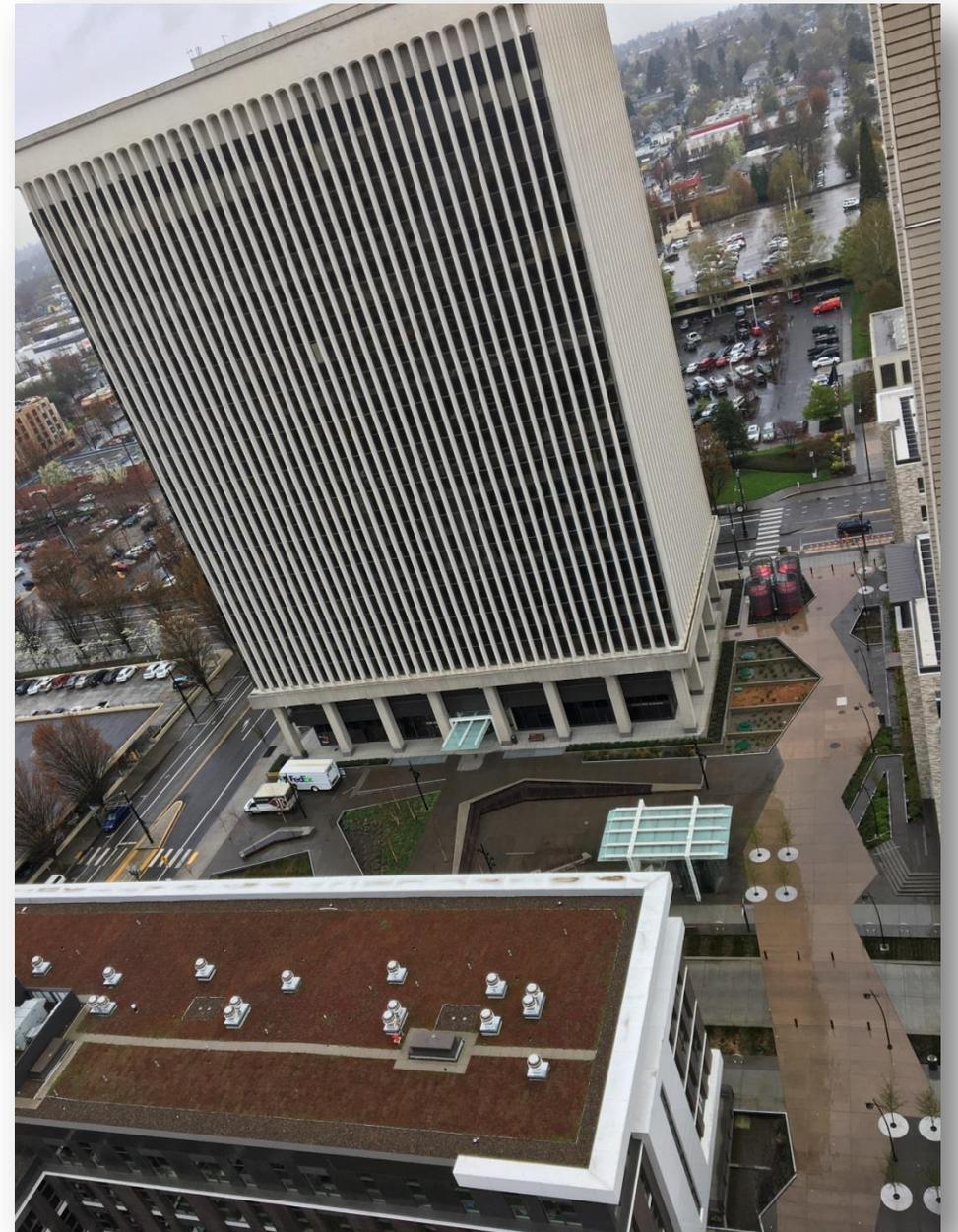


Decentralized Water Reuse NORM & his wastewater cohorts



Erin English, PE LEED AP
Senior Engineer
Biohabitats, Inc.



Decentralized Water Reuse **NORM** & his wastewater cohorts



Erin English, PE LEED AP
Senior Engineer
Biohabitats, Inc.



How cutting-edge water technology saved Hassalo on Eighth builders \$1.5M

Feb 8, 2016, 6:25am PST Updated Feb 8, 2016, 10:07am PST

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James Cronin
Staff Reporter
Portland Business Journal

The developer of the huge **Hassalo on Eighth luxury housing complex** in Portland's Lloyd EcoDistrict saved nearly \$1.5 million after adding an onsite sewer and stormwater treatment system. While San Diego-based American Assets Trust, the building owner, incorporated many green components, none proved as lucrative as the natural organic recycling machine that treats water.



Developers of the Hassalo on Eighth project, in the foreground, saved more than \$1.5 million...

BUSINESS PULSE

Should Oregon lawmakers forsake coal and embrace renewables?

RELATED CONTENT

Hassalo on 8th attracts 2 more hot food peddlers

Green Zebra's Southeast Division store to anchor 126-unit project

HOME OF THE DAY



Secluded Retreat with

Known as **NORM**, Hassalo on Eighth's system is the largest first multifamily use, treating 100 percent of the grey and black water from each of the property's three residential buildings, along with

NORM AT HASSALO ON EIGHTH IS THE LARGEST COMMUNITY WATER PROCESSING SYSTEM IN THE UNITED STATES

Be part of the solution.

MEET NORM, OUR NATURAL ORGANIC RECYCLING MACHINE

We process 100% of our wastewater on-site at Hassalo on Eighth.

BUILDING DESIGN + CONSTRUCTION

MAGAZINE | BUILDING SECTORS | BUILDING TEAM | GIANTS | 40 UNDER 40 | BIM/VDC | AWARDS | BD+C EVENTS

Building from the neighborhood up

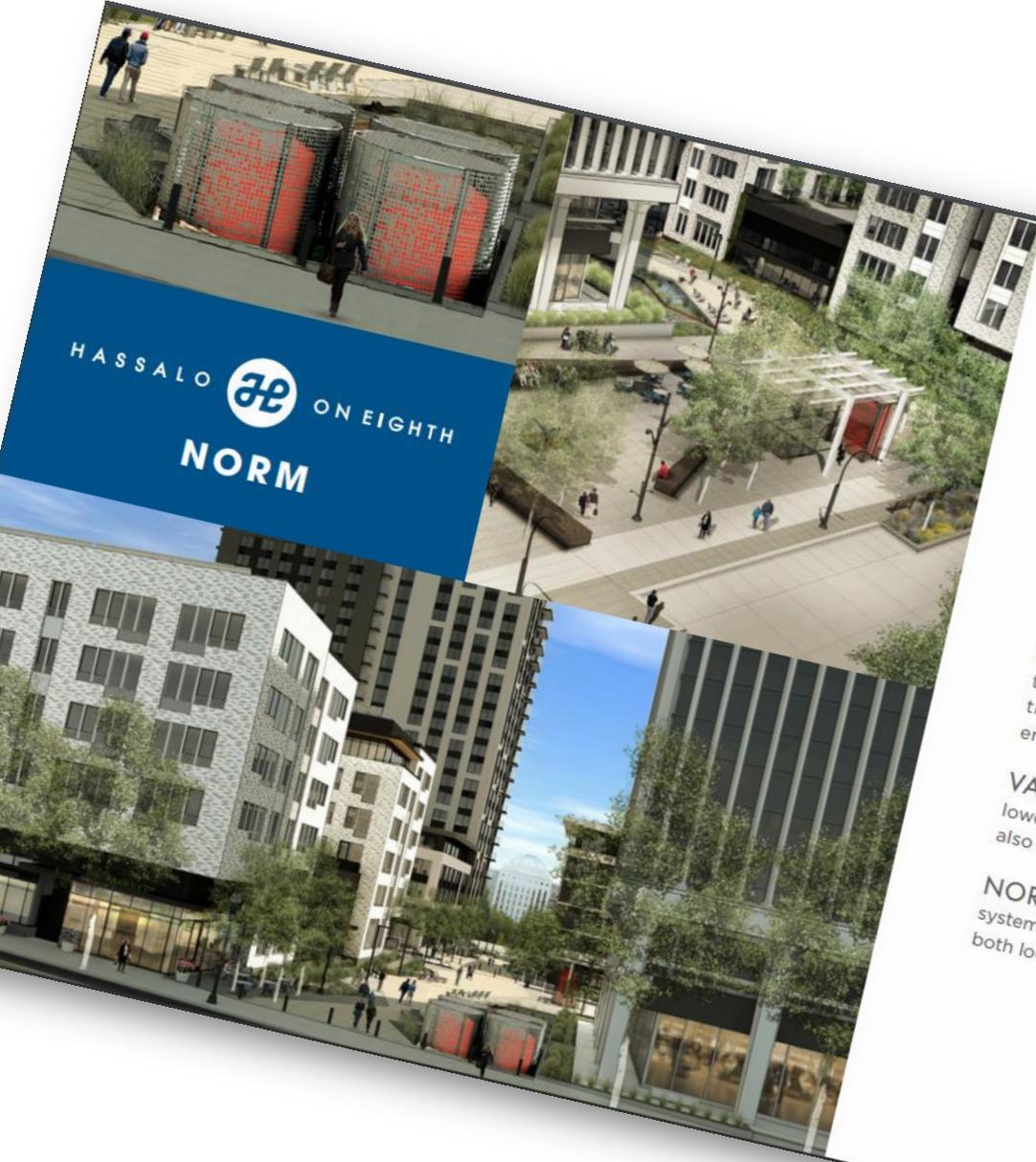
EcoDistricts is helping cities visualize a bigger picture that connects their communities.

