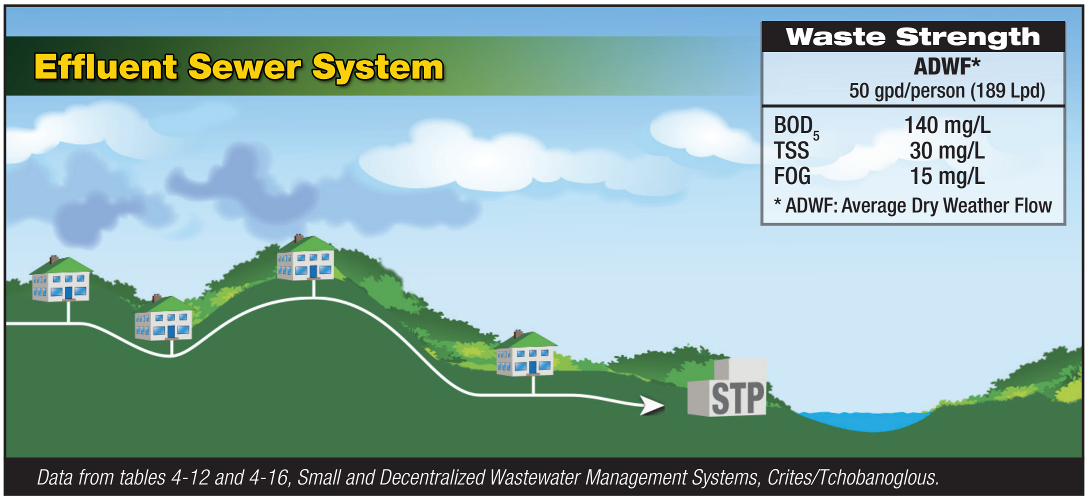
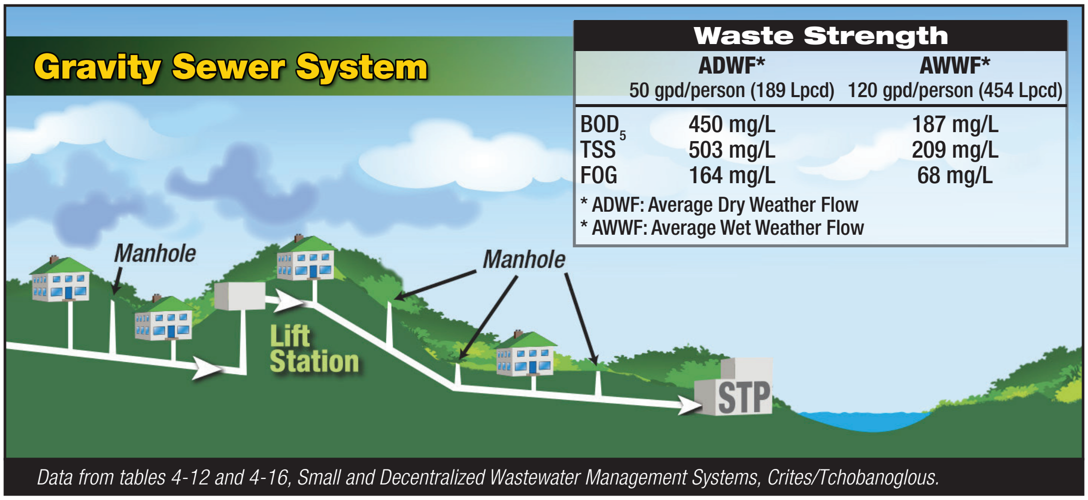
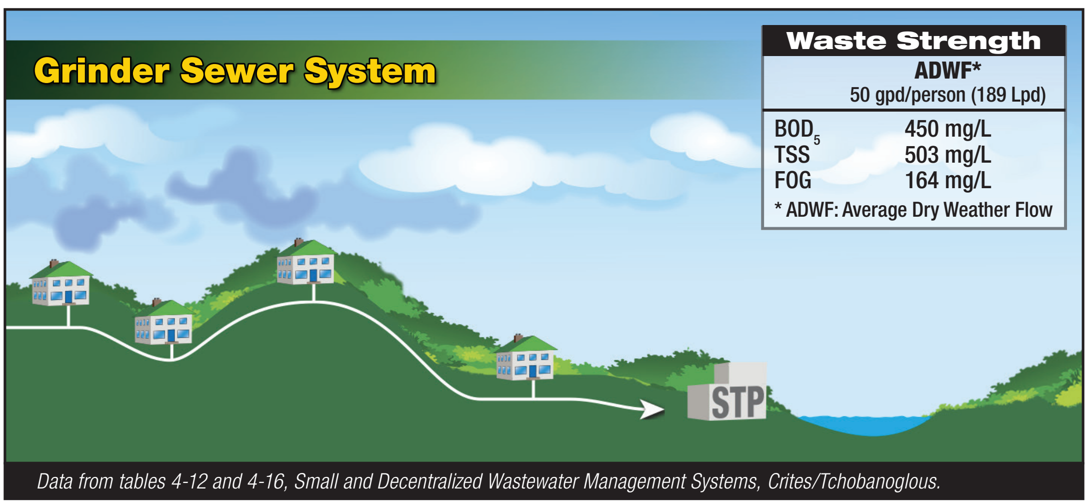
Sewer Comparison Chart:

