Put Greywater to Work for You

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Orenco Systems, Inc.

Our Presenter

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Jeff Pringle is an Account Manager for the Western U.S. Region at Orenco Systems® Inc., a wastewater equipment manufacturing firm based in Sutherlin, Oregon. In this role, he works to manage and grow customer accounts in California, Nevada, Arizona, and Hawaii. Since joining Orenco in 2005, Jeff has become a frequent presenter for the company, providing training for regulators, engineers, installers, service providers, and electricians, as well as other Orenco customers.

Jeff has an Associate of Applied Science degree in digital systems technology from Umpqua Community College in Roseburg, Oregon. In his spare time, he enjoys doing nothing at all.

Overview

- Case Study: BSA Bechtel Summit Reserve
- Definition of Greywater
- NSF350 Treatment Standards
- Project Examples
- Typical Cost
- Energy Usage

BSA Bechtel Summit

Photos courtesy of BSA

BSA Summit Project Goals

- Create a model for sustainability and environmental stewardship.
- Create a site that would be a “net zero energy” and “net zero carbon footprint environment
- Protect the New River by eliminating any direct discharge of treated wastewater

Boy Scouts of America

- 336 shower facilities
- Reuse of greywater for toilet flushing
- Rainwater makeup
- Potable water makeup

BSA Greywater System Requirements

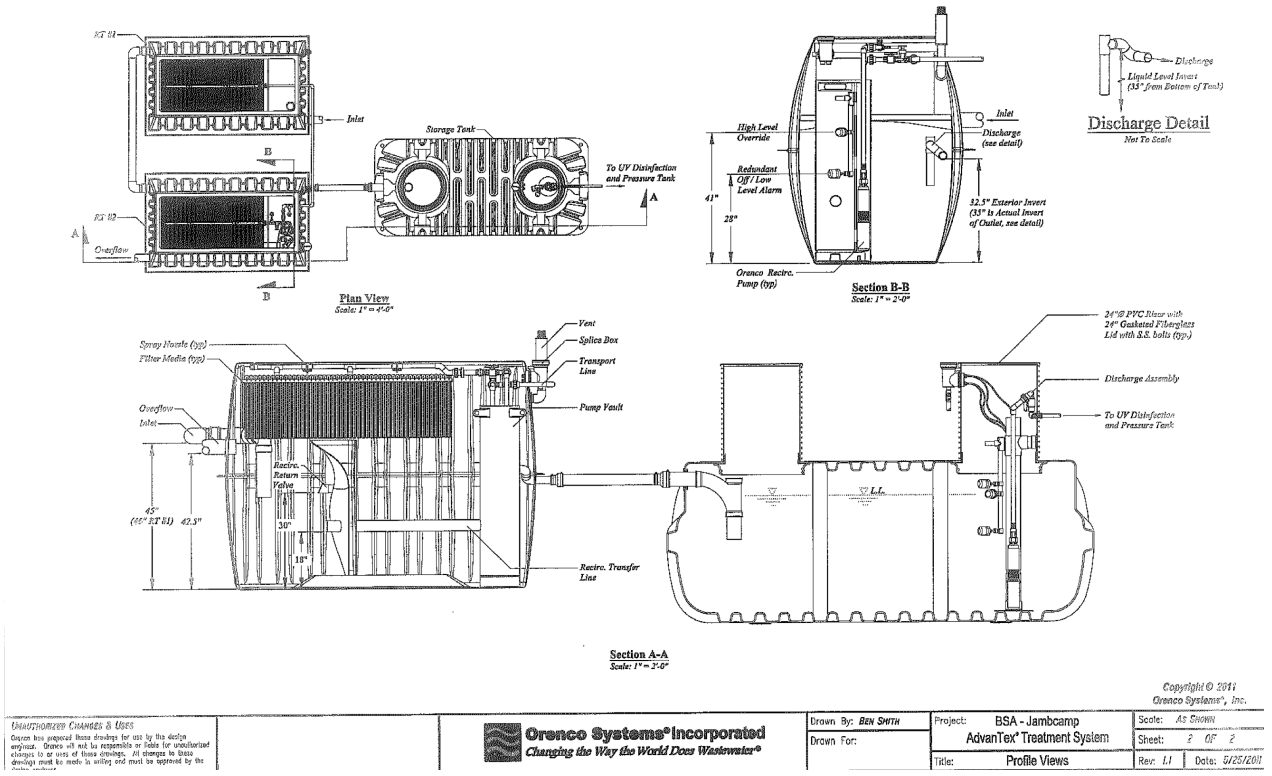
- Capable of treating 2,000 gpd per 24 hour period
- Minimal PVC. Preferable materials: fiberglass and HDPE
- Use of gravity only to divert flow to blackwater system, with no human interaction
- Small footprint
- 112 units required
- From zero use to full treatment use in 24 hours or less
- Energy efficient