GAME CHANGERS | JANUARY 13, 2017 | JOHN CAULFIELD, SENIOR EDITOR



Hassalo on 8th, the first new residential building complex within the Lloyd EcoDistrict in Portland, Ore., has its water treated and recycled through the largest natural urban wastewater system in North America. Provided by Biohabitats and engineered by Glumac, the system, which also serves an office building in the ecodistrict, was installed as a tradeoff with the city for lower utility

Urban Decentralized Wastewater Treatment & Reuse at the District Scale



HASSALO  ON EIGHTH
NORM

WE HAVEN'T REALLY RE-INVENTED THE WHEEL, IT JUST SEEMS LIKE IT

MEET NORM - NATURAL ORGANIC RECYCLING MACHINE

CONSERVATION NORM helps to reduce water use by over 50%—that's 7,000,000 gallons annually—by treating 100% of the wastewater generated from Hassalo on 8th to create clean reclaimed water used to flush toilets, irrigate landscaping and to supply cooling water for interior climate control. Biosolids generated from NORM are reused offsite to make fertilizer and generate energy.

SAFETY, QUALITY AND RELIABILITY Designed with state-of-the-art technology and controls, NORM meets the highest standards for wastewater treatment and reuse and is monitored 24/7 by certified wastewater operators to ensure optimal system performance, water quality and tenant safety.

VALUE NORM reduces water and wastewater utility costs which translate into lower cost of living and smaller environmental footprint for building tenants. NORM also reduces strain on an over-capacity city sewer system.

NORM IS THE FUTURE NOW As the largest, natural urban wastewater reuse system in North America, we're proud to provide this benchmark for sustainable living both locally and globally.

An aerial, black and white photograph of Portland, Oregon. The image shows a dense urban grid with a prominent river (the Willamette River) winding through the center. The city is surrounded by hilly terrain, particularly on the left side. The text "PORTLAND, OREGON" is overlaid in large, white, bold, sans-serif capital letters across the middle of the image.

PORTLAND, OREGON

VICINITY PLAN



ELIOT

IRVINGTON

ROSE QUARTER

CONVENTION CENTER

LLOYD DISTRICT

SULLIVANS GULCH - I-84

KERNS



Hassalo on Eighth:

Lloyd EcoDistrict Super Block Project
Project Team

American Assets Trust (AAT) – Owner
Turner – General Contractor
GBD Architects – Architects
Glumac Consulting Engineers – MEP Engineers
PLACE studio – Landscape Architect
Biohabitats, Inc. – Water Infrastructure
Puttman Infrastructure – Financial Consulting / Operations
Lando & Associates – Infrastructure Integration / Landscape Architecture
Harper Houf Peterson Righellis (HHPR) – Civil Engineers
KPFF – Structural Engineers





657

FOR-RENT HOUSING UNITS

592,000

GROSS SQUARE FEET OF HOUSING

31,700

GROSS SQUARE FEET OF RETAIL

26,400

GROSS SQUARE FEET ANCHOR RETAIL TENANT

271,000

GROSS SQUARE FEET OF EXISTING OFFICE

1,200

UNDERGROUND PARKING STALLS

Aerial view looking northeast - before









MARKET

GBD Architects

Aerial view looking southwest toward downtown.



Aerial view looking southwest toward downtown.

Certifications

Pending LEED for Homes Platinum
Pending LEED ND Platinum certification.

Performance

Energy Savings 30%
Water Savings 50%
100% Wastewater Treatment

Stormwater

Green roofs and gardens
On site rainwater harvesting water feature & cistern

Transit

More than 1,000 bike parking stalls = largest bike storage facility in North America, with valet bike parking, repairs and services.
Access to multiple alternative modes of transportation for car-light or car-free living.

What & Who is NORM?

‘Natural Organic Recycling Machine’ – nickname the contractors and owner selected during construction.

45,000 gallon per day residential & commercial high-performance wastewater treatment + reuse system with natural and mechanical elements

Constructed within the streetscape

Reuse for Toilet Flushing, Irrigation & Cooling Towers

Groundwater Recharge for unused effluent + Back-up Sanitary Connection

Why NORM?

Reduces water demand

Reduces sewer discharges to combined system/surface water protection

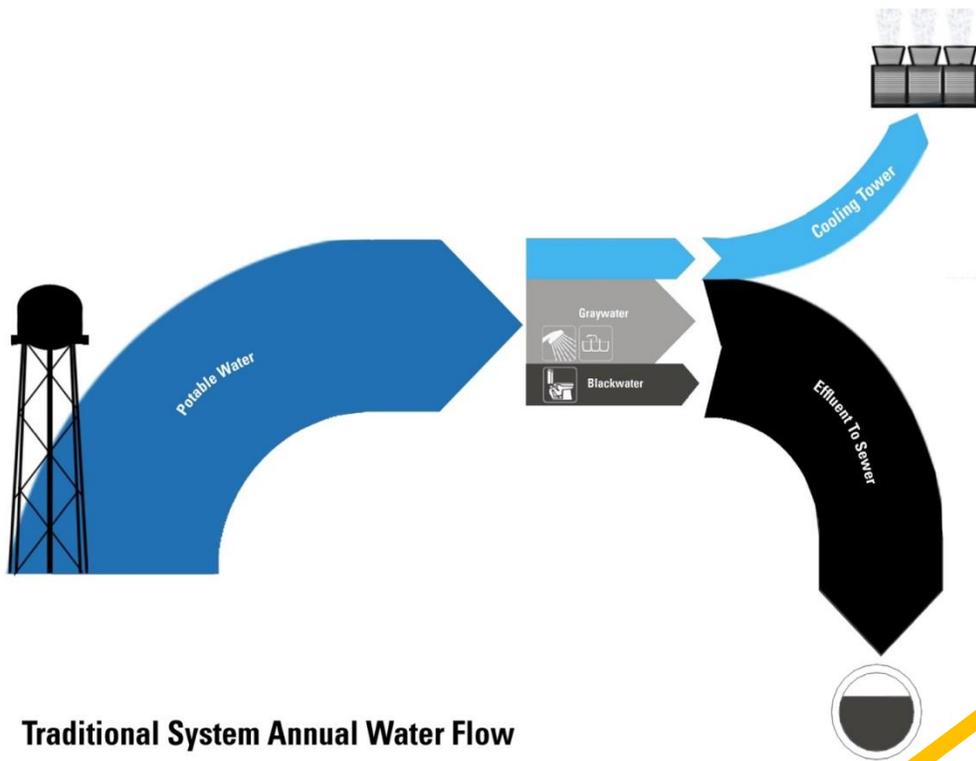
Independent source of recycled water

Economic incentive & attractive payback period (~4 years)

