

Analysis of Existing Community-Sized Decentralized Wastewater Treatment Systems

Only limited information has previously been compiled on the long-term performance of large-scale decentralized or community-sized wastewater collection and treatment/disposal systems. Factors contributing to the shortage of information vary by region and regulatory jurisdiction. Due to their age and condition, many of these systems may soon require upgrading or replacement to meet current requirements. The results of the project will enable designers, regulators, and the industry as a whole to better assess and select large decentralized systems in various geographic settings.

This nationwide study gathered data and performance information on large-scale decentralized and small community wastewater systems treating domestic waste with flows ranging from 5,000 to 50,000 gallons per day with at least five years of operating history.

The research team studied systems designed and constructed in accordance with regulatory requirements and accepted industry practices applicable to the particular state or region and rely either on soil/land disposition or direct discharge of effluent.

Several common elements emerged from interviews with regulators and system operators:

- Both regulators and operators repeatedly pointed to flow equalization and control as critical for achieving good performance.
- They also recommended establishing appropriate upper limits for soil loading rates for subsurface drip irrigation systems to reduce the likelihood of system failure.
- Experienced regulators cited the absence of good management practices most often as the biggest problem with performance. Regulators, however, seemed confident that the technical means of providing good quality decentralized service currently exist.
- Regulators in some states expressed concern about the use of activated sludge treatment for large-scale decentralized systems due to operational vulnerabilities and instabilities.
- Respondents in a state with a large number of activated sludge-based package treatment systems noted start-up problems for seasonal-use facilities.
- Regulators in several states commented that attached growth/fixed film systems seemed to perform the best for decentralized wastewater systems, with recirculating sand/gravel systems mentioned several times as a method of treatment that seemed to perform very well on average.

Systems Performance Findings

The data analyses are not intended to provide a definitive assessment of their individual performance, but instead elucidate trends with the performance of systems nationwide. In general, commonly used technologies appeared capable of meeting specific effluent quality limits. Design details (including unit process sizing and operation) and management practices seemed to be the most likely contributors to performance problems where they were observed. However, some treatment methods tended to show more variability of



The results of this research will enable designers, regulators, and the industry to better assess and select appropriate decentralized systems. Photo courtesy of Orenco Systems, Inc.

BENEFITS

- References systems by types of facilities served, method(s) of treatment, final effluent disposition, type of management entity.
- Provides capital and operating cost information for systems of varying types and sizes.
- Compiles data in spreadsheets organized by state to facilitate future research efforts.

RELATED PRODUCTS

Overcoming Barriers to Evaluation and Use of Decentralized Wastewater Technologies and Management (04DEC2)

Factors Affecting the Performance of Primary Treatment in Decentralized Wastewater Systems (04DEC7)

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RELATED ONGOING RESEARCH

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performance and “excursions,” particularly when serving certain facility types. With regard to secondary treatment and nitrification performance, fixed film processes tended to perform the best on average.

Cost Data Observations

Cost data was gathered from public and private systems owners and operators who were able and willing to share. Some amount of cost information was obtained for over 60 systems in eight states. Both construction and operational costs per treated gallon of wastewater vary widely for large-scale decentralized wastewater systems, with little correlation found between dollars spent and system performance or reliability.

- Initial capital costs ranged from \$6 to \$140 per gallon of daily design wastewater flow but rose to \$18 to \$494 per gallon of average daily flow of treated wastewater once the systems were in operation, indicating that in many cases the systems might be oversized as designed.
- Monthly reported sludge removal/hauling costs ranged from \$0.0034 to \$0.92 per gallon of daily treated wastewater. Observed correlations between high effluent solids levels and hauling frequency point to operational problems at a given facility.
- Power costs ranged from \$0.01 to \$0.81 per average daily gallon of flow. Power usage tended to be higher for activated sludge plants than for systems using some type of packed media/filtration process as the principal method of secondary or advanced treatment.

Operationally, residential user charges for cluster/community systems ranged from \$15 to \$80 per month.

Conclusions and Recommendations

The absence of cohesive electronic statewide databases in the U.S. containing detailed system descriptions and performance data was somewhat surprising given electronic record-keeping capabilities today. Without such databanks, it is not realistic to obtain and review data for large enough populations of systems to offer statistically valid observations relative to performance trends, which are needed to inform the industry and help guide its practices. Therefore, a principal recommendation from this study is to encourage statewide regulatory programs throughout the U.S. to work alongside local programs to further develop and make system information available electronically.

Other recommendations and observations:

- The development of technologies and approaches that can cost effectively and reliably meet applicable nitrogen limits for systems appear badly needed.
- To evaluate decentralized systems alongside centralized wastewater options for providing “permanent” wastewater service, system selection and design need to be based on long-term (30-40 year minimum) cost analyses that include the use of realistic capital and operations costs.
- There appears to be a strong correlation between better overall management practices and good system performance.
- Regulators voiced the importance and need for integrating land use planning and appropriate densities with the planning of decentralized wastewater systems.
- Tracking of systems flows and performance could support the phasing-in of wastewater systems infrastructure to achieve more cost-effective service.
- System management must be based on sound training and experience that is appropriate to the specific processes, rather than on arbitrary timetables and regulatory requirements assigned to broad categories of systems, and which may not be applicable to specific systems.

The final products from this research include a Final Report and a Research Digest. In addition to the WERF website, www.werf.org, this product can also be downloaded from the National Decentralized Water Resources Capacity Development Project (NDWRCDP) website, www.ndwrmdp.org.

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