BSA Greywater Treatment Criteria

	Avg	Max
$cBOD_5$	10 mg/L	25 mg/L
Total Suspended Solids	10 mg/L	30 mg/L
Turbidity	10 NTU	20 NTU
E. coli	14 MPN/100 mL	240 MPN/100 mL
pH	6.5-8.5	

BSA Bechtel Summit

- AX20-RT configuration
- Reuse for toilet flushing
- UV Disinfection



BSA Bechtel Summit

BSA Bechtel Summit

Photo courtesy of BSA

BSA National Jamboree 2013

Photo courtesy of BSA

Typical Greywater Influent Characteristics

Table 4A-1: Standard Advantex Stage Sizing For Greywater

	Design Avg	Design Max.
Hydraulic Loading Rate (HLR)	40 gpd/ft^2 *	80 gpd/ft^2 *
Organic Loading Rate (OLR)	0.04 lbs BOD_5/ft^2/day	0.08 lbs BOD_5/ft^2/day
Total Nitrogen Loading Rate (TNLR)	0.014 lbs TN/ft^2/day	0.028 lbs TN/ft^2/day
Ammonia Loading Rate (ALR)	0.01 lbs NH_3-N/ft^2/day	0.02 lbs NH_3-N/ft^2/day

**This is the maximum rate allowed by Orenco, however local regulation may be more restrictive. Check local regulation.*

Determining Influent Constituent Concentrations:

Orenco prefers sampled data to establish influent waste strengths for greywater applications. When sample data is unavailable, NSF350-1 is typically used to estimate influent constituent concentrations. These concentrations are based upon what is being served and are listed in the tables below.

Table 4A-2: Expected Range of Greywater Constituents, 30-Day Average

	Application Type 6A, Shower/Bath Only	Application Type 6B, Laundry Only	Application Type 6C, Shower/Bath and Laundry
Parameter			
TSS	50-100 mg/L	50-100 mg/L	80-160 mg/L
BOD_5	100-180 mg/L	220-300 mg/L	130-180 mg/L
Temperature	25-35° C	25-35° C	25-35° C
pH	6.0-7.5	7.0-8.5	6.5-8.0
Turbidity	30-70 NTU	50-90 NTU	50-100 NTU
Sodium	n/a	50-90 mg/L	50-90 mg/L
Total Phosphorous P	1.0-4.0 mg/L	<2.0 mg/L	1.0-3.0 mg/L
Total Kjeldahl nitrogen-N	3.0-5.0 mg/L	4.0-6.0 mg/L	3.0-5.0 mg/L
COD	200-400 mg/L	300-500 mg/L	250-400 mg/L
TOC	30-60 mg/L	50-100 mg/L	50-100 mg/L
E. coli	10^2-10^3 cfu/100 mL	10^2-10^3 cfu/100 mL	10^2-10^3 cfu/100 mL
Total coliforms	10^3-10^4 cfu/100 mL	10^3-10^4 cfu/100 mL	10^3-10^4 cfu/100 mL

Table 1. Typical Residential Wastewater Flows per Person Per Day[1]

(40 to 70 gal/person/day, gpcd)

Source	Percent Daily Flow, %	Avg. Flow, gpcd
Dark water		
Toilets	26.7	14.2
Dishwasher	1.4	0.75
Kitchen sink w/grinder	1.1	0.6
Gray water		
Faucets	14.5	7.7
Clothes washer	21.8	11.6
Shower	16.8	8.9
Bath	1.7	0.9
Other domestic	2.3	1.2
Leakage	13.7	7.3

[1] *Adapted from EPA 2002, Metcalf & Eddy 4th Ed, WERF 2006, EPA Design Manual Onsite Wastewater Treatment and Disposal (1980):*
Typical usage per person = 53 gpcd ±
Typical household usage per 3 to 5 occupants = 150 to 250 gpd/household

Greywater: 71% of 53 gpcd = 37.6 gpcd

2019 California Plumbing Code

1501.1.1 Allowable Use of Alternate Water. Where approved or required by the Authority Having Jurisdiction, alternate water sources [reclaimed (recycled) water, grey water, and on-site treated nonpotable gray water] shall be permitted to be used instead of potable water for the applications identified in this chapter.