Compelling infrastructure & place-making

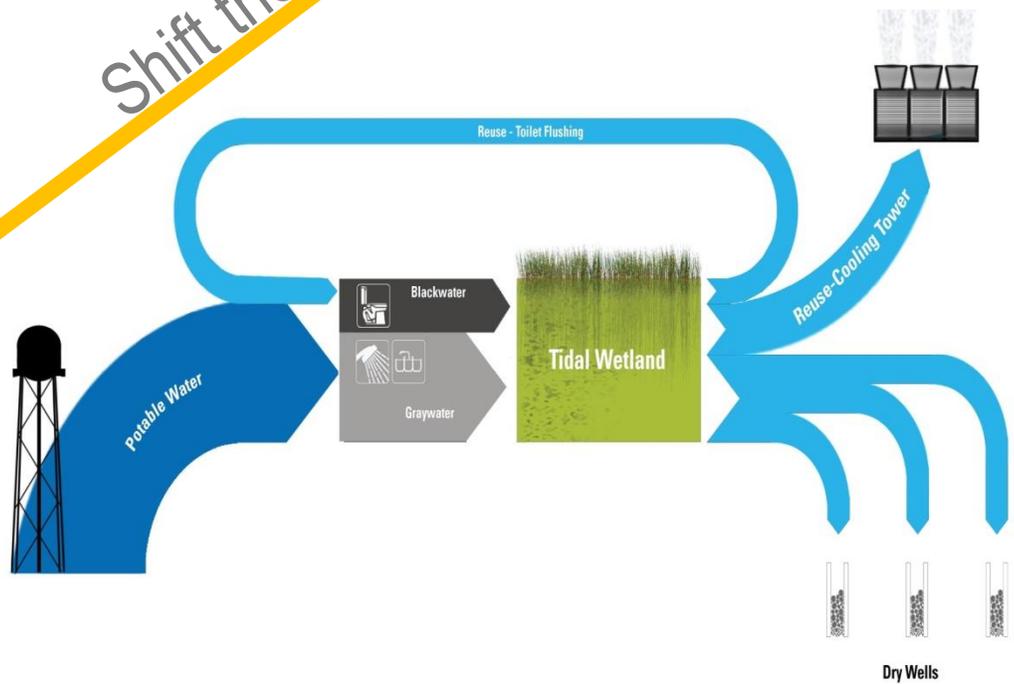
Context





Traditional System Annual Water Flow

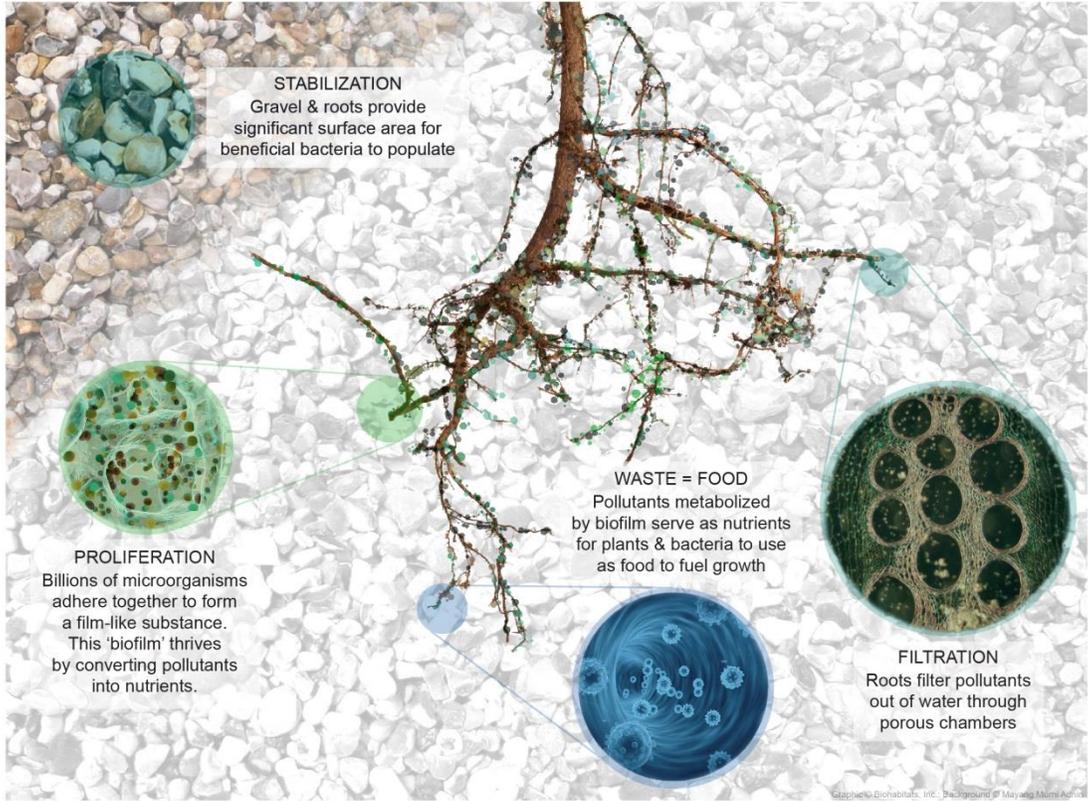
Shift the Water Reuse Paradigm



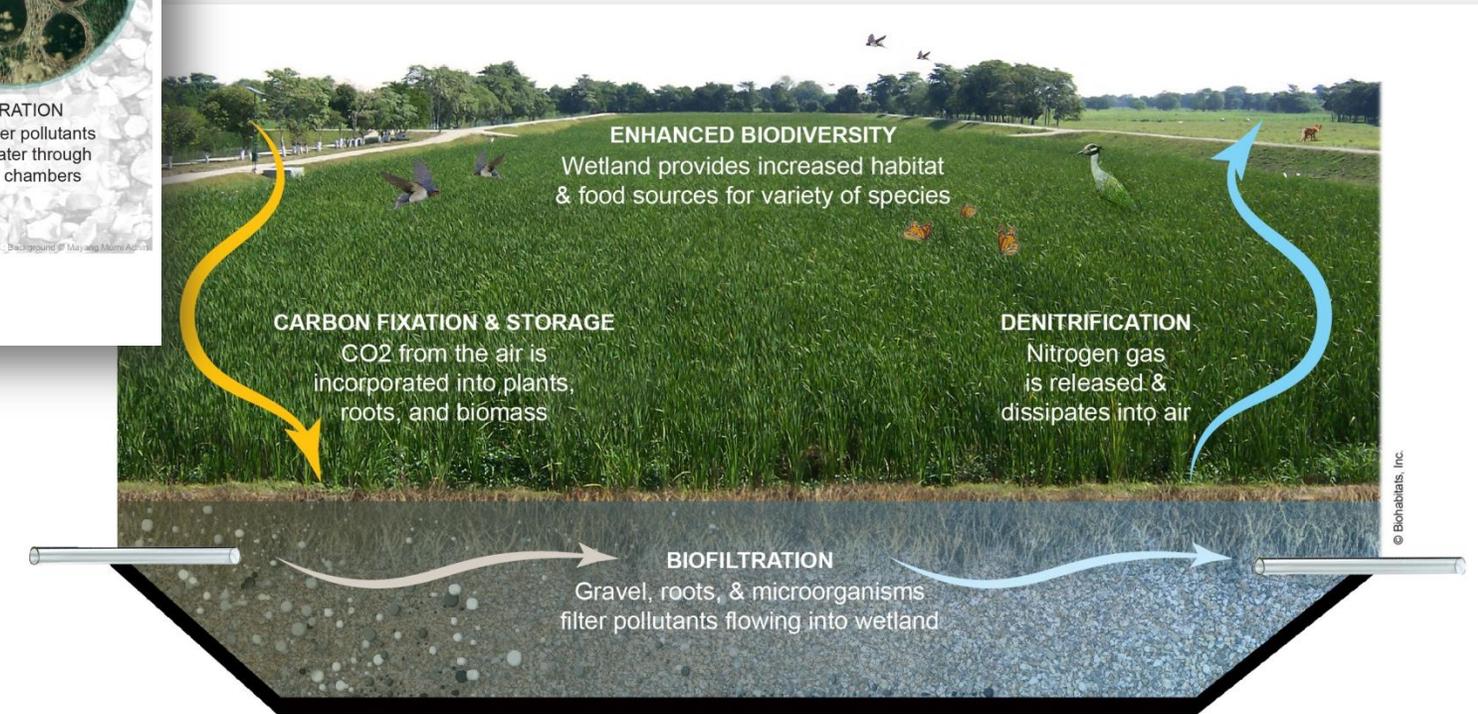
On Site Treatment Annual Water Flow

GLUMAC

Below the Surface: How Wetlands Treat Contaminants



Place Natural Systems at the Core



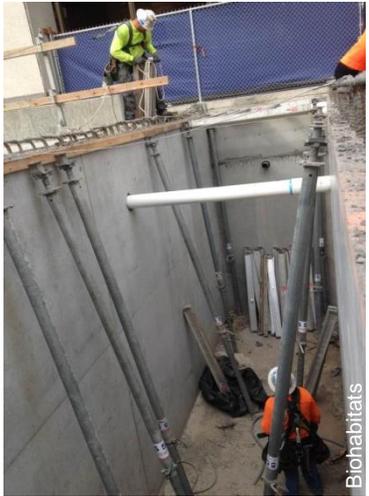
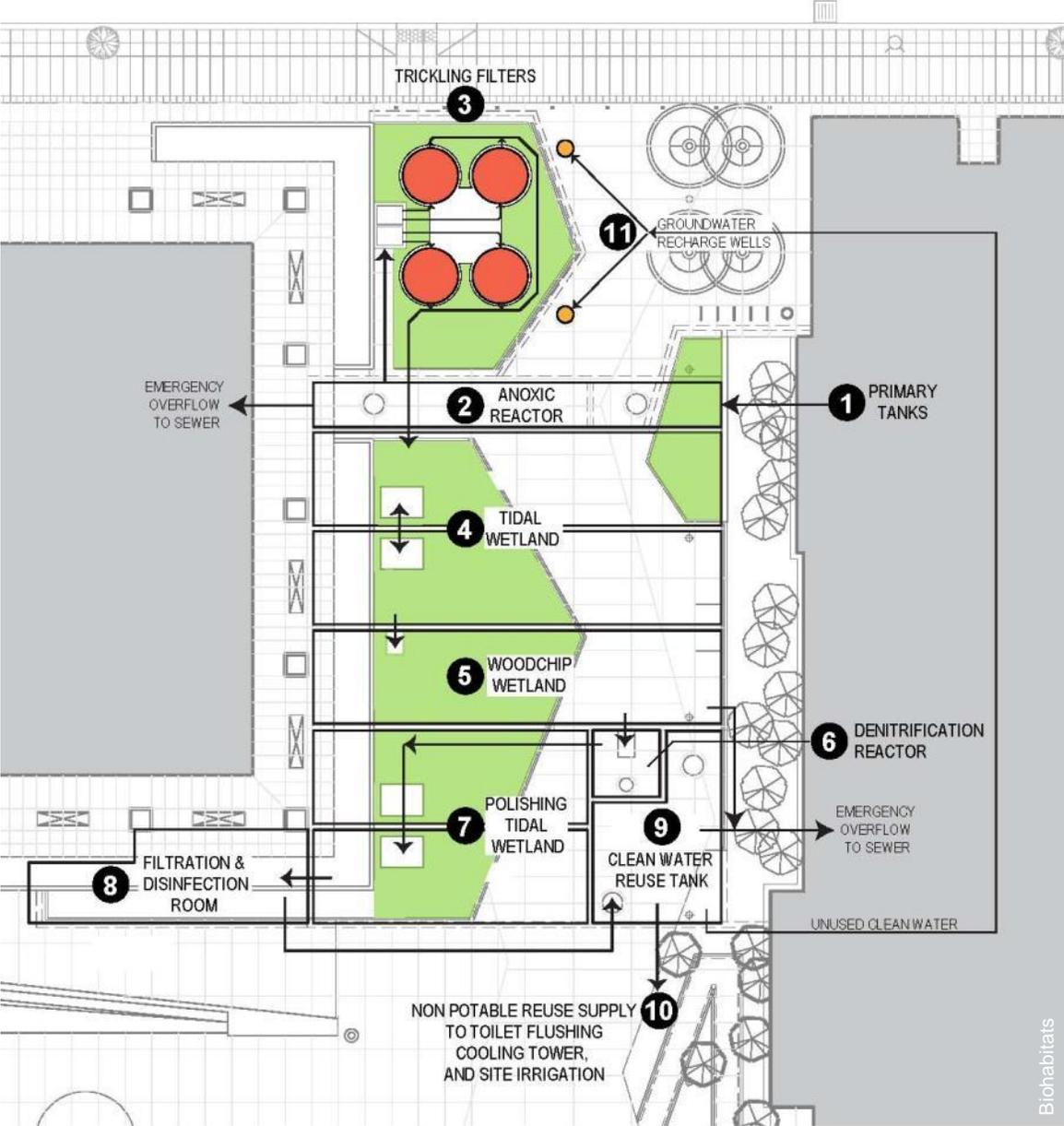
Above the Surface: How Wetlands Help People



- 1 SENSE OF PLACE**
Gives the space a unique & special identity
- 2 BEAUTY & AESTHETICS**
