Effluent Sewer Comparison and Life-Cycle Costs

Orenco Systems, Inc.

03/19/19 #1

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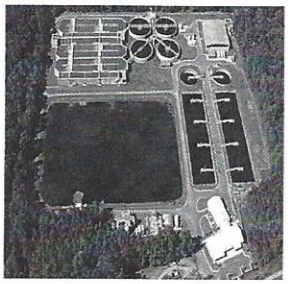
Wastewater Systems
Traditional Solution

- Gravity Collection
- Treatment Plant

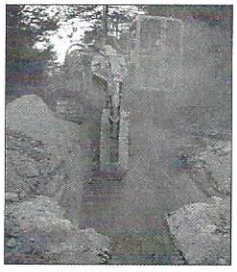


03/19/19 #2

2

Wastewater Systems
Traditional Solution

- Gravity collection
  - Recommended Standards for Wastewater Facilities (2004 Ed.)
    - *"...Minimum 8" dia pipe..."*
    - *"...Minimum slope of 0.4ft/100ft..."*
    - *"...Manholes at 400ft intervals, terminal ends, and changes in grade, size, or alignment..."*
    - *"...multiple pumps shall be provided..."*



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Why Do We Need Other Options?

- Environment
- Cost
- Sustainability

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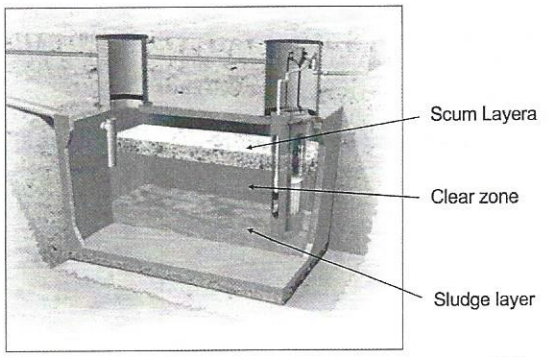
The Concept of Effluent Sewer



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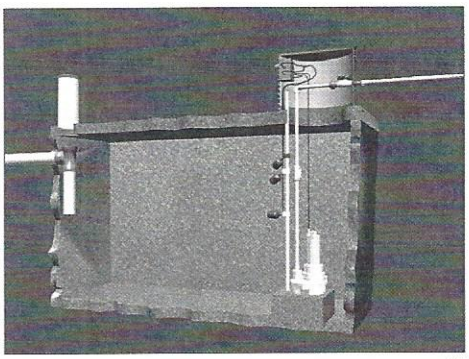
Pump on a block



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System Overview
What is STEP?

- Septic Tank Effluent Pumping
- Septic Tank Effluent Gravity

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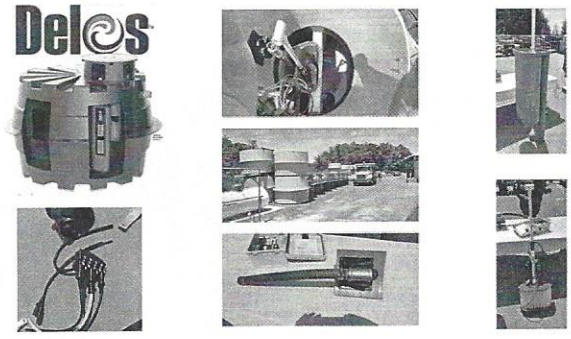
Delos™ Sewer System (October 2019)



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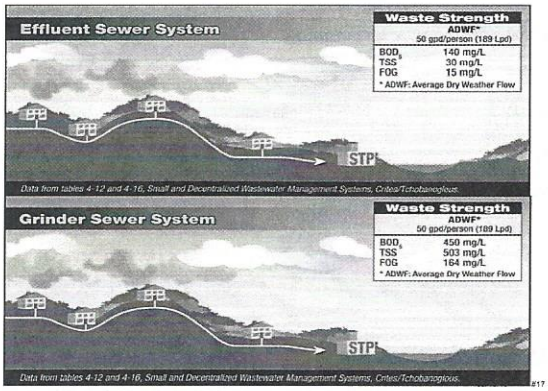
System Comparison