2019 California Plumbing Code

1501.7 Minimum Water Quality Requirements [BSC-CG, HCD 1, DWR]. The minimum water quality for alternate water source systems shall meet the applicable water quality requirements for the intended application as determined by the Authority Havin Jurisdiction. *Water quality requirements for on-site treated nonpotable greywater shall comply with Section 1506.9.2. Recycled water shall comply with the water quality requirements of Section 1505.14.*

2019 California Plumbing Code

1506.0 On-Site Treated Nonpotable Gray Water Systems.
1506.1 General. The provisions of this section shall apply to the installation, construction, alteration, and repair of on-site treated nonpotable gray water systems intended to supply uses such as water closets, urinals, trap primers for floor drains and floor sinks, above and belowground irrigation, and other uses approved by the Authority Having Jurisdiction.

2019 California Plumbing Code

1506.9.2 Minimum Water Quality *[BSC-CG, HCD1]*. On-site treated nonpotable *gray* water supplied to toilets or urinals or for other uses in which it is sprayed or exposed shall be disinfected. Acceptable disinfection methods shall include chlorination, ultraviolet sterilization, ozone, or other methods approved by the Authority Having Jurisdiction. The minimum water quality for on-site treated nonpotable *gray* water systems shall meet the applications as determined by the public health Authority Having Jurisdiction. *In the absence of local water quality requirements for on-site treated nonpotable gray water, the requirements of NSF 350 shall apply.*

2019 California Plumbing Code

1506.9.5 Required Filters. A filter permitting the passage of particulates no larger than 100 microns (100 µm) shall be provided for on-site treated nonpotable gray water supplied to water closets, urinals, trap primers, and drip irrigation systems.

2019 California Plumbing Code

1503.8.3 Daily Discharge. *Gray water systems using tanks shall be designed to minimize the amount of time gray water is held in the tank and shall be sized to distribute the total amount of estimated gray water on a daily basis.*

Exception: *Approved on-site treated nonpotable gray water systems.*

NSF 350

TABLE 1 SCOPE OF NSF/ANSI STANDARDS 350 AND 350-1

NSF/ANSI Standard 350: On-site Residential and Commercial Water Reuse Treatment Systems	
Building Types	Residential, up to 1,500 gallons per day Commercial, more than 1,500 gallons per day and all capacities of commercial laundry water
Influent Types	Combined black and graywater Graywater Bathing water only Laundry water only
Effluent Uses	Nonpotable applications, such as surface and subsurface irrigation and toilet and urinal flushing
Ratings	Two classifications that vary slightly in effluent quality: • Class R: single-family residential • Class C: multifamily and commercial Systems are further described based on the type of influent (combined, graywater, bathing only, laundry only).
NSF/ANSI Standard 350-1: On-site Residential and Commercial Graywater Treatment Systems for Subsurface Discharge	
Building Types	Residential, up to 1,500 gallons per day Commercial, more than 1,500 gallons per day and all capacities of commercial laundry water
Influent Types	Combined black and graywater Graywater Bathing water only Laundry water only
Effluent Uses	Subsurface irrigation only
Ratings	Single effluent quality with no classifications