Enhances outdoor experience & serves as a source of inspiration
- 3 ECOLOGICAL EDUCATION**
Provides a learning outlet for all ages
- 4 CONNECTION**
Reconnects people to natural environment & one another
- 5 HEALTH BENEFITS**
Promotes physical activity; generates positive impacts on nervous system & psyche

base photo © Will Milliken
graphic © Biohabitats, Inc.

Street as Water Infrastructure

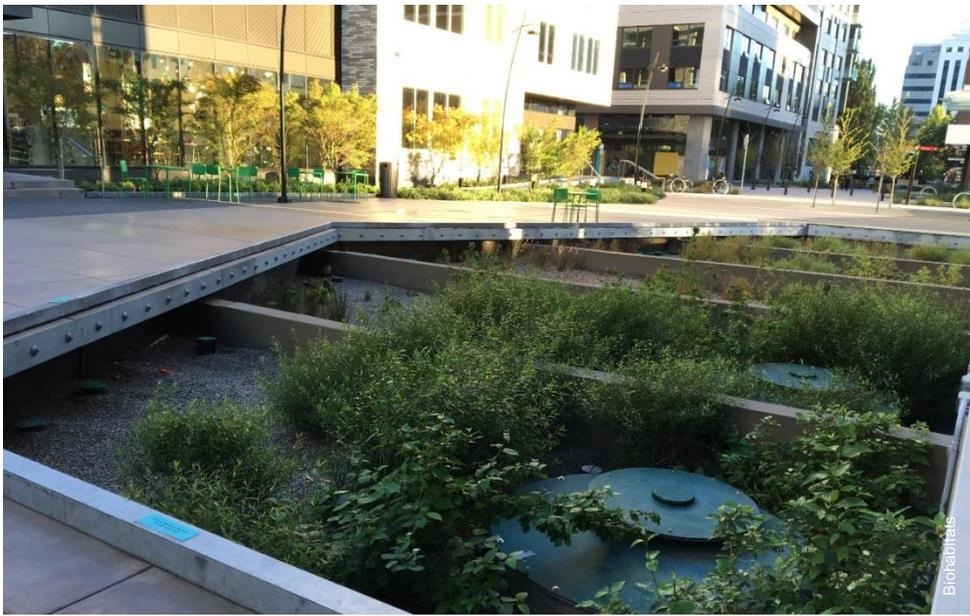


Biohabitats

Biohabitats

Biohabitats

Biohabitats





Personify
Infrastructure



@PortlandNORM

He's a wastewater connoisseur....

and probably the first wastewater
treatment system to have its own
Twitter account

