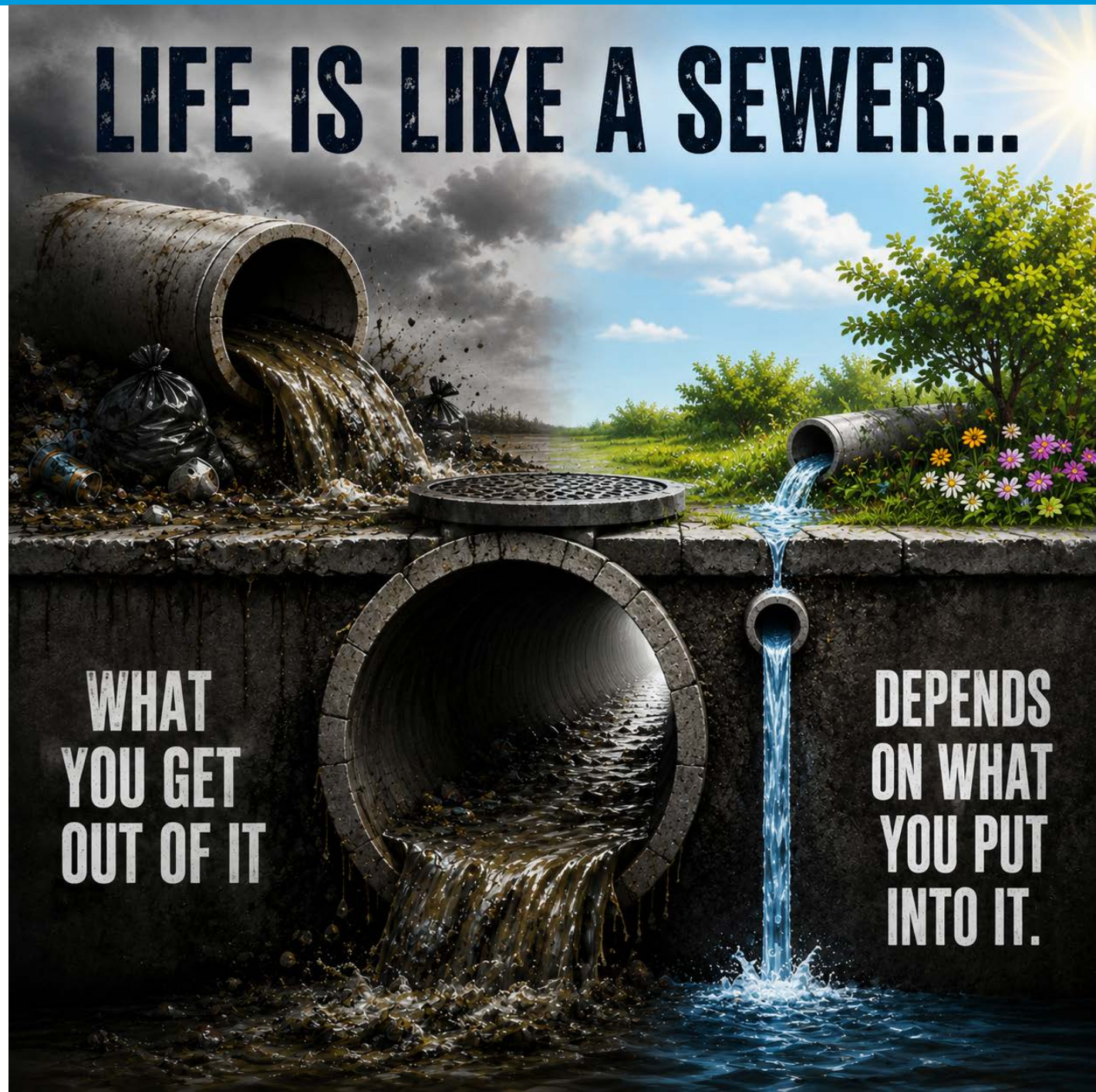
PRESENTER

Mike Saunders
Orenco Systems, Inc.

Liquid Only Sewer
A STEP In the Right Direction

FRWA Annual Conference & Exhibition

Words of Wisdom



Today's Goal: Promote Thoughtful Discussion on Wastewater System Challenges

Today's Goal: Promote Thoughtful Discussion on Wastewater System Challenges

Liquid Only Sewer AKA's

- Septic Tank Effluent Pump Systems (STEP)
- Septic Tank Effluent Gravity System (STEG)
- Effluent Sewer
- Low Pressure Sewer
- Pressure Sewer

The Basic Concept of Liquid Only Sewer (LOS)

1

Enhanced Primary Treatment

2

Scum Layer

Floating materials naturally separate and remain in the tank.

3

Clear Zone

Clarified effluent is pumped from this region for transport.

4

Sludge Layer

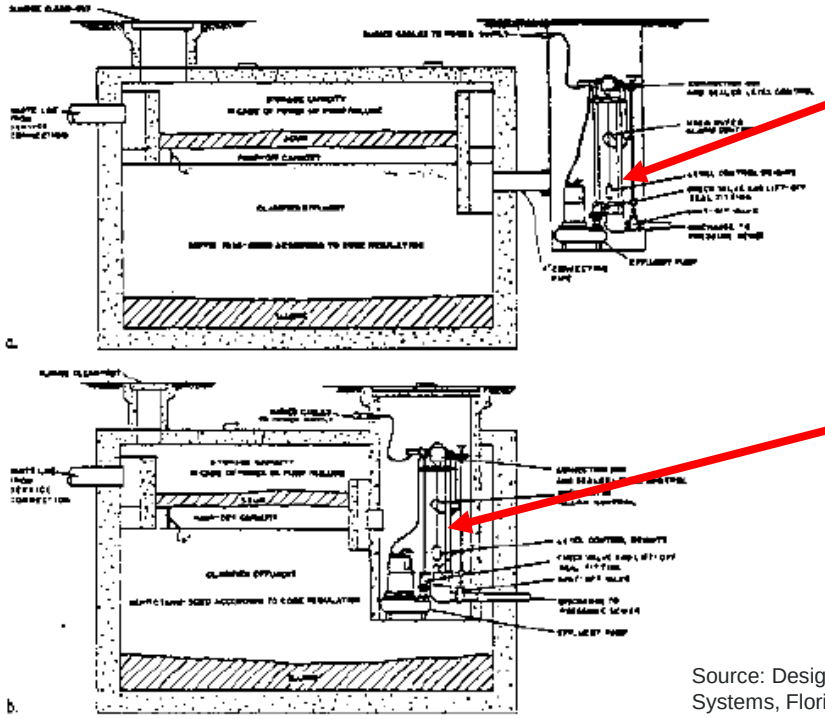
Heavier solids settle to the bottom for natural decomposition.

Florida STEP System (1981)

"STEP" defined as a Septic Tank Effluent Pump system

FIGURE II-2

TYPICAL SEPTIC TANK EFFLUENT PUMPSYSTEMS



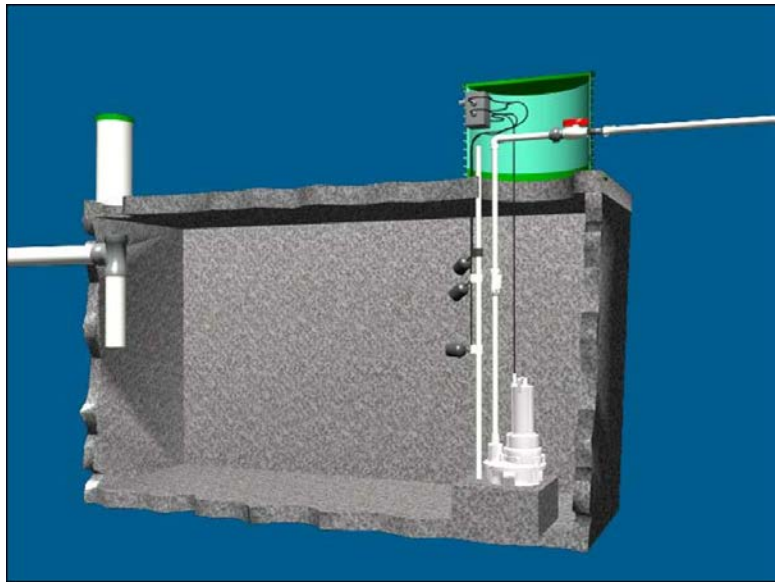
External pump basin

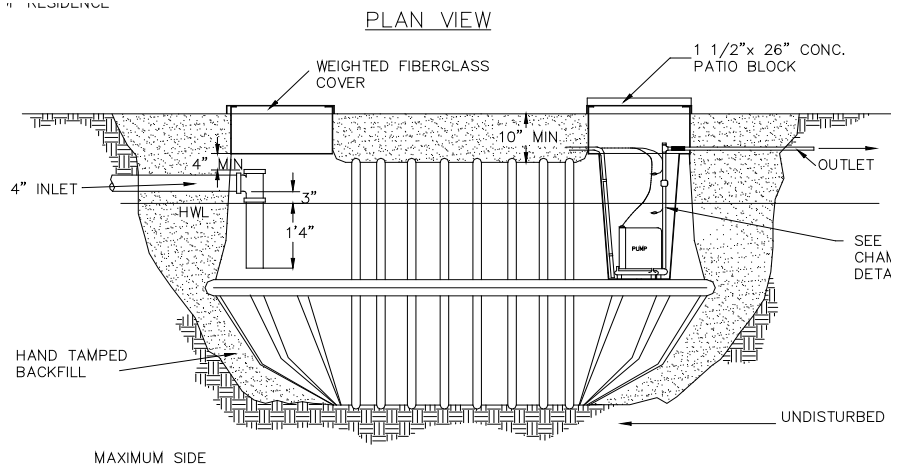
Pump on a shelf

Source: Design and Specification Guidelines for Low Pressure Sewer Systems, Florida DEP 1981