NSF 350

TABLE 6 SUMMARY OF DRAFT NSF STANDARD 350 EFFLUENT CRITERIA FOR INDIVIDUAL CLASSIFICATIONS

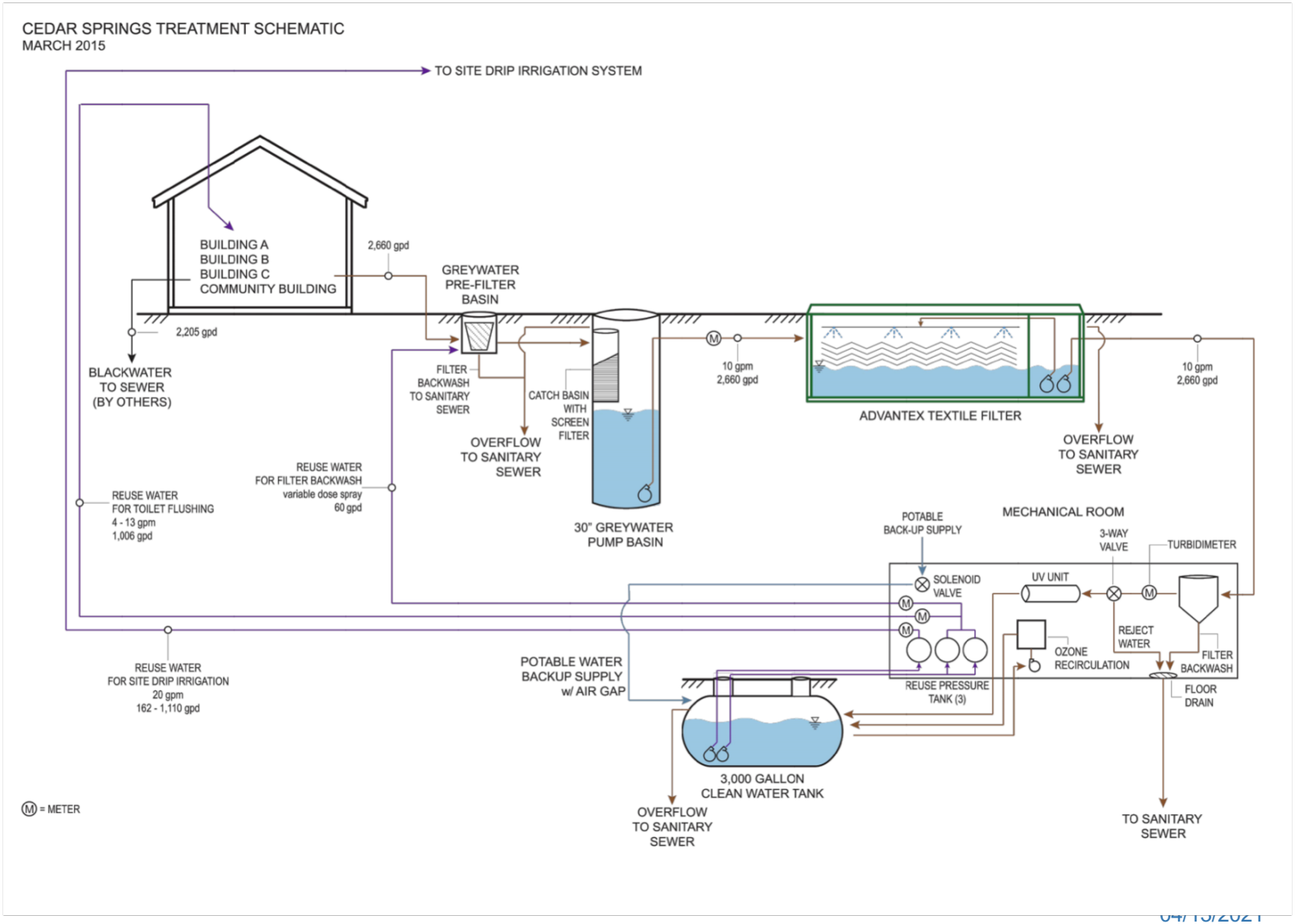
Parameter	Class R		Class C	
	Overall test average	Single sample maximum	Overall test average	Single sample maximum
$CBOD_5$ (mg/L)	10	25	10	25
TSS (mg/L)	10	30	10	30
Turbidity (NTU)	5	10	2	5
E. coli[2] (MPN/100 mL)	14	240	2.2	200
pH (SU)	6–9	NA[1]	6–9	NA
Storage vessel disinfection (mg/L)[3]	≥0.5–≤2.5	NA	≥0.5–≤2.5	NA
Color	MR[4]	NA	MR	NA
Odor	Non-offensive	NA	Non-offensive	NA
Oily film and foam	Non-detectable	Non-detectable	Non-detectable	Non-detectable
Energy consumption	MR	NA	MR	NA

From the California Plumbing Code, Section 1601.7 "for onsite nonpotable treated greywater systems the requirements of NSF350 shall apply."

