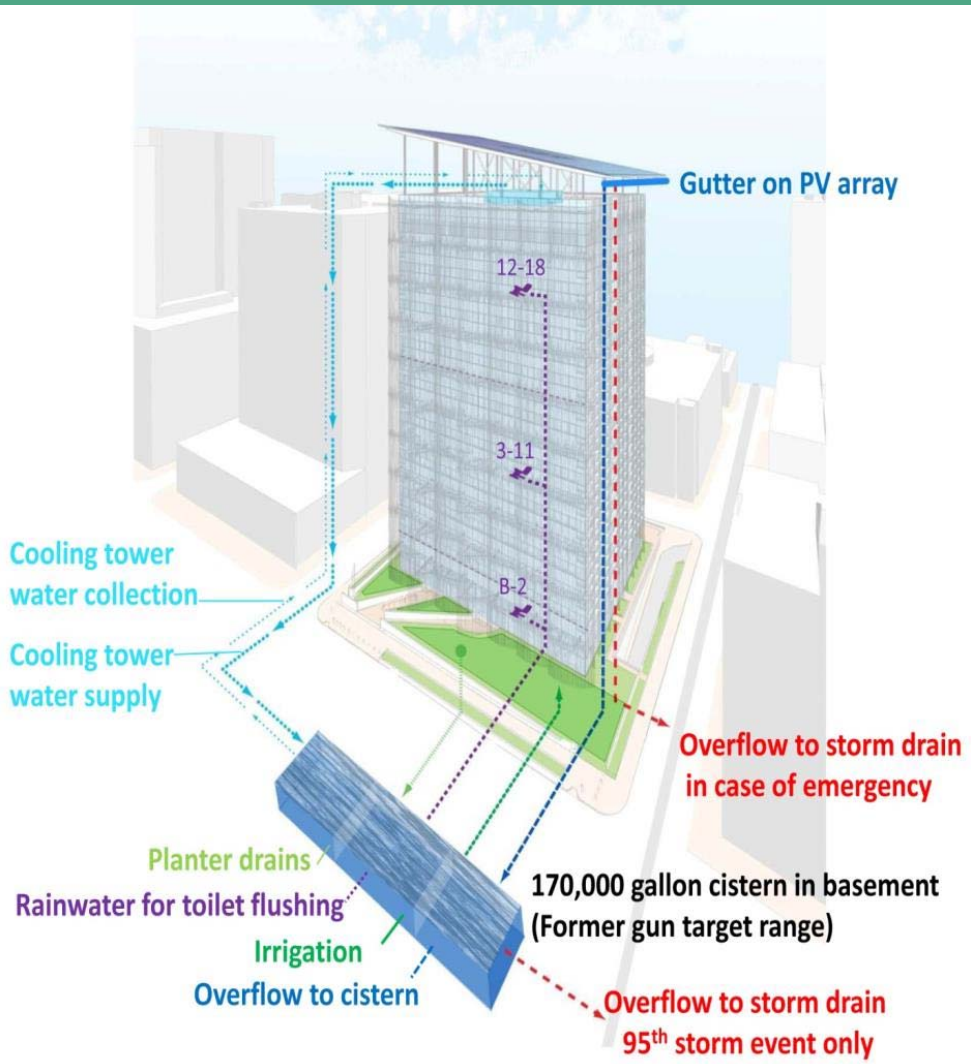


INTERFACE ENGINEERING

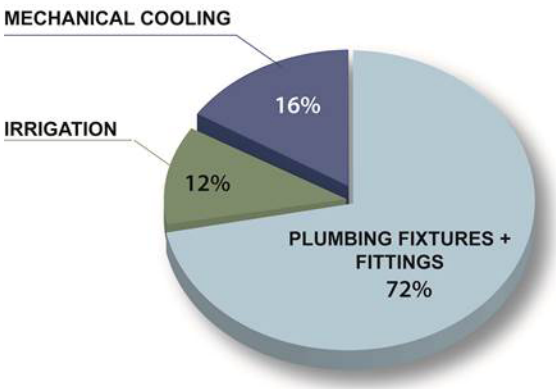
Rainwater Reuse System

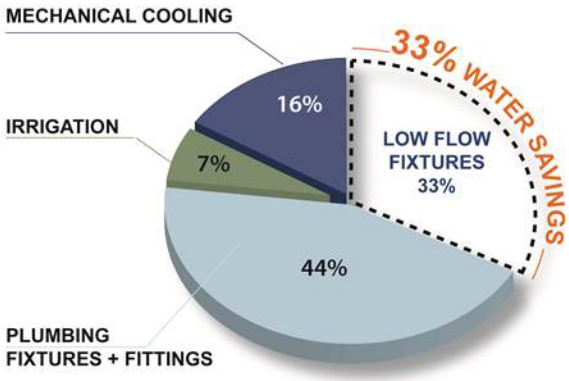
62% Potable Water Use Reduction

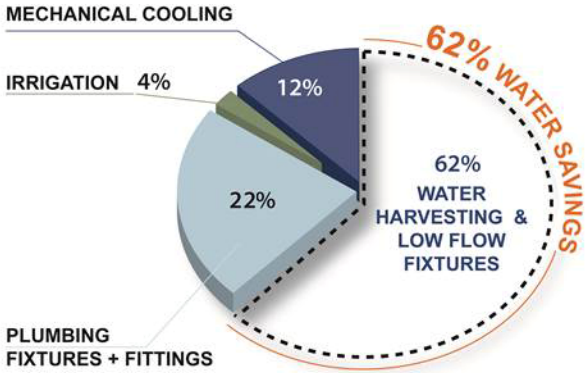
- Low-flow fixtures
- Rainwater collection & reuse
- Stormwater controls