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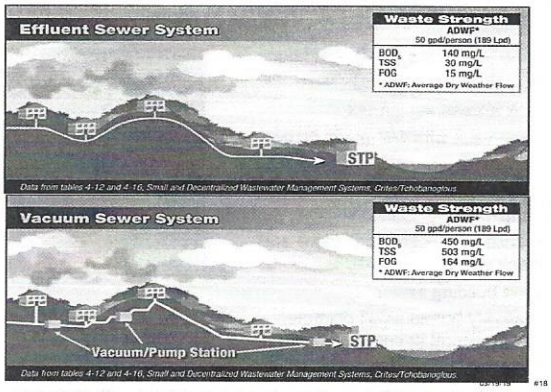
System Comparison



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Comparison of Collection Technologies

	Effluent Sewer	Conventional Gravity Sewer	Grinder Pressure Sewer
Excavation	Minimal disturbance	Significant disturbance	Minimal disturbance
Waste Stream	Liquid stream only	Full stream plus I&I	Macerated stream
Community Vision and Growth	Expandable	Future capacity built in and costs borne by current users	Expandable, but oversizing lines may cause maintenance impacts*

Source: WERF Performance & Cost of Decentralized Unit Processes Fact Sheets C1, C2, & C3
*added by author

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Evaluating Wastewater Systems
Up-front and life-cycle costs

- Up-front capital costs
  - Includes engineering, construction (including land costs), startup/commissioning
  - Generally *similar* for pressure sewer technologies
- Life-cycle costs
  - Represent the ***total*** cost of owning infrastructure
  - Includes engineering, construction, R&R, and O&M
  - *Varies* significantly for decentralized technologies

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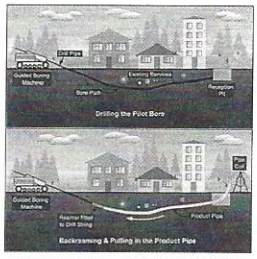
Collection System
Right of Way Components

- Main lines and laterals
  - Small diameter pipe
  - 2 - 4 inch
- No manholes or lift stations
  - Cleanouts at terminal ends of mainlines, etc.
- Largely immune to I&I and leakage

EDUs	Qp	Pipe Size, Inches	Head Loss, ft/1000 ft
10	20	1 1/4	35 ±
100	65	2	54 ±
500	265	4	32 ±
1000	515	6	16 ±



From the FHWA's "Manual for Controlling and Reducing the Frequency of Pavement Utility Cuts" report; used with permission. Contract number DTFH61-01-C-00024.

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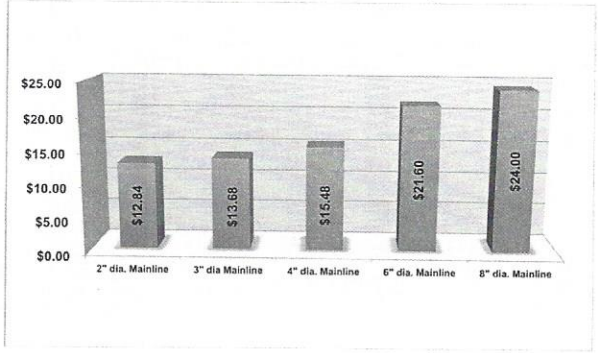
Right-of-Way Capital Costs – Pressure Sewer
(Cost per lineal foot, 2019)



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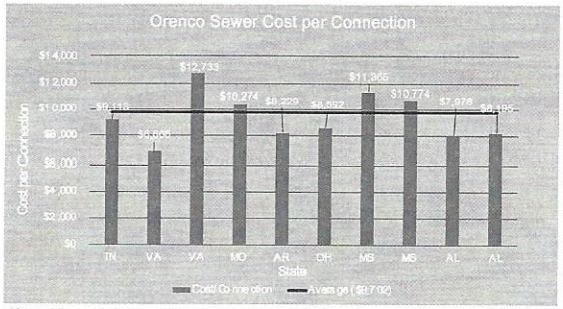
Total Collection System Cost:
Effluent Sewers



Note: All costs shown are for Orenco Sewers

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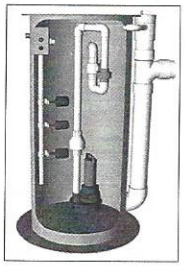
On-Lot Components: Grinder Systems