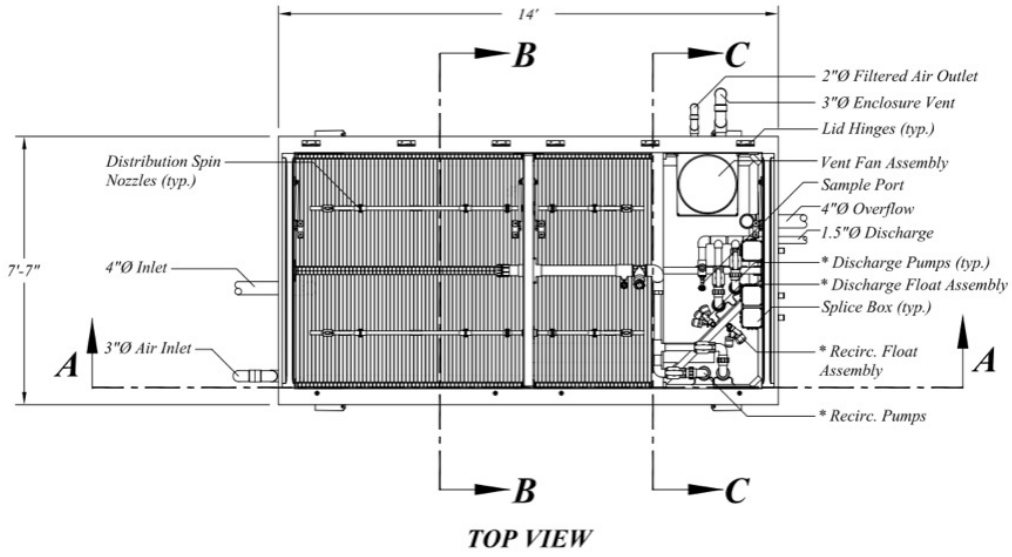
Cedar Springs Apartments – Laverne, CA

Photo courtesy of Biohabitats

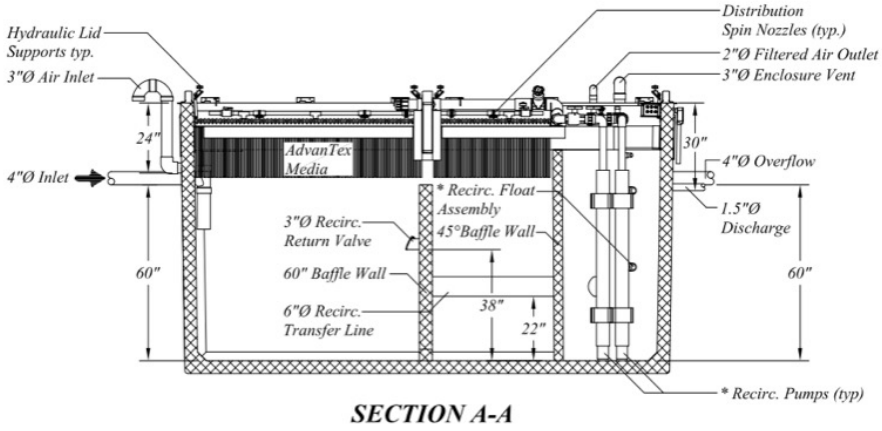
Cedar Springs Apartments – Laverne, CA


CEDAR SPRINGS TREATMENT SCHEMATIC
MARCH 2015
TO SITE DRIP IRRIGATION SYSTEM
BUILDING A
BUILDING B
BUILDING C
COMMUNITY BUILDING
2,660 gpd
GREYWATER
PRE-FILTER
BASIN
2,205 gpd
BLACKWATER
TO SEWER
(BY OTHERS)
FILTER
BACKWASH
TO SANITARY
SEWER
CATCH BASIN
WITH
SCREEN
FILTER
OVERFLOW
TO SANITARY
SEWER
10 gpm
2,660 gpd
ADVANTEX TEXTILE FILTER
OVERFLOW
TO SANITARY
SEWER
10 gpm
2,660 gpd
REUSE WATER
FOR FILTER BACKWASH
variable dose spray
60 gpd
REUSE WATER
FOR TOILET FLUSHING
4 - 13 gpm
1,006 gpd
30" GREYWATER
PUMP BASIN
MECHANICAL ROOM
POTABLE
BACK-UP SUPPLY
3-WAY
VALVE
TURBIDIMETER
SOLENOID
VALVE
UV UNIT
REJECT
WATER
FILTER
BACKWASH
OZONE
RECIRCULATION
FLOOR
DRAIN
REUSE PRESSURE
TANK (3)
REUSE WATER
FOR SITE DRIP IRRIGATION
20 gpm
162 - 1,110 gpd
POTABLE WATER
BACKUP SUPPLY
w/ AIR GAP
3,000 GALLON
CLEAN WATER TANK
OVERFLOW
TO SANITARY
SEWER
TO SANITARY
SEWER
M = METER