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

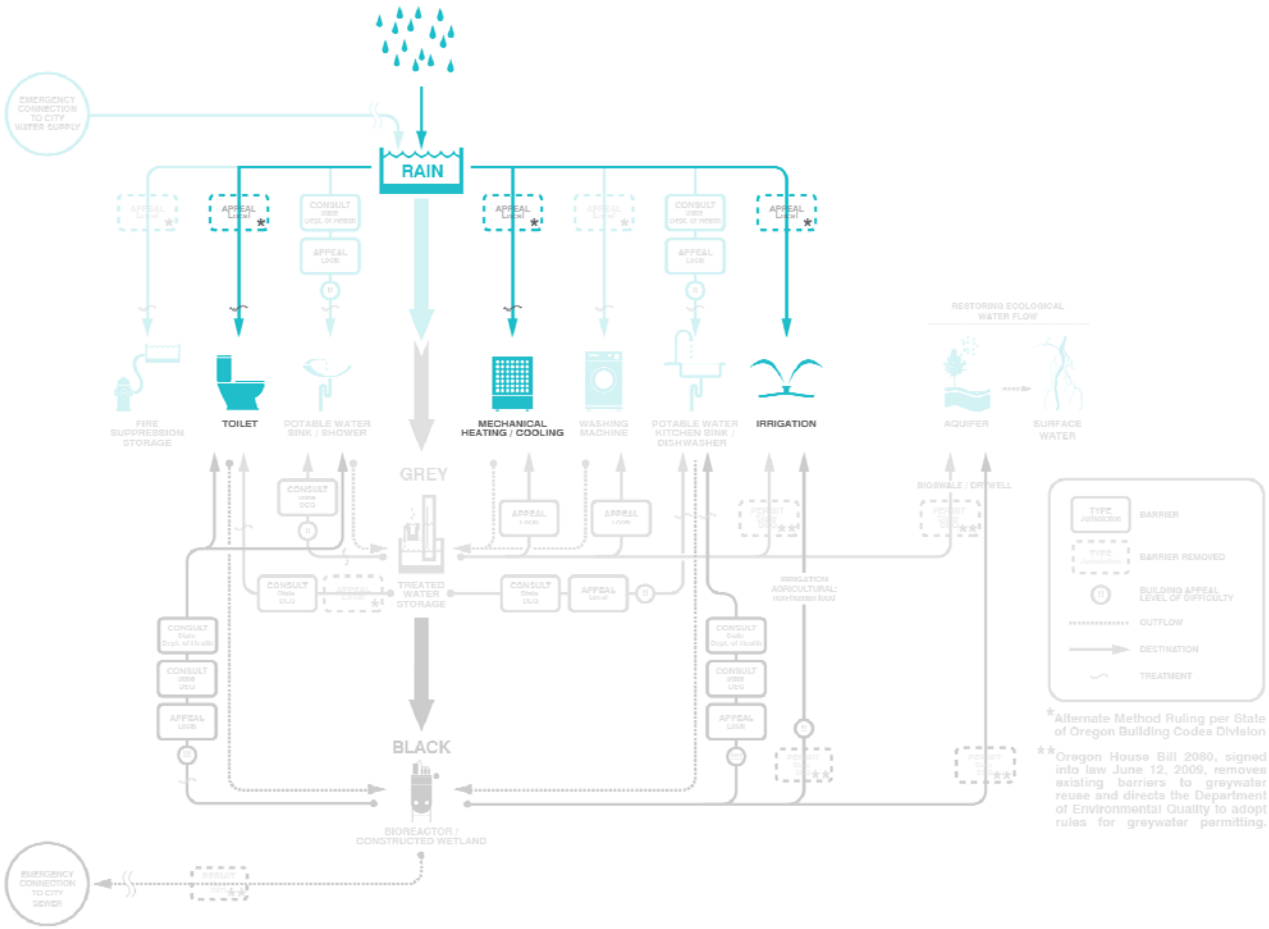
+Rainwater Collection

Proposed Water Use Reduction

CASE STUDY: EDITH GREEN-WENDELL WYATT

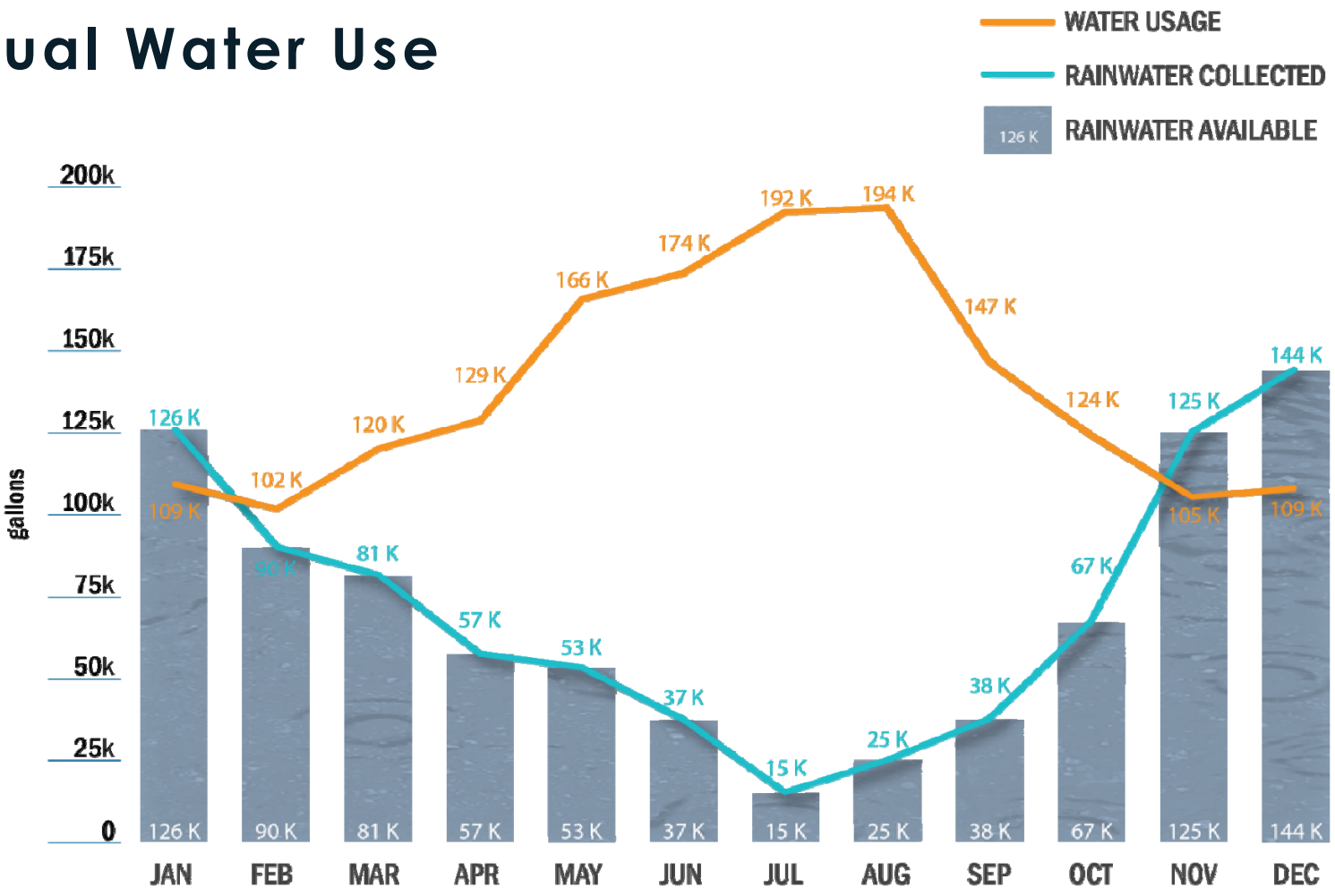
