Design and management considerations in applying minimally treated wastewater to land

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Land has a capacity to treat wastewater just as a primary clarifier, aeration basin, sand filter or any other component of a sewage treatment plant has a capacity to treat wastewater. The treatment capacity of a particular area is more or less fixed since it is determined by the soil type, topography, cropping system, etc. Therefore, the design should start with the land and work backward to determine what, if any, pretreatment is needed. Too often the opposite approach has been used. As a result, systems were designed with excessive pretreatment and were more expensive and energy intensive than they should have been.

A number of good publications are available for use in designing land application systems (see Appendix). Consequently, this paper is not intended as a design manual; it is a brief overview of the factors that should be considered in designing and managing land application systems.

Slow-rate, high-rate, and overland flow are the land application systems currently used in the United States. In slow-rate systems, wastewater is applied by irrigation at a rate of from 0.3 to 3 m per year using irrigation equipment normally used in conventional agriculture. Vegetation may be forages, row crops, or forest. High-rate or rapid infiltration systems apply from 3 to 150 m of wastewater per year and thus require very permeable soils. In areas where soils are impermeable, overland flow systems receiving from 1.5 to 7.5 m per year may be used. With these systems, treatment is effected by filtering the wastewater via surface flow through vegetation. The slow-rate system provides the highest level of treatment and is more widely adapted than are the other two systems. Consequently, it will be emphasized in this paper.

The general design procedure for land application systems is to characterize the wastewater (rate of flow, nutrients, organics, toxic materials), determine the treatment capacity of the proposed site and then determine the land area and pretreatment required (Fig. 1). Another component must be added in the design stage. The treatment capacity of a site (hereafter called the site assimilative capacity) is affected by weather conditions to a greater extent than is the treatment capacity of a unit process in a conventional treatment plant. Consequently, the design must