- 1 to 2 HP, 230 VAC grinder pump
- 80-100 gallon basin (polyethylene or fiberglass)
- Control panel and level controls
- Service connection (ball valve and check valve)
- Short building sewer
- Shallowly buried small diameter service lateral at constant depth (below frost depth)



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Right-of-Way Capital Costs
Gravity Sewer Lift Stations

Project Name	Year	Qty	USD
Coolville, OH	2013	1	$50,000
Coolville, OH	2013	1	$45,000
Coolville, OH	2013	1	$45,000
Coolville, OH	2013	1	$50,000
Coolville, OH	2013	1	$90,000
Harrisville, OH	2013	1	$97,250
Harrisville, OH	2013	1	$97,125
Glenford, OH	2014	2	$90,000

NOTE: All lift-stations serve small communities.

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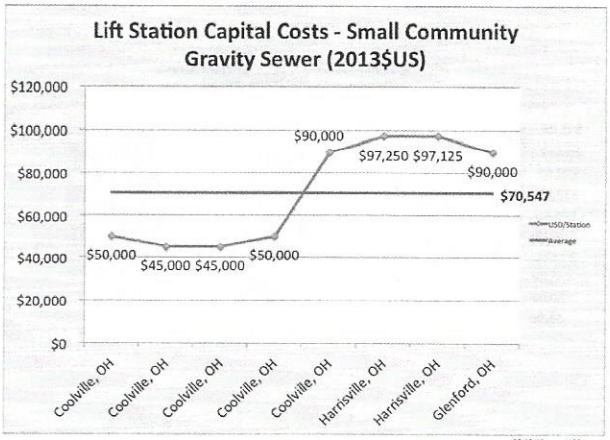

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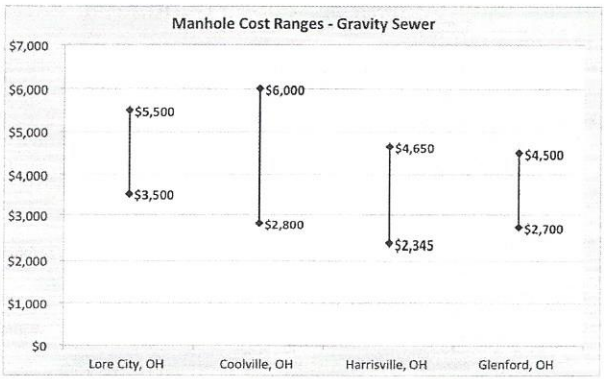

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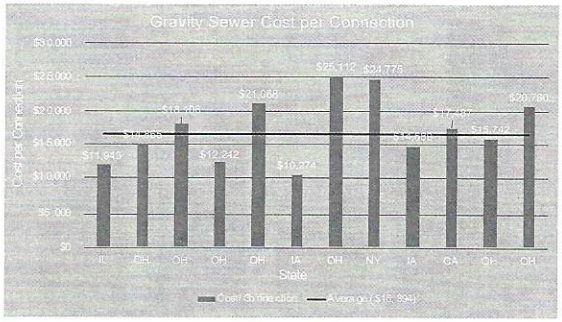
Total Collection System Cost: Gravity Sewers



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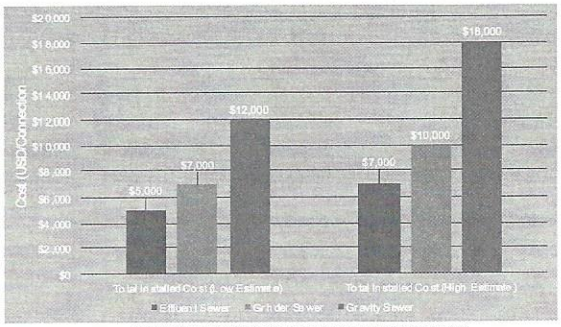
Water Environment Research Foundation Estimated Capital Costs per Connection



Constructed collection system costs for 200 homes in USD 2009 (WERF 2010).
Source: http://www.werf.org/liveablecommunities/Decentralized_Cost.aspx

