Effluent Sewer Myth Busting

Orenco Systems®, Inc
www.orenco.com

Discussion Topics

- Review of different types of sewer systems
  - Gravity sewers
  - Grinder low-pressure sewers
  - Septic Tank Effluent Pumping (STEP) low-pressure sewers
- Some commonly held myths – DEBUNKED!
- Questions

Gravity Sewers

- 4" or 6" transport pipe to collection main
- Large-diameter mains buried deep
- Manholes required throughout collection system
- Large main pumping stations required
- Subject to infiltration and inflow (I/I)
- Expensive and disruptive construction
- Regular maintenance required

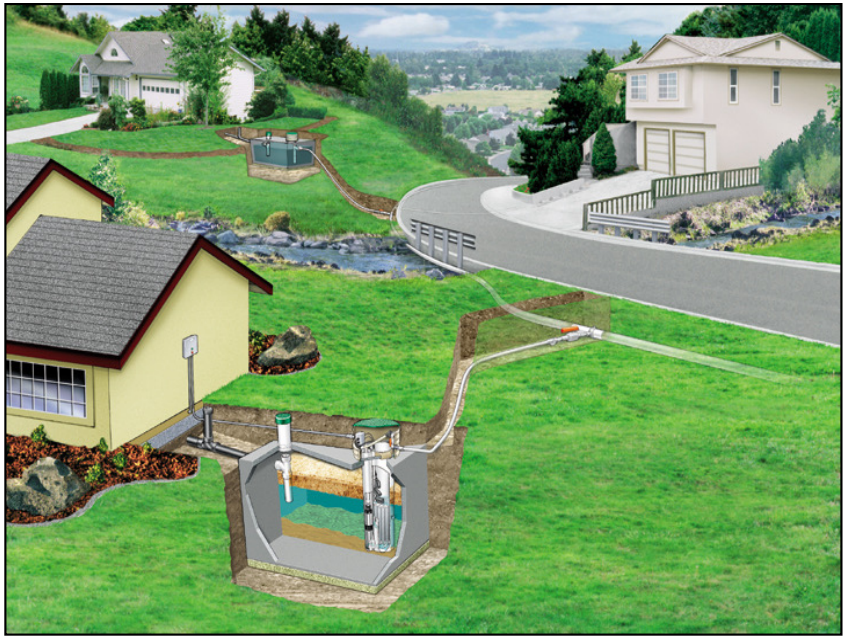
Grinder Pump Low-Pressure Sewers

- Grinder pump basins at each house
- Grinds everything into a slurry
- Pumps through small-diameter, low-pressure lines to WWTP
- Must maintain minimum scour velocity
- Little to no storage in grinder pump station
- Grinder pumps require regular maintenance