Early STEP Systems

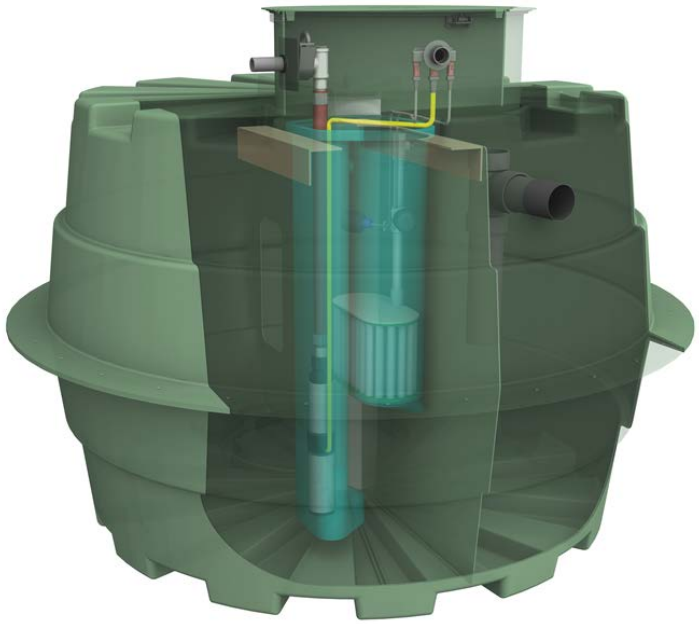
- Poor quality leaking tanks
- “Pump-on-a-block” configuration
- “Pump-on-a-shelf” configuration
- Undersized, unbaffled tanks
- Low head effluent pumps
- Little or no filtering
- “Frankenstein Systems”





Source: Charlotte County Utilities FL Standard Details

Modern Liquid-Only Sewer



Todays Options

1000 or 1500-gallon polypropylene tank

- Multiple size Concrete tanks
- Pump vaults sized to the depth of the concrete tank

1000 or 1500-gallon DCPD (Dicyclopentadiene) tank

Meander tank configuration

Liquid Only Sewer

Collection Mains

- Typically 2”diameter with shallow burial depths
- Simple Installation
- Trenchless installation possible

Flexible Routing

- Flow can move in any direction and can travel uphill without lift stations.

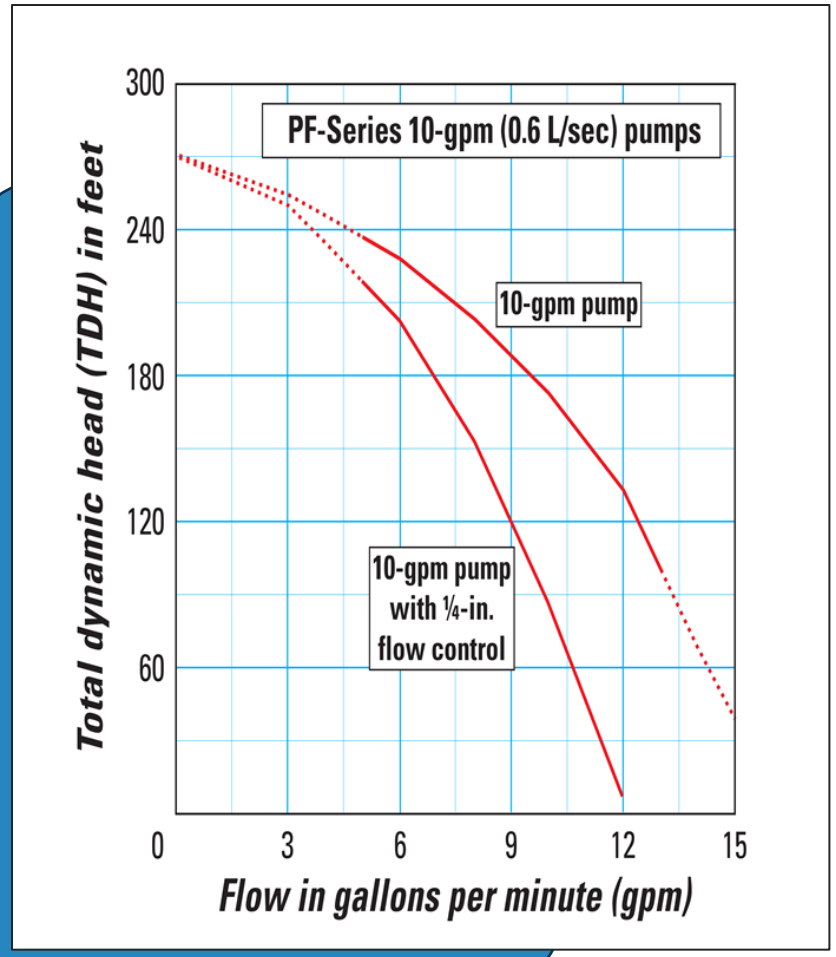
Water-Main-Like Function

- Mains function more like a water main than a wastewater force main

Force Mains

Factor	Prelos Sewer	Grinder Pumps & Lift Stations
Flow Velocity	Not Critical	> 2 ft/sec
Oversizing for future capacity	No limitation	Limited by flow velocity
Low build-out	No issue	Can cause sedimentation and odor problems
Pumping distances	Theoretically tens of miles	Limited by flow velocity
Extensions and additions	Typically no problem	Could require pump upgrades, new lift station or replacement of mains
Fats oils and grease	Reduced by LOS	Can plug mains

Effluent Pumps



Industry Standard

High Performance: Exceptional shut-off head

Reliable & Durable: Built for continuous use and frequent cycling

Lightweight Design: Easy to install and handle

Versatile, Durable Solution

One model should work for all residential connections

Rebuildable, Cost-effective maintenance

CSA & UL listed for wastewater applications

24-hour run-dry (liquid-end), motor submerged

Includes bypass orifice

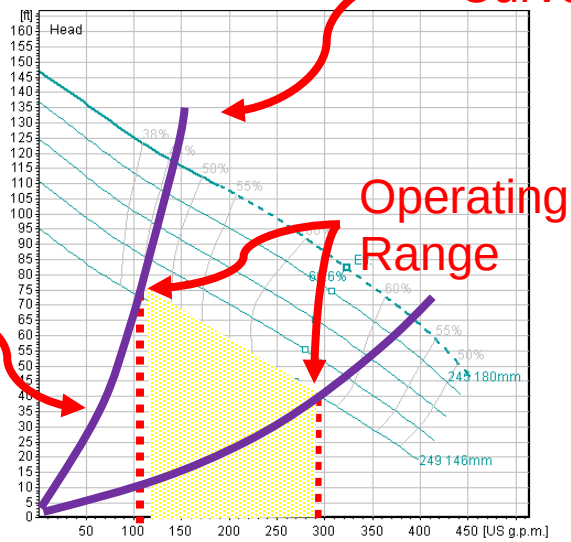
Infiltrator Part of ADS | Orenco SYSTEMS

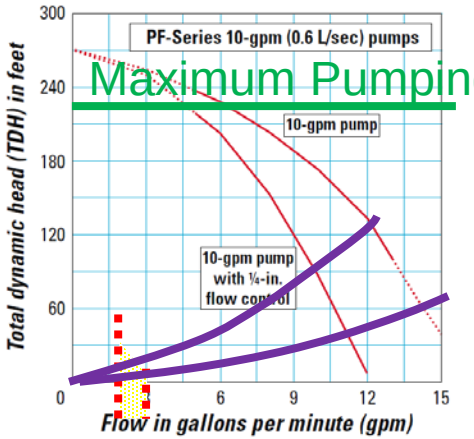
Basic Hydraulics of STEP

Pump Curve

System Curve

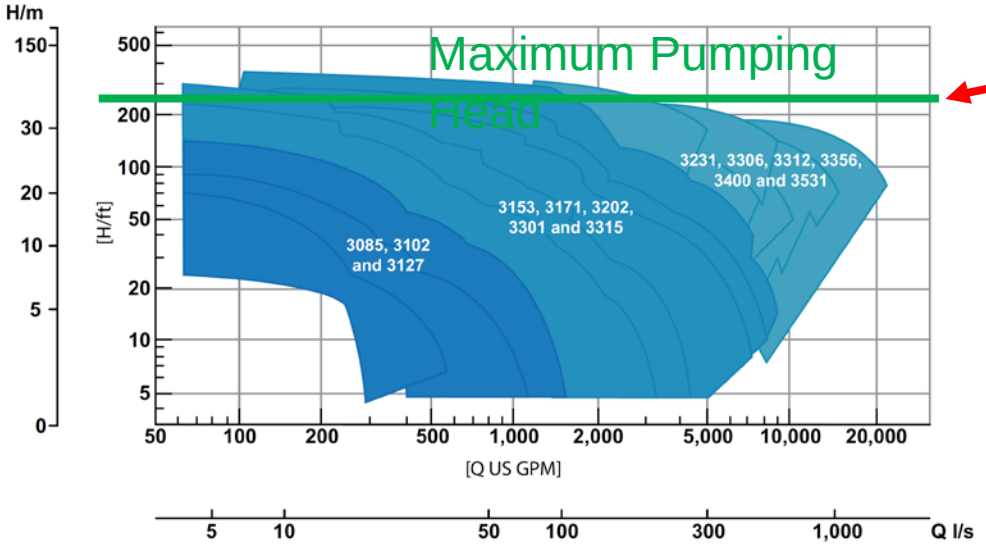
Operating Range





PF-Series 10-gpm pump curve

Maximum Pumping Head



Source: https://www.xylem.com/siteassets/brand/flygt/flygt-resources/flygt-resources/fb002-896876_flygt_n-pump_series.pdf

Infiltrator Part of ADS | Orenco SYSTEMS

Flow Determination

Flow Equation

Qgpm = (EDUs) (PC/ 6) + 15

Simplified Equation

Qgpm = (EDUs/ 2) + 15*

*Flow from a single pump (Only use on terminal end mains)