INTERFACE ENGINEERING

Road Map

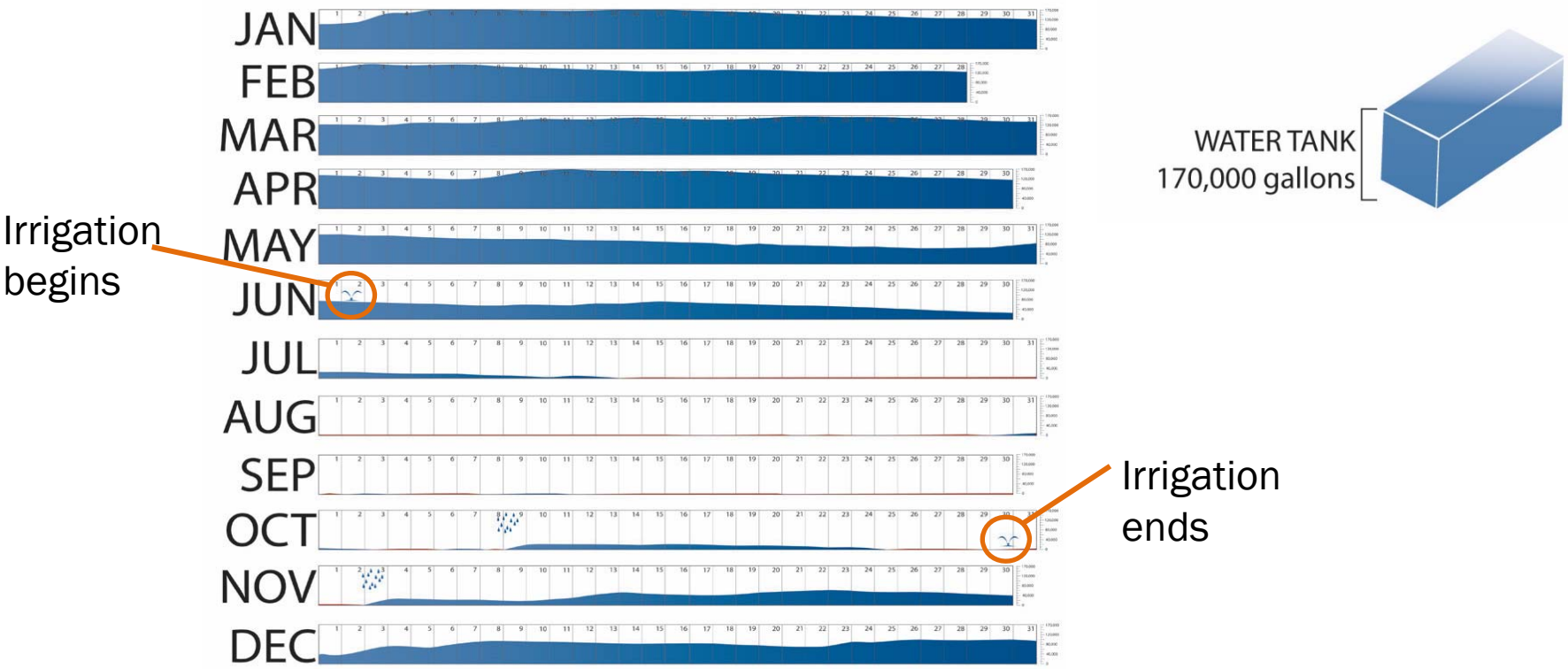


INTERFACE ENGINEERING

Annual Water Use



Annual Water Storage



Chatham University

Eden Hall Campus

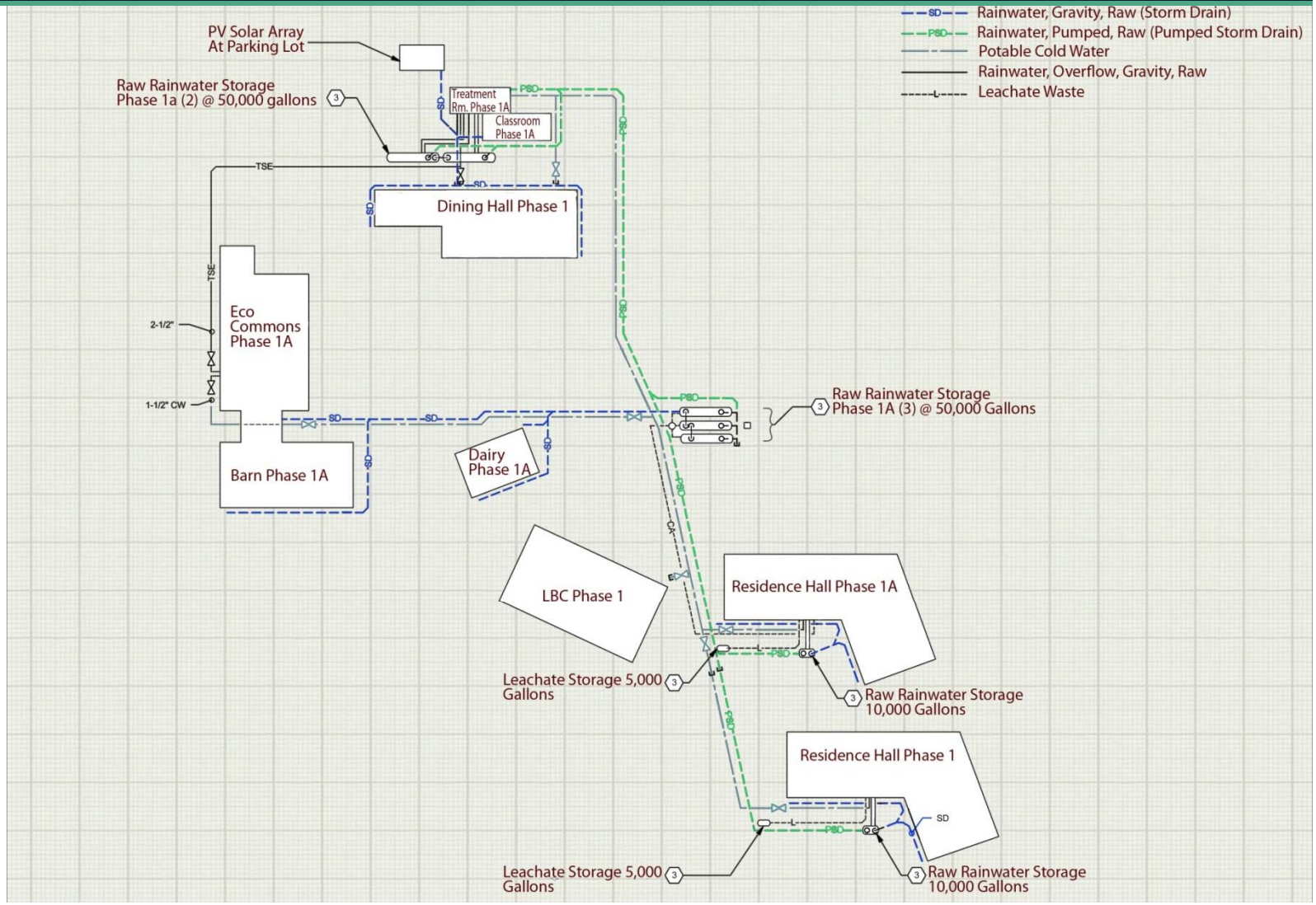
Building stats:

