

Sewer System Alternatives Evaluation for Potential Creswell Area Expansion in Harford County

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Introduction

This report summarizes the findings of the ENCE422 Fall 2018 class term project. Students were tasked with evaluating sewer system alternatives for the Creswell area expansion in Harford County. Student groups were to consider environmental impacts, community/social impacts, and perform financial analysis for the alternatives they chose to evaluate. This report extracts information from 14 separate team presentations and synthesizes it around the following structure;

1. Systems that Utilize Septic Tanks
 - a. Traditional Septic System
 - b. Orenco Effluent System
 - c. Small Diameter Gravity Sewer System
2. System that Do Not Utilize Septic Tanks
 - a. Traditional Gravity System
 - b. Vacuum System
 - c. Grinder Pump System

Other products from this class include a large pdf file of all the PowerPoint presentations made by each of the 14 teams [link to the pdf?] and a summary matrix with highlights of teach teams approach and recommendations. This report does not include any of the financial analysis conducted by the students since these varied so greatly in their assumptions and approach and could not be synthesized. Since homeowners are responsible for septic tanks on their private property, financial analysis pros and cons in the report tables will be from the homeowner's perspective for these systems that utilize septic tanks

Systems that Utilize Septic Tanks

Traditional Septic System

All wastewater runs from the house to the septic tank. Solids settle at the bottom and turn into sludge while effluent exits the tank into the drain field. The tank must be pumped when enough sludge has accumulated.

Environmental Impacts	
Pros	Cons
<ul style="list-style-type: none"> No pollution caused by WWTP Much less energy used overall because no WWTP necessary 	<ul style="list-style-type: none"> Likely to overflow during periods of high rainfall Septic tanks have increased risk of groundwater contamination

Community/Social Impacts	
Pros	Cons
<ul style="list-style-type: none"> Less intrusive to the community during installation than traditional sewer systems 	<ul style="list-style-type: none"> Limits ability for area to expand beyond rural classification

Qualitative Financial Analysis (from homeowner's perspective)	
Pros	Cons
<ul style="list-style-type: none"> Reduced costs for energy and infrastructure to gather/treat wastewater 	<ul style="list-style-type: none"> Responsibility (financial/maintenance) is placed on the homeowner

Orengo Effluent System

Waste flows to an underground tank where the liquid waste is discharged, via small diameter pipes, after it has been filtered. Solid waste remains in the underground tank where it is treated naturally and pumped out when enough has accumulated.

Environmental Impacts	
Pros	Cons
<ul style="list-style-type: none"> Reduce effluent nitrogen by 60-70% Pressure system does not require deep excavations Little conflict with other utility services No energy/pollution from WWTP 	<ul style="list-style-type: none"> Because it is pressurized, in the event of a leakage, discharge will be greater Septic tanks usually have increased risks of groundwater contamination, but Orengo systems are specifically designed to mitigate this, and the Advan-TEX

	option is especially safe for areas with high water tables. Orenco's claims are supported by external testing (see https://odl.orengo.com/documents/AHO-ATX-PERF-1.pdf)
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Community/Social Impacts	
Pros	Cons
<ul style="list-style-type: none"> • 24-hour emergency storage so no need for immediate response in event of leak • Less disruptive to community during construction due to decreased installation time because of shallow excavation • Leaks are easier to repair due to shallow excavation level 	<ul style="list-style-type: none"> • Limits ability for area to expand beyond rural classification • Each unit requires on-site septic tank in addition to the Orenco treatment system, yet the tank need only be a 1000-liter one for a family of up to 8 people, and it does not need to be deeply buried

Qualitative Financial Analysis (from homeowner's perspective)	
Pros	Cons
<ul style="list-style-type: none"> • Mainlines are less than 20% of the overall cost • Shallow excavation leads to lower installation costs 	<ul style="list-style-type: none"> • Responsibility (financial/maintenance) is placed on the homeowner

Small Diameter Gravity Sewer System

Waste travels from the house to a septic tank. Effluent is transported by gravity, pump, or siphon via small diameter pipes from the septic tank to a centralized treatment location. Solid waste remains in the septic tanks.