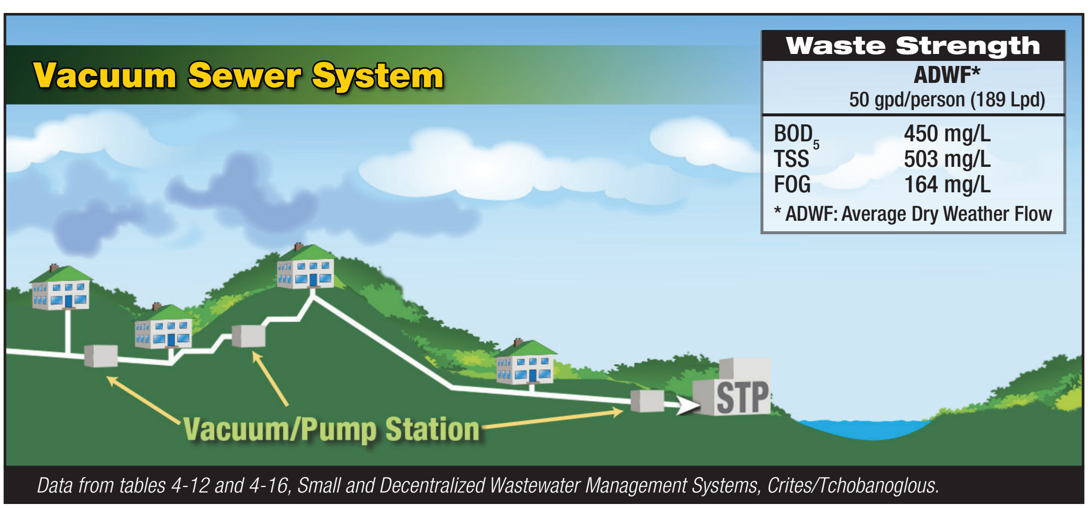
Four Types of Common Sewer Collection Systems & Related Costs

Orenco SYSTEMS


Effluent Sewer System
Waste Strength
ADWF*
50 gpd/person (189 Lpd)
BOD5 140 mg/L
TSS 30 mg/L
FOG 15 mg/L
* ADWF: Average Dry Weather Flow
STP
Data from tables 4-12 and 4-16, Small and Decentralized Wastewater Management Systems, Crites/Tchobanoglous.


Gravity Sewer System
Waste Strength
ADWF* 50 gpd/person (189 Lpcd)
AWWF* 120 gpd/person (454 Lpcd)
BOD5 450 mg/L 187 mg/L
TSS 503 mg/L 209 mg/L
FOG 164 mg/L 68 mg/L
* ADWF: Average Dry Weather Flow
* AWWF: Average Wet Weather Flow
Manhole
Manhole
Lift Station
STP
Data from tables 4-12 and 4-16, Small and Decentralized Wastewater Management Systems, Crites/Tchobanoglous.


Grinder Sewer System
Waste Strength
ADWF*
50 gpd/person (189 Lpd)
BOD5 450 mg/L
TSS 503 mg/L
FOG 164 mg/L
* ADWF: Average Dry Weather Flow
STP
Data from tables 4-12 and 4-16, Small and Decentralized Wastewater Management Systems, Crites/Tchobanoglous.


Vacuum Sewer System
Waste Strength
ADWF*
50 gpd/person (189 Lpd)
BOD5 450 mg/L
TSS 503 mg/L
FOG 164 mg/L
* ADWF: Average Dry Weather Flow
Vacuum/Pump Station
STP
Data from tables 4-12 and 4-16, Small and Decentralized Wastewater Management Systems, Crites/Tchobanoglous.