- 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

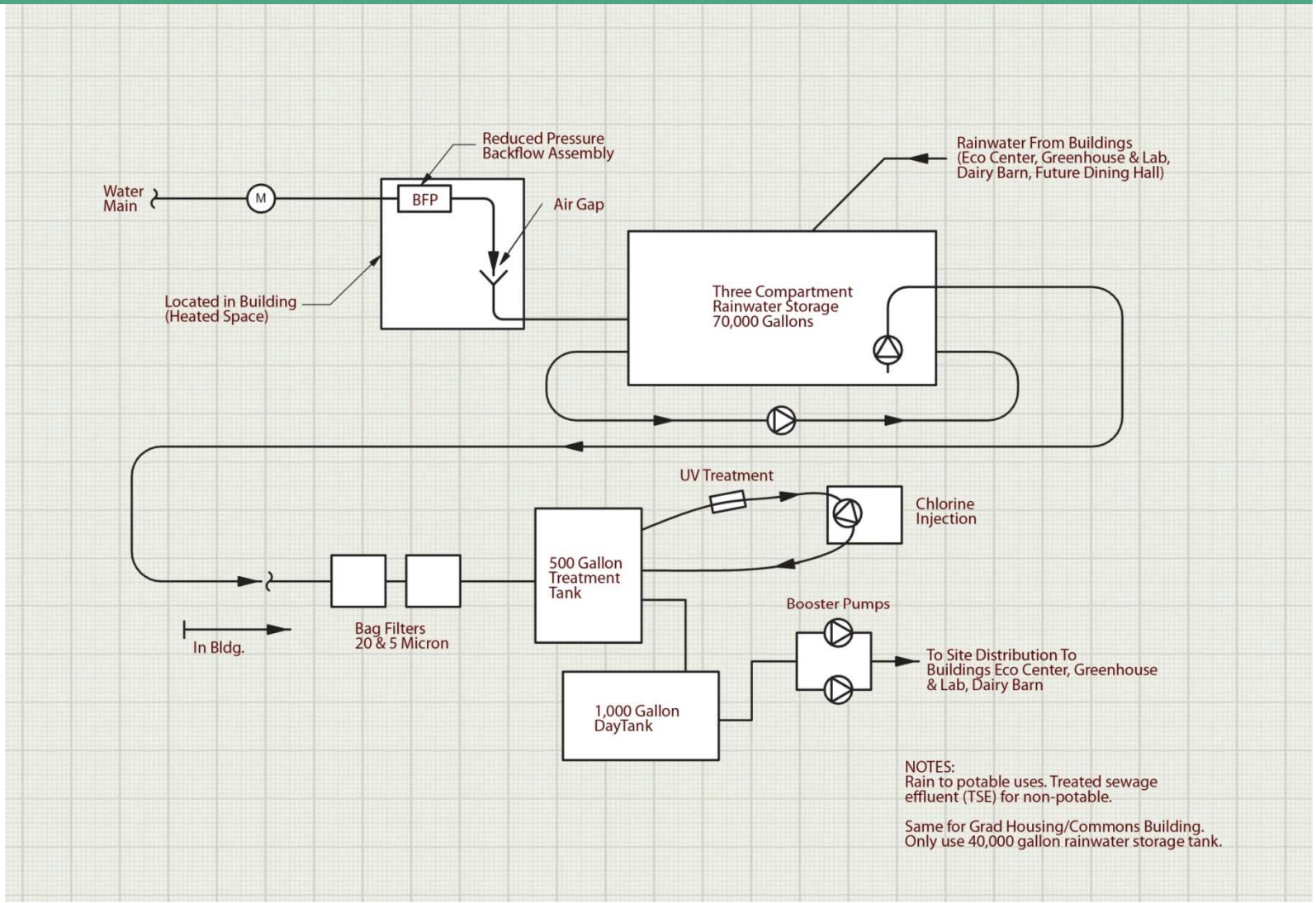
INTERFACE ENGINEERING

Site Plan



INTERFACE ENGINEERING

Water Flow



CASE STUDY: CHATHAM UNIVERSITY

Chatham was to be the first campus built in the U.S. from the ground up to integrate sustainable development, living, and learning:

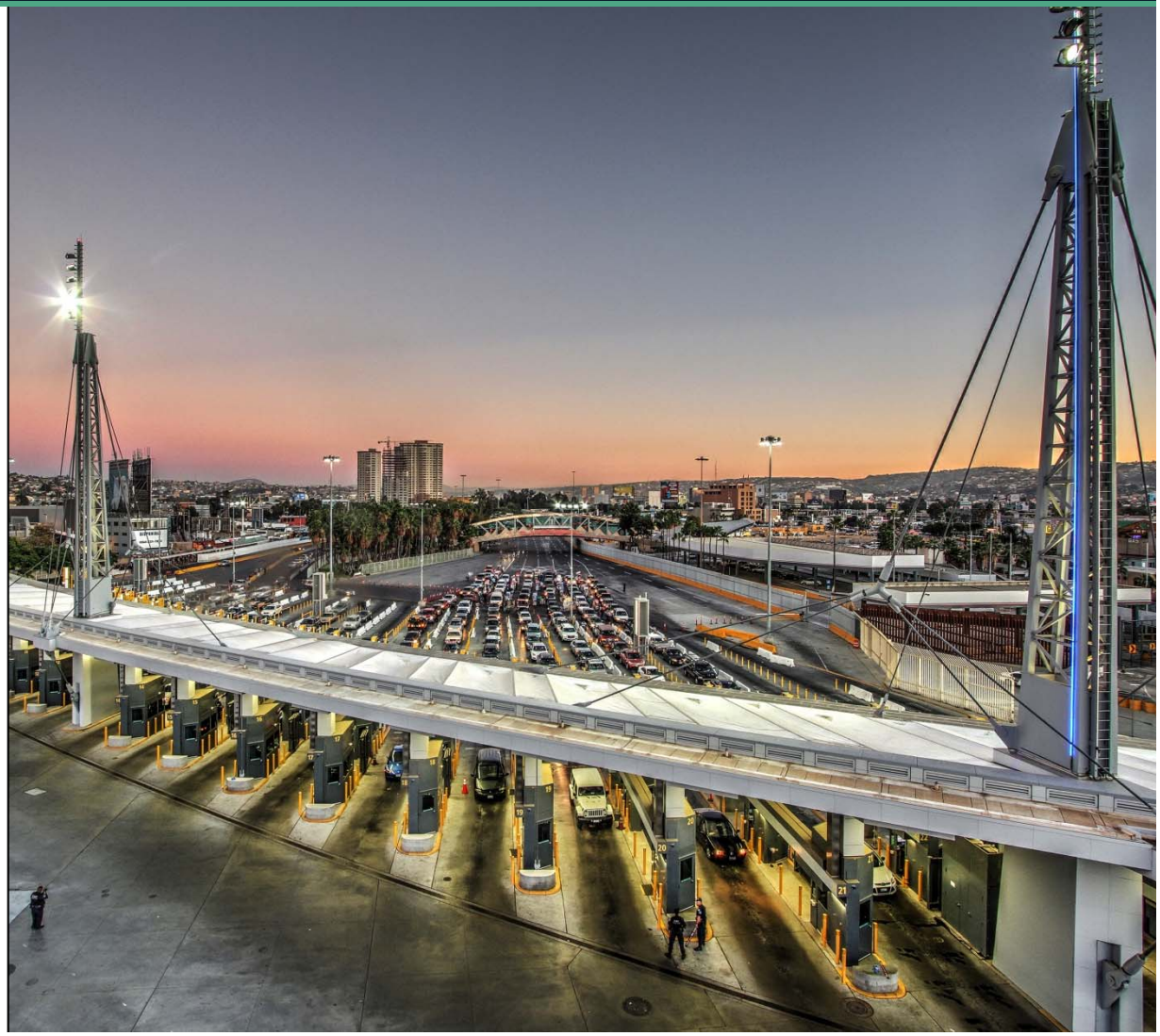
- Net zero water on an average across the campus (the campus, on an average rainfall year, would have utilized water from the Richland Township)
- Potable water would have been provided from the rainwater collection and filtration system
- Incorporated a constructed wetland to treat sewage, providing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

