# Collection System Alternative Evaluation

**Gravity**

Gravity sewers use natural topography to collect the flow into a lift station. As minimum criterion, scouring velocities must be maintained, so the mean flow velocity should be at least two feet per second during full pipe flow. Since gravity is providing the force to convey the wastewater, the greater the slope, the smaller the required pipe. In areas where there is limited natural slope, deeper manholes are required in order to keep the slope; as a result, excavation cost can be relatively high. Gravity sewers have no mechanical parts and usually have low operation and maintenance costs, although in some cases the gravity system may require several lift stations to convey the flow to a main lift station; therefore, the cost of O&M to the utility will be higher.

**Vacuum**

Vacuum sewer systems rely on gravity to move wastewater from homes to a vacuum valve pit package. They then use a pressure differential, instead of gravity, to move wastewater to a vacuum station and on to the treatment plant. Differential air pressure is used as the motive force to transport sewage. The main lines are under a vacuum of 16 inches to 20 inches Hg (-0.5 to –0.7 bar), created by vacuum pumps located at the vacuum station. The vacuum system requires a vacuum/gravity interface valve at each entry point valve pit. Vacuum collection piping typically consists of four-inch to 10-inch diameter installed with minimum cover and a vacuum station. Vacuum stations are usually concrete block buildings on concrete foundations with minimum plan dimensions of approximately 25 feet by 30 feet. Vacuum sewers are recommended where there are at least 75 connections, rolling hills with small elevation changes, a high groundwater table, restricted construction conditions, unstable soils, flat terrain, rock, a sensitive ecosystem, or areas where no reliable power is provided to the community. Vacuum stations will have an emergency generator to keep the collection of the flow, regardless of the status of the power sources.

**Low Pressure**

Low pressure sewer systems are collection systems that use individual residential pumps to push the flow to a master lift station, where a force main conveys the flow to another lift station or directly to the treatment plant. The main characteristic of a low pressure system is that the capacity of the residential pumps selected determines the location of the lift station(s). Other essential components of all low pressure systems are isolation valves and air release valves. Similarities of all low pressure systems are:

- Inflow and infiltration (I/I) reduction
- Smaller diameter (even smaller than vacuum sewers).
- Low pressure sewer can be as small as 1.5-inch to six-inch diameter lines.
- Can be used for both flat and steeply sloping terrain. It doesn't depend on the natural topography of the area to convey wastewater and simplifies the sewer alignment.
- Can be installed in high groundwater areas, reducing the cost of dewatering during construction.
- Can be directionally drilled to avoid environmentally sensitive areas, reducing disturbances to the community.

There are two different types of low pressure systems: grinder pump and effluent pump types.

***Grinder pump systems*** – With this type of pump, tanks at the residence collect the sewer flows and a grinder pump mixes flow with the solids to be pushed through the pipes to the lift station. Like the effluent pump systems, each residential assembly requires periodic maintenance. Some of the advantages and disadvantage of this type of pump are:

- The tanks do not require periodic solids removal.
- Sewage is not as corrosive because of the air introduced, which may assist with odor reduction.
- Velocities need to be between three and five feet per second in order to avoid solids settling and grease buildup, according to the *Myers Design Manual for Pressure Sewers, Based on Grinder & Effluent Pumps*.

***Effluent pumps systems*** – For effluent type systems, the solids settle in the bottom of the tank. Then, the gray/effluent will flow through a weir into a chamber, where an effluent pump will, by level sensors, initiate the push of flow toward the lift station. Some of the advantages and disadvantages of this type of pumps are:

- The tanks require periodic solids removal.
- It is recommended that all the system components be non-metallic.
- Routine maintenance is necessary; however, pump repairs are not frequent.
- Velocities can be a minimum of one foot per second.
- Grease and solids are expected to remain in the tank and not travel through the collection system, reducing the need for flushing maintenance.

In summary, the major decisive factors for the City in selecting the low pressure grinder systems were:

- Lower cost of construction. The low pressure sewer system allows for shallower pipe installation.
- Less above-ground infrastructure. Unlike the case of the vacuum system that requires a vacuum station and structures above ground, the low pressure system requires a standard lift station without any significant above ground structures.
- Can be directionally drilled to avoid environmentally sensitive areas, reducing disturbances to the community.
- Less maintenance cost. Vacuum systems require a full-time, well-trained operator, while low pressure systems require only periodic maintenance.