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Capital Cost Summary

- Small communities face enormous challenges when constructing and maintaining wastewater infrastructure
- Gravity collection systems for small communities typically result in a cost that exceeds affordability thresholds (1.5 to 3% of MHI)
- Effluent sewers ($9,702/connection) have resulted in an average savings of $1,762 (15%) when compared to grinder sewers ($11,468/connection) and $6,692 (41%) when compared to gravity sewers ($16,394/connection)

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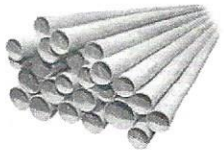
Pressure Sewer Phasing Considerations

- For pressure sewers, front end infrastructure (mainlines) represent roughly 20% of overall cost of collection system
- Majority of cost (on-lot) equipment is deferred until home is constructed and generally financed with the home
- Gravity sewers generally require large up-front capital expenditures, often in excess of 80% of the overall cost of the collection and treatment system



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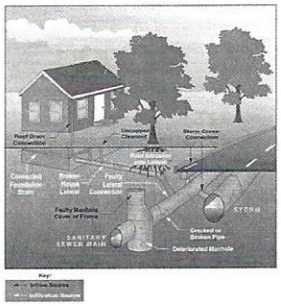
Gravity Sewer I&I Considerations

- Gravity sewer I&I identification and correction programs are typically costly and often times ineffective



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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)

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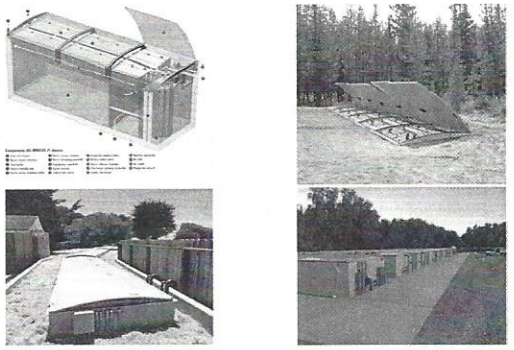
Attached Growth Treatment



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Life-Cycle Costs

- User charges must include ...
  - Monthly operation and maintenance costs
  - Capital recovery and debt service
  - Reserve fund for equipment replacement and repair
  - Analysis period long enough to capture all R&R
- Not normally included, but should be ....
  - I&I impact
    - Pumping cost
    - Treatment cost
    - Lost treatment capacity
    - Aeration cost
  - Biosolids handling cost
    - Headworks, aeration, processing, trucking & capital cost
  - Property owner costs
    - Contract maintenance on grinder pumps

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Life-Cycle Costs

- Should also include:
  - Capital cost and debt service on excess capacity
  - Build-out rate
  - O&M associated with low flow (lift stations and gravity mains)
  - Lot size/front footage
  - Project timing (Many septic to sewer projects are taking 5 to 10 years to plan, fund, design and construct)
    - Project on Cape Cod is now out 45 years
  - Phasing approach
    - Septic to sewer can be planned to focus on hot spots or be all-in

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Equipment Repair and Replacement (R&R)

	Effluent Sewers*			Grinder Sewers		
Component	Freq.	Cost/ Event	4% Amortized	Freq.	Cost/ Event	4% Amortized
Pump Replacement	20 yrs	$600	$1.62/mo/EDU	20 yrs	$2,500	$7.00/mo/EDU
Pump Repair	N/A	N/A	N/A	10 yrs	$800	$5.22/mo/EDU
Float Replacement	10 yrs	$100	$0.68/mo/EDU	10 yrs	$100	$0.68/mo/EDU
Misc. Components	10 yrs	$75	$0.51/mo/EDU	10 yrs	$75	$0.51/mo/EDU
		Total:	**$2.81/mo/EDU**		**Total:**	**$13.41/mo/EDU**

* Cost shown associated with STEP systems. Costs for STEG systems are a fraction of this value

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Solids Management: ES Systems

ES Systems				
Component	Freq.	Tank Size	Cost/Event	4% Amortized
Tank Pump-out	10 yrs	1,000 gal	$300	$2.04/mo/EDU
			Total:	**$2.04/mo/EDU**

Grinder systems manage solids at the wastewater treatment plant.