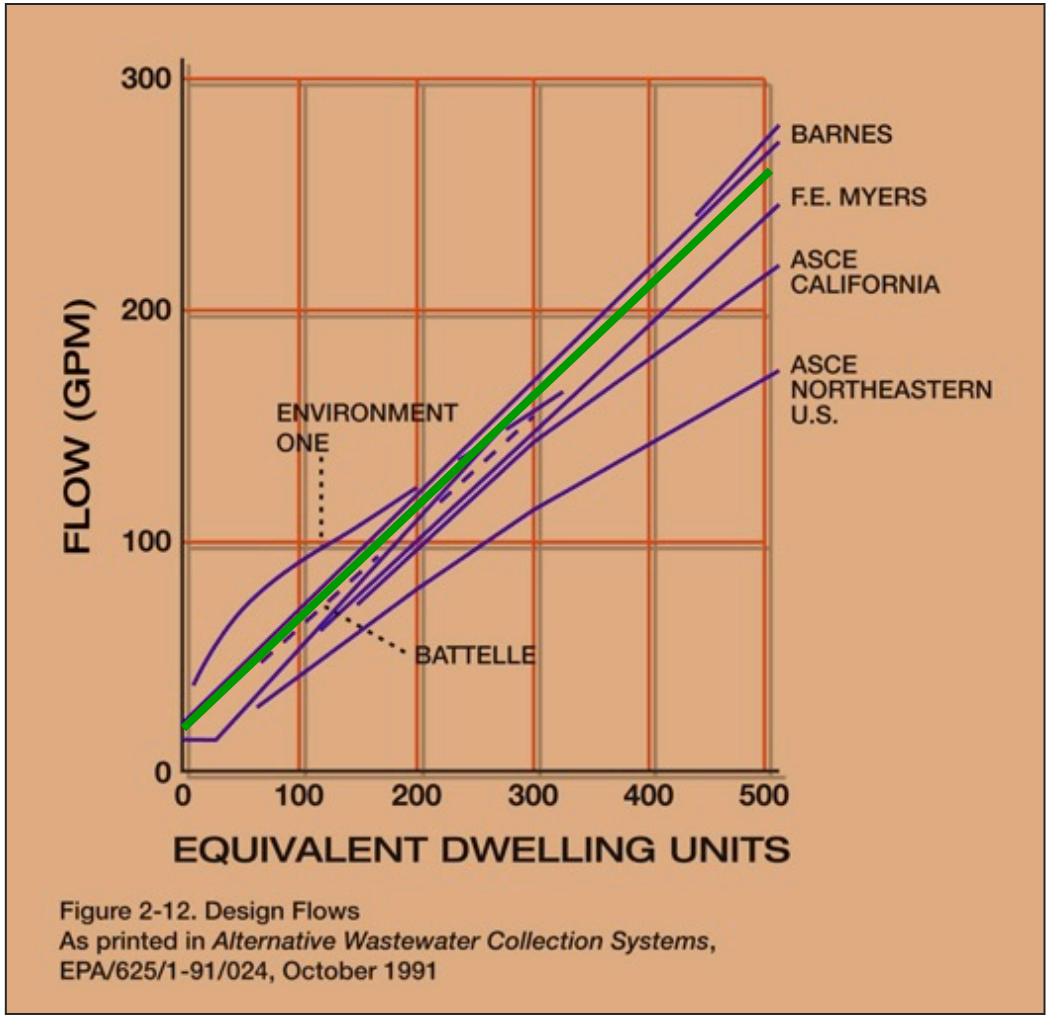


Figure 2-12. Design Flows
As printed in *Alternative Wastewater Collection Systems*, EPA/625/1-91/024, October 1991

Typical Line Sizing

Table 2. Typical Line Sizes Using PVC and HDPE Pipe

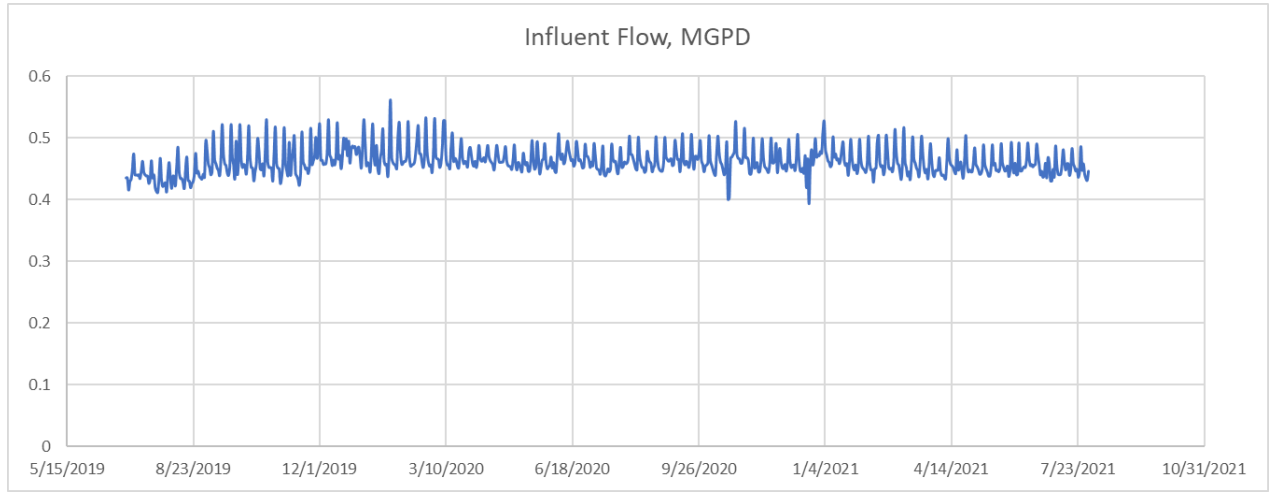
EDUs	Q_P, gpm (L/sec)[1]	PVC Pipe[2] Size, in. (mm) nominal	Head Loss ft/1000 ft or m/1000m	HDPE Pipe[3] Size, in. (mm) nominal	Head Loss ft/1000 ft or m/1000m
1-50	15-40 (1-2.5)	2 (50)	3.6-22.1	2 (50)	7.2-43.7
51-150	40-90 (2.6-5.7)	3 (75)	3.7-16.2	3 (75)	6.8-29.7
151-250	90-140 (5.7-8.8)	3 (75)	16.3-36.7	4 (100)	8.8-19.7
251-350	140-190 (8.9-12)	4 (100)	10.0-17.5	4 (100)	19.9-34.7
351-500	190-265 (12-16.7)	4 (100)	17.6-32.4	6 (150)	5.3-9.8
501-1000	265-515 (16.8-32.5)	6 (150)	5.0-16.9	6 (150)	9.8-33.4

[1]Assumed P_c of 3, Q_c of 50 gpcd (190 Lpcd), and B value of 15 gpm (1 L/sec); this B value can be dropped after 20 connections, but has been left in for this example.

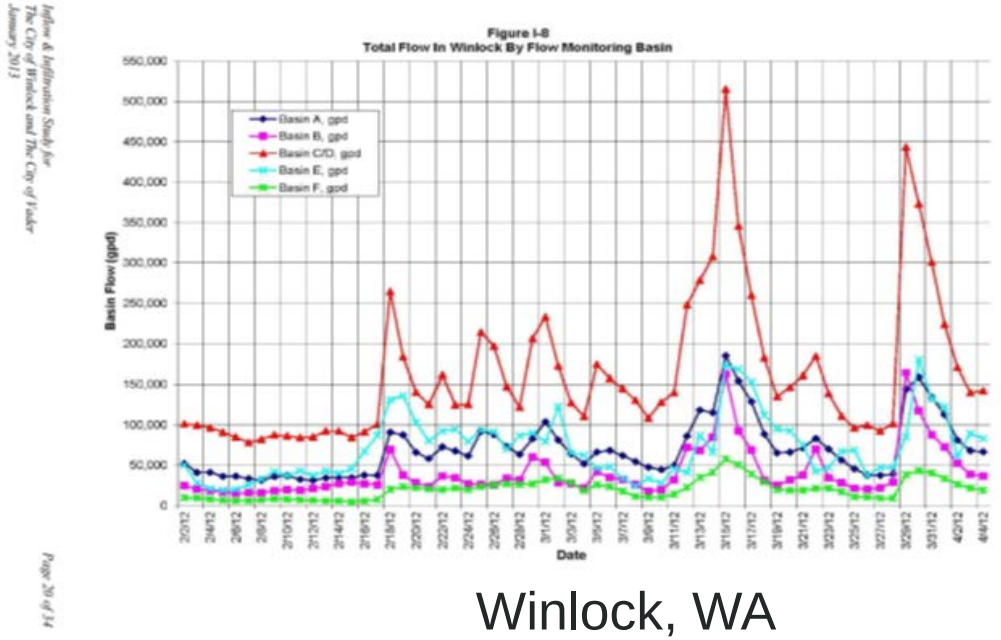
[2] Nominal diameter shown, Class 200 pipe

[3] Nominal diameter shown, DR11 pipe

I&I (Inflow & Infiltration)