Environmental Impacts	
Pros	Cons
<ul style="list-style-type: none"> • Shallow excavation depth compared to traditional systems 	<ul style="list-style-type: none"> • Septic tank that holds solids can cause groundwater contamination

Community/Social Impacts	
Pros	Cons
<ul style="list-style-type: none"> • Less disruptive to community during construction due to decreased installation time because of shallow excavation 	<ul style="list-style-type: none"> • Only ideal for rural areas limiting ability to expand • Only ideal under particular circumstances: solely flat/hilly terrain and high level of groundwater • Odor has been reported in areas where this system has been implemented (this can be controlled with proper engineering)

Qualitative Financial Analysis (from homeowner's perspective)	
Pros	Cons
<ul style="list-style-type: none"> • Reduced costs due to lower potential of clogging by removing solids from waste stream • Shallow excavation leads to lower installation costs • Material cost lower due to small diameter piping 	<ul style="list-style-type: none"> • Responsibility (financial/maintenance) is placed on the homeowner • Air release risers are required at or downstream of summits in the sewer profile to prevent smell

Systems that Do Not Utilize Septic Tanks

Traditional Gravity System

Waste is transported from houses to a central treatment facility, using gravity and pumps where necessary.

Environmental Impacts	
Pros	Cons
<p>Could not find any significant Pros in this area. Many of these other systems were developed to replace this commonly used method since it is not environmentally friendly</p>	<ul style="list-style-type: none"> • WWTP produce harmful greenhouse gas emissions; reducing these emissions involve invasive methods as well • Requires deep excavation depth leading to considerable soil disturbance

Community/Social Impacts	
Pros	Cons
<ul style="list-style-type: none"> • Leaks are not very commons since pipes aren't pressured • System is better in urban setting which will attract more residents to Harford County • Low chance of groundwater contamination though infiltration and inflow can occur in older systems • No odors 	<ul style="list-style-type: none"> • Not ideal in certain conditions: high groundwater table, low depth of bedrock, very long distance between houses • Very disruptive during construction and maintenance in terms of traffic delays and noise pollution

Qualitative Financial Analysis (from county's perspective)	
Pros	Cons
<ul style="list-style-type: none"> • Does not require extensive engineering effort: most commonly used system • Infrequent emergency maintenance needed since leaks are infrequent 	<ul style="list-style-type: none"> • Require manholes every ~500 feet or wherever the pipe direction or slope changes • High construction costs due to deep excavation • Require pump stations for topo variations which are costly and require maintenance

Vacuum System

Waste from a house collects in a valve pit. When a sensor determines the pit is filled, a valve opens, and the pressure difference between the valve pit and the pipe network cause sewage to be pulled to the next valve pit. This process continues until the sewage reaches the central vacuum located at a collection station.

Environmental Impacts	
Pros	Cons
<ul style="list-style-type: none"> • Shallow excavation depth compared to traditional systems • Under negative pressure so wastewater won't be ejected in event of a leak 	<ul style="list-style-type: none"> • Requires above average electrical power

Community/Social Impacts	
Pros	Cons
<ul style="list-style-type: none"> • Less disruptive to community during construction due to decreased installation time because of shallow excavation • No smell produced 	<ul style="list-style-type: none"> • Only suitable for flat areas

Qualitative Financial Analysis (from county's perspective)	
Pros	Cons
<ul style="list-style-type: none"> • Shallow excavation leads to lower installation costs • Material cost lower due to small diameter piping • Lower chance for leakage • No manholes required 	<ul style="list-style-type: none"> • Requires high level of design and engineering leading to high upfront costs • Must always have a skilled and trained operator on duty to operate/maintain the system • Require interface valve units near every household (connects service line to main vacuum line)

Grinder Pump System

Waste from a house flows into the grinder pump’s holding tank. Once the wastewater in the holding tank reaches a certain level, the pump grinds the waste into a slurry and pumps it either to a central sewer system or a septic tank.

Environmental Impacts	
Pros	Cons
<ul style="list-style-type: none"> • Shallow excavation depth 	<ul style="list-style-type: none"> • Relies solely on electricity

Community/Social Impacts	
Pros	Cons
<ul style="list-style-type: none"> • Each residence has a 24-hour emergency capacity • Less disruptive to community during construction due to decreased installation time because of shallow excavation 	<ul style="list-style-type: none"> • Homeowners need to maintain pump • Need a backup generator as the pump relies on electricity and will not function during power outage • Sewage odors common • Short life expectancy: Pump needs to be replaced every ~25 years and needs repairs every 7 years

Qualitative Financial Analysis (from county’s perspective)	
Pros	Cons
<ul style="list-style-type: none"> • Low construction costs due to shallow excavation depths and small diameter piping 	(Similar to septic system, homeowner is responsible which provides large cost savings for the county)