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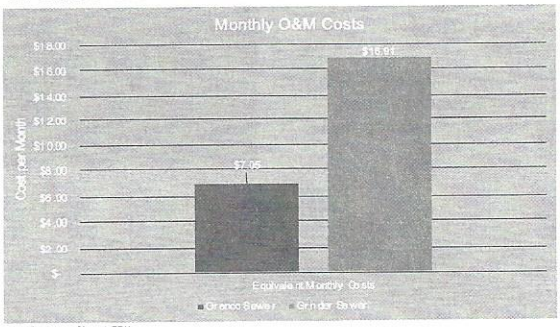
O&M Cost Estimate
Orenco Sewer & Grinder Sewer



NOTE: All costs $/month/EDU

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Electrical Usage: STEP and Grinder

- All costs typically funded by homeowner

	Pump	Pump Run Time	Power Cost	Equivalent Monthly Costs ($/month/EDU)
Grinder Sewer	1.5 Hp, 230 VAC, 16 amps	20 mins/day	$0.10/kWh	**$3.70**
Effluent Sewer (STEP)	0.5 Hp, 115 VAC, 12 amps	20 mins/day	$0.10/kWh	**$1.38**

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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

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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

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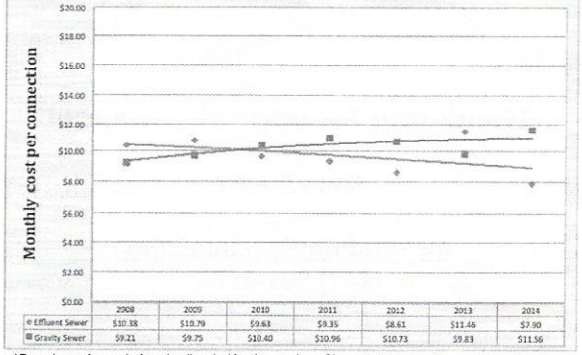
City of Lacey, WA O&M Costs 2008-2014



	2008	2009	2010	2011	2012	2013	2014
Effluent Sewer	$10.38	$10.79	$9.68	$9.35	$8.61	$11.46	$7.90
Gravity Sewer	$9.21	$9.75	$10.40	$10.96	$10.73	$9.83	$11.56

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

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In Summary

- Pressure sewers are cost effective options for communities of all sizes
- Pressure sewer technologies are cost effective when comparing capital costs to those of gravity
- Effluent sewer O&M life-cycle cost comparable to gravity sewer and significantly lower than grinder sewer
- Effluent sewer provides the lowest total life cycle cost
- Pressure sewers provide a reduced hydraulic impact on the treatment plant
- Effluent sewers provide primary treatment, reducing loading at the treatment plant

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Life-Cycle Costing

Wed., Dec. 12th, 9-10am Pacific Time

This one-hour webinar presents long-term data that shows how Orenco Sewer™ collection systems can effectively and affordably serve municipalities of all sizes. We'll compare capital cost information compiled from over 50 publicly funded bids for Orenco Sewer, grinder sewer, and gravity sewer, as well as look at operational costs for these technologies.

Register Today!

Orenco® SYSTEMS **Presenter's Bio**

Michael Saunders

Michael Saunders is the Market Segment Leader for the Engineered Systems Department of Orenco Systems® Inc., a wastewater equipment manufacturing firm based in Sutherlin, Oregon. He identifies, develops, and monitors opportunities that are ideally suited to the use of Orenco's wastewater collection and treatment solutions.

Mike was previously with Orenco from 2004 to 2012 as a National Accounts Leader. Since then, he worked as a Regional Manager for a company that provides products and services for the biological removal of nutrients during wastewater treatment. Earlier in his career, he spent ten years with a large utility and also worked for several consulting engineering firms. In his decades of industry experience, Mike has overseen $100,000,000 in sewer projects. He is widely recognized as an expert in sewer technologies and the integration of decentralized STEP sewers into centralized wastewater systems.

In his spare time, Mike enjoys golfing, making home improvements, watching his son play hockey, and spending time with family.

An Article by Michael Saunders:

Michael Saunders, "O&M Considerations for STEP Systems," Water Environment & Technology, March 2009.