25-year-old liquid only sewer

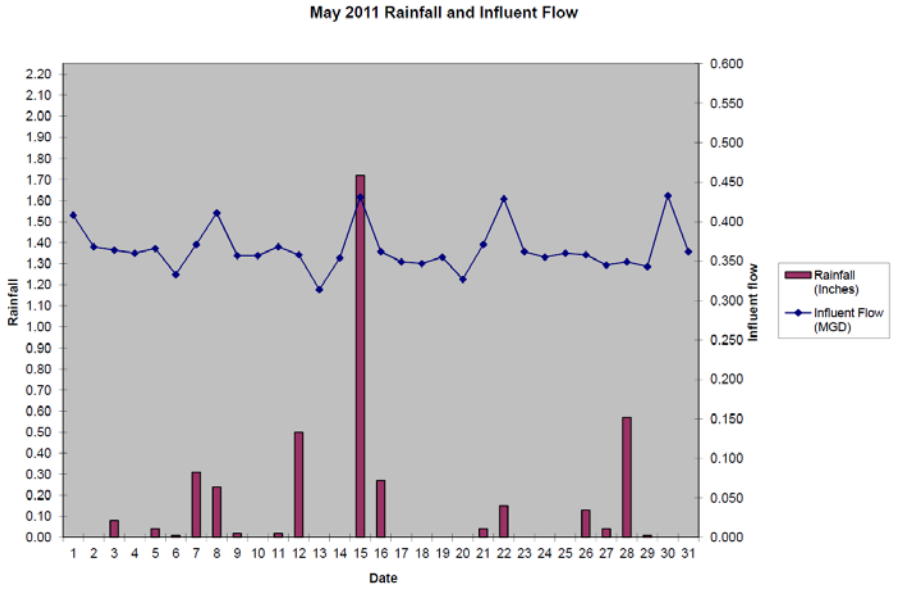


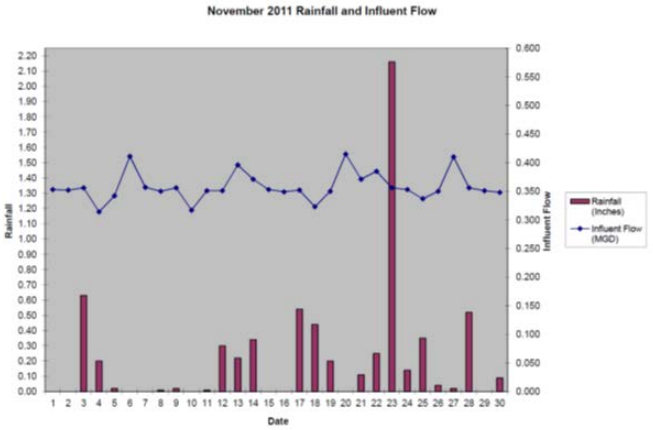
Winlock, WA
Gravity sewer
70% PVC pipe

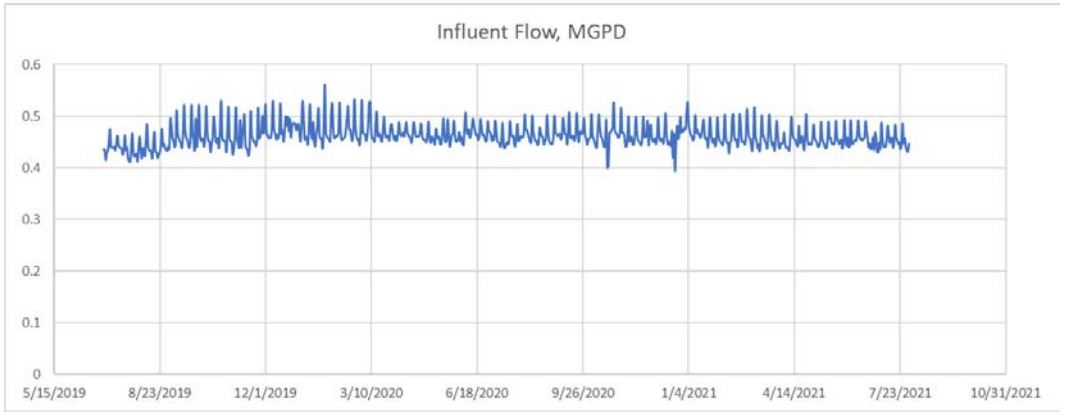
Typical flow generation is 50 gpd/person and not 75 or even 100 gpd/person