Sewer Comparison Chart: Four Types of Common Sewer Collection Systems & Related Costs

		Orenco Effluent Sewer System	Gravity Sewer System	Grinder Sewer System	Vacuum Sewer System
On-Lot Components & Features	1	Performs primary treatment/sedimentation, allowing smaller downstream treatment facility	Performs no primary treatment; full waste stream with I/I is conveyed to larger treatment facility	Performs no primary treatment; full waste stream is conveyed to larger treatment facility	Performs no primary treatment; full waste stream is conveyed to larger facility
	2	**Costs approximately $3,000-$5,000** in materials/installation for pump, septic tank, controls, excavation, and connection to network[1]	**Costs approximately $1,800-$2,700** in materials/installation to install building sewer and connect to sewer main[2], depending on terrain	**Costs approximately $4,800-$7,200** in materials/installation to install pump, pump basin, controls, excavation, and connection to network[3]	**Costs $1800-$2700** in materials/installation to install valve pit, air intake and connection to network
	3	Residences typically require one 1000-gal. (3785-L) tank, depending on size	Residences typically require a 4-in. diameter (100-mm) service lateral at a constant slope to the mainline (see item #11)	Residences typically require a 50- to 150-gal. (189- to 567-L) on-lot pump basin	Requires a 10-gallon (37-L) capacity valve pit
	4	No need for immediate operator response in emergencies due to 24-hr emergency storage (> 200 gal. or 757 L) provided by on-lot tank	Immediate operator response required when sanitary sewers back-up into homes/businesses	Immediate operator response required in emergencies due to lack of emergency storage provided by on-lot pump basin	Immediate operator response required in emergencies due to potential sewer backup into homes/businesses and possible discharge of sewage
	5	Caustic chemicals and other system abuses can sometimes be identified and controlled	Caustic chemicals, other system abuses, and on-lot I/I (the main source of I/I problems in gravity sewers) are very difficult to identify and control	Caustic chemicals and other system abuses can sometimes be identified and controlled	Caustic chemicals and other system abuses can sometimes be identified and controlled
	6	**Costs $7.05/mo/EDU** in annual on-lot O&M[4]	**Costs $1.33-$2/mo/EDU** in annual on-lot O&M[2]	**Costs $10-$20/mo/EDU** in annual on-lot O&M[3]	**Costs $1.33-$2/mo/EDU** in annual on-lot O&M (valve R&R)[5]
	7	On-lot electricity costs: ~ $1.50/mo/EDU to operate pump	No on-lot electricity costs unless lift pump required	On-lot electricity costs: ~ $3.70/mo/EDU[3] to operate pump; many homes require costly upgrades for 230 VAC power	No on-lot electricity required. Costs per connection $1.66-$3.34/mo[5]
	8	Uses lightweight pumps: ~30 lb, 115 VAC, ½ hp, 10 gpm, 250 ft of head capability (~13.6 kg, 115 VAC, 0.37 kW, 0.63 L/sec, 76.2 m head capability)	If required, a variety of lift station pumps are used	Uses heavy pumps: 100+ lb, 230 VAC, 1½-2 hp, 150 ft of head capability (45+ kg, 230 VAC, 1.12-1.49 kW, 45.7 m head capability)	No pumps required
	9	Sometimes accommodates gravity (STEG) connections where terrain & hydraulics allow	Generally accommodates gravity connections but sometimes lift pumps are required	Always requires a pump connection	Gravity building sewer only
	10	Installation easily avoids conflicts with other utility services, at little or no cost, particularly with directional boring	Installation often conflicts with existing utility services, requiring costly change orders and redesigns	Installation easily avoids conflicts with other utility services, at little or no cost, particularly with directional boring	Installation easily avoids conflicts with other utility services, at little or no costs, particularly with directional boring
	11	Allows inexpensive, shallowly-buried, 1-in. diameter (25-mm) service lateral for STEP, 1¼-in. diameter (30-mm) service lateral for STEG	Requires more costly 4-in. diameter (100-mm) service lateral, sometimes deeply excavated	Allows inexpensive, 1¼-in. diameter (30-mm) service lateral	Requires more costly 3- or 4-inch (75- or 100-mm)
Mainlines	12	Uses small-diameter force mains, typically 2-in. (50-mm) diameter for small communities	Uses mainlines of 8-in. (200-mm) minimum diameter or larger	Uses small-diameter force mains, typically 2-in. diameter (50-mm) for small communities; mainline size is critical: excessive head loss if too small; frequent pigging due to low scouring velocities if too large	Uses 4-inch (100-mm) mainlines for smaller systems and 6-inch (150-mm) diameter mainlines for larger systems
	13	**Costs approximately $340,000-$510,000** in materials/installation for 50,000 gpd (189 m^3/day) or 200 homes[1]	**Costs approximately $2,182,000-$3,273,000** in materials/installation for 50,000 gpd (189 m^3/day) or 200 homes[2]	**Costs approximately $344,000-$516,000** in materials/installation for 50,000 gpd (189 m^3/day) or 200 homes[3]	**Costs $1,869,000-$2,804,000** in materials and installation for 50,000 gpd (189 m3/day) or 200 homes[5]