AX-Max 075-14



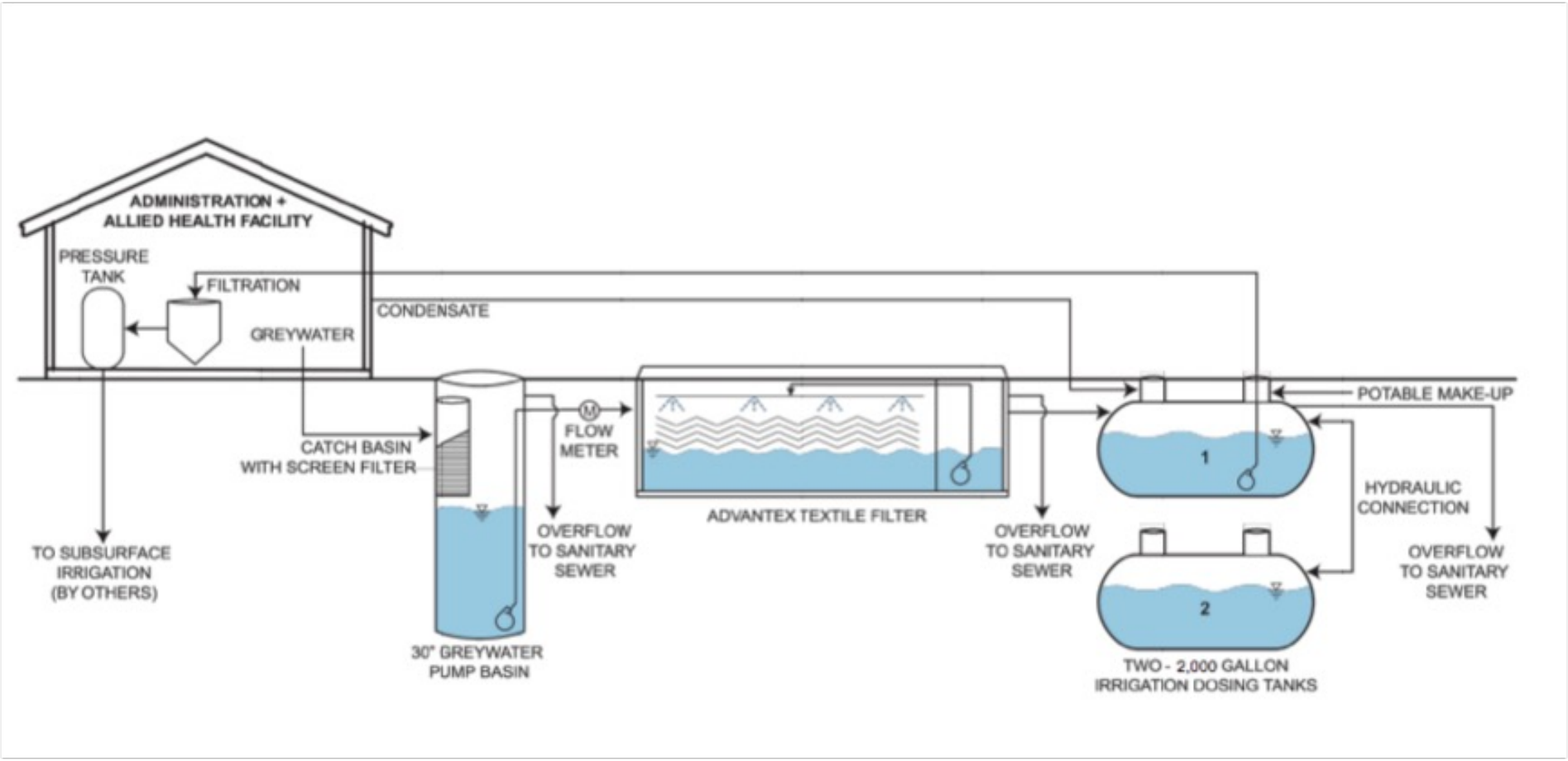
TOP VIEW



SECTION A-A

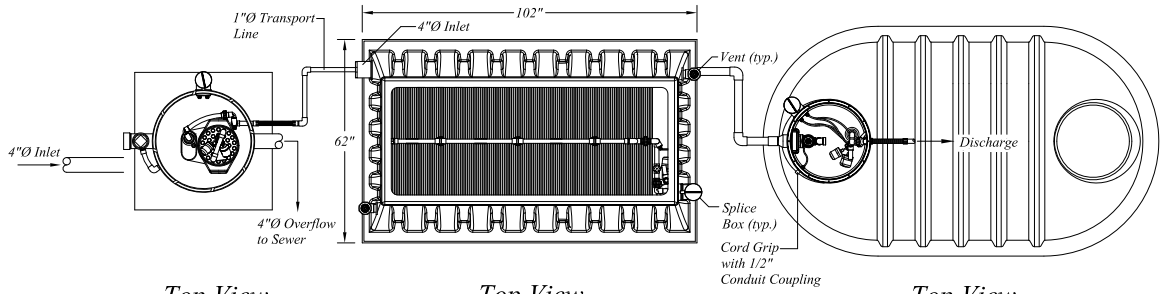
University of Hawaii Administration Building