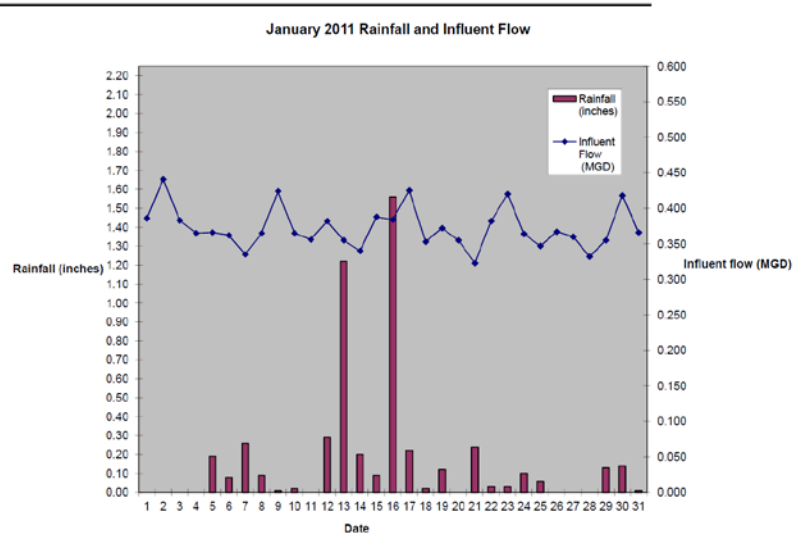
I&I

The Yelm system (25 years old) has little to no I&I

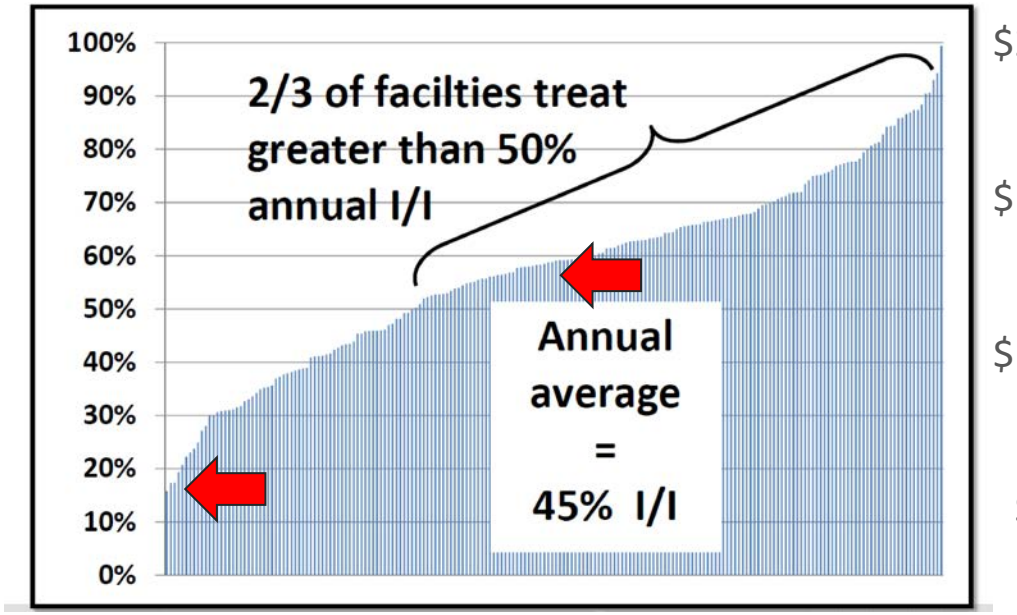


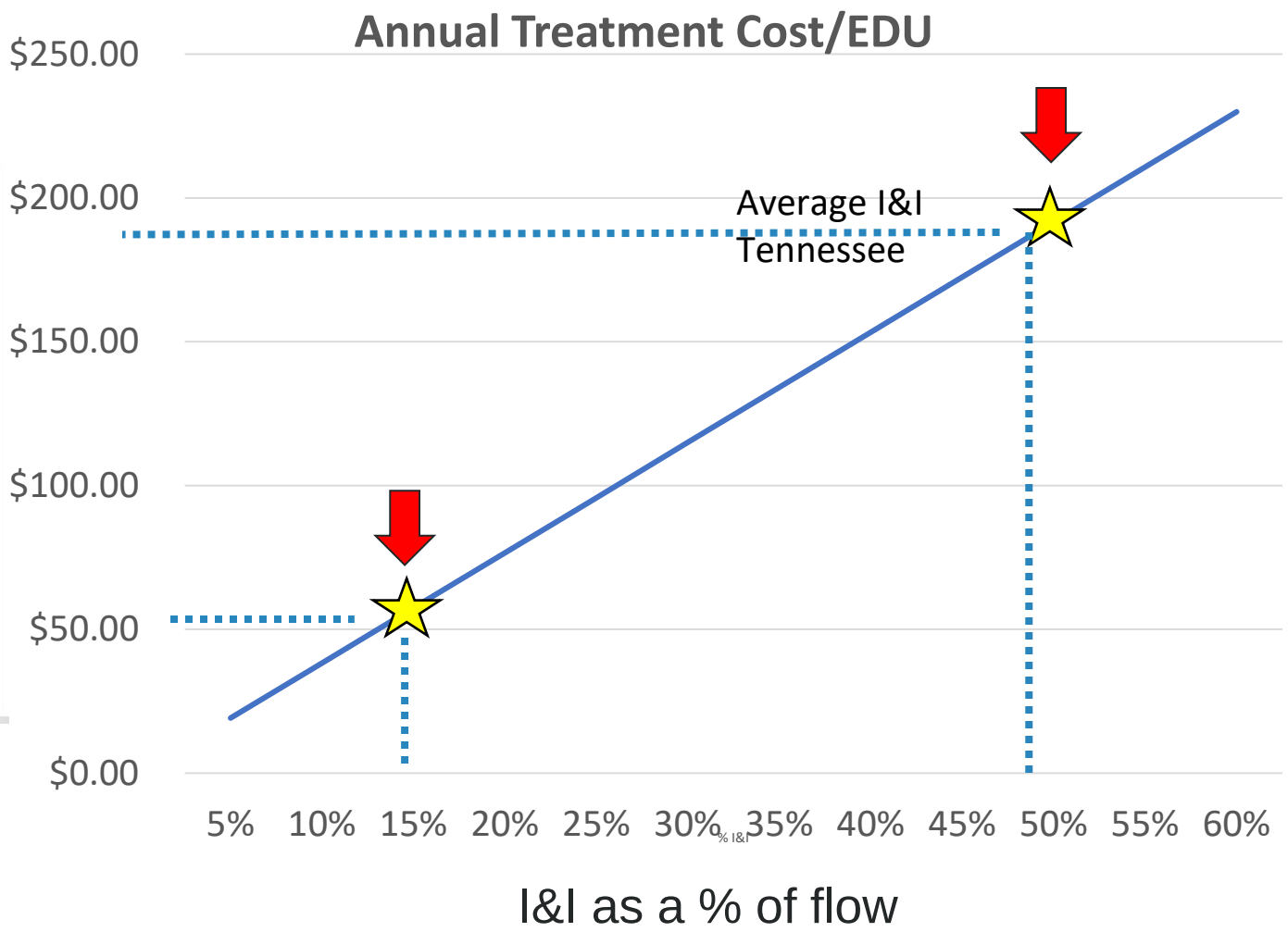






The Cost of I&I

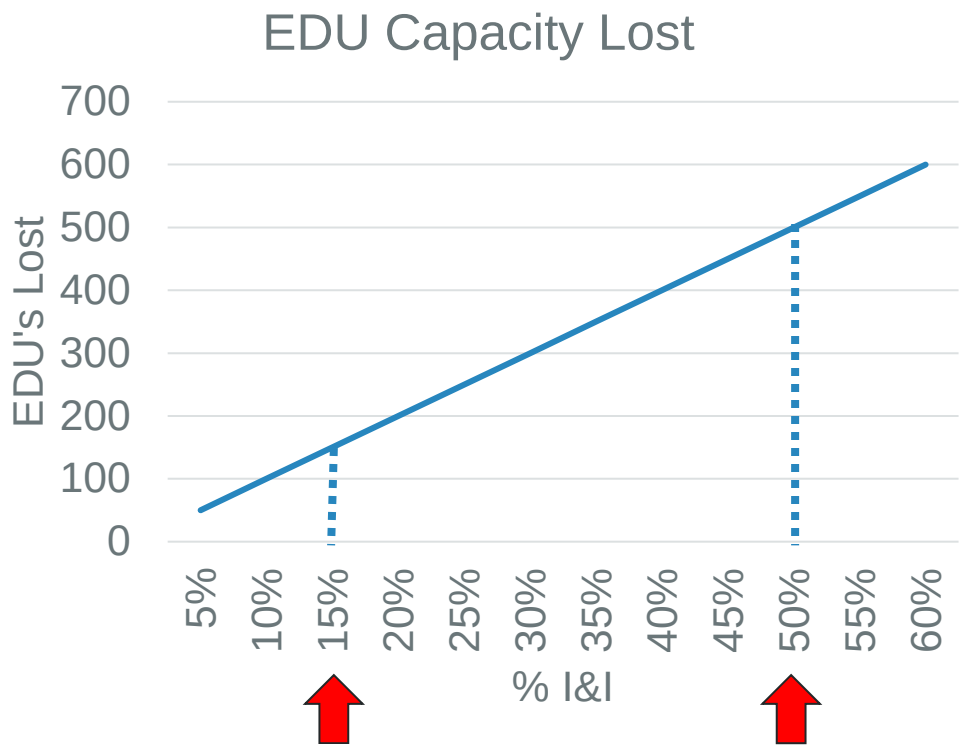




* Cost based on $7 per 1000 gallons treated

Infiltrator Part of ADS | Orenco SYSTEMS

Lost Capacity Due To I&I
(1000 home community)



Daytona Beach

Connection Fees – $2,814.00

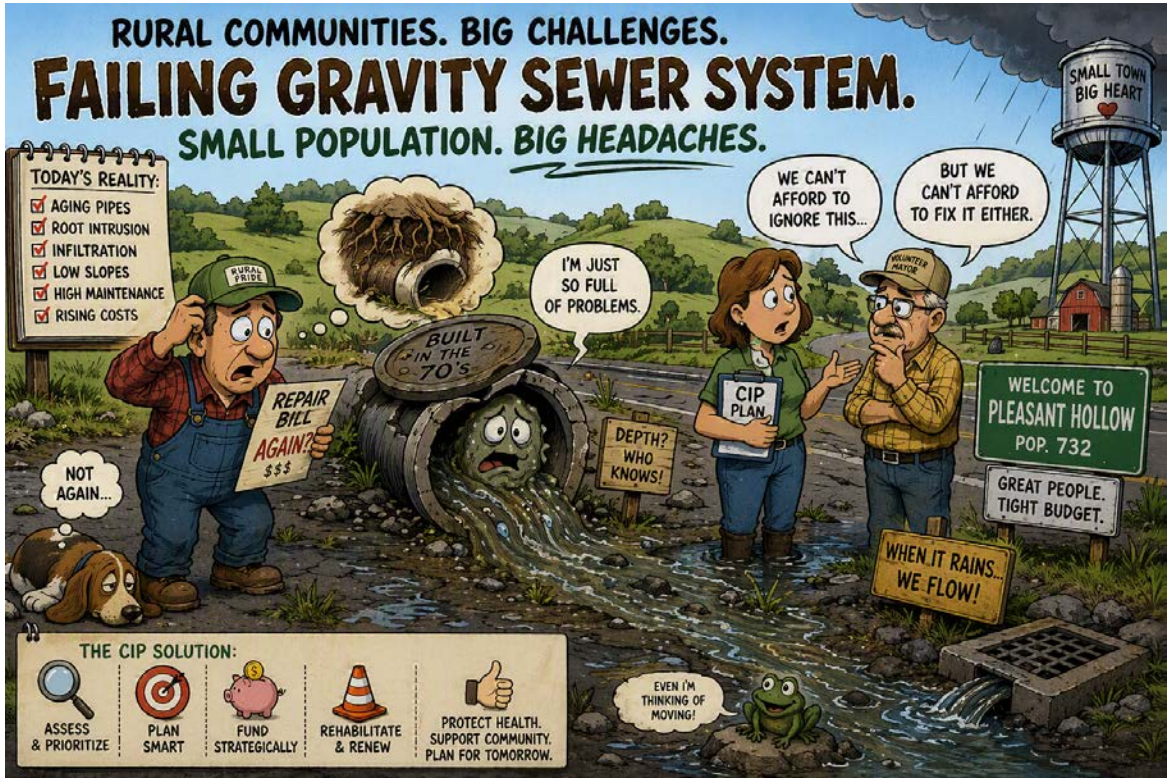
Wastewater Customers – 100,000

Value of lost capacity at 15% - $42 million or $422 per existing customer ($35 annually over 20 years)

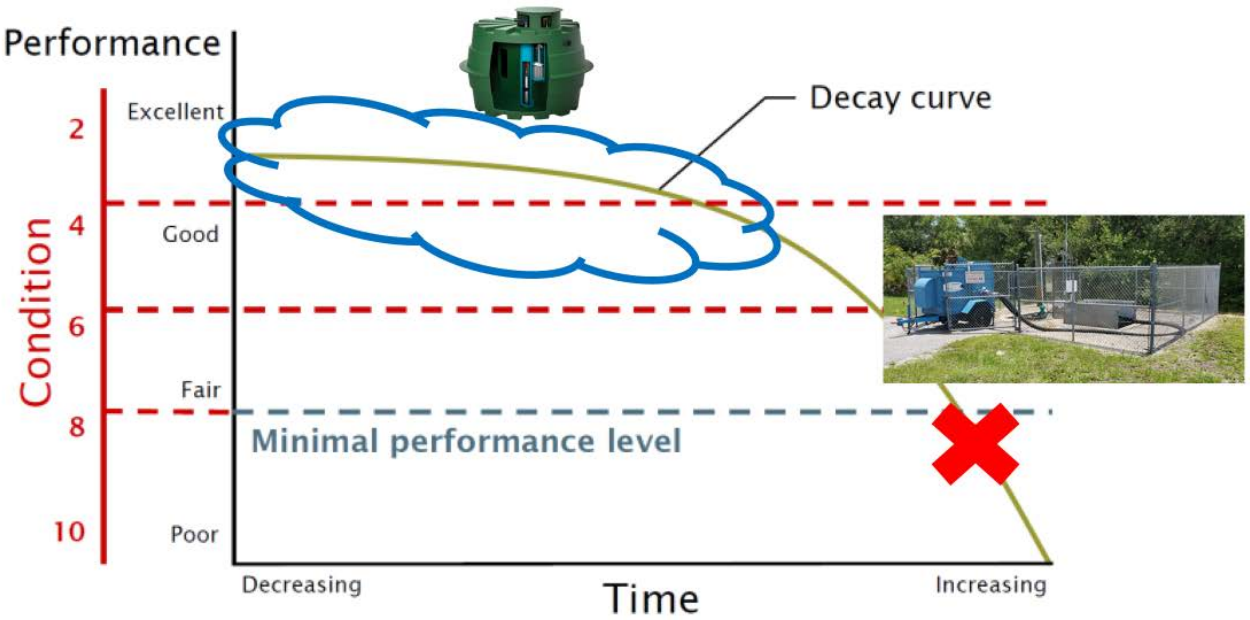
Value of lost capacity at 50% - $141 million or $1,407 per existing customer ($125 annually over 20 years)

Or what if we didn't need to build the extra capacity?

Note: This is for demonstration only…I don't know what Daytona has for an I&I rate, it's probably zero.



Renewal & Replacement (R&R) & Sustainability



THEORETICAL DECAY CURVE

Availability Cost

Making sewer available for connection

Liquid-Only Sewer

- ✓ Typically 2" pressure mains buried 3' to 5'
- ✓ Typically 1" laterals top property line (occupied properties only)

Gravity Sewer

- ✓ Manholes every 400' min.
- ✓ 8" min. diameter mains at 0.4% min slope
- ✓ 4" service laterals (all properties)
- ✓ Lift stations
- ✓ Force mains

Directional Boring

Trenchless Technology

Installs pipelines/cables with minimal surface disruption.