Photo courtesy of E-One website

STEP Low-Pressure Sewers

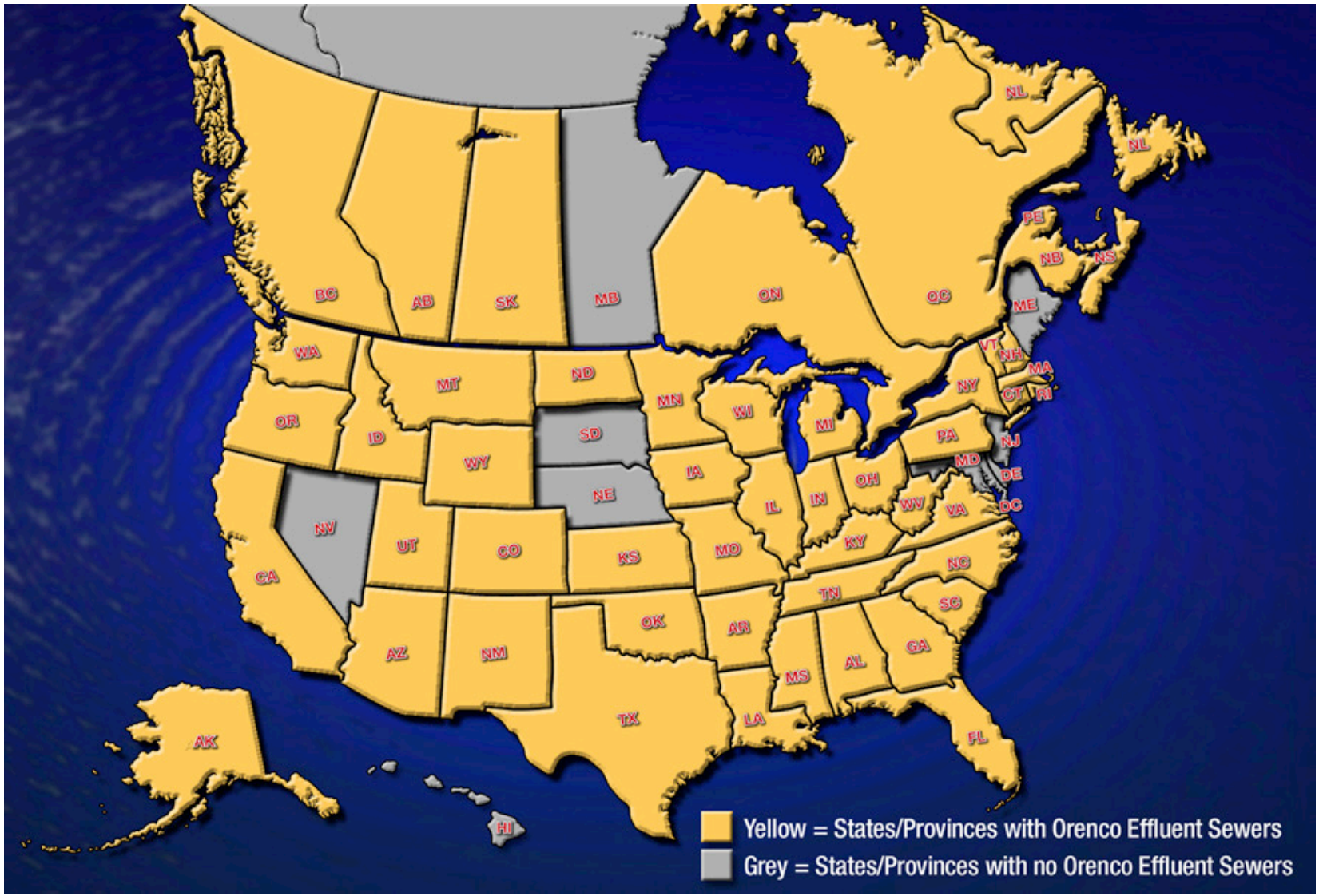
- Watertight septic tanks at each home/business
- Effluent pumps in each tank push effluent to WWTP
- 1/8" mesh effluent filter protects the pump
- Uses small-diameter transport and main lines
- Solids remain in tank



Myth Number 1:

“STEP systems are a new and unproven technology.”

Orenco STEP Sewers Location Map



Orenco STEP Sewer Installations

- 35+ years of documented system performance
  - Glide, OR, 1100+ connections (installed in 1980)
- Other Regional examples and number of connections
  - Northern: Southwest Barry County, MI, 1000+
  - Mountain: Missoula, MT, 1700+
  - Central: Bucyrus, KS, 80; Christiansburg, OH, 250
  - Southwest: Penn Valley, CA, 240
  - Southeast: Ariton, AL, 340; Vero Beach, FL, 1,500 (in construction)
  - Northeast: Hillsdale, NY, 130; South Kent Island, MD, 775 (in construction)
  - Northwest: Lacey, WA, 4000; Camas, WA, 2900; Yelm, WA, 1100; Montesanto, WA, 1500+; Coburg, OR, 420

Myth Number 2:

“STEP Systems can’t be installed on small lots and/or lots with difficult access.”

Orenco STEP Sewer: Parcel Statistics[A]

Size	# Parcels						
Acres	Montesano, WA	Missoula, MT	Coburg, OR	Elkton, OR	Diamond Lake, WA	Christiansburg, OH	Vero Beach, FL[B]
0 - 0.15	369	68	55	42	19	5	4
0.16 - 0.2	158	15	74	10	5	1	3
0.2 - 0.3	468	15	156	36	15	12	82
0.3 - 0.4	183	3	72	8	5	5	38
0.4 - 0.5	111	8	32	8	6	9	18
>0.5	127	2	31	19	206	42	12

[A] Derived from county GIS data. The summarized data may not include all of the parcels that the sewer system serves or include empty parcels within the service area that have yet to be built out.