	14	Force mains follow the contour of the land and are installed in shallow (below frost depth), narrow trenches that go in quickly with limited disruption to the community	Mainlines must be laid to grade, requiring excavations as deep as 20-40 ft (6-12 m) depending on terrain; deep & wide trenches go in slowly with significant disruption to the community	Force mains follow the contour of the land and are installed in shallow (below frost depth), narrow trenches that go in quickly with limited disruption to the community	Force mains require more precision in placement to ensure plug-flow conditions. Installed in saw-tooth or zigzag configuration
	15	Typically installed with a trencher or directional borer	Large excavator and shoring typically required during excavation	Typically installed with a trencher or directional borer	Typically installed with a trencher or directional boring
	16	Avoids installation conflicts with existing utility services easily, at little or no cost	Installation can conflict with existing utility services, requiring costly change orders and redesigns	Installation avoids conflicts with existing utility services easily, at little or no cost	Installation avoids conflicts with existing utility services easily, at little or no cost
	17	Uses low-cost air-release valves	Often uses high-cost air release valves	Uses high-cost air release valves	No air release valves required; however, system must not have any line leaks in order to maintain the required vacuum
	18	Watertight collection system is largely immune to I/I	Non-watertight collection system is plagued by I/I, significantly increasing treatment costs	Watertight collection system is largely immune to I/I	Watertight collection system is largely immune to I/I
	19	Does not require lift stations	Often requires multiple, large lift stations costing >$100,000 that require immediate alarm response, back-up power; lift station R&R costs are expensive	Often requires large, intermediate lift stations costing >$100,000 that require immediate alarm response, and back-up power; lift station R&R costs are expensive	Requires a vacuum station costing $470,000 which requires immediate alarm response and back-up power, along with regular maintenance and replacement of components
	20	Inexpensive clean-outs (at terminal ends of mainlines) replace expensive manholes	Requires manholes at intersections, changes in slope or direction, and at regular intervals along lines	Inexpensive clean-outs replace expensive manholes	Inexpensive clean-outs replace expensive manholes
	21	Does not require minimum velocities to avoid deposition of solids; no pigging required	Requires minimum velocities to avoid solids deposition; due to conveyance of the full waste stream, periodic cleaning and flushing of the lines is often required	Requires minimum velocities to avoid solids deposition; due to conveyance of the full waste stream, cleaning and flushing of the lines is sometimes required	Requires minimum velocities to avoid solids deposition due to conveyance of full waste stream; periodic cleaning and flushing may be necessary
Other Notes	22	Allows smaller, energy-efficient, low-cost treatment systems – such as media filters – because of lack of I/I and solids; solids digestion in on-lot tank significantly reduces solids management at treatment facility	Requires larger, more energy-intensive, and higher-cost treatment facilities to handle I/I & solids compared to effluent sewers; I/I can increase facility size by a factor of 10 or more	Requires larger, energy-intensive, costlier treatment facilities than effluent sewers due to solids; allows smaller treatment facilities than gravity sewer due to lower I/I	Requires larger, energy-intensive, costlier treatment facilities than effluent sewers due to solids; allows smaller treatment facilities than gravity sewer due to lower I/I
	23	Does not require influent bar screens, other traditional headworks, or full solids handling capacity	Requires influent screening, primary treatment, and full solids handling capability	Requires influent screening, primary treatment, and full solids handling capability	Requires influent screening, primary treatment, and full solids handling capability

[1] *WERF Fact Sheet C3: "Performance & Cost of Decentralized Unit Processes: Effluent Sewer Systems," Water Environment Research Foundation, April 2010*

[4] *Orenco Effluent Sewer Systems: Operational Cost — On-lot Components." Orenco Systems, Inc., July 2014*

[2] *WERF Fact Sheet C1: "Performance & Cost of Decentralized Unit Processes: Gravity Sewer Systems," Water Environment Research Foundation, April 2010*

[3] *WERF Fact Sheet C2: "Performance & Cost of Decentralized Unit Processes: Pressure Sewer Systems," Water Environment Research Foundation, April 2010*

[5] *WERF Fact Sheet C4: "Performance & Cost of Decentralized Unit Processes: Vacuum Sewer Systems," Water Environment Research Foundation, April 2010*