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

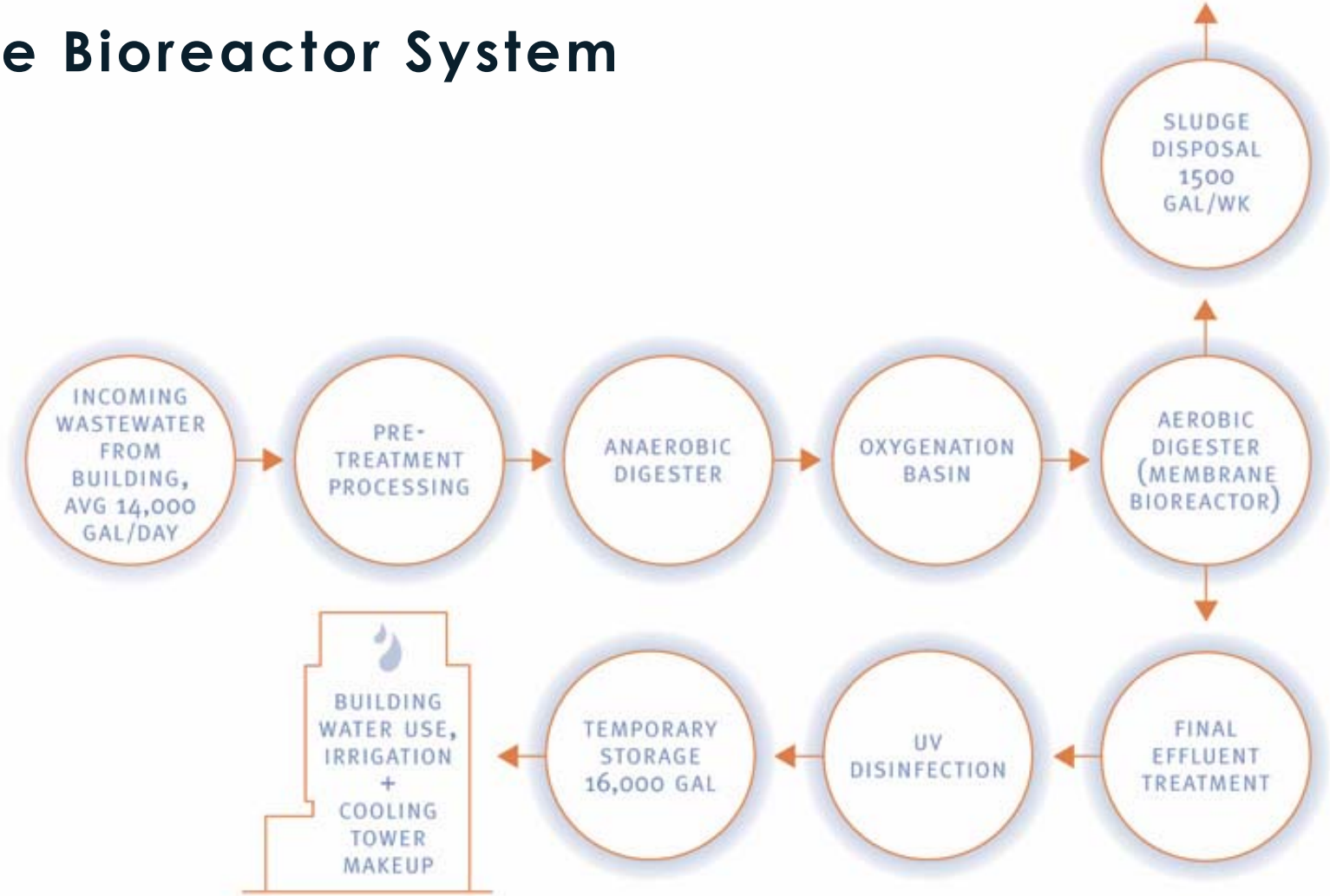


CASE STUDY: SAN YSIDRO US LAND PORT OF ENTRY

INTERFACE ENGINEERING

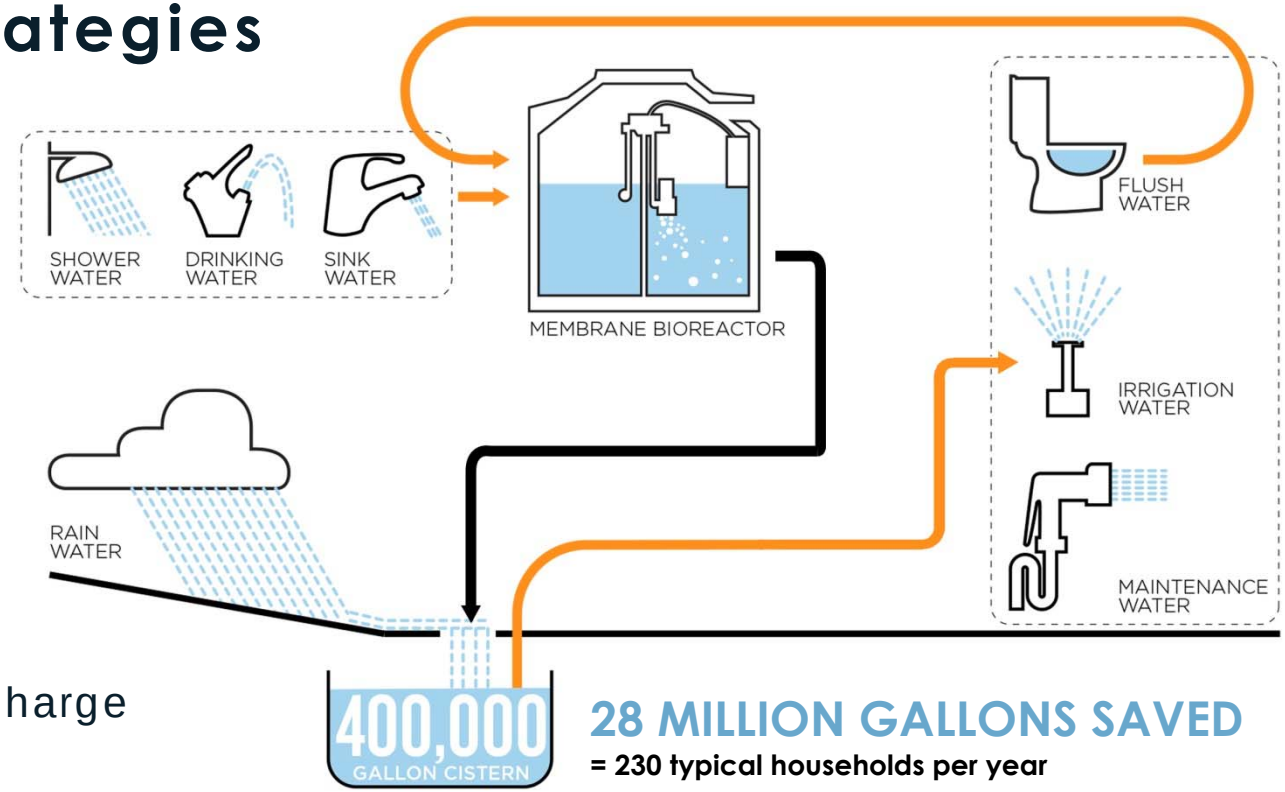
Membrane Bioreactor System

Headhouse (HH)



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)