[B] Denotes STEP system was under construction

Montesano, Washington

- 1,500+ connections
- Replaced old gravity sewer
- Orenco STEP Sewer installed in half the time
- Lower cost than replacing with new gravity sewer
- Old system converted to storm sewer
- 25% of installs on lots smaller than 6,500 ft^2

Image courtesy of Google Earth www.earth.google.com

Missoula, Montana

- Over 1,700 installs to date
- Average lot size less than 6,000 ft^2
- Tank burial depth typically greater than 6'

Image courtesy of Google Earth www.earth.google.com

Elkton, Oregon

- 113 connections
  - 79 STEP
  - 34 STEG
- Serves a densely populated, commercial downtown area

Image courtesy of Google Earth www.earth.google.com

Diamond Lake, Washington

- 530+ connections
- Serves residential and commercial establishments
- Small, lakefront properties

Image courtesy of Google Earth www.earth.google.com

Vero Beach, Florida

- Failing onsite septic systems
- In 2004, 60 homes connected to gravity sewer
  - Expensive
  - Intrusive
- Needed a better sewer option
  - 93,000 linear feet of 2" directionally bored HDPE lines
- 1,500+ Orenco Sewer connections at project's end

Vero Beach *(Continued)*

On-Lot Construction

- 1,500 connections
  - 1,000 gallon tanks for residential
  - 1,500 or 2,000 gallon tanks for commercial
- Roth polyethylene tanks
  - Small excavated footprint (~108 sf)
  - Two risers per tank
- Orenco S1 series panel