Photo courtesy of University of Hawaii


ADMINISTRATION +
ALLIED HEALTH FACILITY
PRESSURE
TANK
FILTRATION
GREYWATER
CONDENSATE
POTABLE MAKE-UP
CATCH BASIN
WITH SCREEN FILTER
FLOW
METER
ADVANTEX TEXTILE FILTER
HYDRAULIC
CONNECTION
TO SUBSURFACE
IRRIGATION
(BY OTHERS)
OVERFLOW
TO SANITARY
SEWER
OVERFLOW
TO SANITARY
SEWER
OVERFLOW
TO SANITARY
SEWER
1
2
30" GREYWATER
PUMP BASIN
TWO - 2,000 GALLON
IRRIGATION DOSING TANKS

Napa Creek Village – Napa, CA

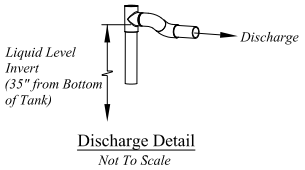
Image courtesy of Napa Creek Village website



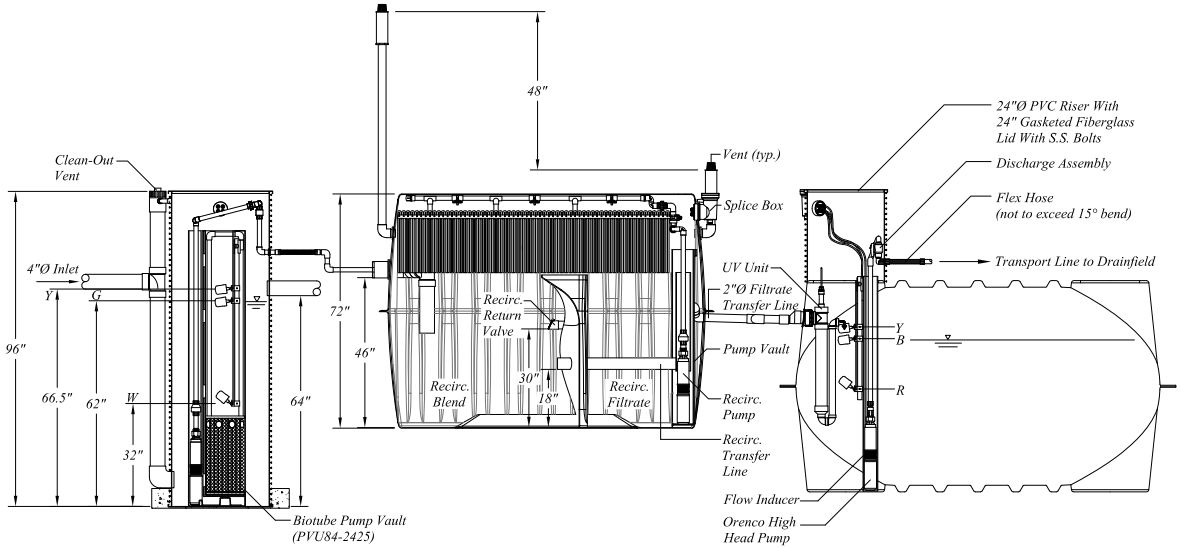
Top View
Collection Basin

Top View
AX25 800 gal. Recirc. Tank

Top View
1000 gal. UV Dose Tank



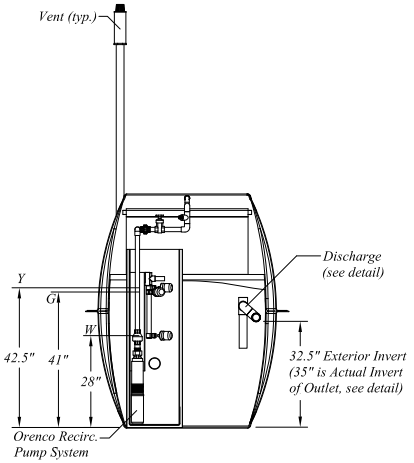
Discharge Detail
Not To Scale



Side View
Collection Basin

Side View
AX25 800 gal. Recirc. Tank

Side View
1000 gal. UV Dose Tank



Discharge Chamber
AX25 800 gal. Recirc. Tank

Float Functions	
Y	*High Level Alarm*
G	*Override Timer ON/OFF*
W	*LLA/RO*
B	*Pump On*
R	*Pump Off*

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Portions or all of this Proposed System Configuration Drawing, as appropriate, may be reproduced and integrated into the site-specific layout and configuration of a system by its designer.