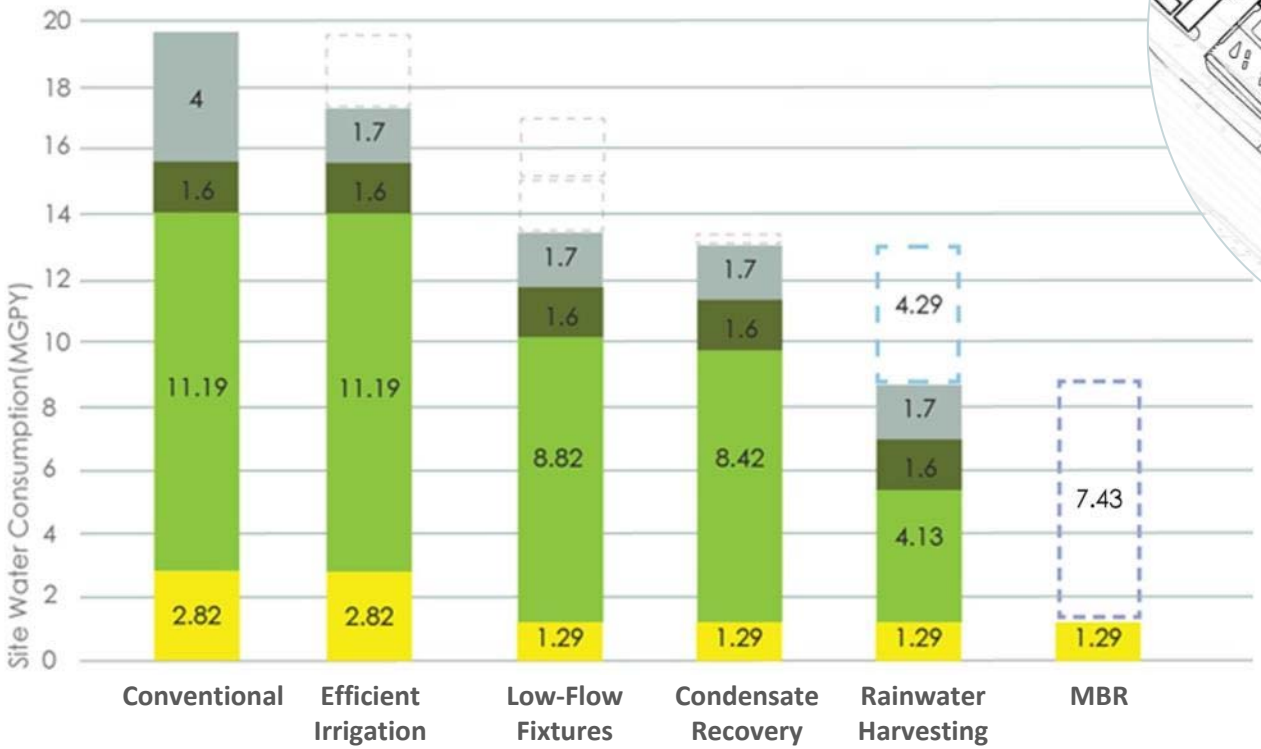


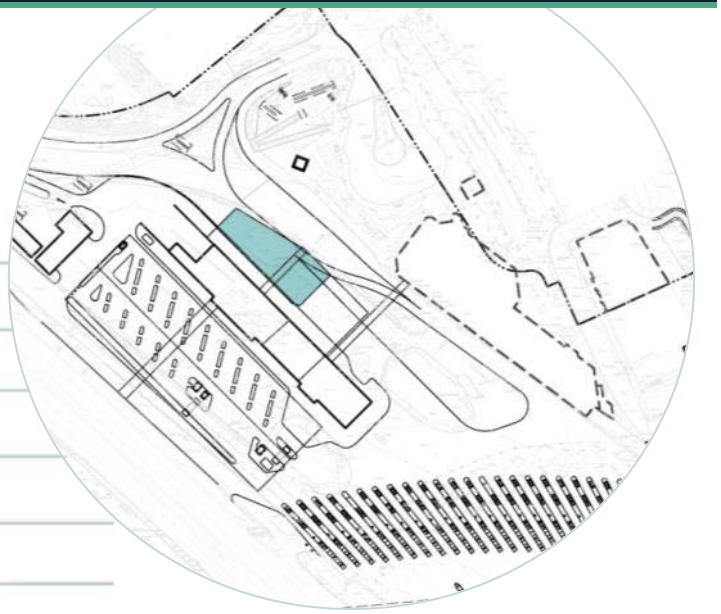
28 MILLION GALLONS SAVED

= 230 typical households per year

INTERFACE ENGINEERING

Water and Waste





Irrigation
Cooling Tower
Nonpotable
Potable
Cistern Supply
Membrane Bio-Reactor

40-YEAR COST SAVINGS: $3.6 MILLION

CASE STUDY: SAN YSIDRO US LAND PORT OF ENTRY

INTERFACE ENGINEERING

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

INTERFACE ENGINEERING

EXISTING CAMPUS CONDITIONS

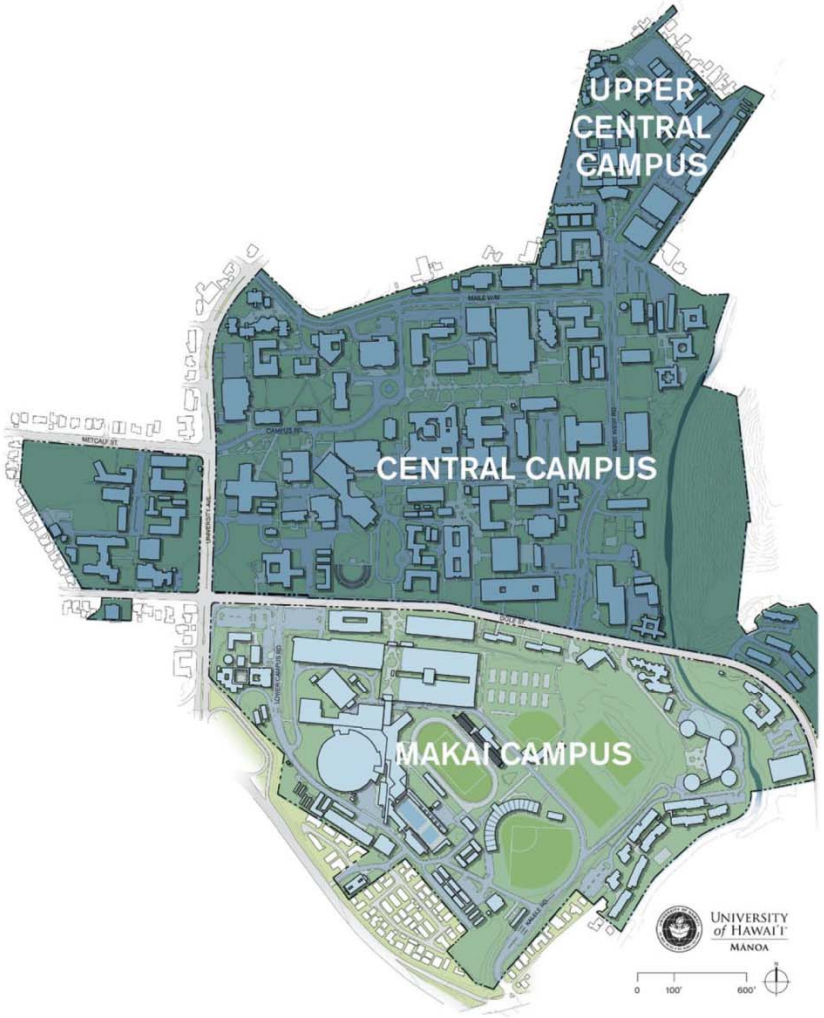
MAUKA CAMPUS & MAKAI CAMPUS

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

INTERFACE ENGINEERING

EXISTING CAMPUS CONDITIONS

MICROCLIMATES

UPPER CENTRAL

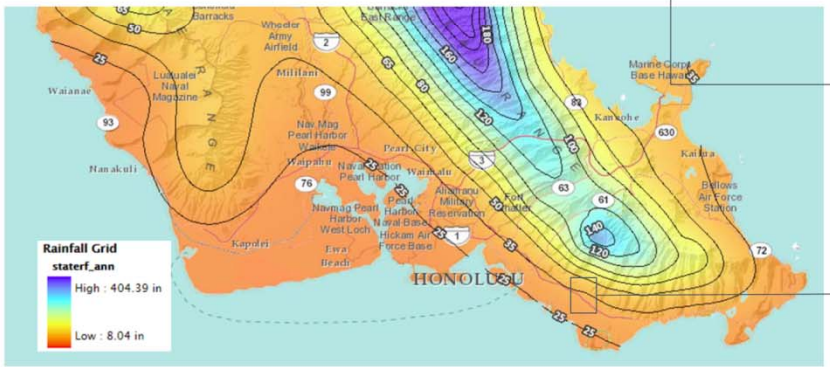
- Wettest Zone - Avg. Rainfall = 39"/year
- Approx. Elevation Range = 80' to 150'

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'