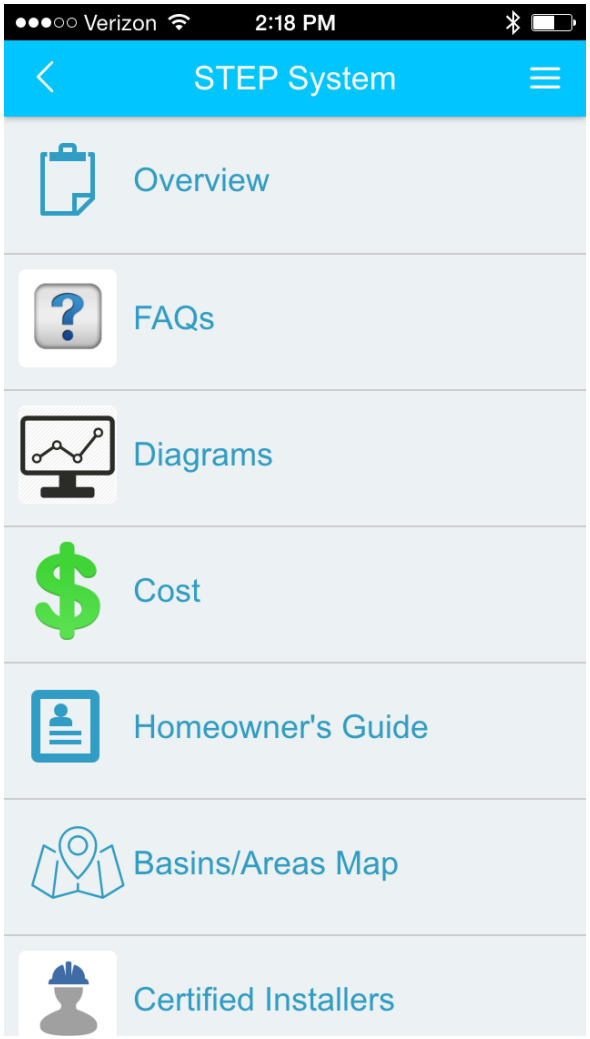
Vero Beach *(Continued)*

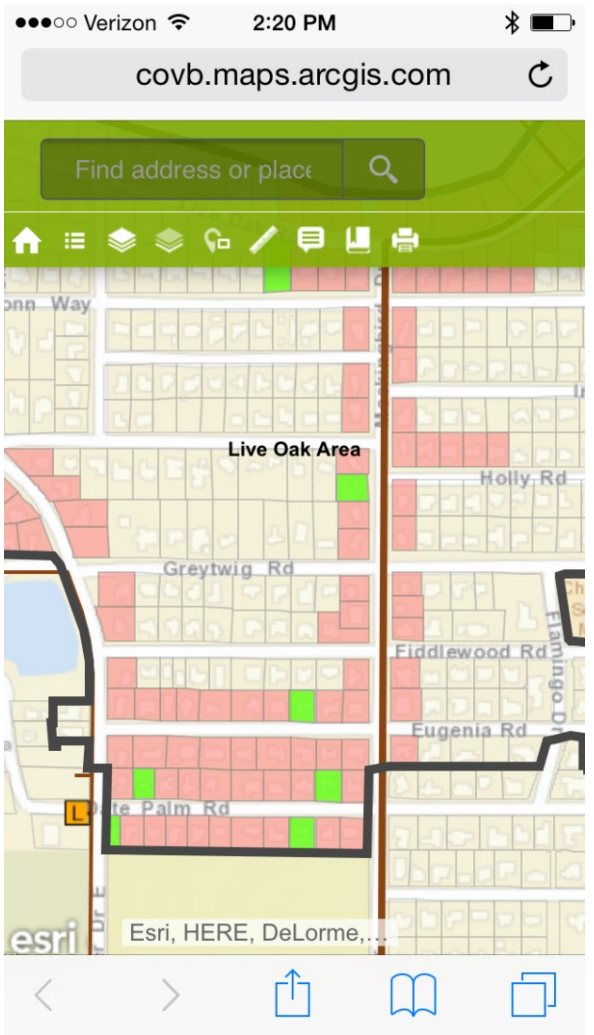
Estimated Construction Duration

Sewer System	Mainlines	On-Lot Components
Effluent Sewer	~ 6 Weeks	1 - 2 days
Gravity	6 - 9 months	< 1 day

- Directional boring speeds up mainline installation
- 1-2 days for STEP install includes landscape restoration to make surrounding land appear undisturbed

STEP Cell Phone Application





Myth Number 3:

“Septic tank effluent is difficult to treat and not compatible with most treatment technologies.”

Coburg, Oregon

- 420 connections
- Serves commercial businesses and mobile home parks
- Discharges to an MBR (membrane bioreactor) WWTP

Image courtesy of Google Earth www.earth.google.com

Effects of Effluent Sewers on WWTPs

Preliminary Treatment

- Effluent sewers eliminate comminuters, grit chambers, primary clarifiers, and influent fine screens
- Eliminates long-term O&M costs of equipment and costs of screening disposal
- Odor control systems may be downsized or eliminated

	50,000 gpd	500,000 gpd
Rotary Drum Screen	$40,000	$140,000
Grit Removal	$75,000	$125,000

Cost Estimates for Typical Rotary Drum Screen and Grit Removal Equipment (Kershner, 2015)

Effects of Effluent Sewers on WWTP's

Influent Waste Stream Characteristics

Collection system type will dictate influent wastewater characteristics

Constituent Loading Assumptions	Effluent Sewer	Grinder Sewer	Gravity Sewer
Design Average Flow	50 gpcd	50 gpcd	120 gpcd
Biochemical Oxygen Demand (BOD_5)	150 mg/L	450 mg/L	200 mg/L
Total Suspended Solids (TSS)	40 mg/L	500 mg/L	210 mg/L
Total Kjeldahl Nitrogen (TKN)	65 mg/L	70 mg/L	35 mg/L
Ammonia (NH_3-N)	40 mg/L	55 mg/L	21 mg/L
Total Phosphorus	16 mg/L	17 mg/L	7 mg/L
Fats, Oils, Greases (FOG)	15 mg/L	164 mg/L	80 mg/L

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

Effects of Effluent 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
Nitrogenous O_2	0.103 lbs/day	0.111 lbs/day	0.133 lbs/day
Sludge Production			
Heterotrophic, $P_{x,vss}$	0.019 lbs/day	0.058 lbs/day	0.061 lbs/day
Autotrophic, $P_{x,nvss}$	0.0014 lbs/day	0.0015 lbs/day	0.0018 lbs/day