Disclaimer: This Proposed System Configuration Drawing is provided solely as a design aid and illustrates one possible configuration of a system that would comply with Orenco's design criteria for the requirements and/or specifications that have been communicated to Orenco (based on third-party standards testing protocols and performance reports, as applicable). Design decisions, including the actual layout and configuration of the system and its viability for the project, are at the sole discretion of the systems's designer.

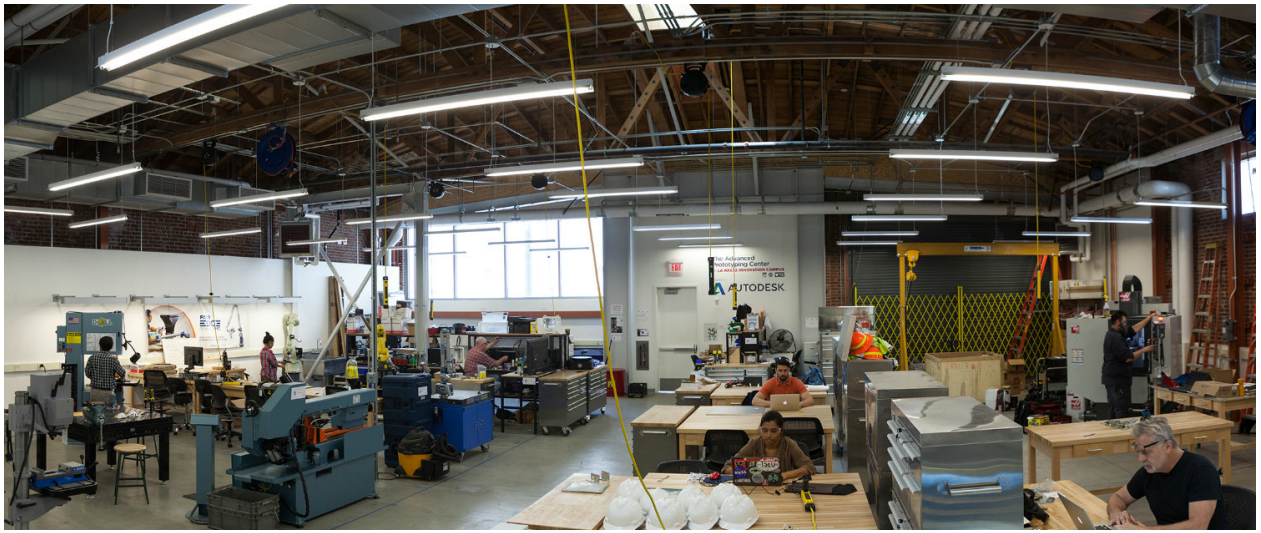
Napa Creek Village
AdvanTex AX25RTUV Treatment
System Details

Drawn By:	BEN SMITH	Scale:	1" = 3'-0"
Reviewed By:	JP	Sheet:	1 OF 1
File Name:	DRI880.DWG	Rev: 1.0	Date: 8/18/2016

Harvest Village – Napa, CA

Photo courtesy of Napa Creek Village website

La Kretz Innovation Center, Los Angeles, CA



Images courtesy of the LaKretz web page

La Kretz Innovation Center, Los Angeles, CA

AdvanTeX Greywater Typical Cost

Unit	Sq Ft	Flow	List	Per Gallon List	Installed	Per Gallon Ins
AX25RTUV	25	1000 gpd	$15,000	$15.00	$24,000	$24.00
AX-Max 75-14	75	3,000 gpd	$45,000	$15.00	$72,000	$24.00
AX-Max 125-21	125	5,000 gpd	$83,000	$16.60	$120,000	$24.00
AX-Max 250-42	250	10,000 gpd	$121,000	$12.10	$173,500	$17.35
AX-Max 500	500	20,000 gpd	$197,000	$9.85	$281,000	$14.05

Treatment System Energy Usage

Unit Process	1 MGD Average Flow	5 MGD Average Flow
Attached Growth	630 kWh/MG	580 kWh/MG
Aeration with Nitrification	1080 kWh/MG	1080 kWh/MG
Sequencing Batch Reactors	1090 kWh/MG	1090 kWh/MG
Membrane Bioreactors	2700 kWh/MG	2706 kWh/MG

Energy Intensity Values for Various WWTP Unit Processes (source: EPRI, 2013)

Summary

- Packed bed filter treatment is a cost-effective, energy efficient option for greywater recycling.
- Decentralized wastewater management allows solutions to serve a larger audience and customer base.
- Demand for water recycling continues to grow and an increasing number of successful water reuse projects prove that recycling can be done safely at smaller scales.