CASE STUDY: UHM INFRASTRUCTURE AND WATER MASTER PLAN

INTERFACE ENGINEERING

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

INTERFACE ENGINEERING

PROPOSED DESIGN CONCEPT

WATER BALANCE - RECOMMENDATION

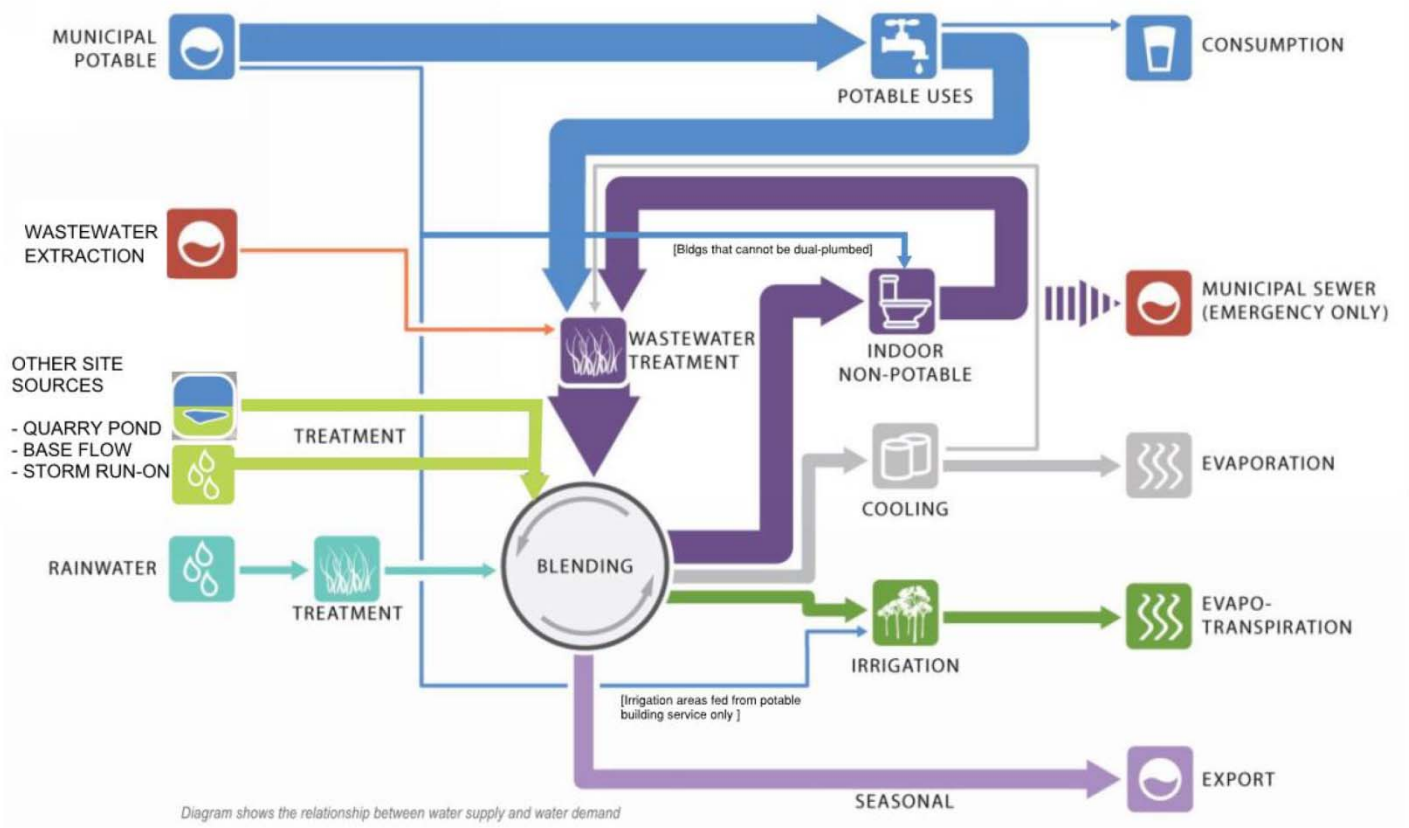


Diagram shows the relationship between water supply and water demand

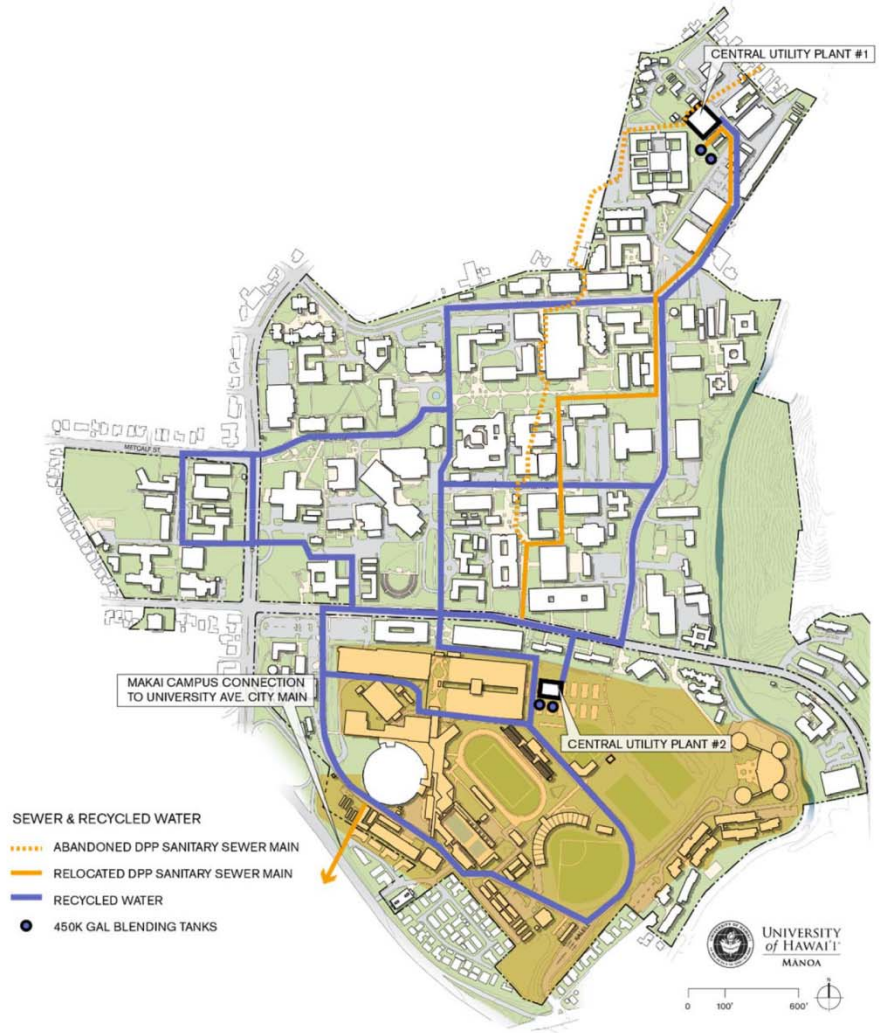
CASE STUDY: UHM INFRASTRUCTURE AND WATER MASTER PLAN

INTERFACE ENGINEERING

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.