Metcalf & Eddy, 2003. Crites and Tchobanoglous, 1998.
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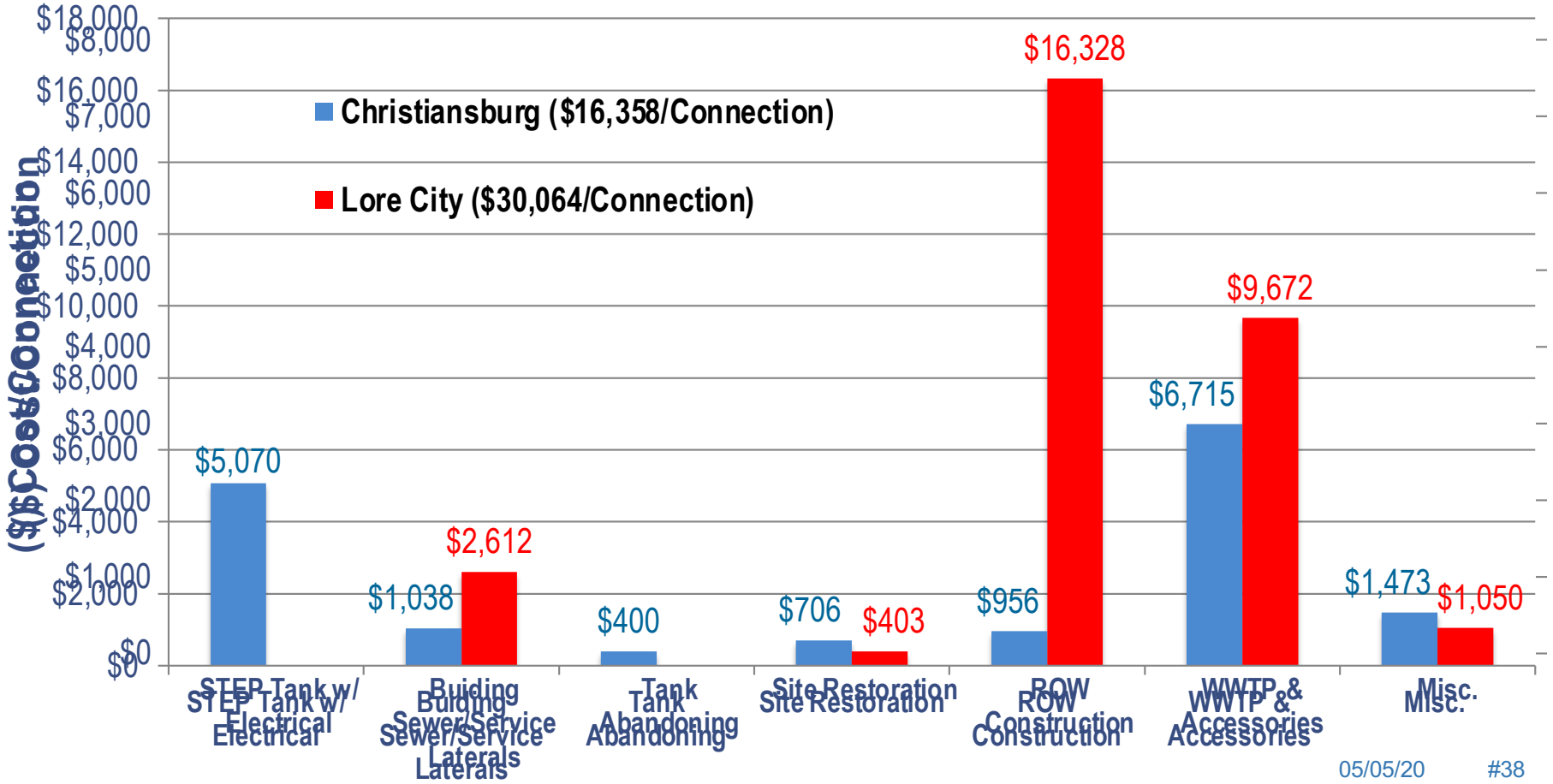
Christiansburg, Ohio

- Approx. 250 connections
- Two-stage Orenco AX-Max Treatment System
- Strict ammonia discharge limits

Small Community Projects in Ohio

Project Costs (From Home to Final Discharge)

- Christiansburg, OH – 250 Connections (Effluent Sewer to AdvanTex)
- Lore City, OH – 160 Connections (Gravity Sewer to Package Plant)



Effects of Effluent Sewers on WWTP's

Summary

- Elimination or downsizing of screening and grit removal systems
- Elimination or downsizing of primary, flow equalization tankage
- Reduction of system footprints
- Reduction of cleaning and other O&M needs
- Extension of membrane life expectancy in MBRs
- Improvement of process stability and efficiency
- Compared to grinder sewers, effluent sewers …
  - Reduce bioreactor volume by up to ~ 57%
  - Reduce bioprocess aeration power cost by up to ~ 57%
  - Reduce WWTP solid management by up to ~ 75%

Myth Number 4:

“STEP Systems cost more to operate and maintain compared with other types of collection systems.”

Collection System Comparison

Water Research Foundation

	Effluent Sewer	Conventional Gravity Sewer	Grinder Pressure Sewer
Materials/Install	**$0.90-1.35 M**	$2.43-3.64 M	$1.34-2.01 M
Annual O&M	**$60,000-90,000**	$65,000-97,000	$106,000-159,000
60 Year Life Cycle Cost – Present Value (2009 Dollars)	**$2.45-3.68 M**	$4.47-6.71 M	$4.71-6.11 M

Source: WERF Fact Sheets C1, C2, & C3
"Performance & Cost of Decentralized Unit Processes," 2010

Data based on 50,000gpd or 200 homes

Lacey, WA

- Traditional sewer expansion too costly
- Alternative system looked at in mid-1980's
- 1986 first STEP connection installed
- High growth rate; up to 31,000 in 2000
- Primarily driven by small developers

Lacey, WA

- Relatively new technology
- Engineering standards incomplete
- Minimal construction oversight
- No preventive maintenance
- High amounts of callouts, lower LOS