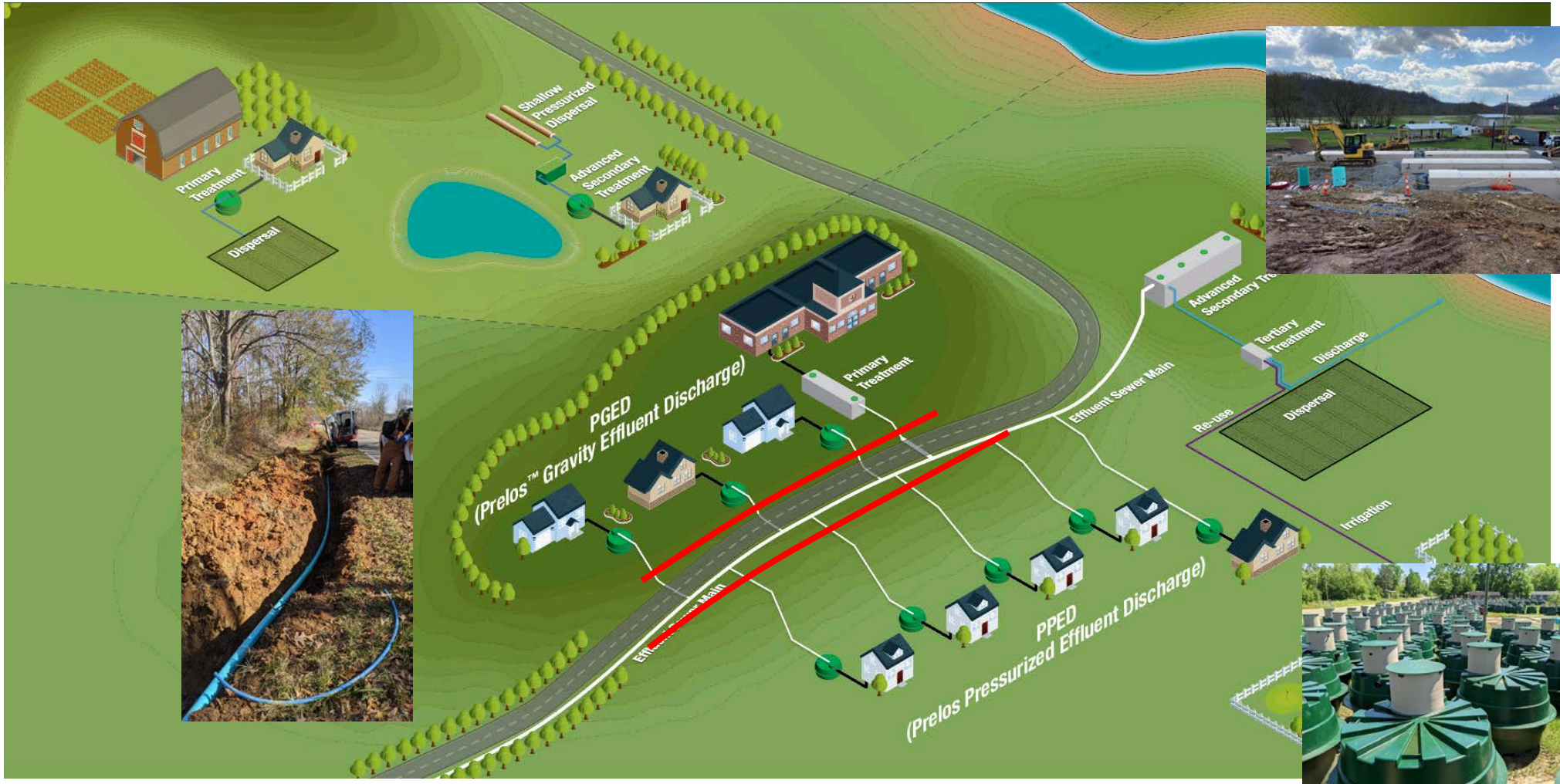
Eco-Friendly

Minimizes environmental impact compared to traditional trenching.

Cost-Effective

Reduces restoration costs and project timelines.

Liquid-Only Sewer
Up-Front vs. Deferred Capital Cost



Vero Beach, Florida

Failing onsite systems

Existing infrastructure adjacent

Existing treatment

Infilled with liquid only sewer

Sewer made available to > 1000 properties for < $1000/home (2018)

Reactive Maintenance (RM): LOS Systems

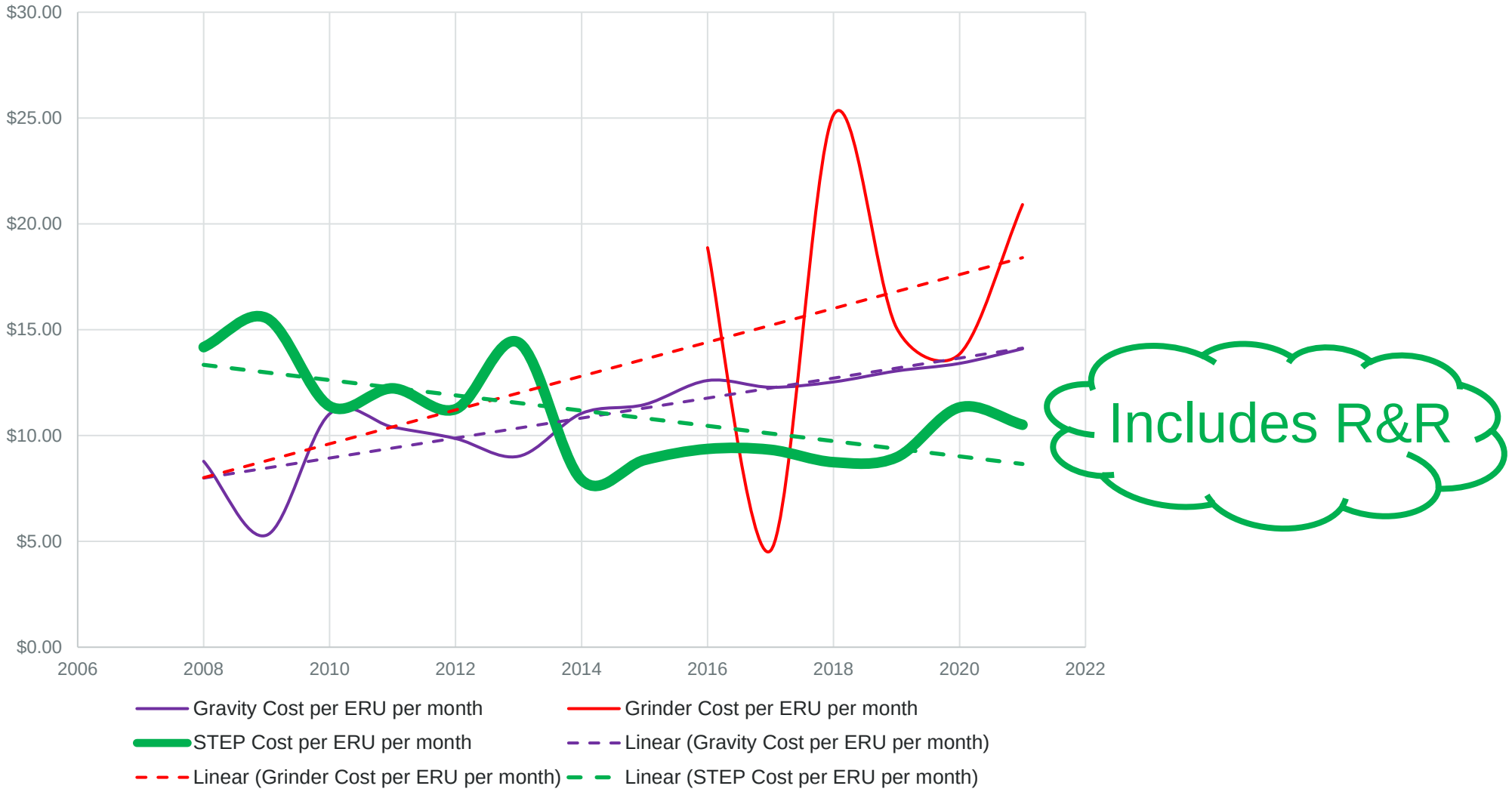
State	Community	EDUs	Screened	Hrs/mo./100 EDUs
CA	Mt. Lake Estate	8	yes	1.0
CA	Villa Verona	337	yes	2.5
MT	Missoula	350	yes	1.5
OR	Elkton	135	yes	0.7
OR	Glide	1,054	30%	1.5
OR	Lakeside	51	yes	0.3
OR	La Pine	215	yes	1.8
OR	Tangent	180	yes	2.5
WA	Boston Harbor	166	yes	1.6
WA	Conconnully Lake	75	yes	0.5
WA	Diamond Lake	525	yes	1.2

Typical to see 1 FTE with small service truck maintaining > 3000 connections

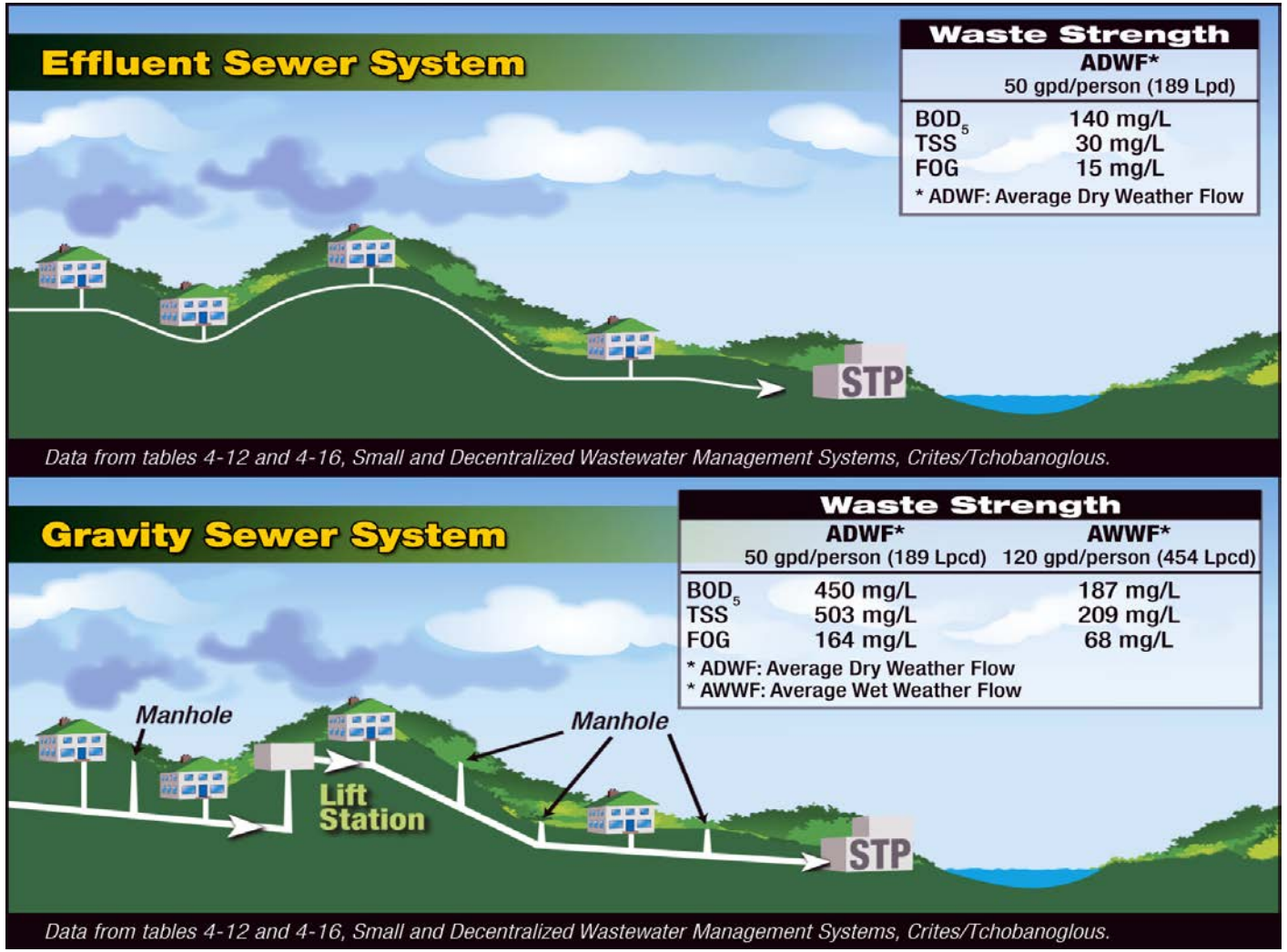
City of Lacey, Washington
Liquid Only Sewer System O&M