Harvest & Manage Stormwater as an Amenity



WATER STREET District Water Strategy

WASTEWATER
TREATMENT & REUSE

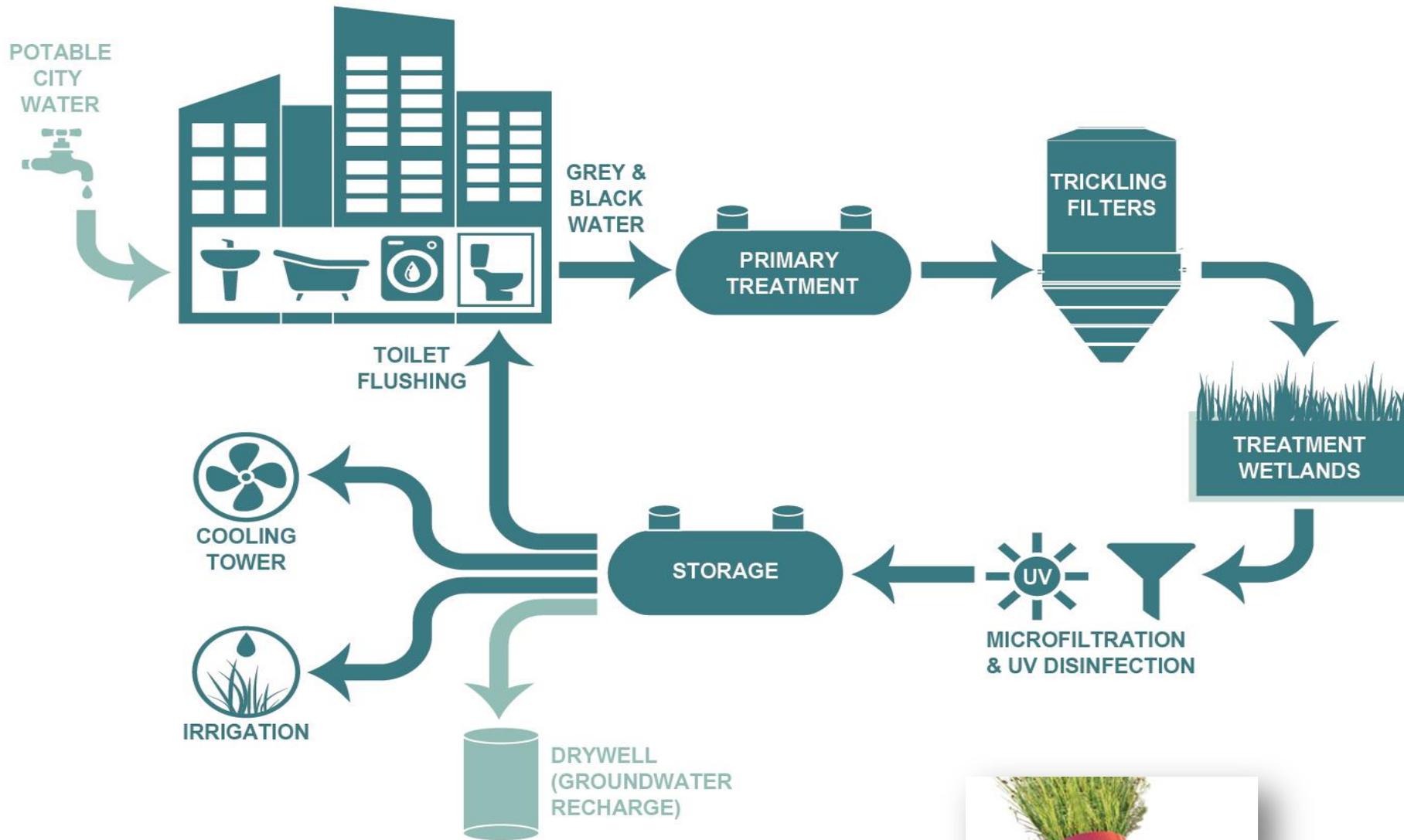
GREEN ROOFS &
BMPS THROUGHOUT

STORMWATER,
BEAUTY, HABITAT WATER
FEATURE

RAINWATER CISTERN

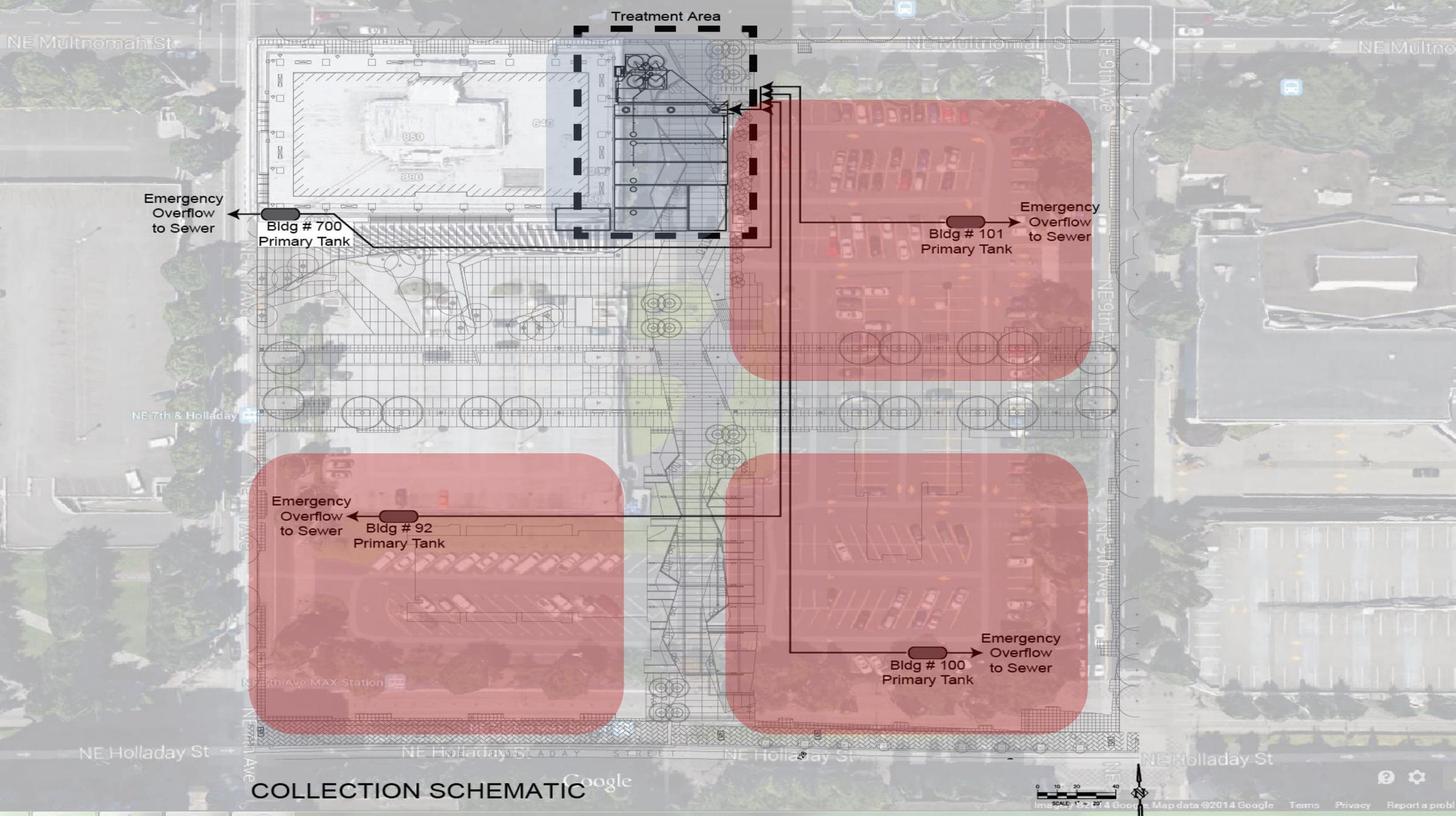


Courtesy of GBD & Place Studio



NORM: NATURAL ORGANIC RECYCLING MACHINE





Treatment Area

Emergency Overflow to Sewer

Bldg # 700 Primary Tank

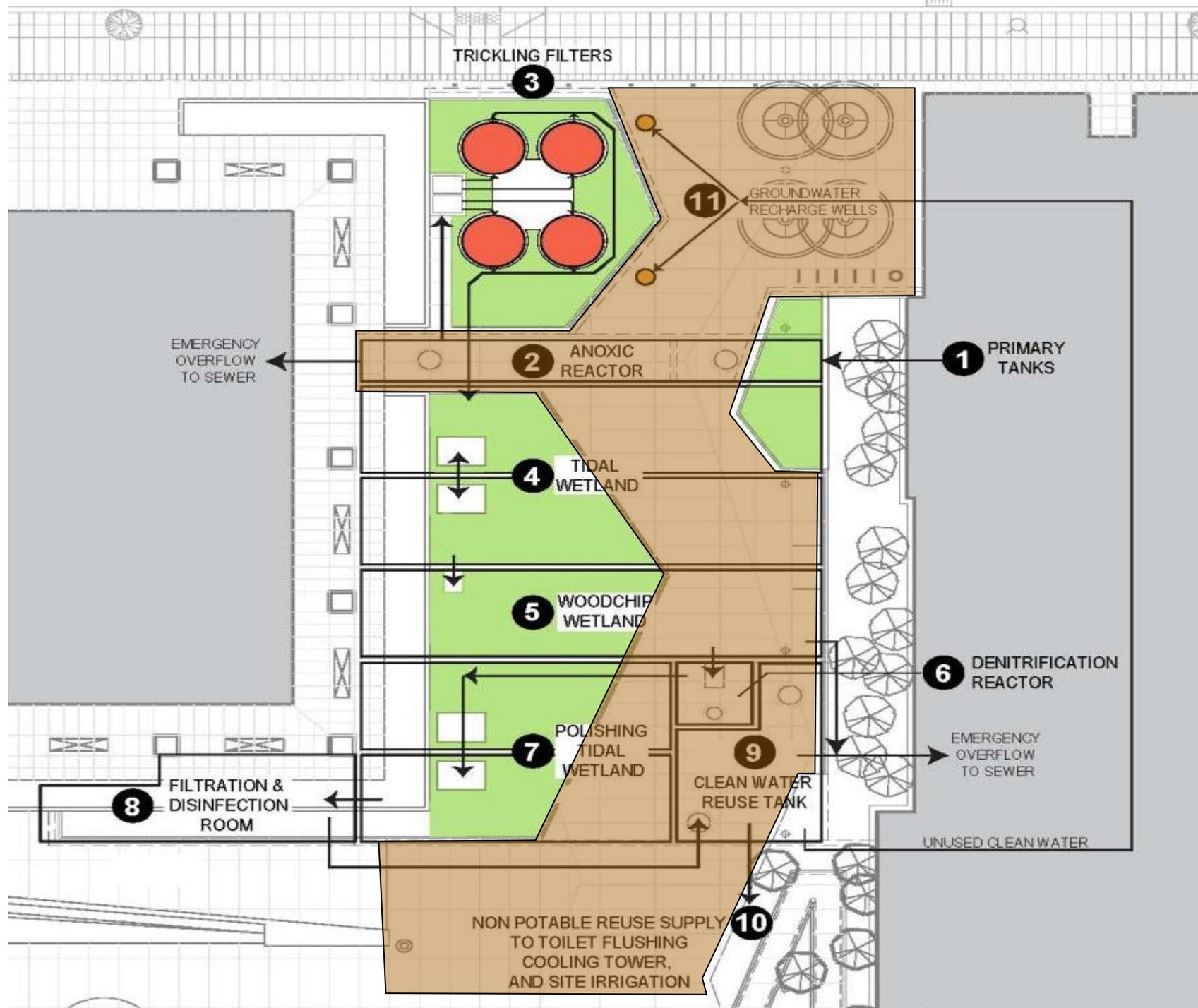
Emergency Overflow to Sewer
Bldg # 101 Primary Tank