Aggressive Maintenance Approach

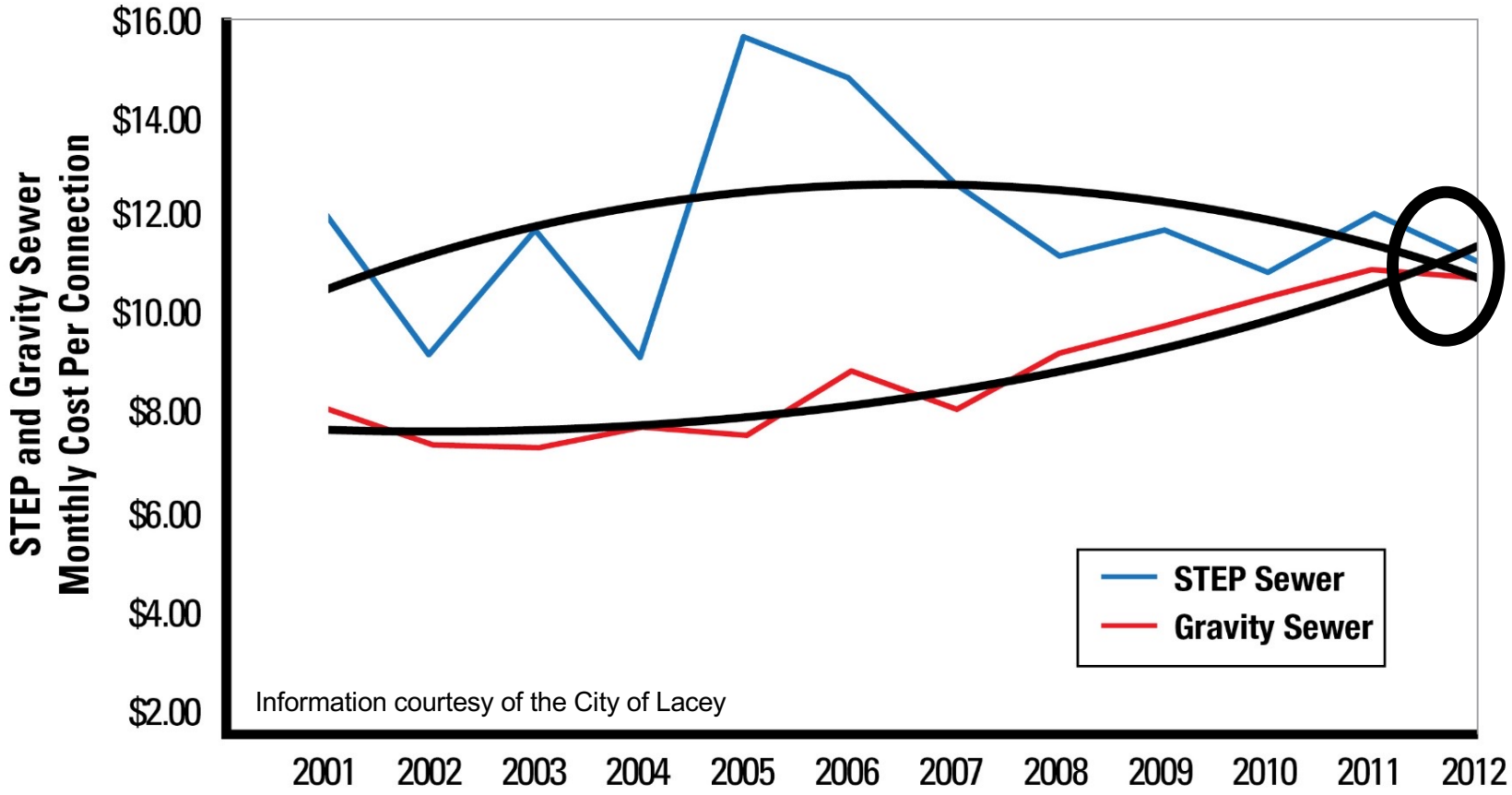
- Full Service Maintenance (FSM)
- All new systems inspected
- Bioxide injection at all STEP discharge points
- Tanks pumped and cleaned on a 3-year cycle

The Right Balance

- In 2007 a team was formed to evaluate STEP
- Modern equipment decreases cost associated with FSM
- Alternatives to Bioxide (Aeration); better design principles
- Tanks pumped on an on-demand basis

STEP Versus Gravity Sewer Life-Cycle Costs

Lacey, WA



**Based on odor control costs allocated by the number of households served*

STEP Sewer Customers Benefit From Affordable Sewer Rates

STEP Sewer Community	Residential Rate*
Bethel Heights, AR	$35/month
South Alabama Utility District, AL	$35/month
Yelm, WA	$43/month
Victoria, PEI	$43/month
Lacey, WA	$50/month