- Installed in 1989
- ~ 4,000 total Liquid Only Sewer, 12,000 gravity, and 3,000 grinder connections
- City utilizes 2 full-time employees for Liquid Only Sewer
- Since 2008, all properties are on an 8-year preventative maintenance cycle
- Fewer than 20 pumps replaced annually
- Cost for operating Liquid Only Sewer is currently lower than the gravity sewer

Lacey, WA Monthly Cost



Liquid Only Sewer Systems Provide
Free Primary Treatment & No I&I

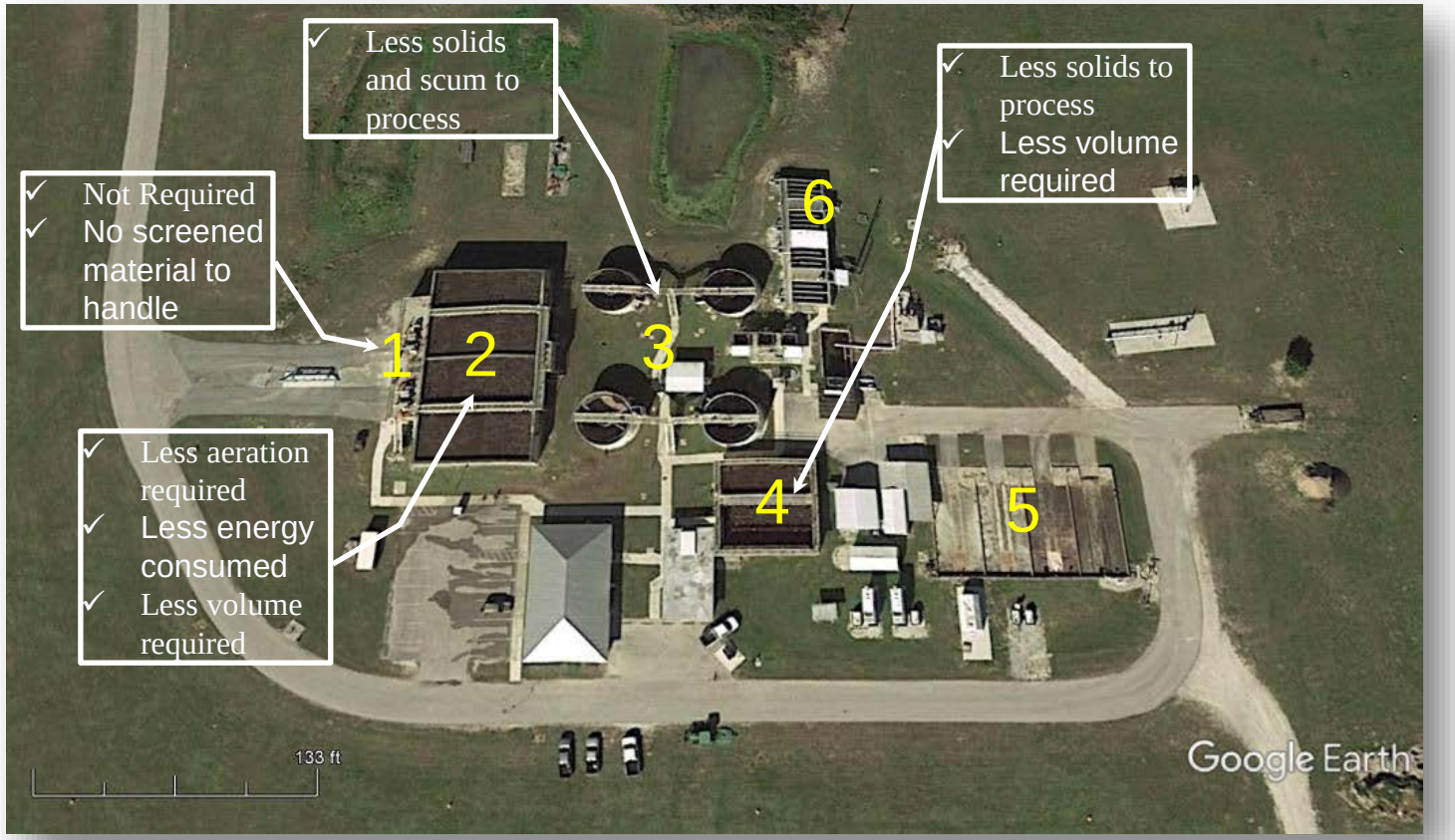


How Big Would the Primary Tank Need to Be…

to replace the primary treatment provided by Prelos Sewer?

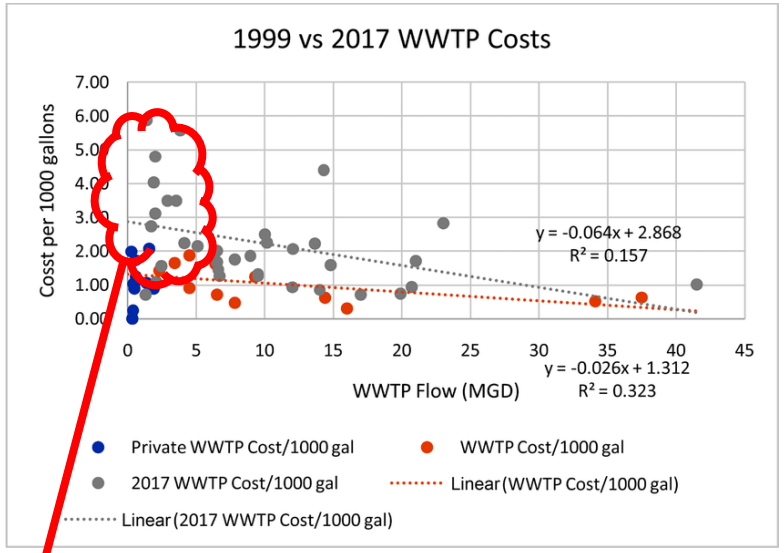
For a 1.2 mgd plant, assuming 1 residential connection generates 200 gpd, the primary tank would be 6 million gallons in volume, equivalent to a 2-acre reservoir with 10-foot-high walls.

1.2 mgd Activated-Sludge Plant



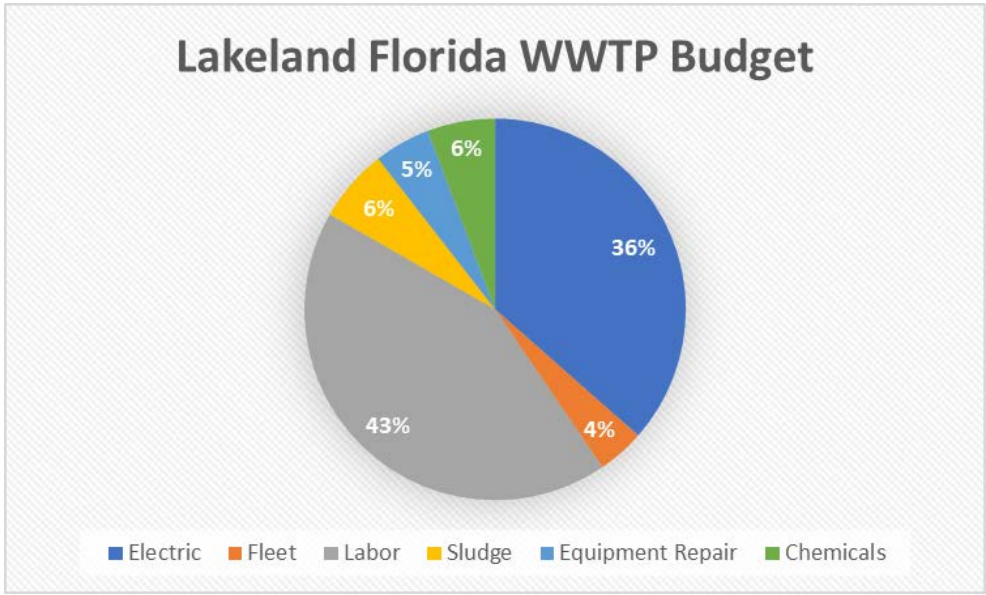
1. Headworks
2. Aeration Basin
3 Clarifiers
4. Digester
5. Drying Beds
6. Disinfection

Treatment Considerations



Source: Risk and Economic Development in the Provision of Public Infrastructure, Journal of Environmental Protection. 09.973-990. 10.4236/jep2018.99061