Emergency Overflow to Sewer
Bldg # 92 Primary Tank

Emergency Overflow to Sewer
Bldg # 100 Primary Tank

COLLECTION SCHEMATIC





TRICKLING FILTERS

3

11

GROUNDWATER RECHARGE WELLS

EMERGENCY OVERFLOW TO SEWER

2

ANOXIC REACTOR

1

PRIMARY TANKS

4

TIDAL WETLAND

5

WOODCHIP WETLAND

6

DENITRIFICATION REACTOR

7

POLISHING TIDAL WETLAND

EMERGENCY OVERFLOW TO SEWER

8

FILTRATION & DISINFECTION ROOM

9

CLEAN WATER REUSE TANK

UNUSED CLEAN WATER

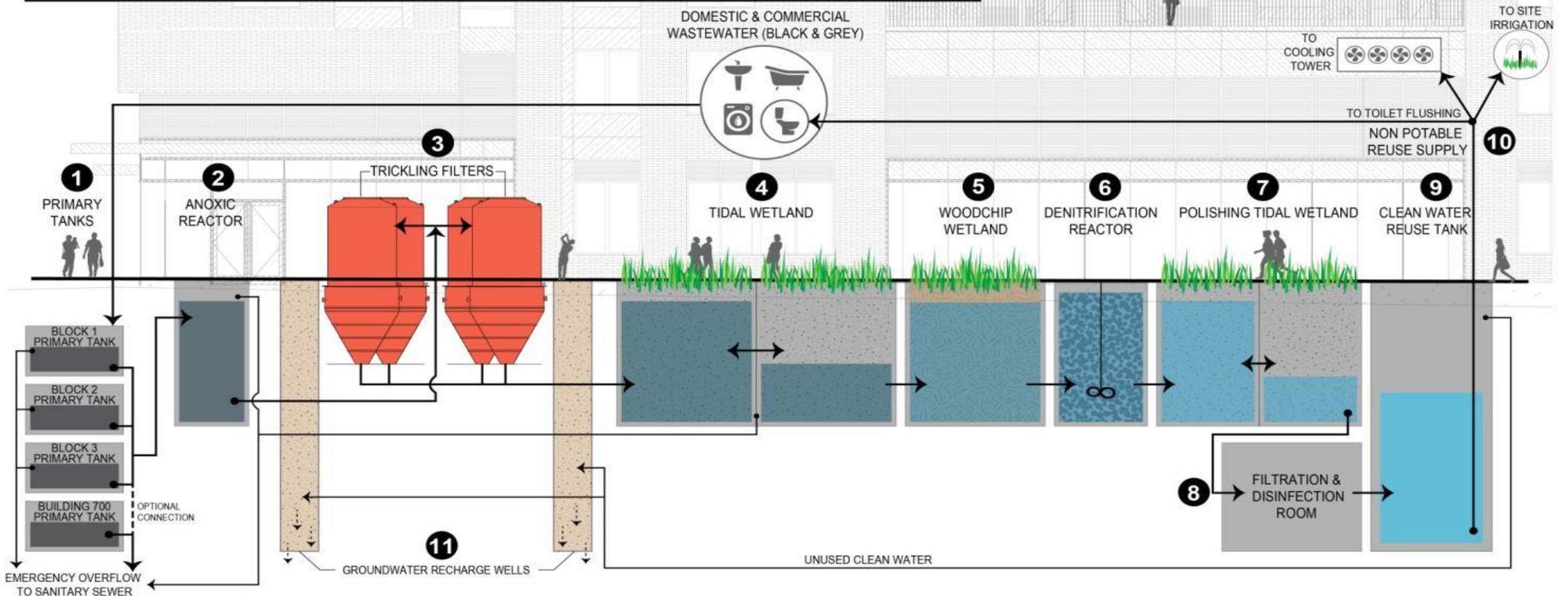
NON POTABLE REUSE SUPPLY TO TOILET FLUSHING, COOLING TOWER, AND SITE IRRIGATION

10

HASSALO ON 8TH: NATURAL TREATMENT AND REUSE AT THE URBAN DISTRICT SCALE

WASTEWATER TREATMENT AND REUSE PROCESS

- 1 Primary tanks provide solids settling and digestion.
- 2 Anoxic reactor starts the denitrification process.
- 3 Trickling filters reduce organic loading and provide nitrification.
- 4 Tidal wetlands operate on reciprocating drain/fill cycles to further reduce organic and nutrient loading.
- 5 Woodchip wetlands provides nutrient reduction through denitrification.
- 6 Denitrification reactor completes the denitrification process.
- 7 Tidal wetlands operate on reciprocating drain/fill cycles to further reduce organic and nutrient loading.
- 8 Effluent is filtered and disinfected using UV and ozone.
- 9 Cleanwater reuse tank stores effluent prior to reuse.
- 10 Reclaimed water used to supply 100% of toilet flushing, cooling tower demand and site irrigation.
- 11 Unused clean water is infiltrated through groundwater recharge wells.







The Numbers

\$3.3 million price tag, \$1.5 million credit, 4 year pay back

6,000 sq ft of space required, above and below ground components

Class A Reuse Standards = daily testing

Recycled Water:

20,000 gpd non-potable water demand

25,000 gpd groundwater recharge



The Permits

Recycled Water for beneficial purposes - Department of Environmental Quality under the Recycled Water Use rules

Artificial groundwater recharge - Water Pollution Control Facilities permit Class V Underground Injection (in accordance w/ OAR 340-045).

The project is subject to the state and federal Underground Injection Control regulations, and state's Groundwater Quality Protection regulations.

Drywells = 4 ft diameter x 40 ft. Approximately 80 ft unsaturated soils prior to groundwater at 120 ft.

The Permits

Class A Recycled Water

oxidized, filtered, disinfected
NTU < 2 before disinfection
Total Coliform = 2.2 CFU/100 mL

Groundwater Protection

<10 mg/L TN at discharge

Performance Goals

BOD < 5 mg/L

TSS < 2 mg/L

6-12 month ramp-up period prior to reuse or discharge

Table B1: Influent Monitoring

Item or Parameter	Minimum Frequency	Sample Type/Required Action	Report
Total Flow (MGD)	Daily	Measurement	1. Daily values 2. Monthly total 3. Monthly average
Flow Meter Calibration	Annual	Verification	Report that calibration was completed.
BOD5 or CBOD5 and TSS (mg/L)	Monthly, first year only	Grab	1. Monthly average
pH (S.U.)	2/Week	Grab	1. Weekly values

Table B2: Recycled Water Monitoring

Item or Parameter	Minimum Frequency	Sample Type/Required Action
Total Coliform	Daily (Class A)	Grab
Turbidity	Hourly average (Class A only)	Measurement
Total nitrogen	Monthly	Grab

August 2016-March 2017

	NH3-N	NO3-N	TN	BOD	TSS
INFLUENT					
MAX	57.1			205.0	72.0
MIN	20.2			112.0	28.0
AVERAGE	46.9			157.1	56.4
EFFLUENT					
MAX	1.8	6.9	15.5	7.2	<5
MIN	0.4	3.9	0.8	2.6	ND
AVERAGE	1.0	5.4	6.7	4.95	2.0



ATMENT
D
OUT

Public Outreach Events
 Ongoing Tours
 Website
 Tenant Education
 Selective Signage
 @portlandNORM twitter



Public Outreach and Education



HASSALO
ON EIGHTH

WELCOME THE BUILDINGS **NORM** COMMUNITY BLOG CONTACT

MEET NORM, OUR NATURAL ORGANIC RECYCLING MACHINE

We process 100% of our wastewater on-site at Hassalo on Eighth.

Every used drop of water from sinks, toilets, showers and laundry (black and grey wastewater) is collected and stored by NORM. NORM then uses innovative treatment technologies to process/clean the wastewater. NORM's high tech filtration and disinfection system creates the highest quality of reclaimed water that goes back into the community system to irrigate landscape and flush toilets. The rest of the water is so clean we can release it into the groundwater.

Designed with state-of-the-art technology and controls, NORM meets the highest standards for wastewater treatment and reuse and is monitored 24/7 by certified wastewater operators to ensure optimal system performance, water quality and resident safety.

Get more **NORM** information.



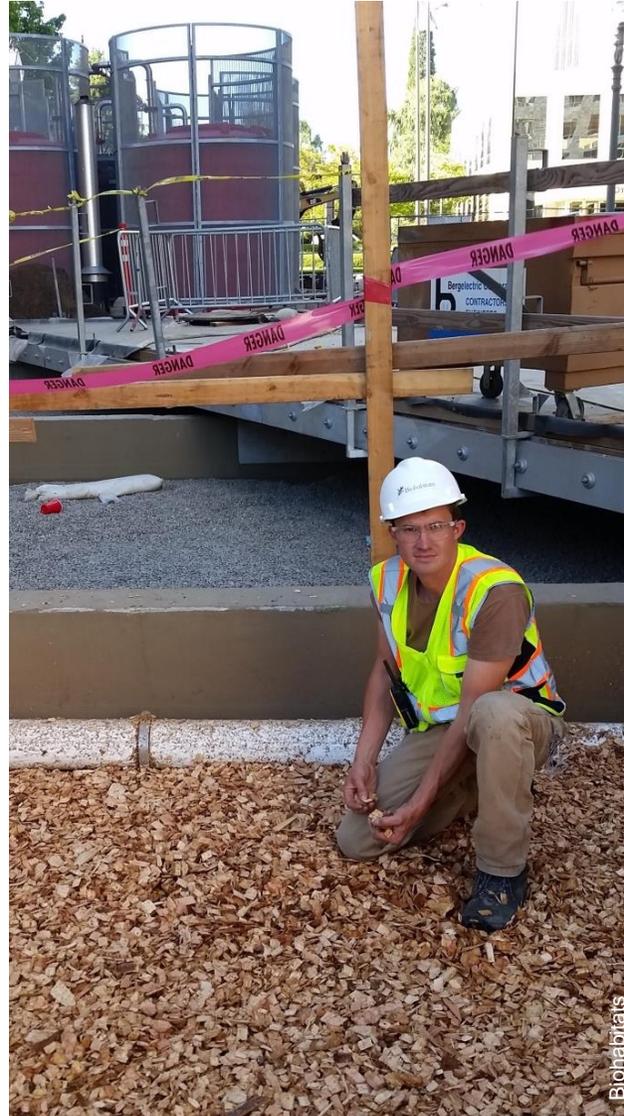
HASSALO
ON EIGHTH

WELCOME THE BUILDINGS **NORM** COMMUNITY BLOG CONTACT

How NORM Helps You:

- As a resident, you could see a savings of up to 65 percent on the water/sewer portion of your utility bill.
- Enjoy being part of the change as we work together to create an EcoDistrict in the heart of the city.
- Reduce your carbon footprint – just by living here!