**All monthly rates include collection and treatment*

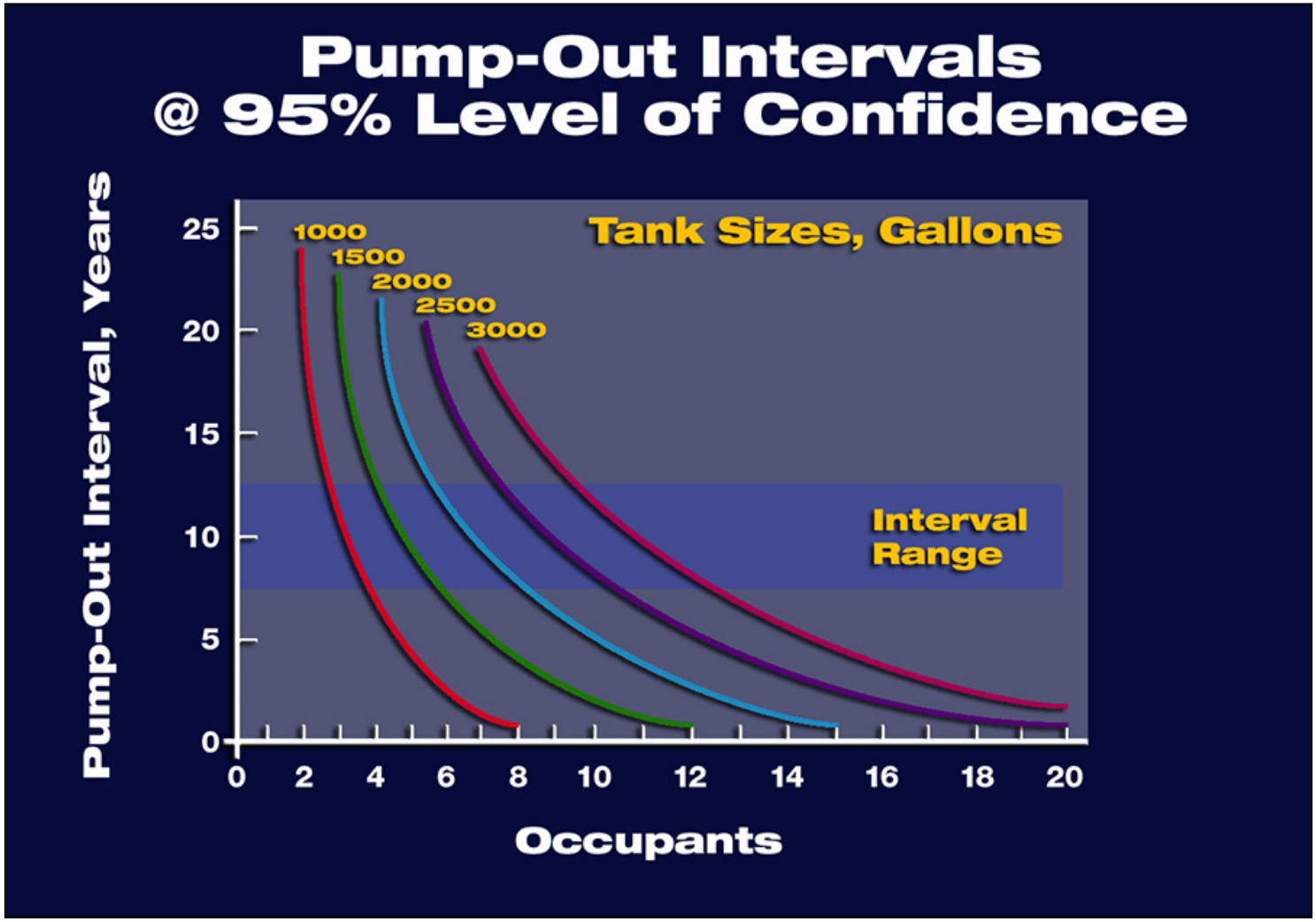
Myth Number 5:

“STEP tanks need to be cleaned and pumped free of solids every 2-3 years.”

Function of a Septic Tank

- Settling and digestion
- Heavier solids sinks to the bottom, lighter solids float to the top
- Anaerobic microbes digest the waste
  - Produce methane, sulfur dioxide, and other gases
  - Heavier solids produce a dense sludge
- Efficiency increases over time
- STEP systems combine primary treatment and collection in one package. They are the only technology to do so.

Properly Sized Tanks Reduce Pumping



The pumping interval for properly sized and managed watertight tanks is about 12 to 20 years.