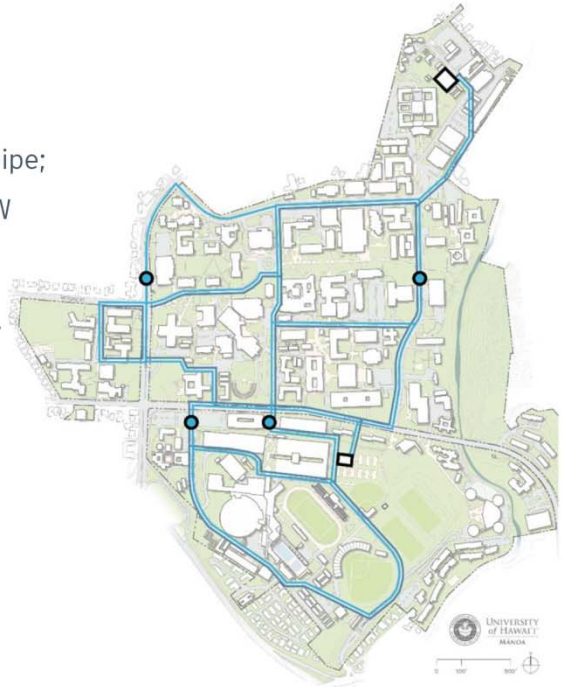
INTERFACE ENGINEERING

PROPOSED DESIGN CONCEPT

WATER

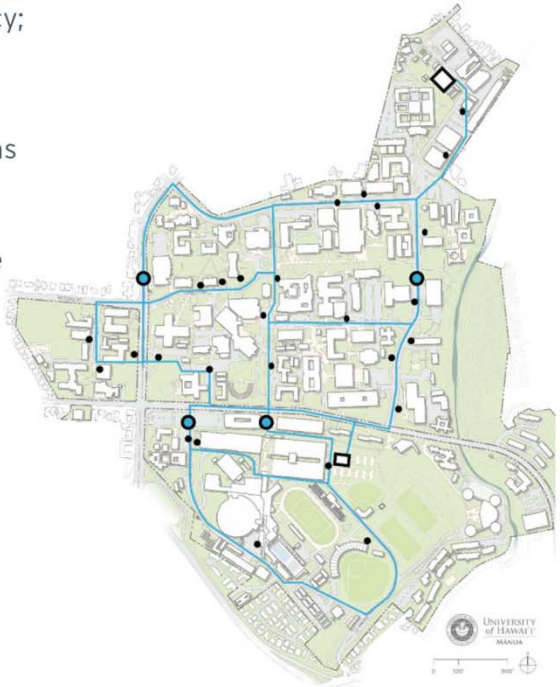
OPTION 1: SEPARATE FIRE AND DOMESTIC LOOPS

- 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.



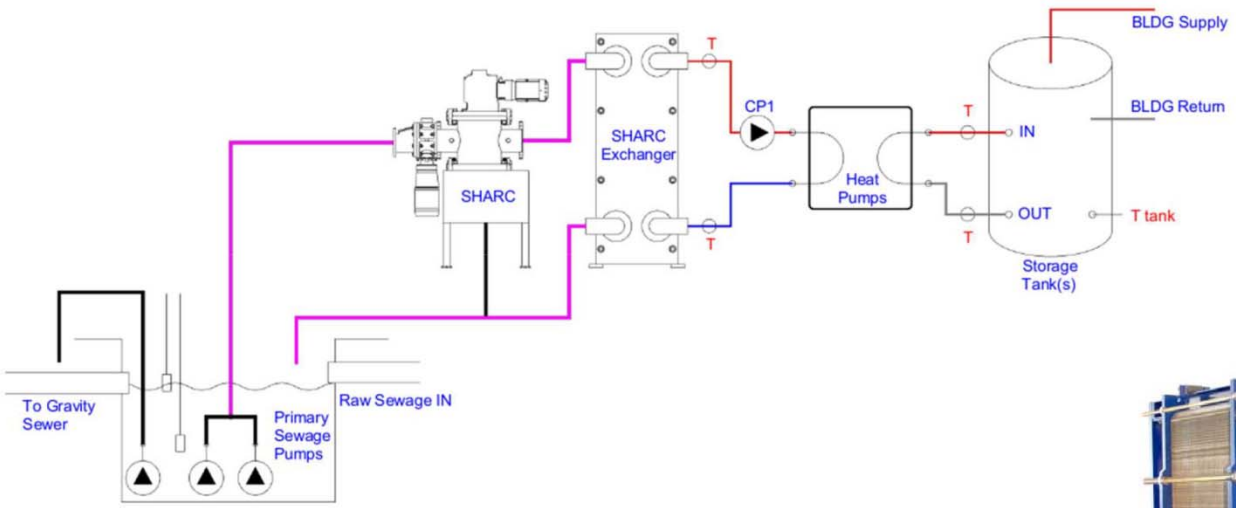
OPTION 2: COMBINED FIRE AND DOMESTIC LOOP

- 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.



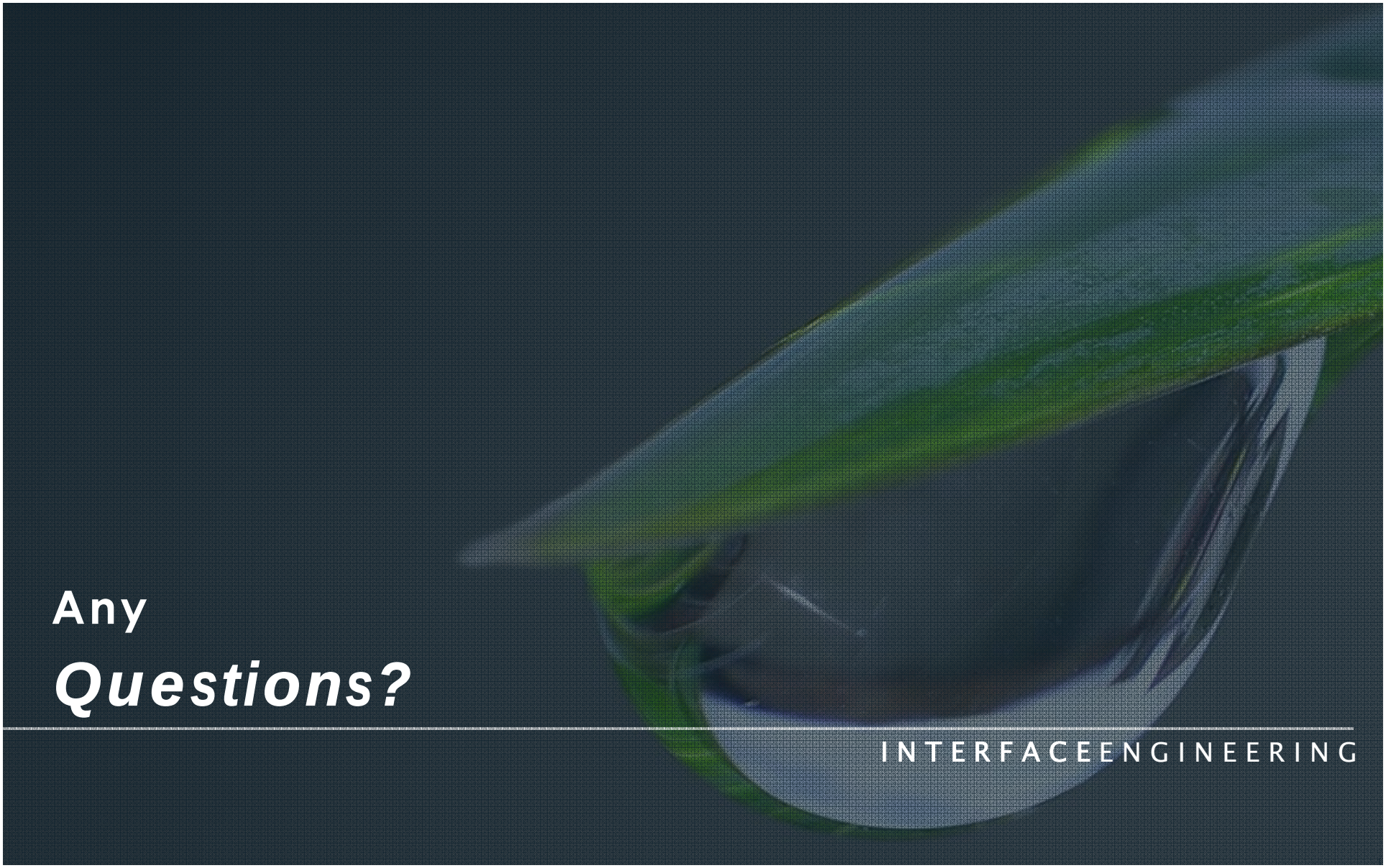
PROPOSED DESIGN CONCEPT

Conceptual Ideas Being Considered



Scale Jumping Sewage Thermal Recovery

Issue to resolve: Odors downstream



Any

Questions?

INTERFACEENGINEERING