Waterproofing
Commissioning
Biological
Mechanical
Backup
Woodchip Wetlands
Permitting



Lessons Learned



DECENTRALIZED SCALE WASTEWATER
TREATMENT AND REUSE



EMORY'S WATER HUB™

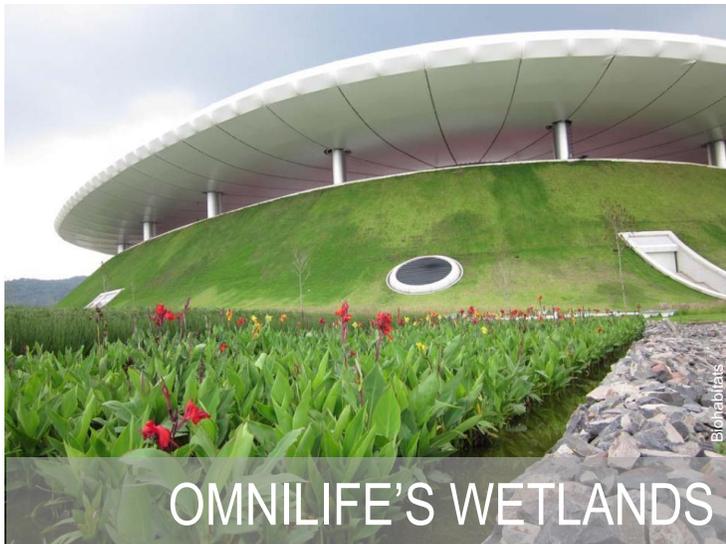


SIDWELL'S WETLANDS

Other
Precedents



LIVING
BUILDING
CHALLENGE™

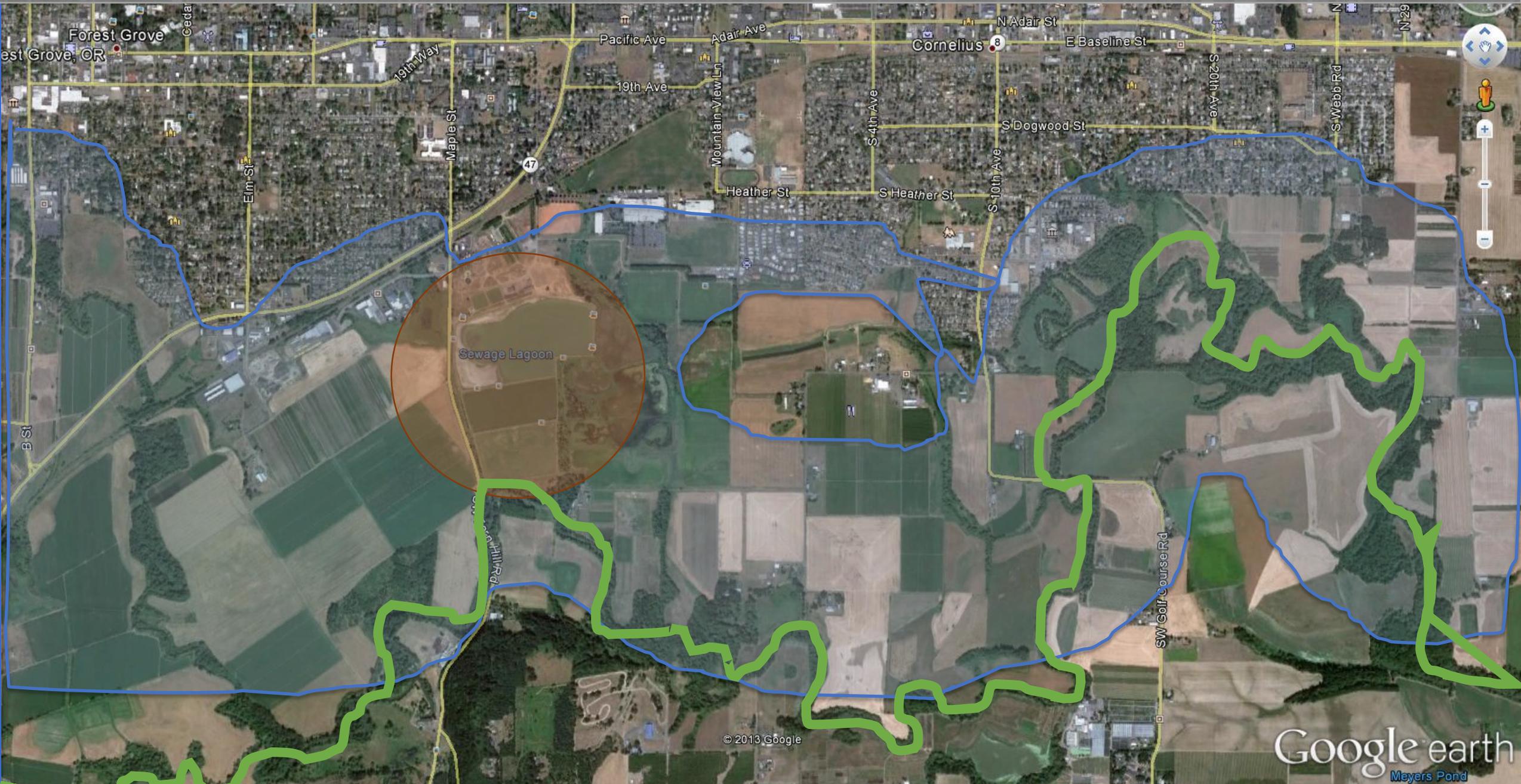


OMNILIFE'S WETLANDS



OMEGA'S ECO-MACHINE™

Fernhill Wetlands Retrofit – Forest Grove, OR



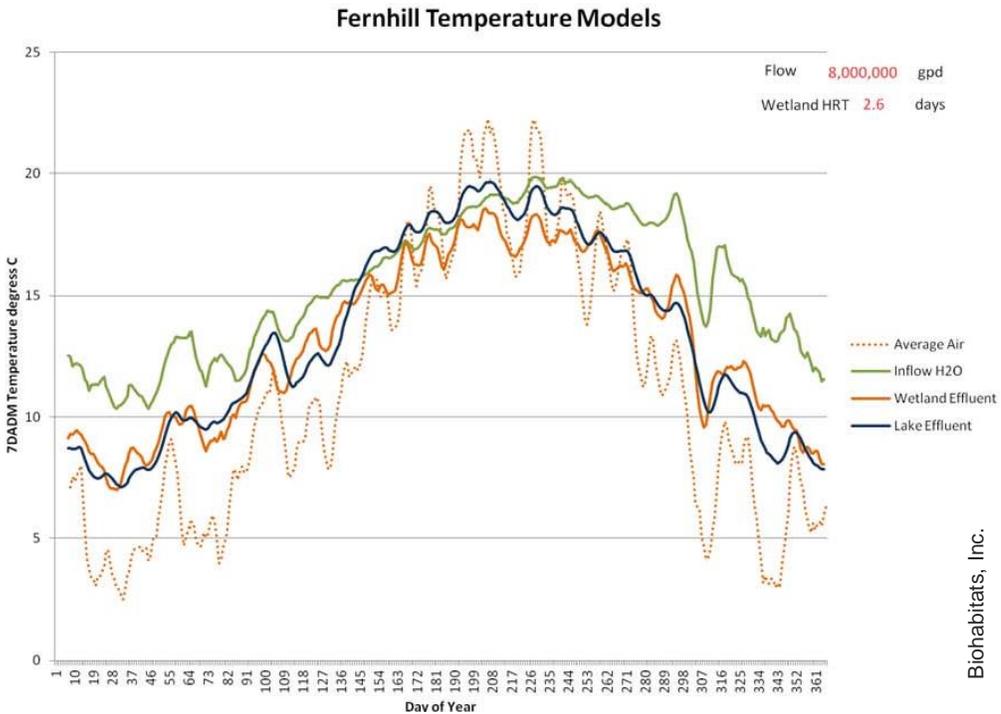
Fernhill Wetlands Retrofit – Forest Grove, OR