Bounds, Terry R. 1988. Glide audit 1986-1987, summary of sludge and scum accumulation rates. Douglas County Department of Public Works, Roseburg, Oregon.

Myth Number 6:

“Managing ALL THOSE STEP systems will be too burdensome on the owner/municipality.”

STEP System O&M

- Occasional inspection and cleaning
  - Pull and clean effluent filter
  - Record depth of sludge and scum layer
  - Verify pump amperages
  - Verify float operation
- Documented tank pump-out intervals of 10 to 12 years
- About $1 per month for electricity per household

City of Lacey, Washington
STEP System O&M

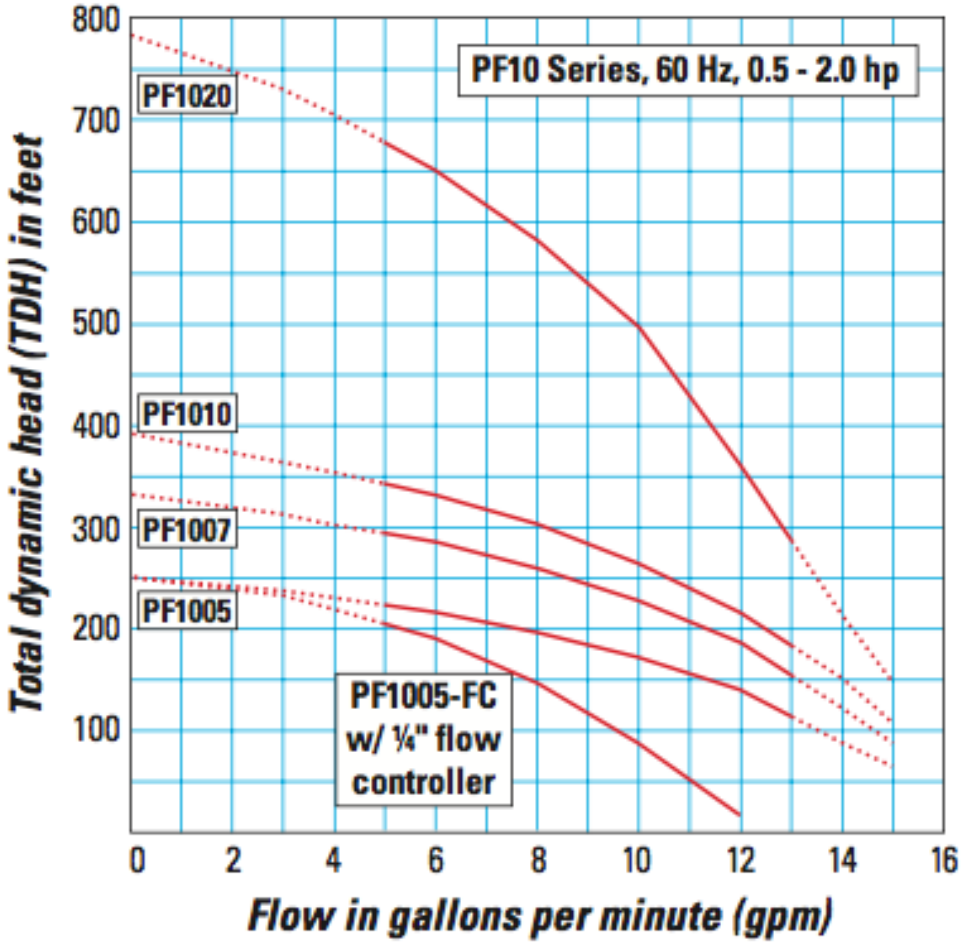
- Installed in 1989
- ~ 4,000 total STEP, 12,000 gravity, and 3,000 grinder connections
- City utilizes 2 full-time employees
- Since 2008, all properties are on an 8-year maintenance cycle
- Maintenance requires 2.5 man hours per connection
- Fewer than 20 pumps replaced
- Cost for operating STEP is the same as the gravity sewer

Orenco Effluent Pump Profile

High-Head Effluent Pump

- Non-corroding stainless steel
- 115V
- Lightweight; under 30 pounds
- Long life; 20 to 30 years
- Easy to maintain
- 10-year warranty available

Orenco Effluent Pump Profile



High-Head Effluent Pump Curve

Summary

- STEP systems are a proven sewer technology
- Have been in operation for more than 35 years
- Thousands are installed all over the world
- Can be installed on tight lots with difficult access
- Easy to pair with traditional treatment technologies
- Low up-front capital costs and affordable O&M costs
- STEP systems are easy to maintain