Special Section
RURAL & SMALL
UTILITY SYSTEMS

Sensible Land Use & Sustainable Development

By Curtis J. Sparks

Cluster wastewater systems using constructed wetlands offer ease of use in rural areas and beyond

Wastewater systems are the key to providing sensible and sustainable land development in urban and rural areas alike. Respect for the land, maintaining natural features and creating livable communities is challenging regulators and developers as the demand for residential growth reaches areas where centralized wastewater infrastructure does not yet exist.

Creative and eco-friendly wastewater alternatives are emerging. The preservation of open space for recreation and wildlife habitat is a top priority in creating livable, people-friendly communities. Recent studies indicate that homeowners prefer residential developments that provide open space, parks and trails as an integral part of the neighborhood.

"Smart growth" planning, where homes are clustered within the development and the remaining area is preserved as open space, is one solution. Because of the associated smaller lot sizes and setback requirements, the use of individual onsite septic systems in these communities can be problematic. A viable solution is a community wastewater system, many of which incorporate engineered wetlands. Engineered wetlands are emerging as one of today's "green" choices for wastewater treatment, and the cost benefits can be summed up in a simple phrase: "Plants and bacteria work for free; people and machines don't."

What makes engineered wetlands unique from other treatment processes is that they employ vegetation as part of the treatment process. Where adequate space is available, engineered wetlands offer substantial capital cost savings and low operating costs.

A constructed wetland wastewater system fits in the open space and actually becomes a part of the natural area in a cluster development.

Wetland treatment systems

There are two major types of constructed wetlands; free water surface and subsurface systems that are either vertical or horizontal flow.

Subsurface flow wetlands are ideal for residential sewage treatment. In these systems, water flows horizontally through a gravel bed planted with wetland plants. Because no water is exposed during the treatment process, subsurface flow wetlands do not produce mosquitoes or odors. The newest of these types of wetlands are vertical flow processes. They provide the greatest amount of treatment within a given area and are ideal where space is limited. They can be insulated for cold climates and are ideal for residential applications when combined with a septic tank and a soil absorption system.

Aerated wetland systems

The primary factor that limits the performance of wetland systems is the availability of oxygen for treatment. This led to the development of aerated wetland systems that either use a fluctuating water level or distributed aeration to introduce oxygen into the treatment zone. These aerated wetland reactors are efficient in removing the pollutants commonly found in residential wastewater and are effective in treating variable flow and load. Aeration also addresses concerns over nitrogen compounds by converting ammonia to nitrate. When designed properly, denitrification can also be provided.

Cold climate wetland design/performance

Introduction of engineered wetland technology into northern areas has been limited by the ability of conventional wetland systems to operate without freezing during the winter. A new design approach is to use horizontal subsurface-flow and vertical flow-constructed wetlands covered with an insulating mulch layer to prevent freezing and hydraulic failure. This allows the wetland to operate effectively throughout the winter months when snow and

ice cover alone does not provide reliable insulation.

Management of community wastewater systems

The question most frequently asked by community leaders is: Who is going to own and operate these cluster wastewater systems?

In the case of regional treatment, the infrastructure model is highly maintained and regulated, and the public owns the systems. These systems have many ways to pay for construction, operation and maintenance. In contrast, homeowner owned and operated onsite septic systems have a poor record of maintenance. While homeowner education is improving, there is a very wide range of homeowner operation, inspection and maintenance that occurs. A few wastewater-engineering companies have actually created management models for community owned systems, homeowner cooperatives and privately owned options.

Jackson Meadow: Cluster development success

A classic example of this type of development is Jackson Meadow, a residential community in the city of Marine on St. Croix, Minn. Here, town leaders and residents had requests from numerous developers wanting to build large-lot communities. They believed this sort of development would diminish the "community" nature of the area. The concept of an open space cluster development that offered a people-friendly model intricately linked to the existing town center was proposed. It also solved the concern regarding rural sprawl associated with large-lot development and individual onsite wastewater technology. The result was the approval of a cluster 64-lot development over 250 acres, with 75% of the development remaining in open space.

The next challenge for this new community was to incorporate and manage an effective wastewater treatment program. The capacity of the city's existing sewer system was limited, and sewer service was not available for Jackson Meadow. The smaller lot sizes were not suitable for individual onsite sewage treatment systems. A number of alternatives were explored, and the decision was made to construct two engineered wetland systems.

The first system was constructed in 1998 to serve the north half of the development, and a second wetland was constructed in 2002 to serve the south portion. Each wetland system was integrated into the community open space. The Jackson Meadow development has won numerous awards for its architecture, planning and environmental protection and has become a model for communities throughout the country.

The U.S. has not seen residential growth equal to the last decade since the end of World War II. The creation of open space for recreation and wildlife habitat is often a top priority in creating livable, people-friendly communities. The potential of constructed wetland technology, while better accepted in Europe than in the U.S. and Canada, has emerged as a preferred wastewater option. The new challenges in land development, however, force everyone involved to be receptive to innovative approaches to infrastructure service. By using new, "green" technology embodied by engineered wetlands, environmental professionals can continue to solve their clients' problems in effective, environmentally sound and creative ways. WWD

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