Chapter 6. CLUSTER SYSTEMS, COMBINATIONS, AND DECENTRALIZED SYSTEMS WITH CENTRALIZED MANAGEMENT

Cluster systems are cooperative wastewater systems serving groups of homes or businesses too small to be considered a town or village, but within close enough proximity to jointly handle their wastewater. A group of homes within a town for which a common system is feasible can also form a cluster.

A small community wastewater system can use a single type of system or a combination of collection and treatment methods, using the most appropriate method in each section (a collection of clusters). For instance, if the housing density in the center part of the town is high, a gravity sewer may be most cost effective, but more scattered outlining areas may be best served by STEP (Septic Tank Effluent Pump) or grinder pump systems. Some homes may be more effectively served by onsite systems at lower cost. Figure 1 shows a cluster of homes using individual septic tanks and small diameter pipes to a common absorption field. A community that uses several systems has a hybrid or combination community system. Figure 2 shows a community that uses gravity flow from the closely spaced homes at the top of the hill, STEP systems up to the main sewer from the lower homes, and onsite septic systems for the homes in the outskirts of town which also eliminates the need for a sewer under or across the valley.

A. Decentralized Systems with Centralized Management

Typically every community seeking to develop a wastewater system wants a traditional central collection and treatment system (central collection system flowing by gravity that uses large diameter pipes and a central treatment system). These communities want this type of system because they know it works and customers will support the development of this type of system. However, if this type of system is much too costly, there are other possible systems to use and different ways to organize the management that may make good wastewater collection and treatment a reality.

The U.S. Environmental Protection Agency and other wastewater leaders have developed several special models of community wastewater systems that retain the advantages of the centralized model, but are less expensive for small rural communities to build. EPA calls these special community systems “decentralized systems,” defining one as “an on-site or cluster wastewater system that is used to treat and dispose of relatively small volumes of wastewater, generally from individual or groups of dwellings.” These systems use central management even though the systems may not be connected.

Central management is required to ensure these special systems are properly operated, maintained, and financed. Facilities, even if they are completely contained on a private homesite, are usually owned or at least controlled and managed by the governing body. Access to the land for the governing body is attained through a “perpetual facility easement,” a recorded easement that will be discussed in the chapter on Funding.

The traditional centralized wastewater system is popular with customers because:

1. The community assumes the responsibility for maintenance. For customers, it is out-of-sight and out-of-mind. Customers do not have to check septic tanks, drain fields, or pipes.
2. The community assumes the responsibility for liability caused by environmental mishaps.
3. Costs are predictable. Customers know approximately each month what their costs for

wastewater treatment will be, and can budget for costs. Owners of onsite systems such as a septic tank and a lateral field are often faced with very large, unexpected costs when their system fails and must be fixed or replaced.

4. Community systems are managed by trained personnel.
5. Improvements possibly can be funded through low interest loans and grants from the government. An owner of an onsite system will probably have to seek commercial financing that has a higher interest rate and few grants are available.

Even if a small community uses a decentralized system, centralized management allows a community to reap the advantages of a traditional wastewater system. Centralized management means the community:

1. Is responsible for maintenance.
2. Is responsible for liability caused by environmental mishaps.
3. Pays for the system. Costs are spread over a long period of time. Income from customers is predictable, because they pay for their share of the system through regular payments.
4. Has trained personnel to operate, maintain, and manage the system.
5. Can fund improvements through low interest loans and/or grants from the government.

Management of onsite systems can be organized in several ways. The most completely managed system would be an arrangement where the district owns the septic tanks and any equipment in or downstream of the septic tanks. It would arrange for inspection and pumping of tanks on a regular basis, repairs and replacements, and record keeping. It requires free access to the equipment that is on private property. Another way that management could be organized is for the homeowner to retain ownership of and responsibility for the septic tank and any other equipment on his or her property. The District would maintain records and arrange for service contracts for pumping and other maintenance with private firms. Usually such Districts require system inspections and operating permits to ensure that poor maintenance by one owner does not jeopardize the performance of the whole system.

A local example is Bucyrus, a town in far eastern Kansas, that is developing a STEP system with recirculating sand filter treatment. Miami County will install new septic tanks and effluent pumps for each customer. The County will provide septic tank pumping and other maintenance for the tanks and pumps for a monthly fee. The customers will provide and pay for the electricity.

B. Selection Criteria

The best approach is to evaluate the needs and resources of a community or cluster of homes and to evaluate a variety of options to find a system and organization that will fit that community.

Building Density and Available Space

The distance between houses or businesses is a key factor in selecting a wastewater collection and treatment option. The distance between houses is more important than actual lot size, because separation distances may constrain the use of onsite systems, even if total space is available. Conversely, if houses on adjacent lots are clustered reasonably close to each other as opposed to each being located in the middle of its property, a common collection and treatment

system may be more feasible. Including this factor in the design parameters during the original subdivision of a property may increase the options and decrease the costs. The key to making traditional sewer lines cost-effective is to have a high number of users per foot of pipe. In urban areas with dense populations, reasonable cost effectiveness can be attained. However in rural areas, many feet of line are paid for by very few people.

Soils

The quality and depth of soils, as well as depth to bedrock or water table, determine whether onsite options are viable. If conditions are not suitable for a conventional system or a wastewater pond, and individual alternative onsite systems would be required, comparing these costs against a community-wide system should be considered.

Cost

The total costs (construction, operation and maintenance, replacement, training, financing, and management) over the long term should be considered for all alternatives. Evaluating the total costs over the life of loans or bonds (often 20 to 30 years) is especially important.

Slope

A large-diameter gravity sewer must keep going downhill. It needs enough slope to keep the velocity high enough to keep the solids in it moving. As much as possible, the slope should be constant for long sections. Depending on the topography of the land, the lower end of the sewer can become quite deep. This adds to the costs in several ways. As the trench dug for the sewer deepens, the probability of hitting bedrock or water increases. In addition, if a trench is deeper than about 5 feet, it must be shored, if workmen need to work in the trench. This is usually required during the laying of large-diameter pipe. These all add to the costs of a large-diameter sewer. A small-diameter variable grade gravity sewer or pressure sewer can reduce the amount of difficult and expensive trenching required.

Depth to Bedrock

If the depth to bedrock is shallow, but is more than the frost depth, small-diameter variable grade gravity sewers or pressure sewers are possible alternatives to reduce the difficulty of installing sewers. Conventional onsite systems are usually not suitable for shallow bedrock conditions.

Depth to Water Table

If the water table is high, having tight-jointed pipe like those used in pressure sewers can reduce the amount of infiltration. Conventional onsite systems are usually not suitable for shallow groundwater conditions.

Availability of Equipment and Parts

Having an inventory of key equipment and parts on hand so that individual systems will have minimum downtime will be important to system operation and owner satisfaction. If a failed pump can be replaced by a spare pump while the broken one is repaired, the downtime on the system is reduced. If parts are readily available parts from nearby suppliers, there will be less need for extensive spare parts inventories.

Availability of Operators and Repairmen

The more complex the system, the more highly trained the operators and repairmen will need to

be. Hiring, training, and keeping adequately qualified personnel will be more of a challenge with the more sophisticated systems.