Area: 90 acres / 36 hectares
Flow: 4-18 MGD / 15K-68K m³

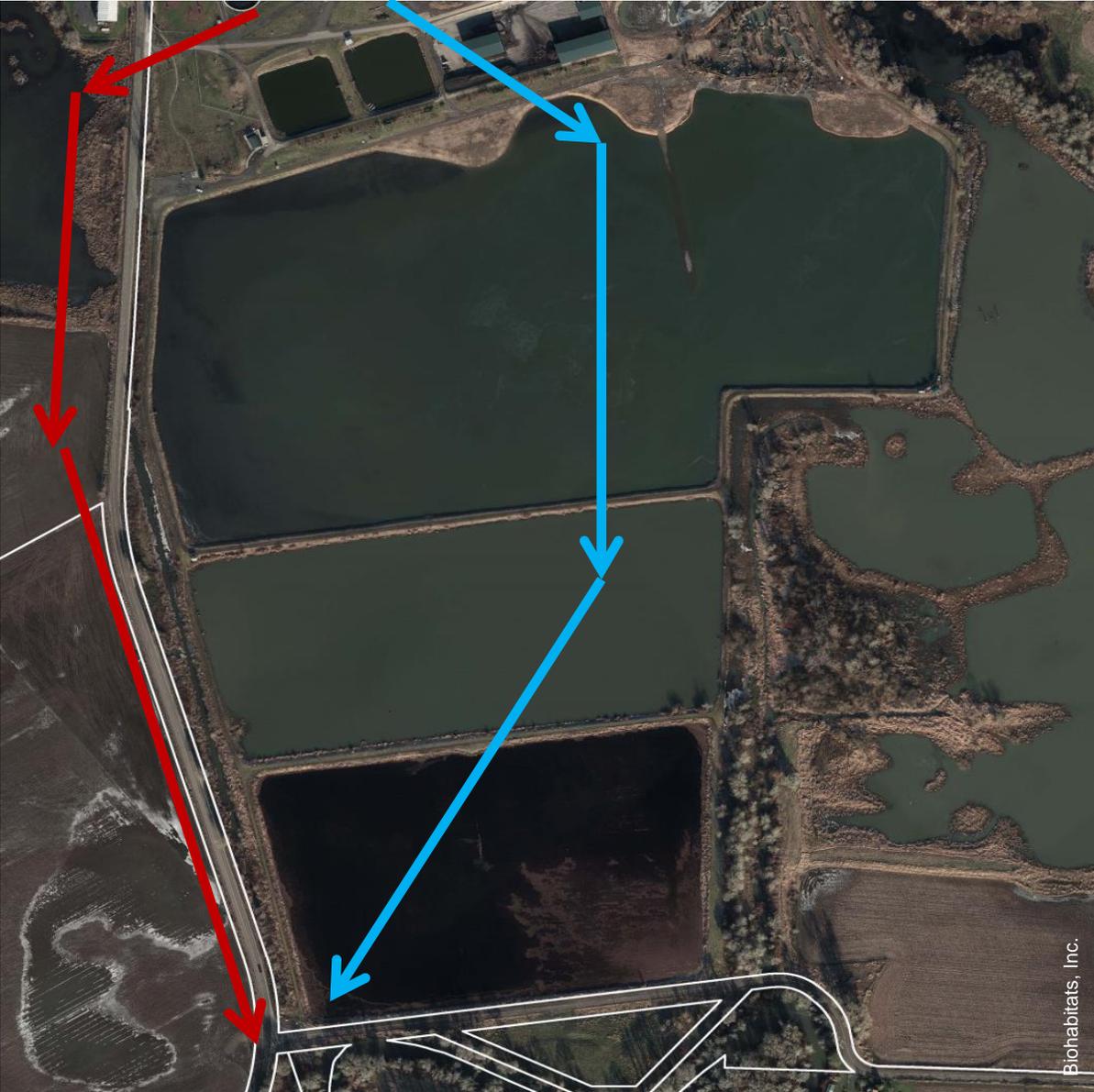
Treatment for temperature, nutrients, metals

Create public open space

Enhance habitat



Biohabitats, Inc.



Biohabitats, Inc.

- 1 Forest Grove Clean Water Facility (existing)
- 2 Natural Treatment System
- 3 Future Environmental Learning Center Site
- 4 Fernhill Lake
- 5 Cattail Marsh
- 6 Eagle Perch Marsh
- 7 Hyporheic Zone Demonstration
- 8 Mitigation Wetland Area (existing)
- 9 Ecological Crop/Overland Flow Reuse Demonstration Area
- 10 Riparian Reforestation Area
- 11 Agricultural Area



Figure 2: Treatment Wetland Area Water Circulation Path

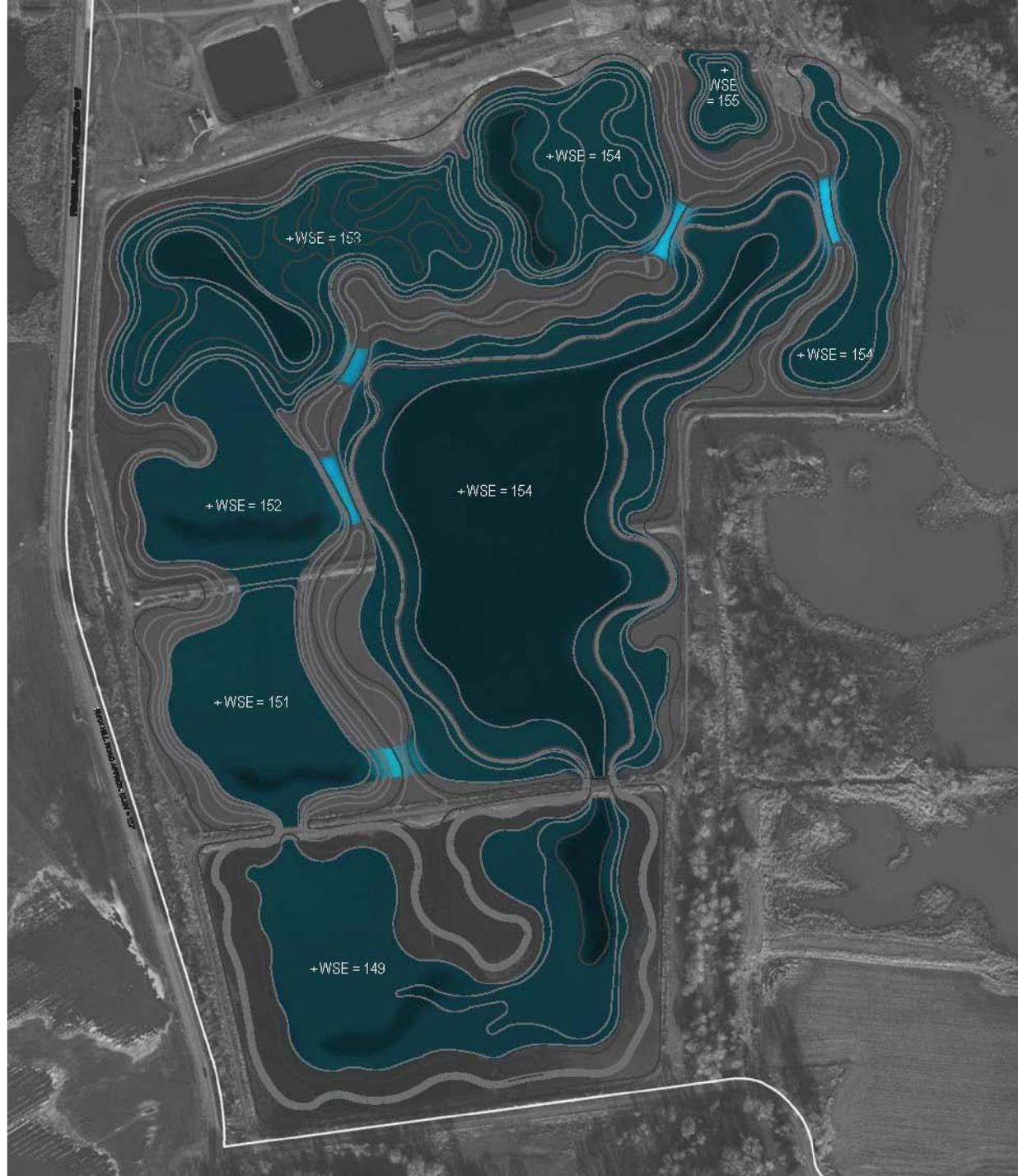
Figure 3: Fernhill Lake Natural Area Wetlands Water Circulation Path

Current Elements of Project (2013-2015)

Future Elements of Project (2014-2017)

Future Elements

HILL WETLANDS MASTER PLAN



Fernhill Wetlands Retrofit – Forest Grove, OR