For small activated-sludge plants, treatment cost is typically $10 to $35 monthly per EDU



Liquid-only sewer is the **ONLY** wastewater collection system that will save money in treatment costs

Effects of Liquid Only Sewers on WWTP's
Influent Waste Stream Characteristics

Typical Wastewater Collection System Daily Per Capita Organic Loads

	Effluent Sewer	Grinder Sewer	Gravity Sewer	
Oxygen Requirements				
Carbonaceous O_2	0.063 lbs/day	0.188 lbs/day	0.200 lbs/day	69% less
Nitrogenous O_2	0.103 lbs/day	0.111 lbs/day	0.133 lbs/day	23% less
Sludge Production				
Heterotrophic, $P_{x,vss}$	0.019 lbs/day	0.058 lbs/day	0.061 lbs/day	69% less
Autotrophic, $P_{x,nvss}$	0.0014 lbs/day	0.0015 lbs/day	0.0018 lbs/day	22% less

Metcalf & Eddy, 2003. Crites and Tchobanoglous, 1998.
"Optimizing MBR Treatment Facilities with Effluent Sewer Collection Systems" T.R.Bounds, PE, Tyler J. Molatore, PE

Biosolids

- Liquid Only Sewer reduces biosolids by up to 80% when compared to grinder or gravity sewer*
- Biosolids handling costs are a major component of total wastewater treatment costs
- Don’t need headworks
- Less digester capacity Required

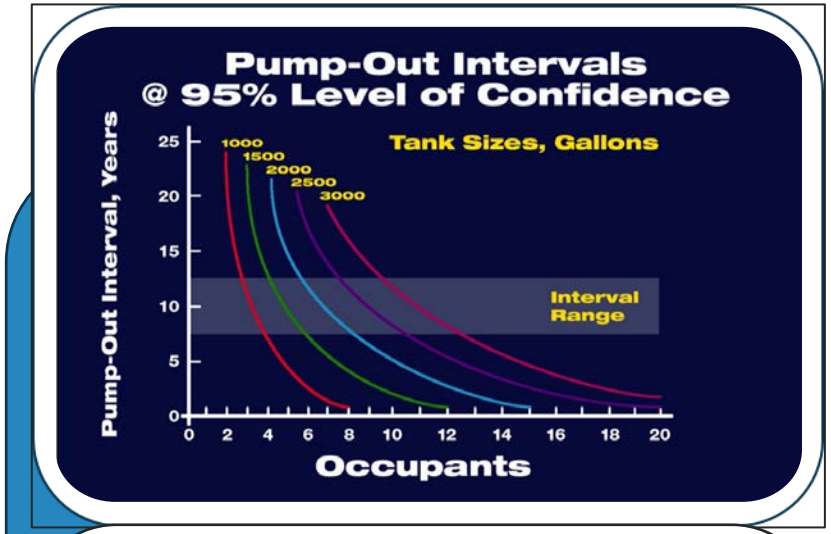
*Internal calculations

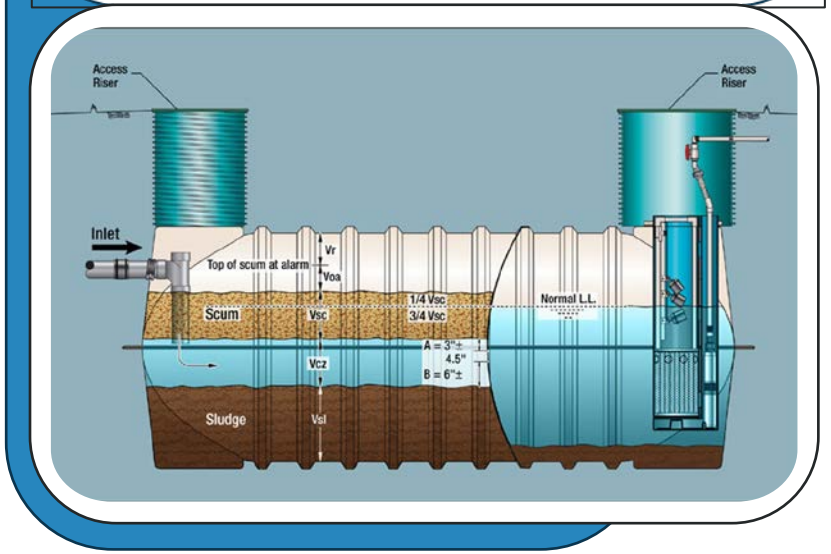
Two years of biosolids (15 cubic meters) for over 1000 connections in Glide, Oregon, naturally dried in a drying bed.

This equates to roughly $150 annually in solids handling savings per home (2.5 residents) versus $50/yr for pumping to pump onsite tank

1 Week Below Sludge Chute – Coburg Oregon MBR. 700 Connections

Tank Sizing Considerations





Warmer Climates

Warmer climates show enhanced performance

Large Flows

Minimum 2 days detention of maximum flow with pump tank minimum 25% of maximum flow.

Financial Impact

Consider the economics of pump-outs versus capital cost

Garbage Disposals

Garbage disposal can add up to 36% more solids loading

Time in Tank

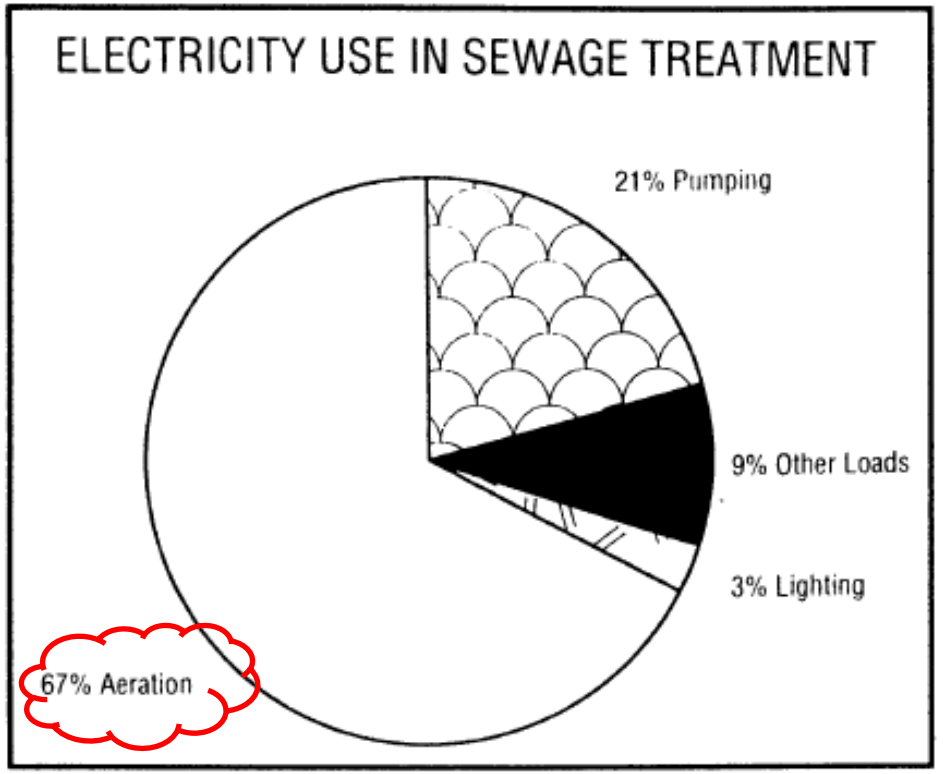
Keep sludge and scum in the tanks for as long as possible

Electrical Costs Associated with Wastewater Treatment

Figure 6 WWTP Efficiency Baseline Ranges

Treatment Type	Flow (MGD)	MWh/MG	kWh/lb BOD
Extended Air	<0.1	1.1 - 46.0	1.9 - 20.3
Conventional Activated Sludge	0.1 - <0.5	3.3 - 6.9	2.5 - 4.9
	0.1 - <0.5	2.5 - 5.3	2.8 - 6.3
	0.5 - <5	1.1 - 6.1	0.9 - 4.7
	>5	0.4 - 1.2	0.2 - 2.2
Sequential Batch Reactor	<0.1	8.7 - 25	3.2 - 7.1
	0.1 - <0.5	1.2 - 12.6	1.6 - 7.2
	0.5 - <5	1.8 - 6.6	1.4 - 4.5
Oxidation Ditch	0.1 - <0.5	2.2 - 6.6	2.1 - 6.4
	0.5 - <5	3.3 - 4.5	1.6 - 5.1

Source: Electric Use at Pennsylvania Sewage Treatment Plants (PDEP 2011).



Source: New York State Energy Research and Development Authority

Higher wastewater strength and more biosolids equate to more energy use.

Annual Energy Savings (BOD5 only)
$44 annually per customer served

Assumptions

- 200 gpd flow per household
- Influent liquid only seer BOD – 150 mg/L
- Influent gravity BOD5 – 300 mg/L
- Electrical rate $0.16 per kWh
- Electrical use per lb of BOD removed – 3 kWh/lb

Decentralized/Distributed Wastewater Management

Collect and treat wastewater at or near the source

- Consists of a variety of approaches for collection, treatment, and dispersal/reuse of wastewater
- Can be used for individual dwellings, industrial or institutional facilities, clusters of homes or businesses, and entire communities
- Treatment can be as simple, passive treatment or can be more complex, capable of reducing nutrients like nitrogen

Decentralized Wastewater Management
Creating a Community Solution

Attached Growth WWTP – Designed for Liquid Only Sewer

- Attached growth
- No open tanks
- Modular
- Low energy
- No headworks
- No clarifiers
- No aeration/no blowers

Treatment cost is typically 1/10 the cost of an activated-sludge plant


Our new treatment decision was a great success! Efficient and compliant!
And the plant is running perfectly, boss!
LAKEVIEW WASTEWATER TREATMENT PLANT - -OPERATIONAL SUCCESS!
WASTEWATER PERFORMANCE: EXCELLENT
EFFICIENCY UP 40% SAVINGS!
PASSED
ACTIVE TREATMENT

Mike Saunders
msaunders@orenco.com
(941) 661-5776