

# Sundrive Biovapoator™ Greenhouse ET Wastewater System

## Introduction

Evapotranspiration (ET) wastewater systems, using the combination of direct evaporation plus plant transpiration for effluent disposal are used for those building sites which cannot support any other type of soil absorption based septic system. ET systems are used for sites with limitations which include shallow depth to mottling or extremely low or no permeability ("no perc") in the soil, such as with heavy clay. Because of an impermeable liner installed under the bed, ET systems offer the benefit of zero discharge to groundwater.

Sundrive ET systems consist of low flow plumbing fixtures installed inside the building served, a treatment tank, usually an aerobic unit, and a specially modified greenhouse, containing the ET bed, where the wastewater is removed by evapotranspiration.

A large number of open (without a greenhouse cover) ET systems have been installed in the U.S. over the past several decades. These systems have generally been used in areas of the country with a warm, arid climate for year round occupation and in more temperate climates for seasonal use.

Open ET systems require a relatively large area, even in dry climates. In order to enable ET systems to function year round in climates such as that found in the northeast U.S., Sundrive Inc., in 1981, developed the concept of installing ET beds inside of a specially modified passive solar greenhouse. Since the first system became operational in 1981, a number of Sundrive Greenhouse ET systems have been installed in New Jersey, Pennsylvania and Maryland. The design of greenhouse ET systems has advanced to the point that Pennsylvania DEP now classifies these systems as an "alternate on-lot system, with DEP Central Office review required".

## Description

A minimum lot size of about one acre is usually needed to fit both the greenhouse and the structure being served inside of the building envelope, although smaller lots may sometimes be accommodated using special design features.

A three bedroom home typically requires a greenhouse of about 1800 ft<sup>2</sup>. The greenhouse must be sited so that it receives full sun all day, thus requiring some clearing of wooded sites. Slopes are usually not a limitation; however steep slopes will result in higher construction costs.

### *Water Conservation*

An effective water conservation program is essential in order to reduce the volume of wastewater to be evapotranspired and thus help reduce the size and cost of the ET greenhouse beds.

Wastewater flows of 35 - 45 gal/person/day for residential use are readily achievable by using appropriate low flow plumbing fixtures, including front load washing machines, and pressure assisted toilets. It is important to note that little or no sacrifice on the part of the occupants is needed for this level of water conservation.

### *Wastewater Treatment*

Home scale aerobic tanks are usually used for single family homes instead of a septic tank to provide treatment for the wastewater before it gets to the greenhouse ET beds. Aerobic tanks provide a higher level of treatment than septic tanks and help to ensure that there are no "sewage odors" detectable within the greenhouse.

### *ET Greenhouse Bed*

An insulated masonry foundation is constructed along the east-west axis. An impervious plastic liner is installed inside the foundation before the bed is filled with a layer of gravel followed by a layer of sand. Compost is tilled into the top of the sand to create a sandy loam type of soil to support plant growth.

A commercial greenhouse type cover frame is mounted on the foundation. The clear covering (glazing) for the roof/sidewalls of the greenhouse is usually air inflated, double layer greenhouse grade polyethylene film. Cover systems with a different appearance are available depending on the budget and aesthetic needs of a given project.

The greenhouse is equipped with a ventilation system including thermostat, exhaust fans, and intake louvers. In addition, a simple spray system is installed to "water the bed surface" several times a day to help maximize ET rates.

## Operation and Maintenance

A small amount of regular maintenance is required to ensure the continued proper functioning of Sundrive ET wastewater systems.

- Monthly inspections and water meter reading to check that all components (fans, pumps, etc.) are operating .
- Mow cover crop and replant as needed once or twice per year.
- Replace greenhouse poly film glazing every 4 to 5 years.
- Residual solids should be pumped from the aerobic tank every 3 to 5 years, similar to a conventional septic tank.

Most of this maintenance could be performed by a motivated homeowner, or it could be contracted out to a qualified service company. Most suppliers of aerobic tanks offer service contracts, which should be used by the homeowner.

Usual cover crops for the ET beds are wet tolerant grasses, and local native plants that become established. Plant growth in the ET beds is very vigorous owing to ample moisture and the nutrients present in the treated wastewater. Plant cuttings are best used by placing them on a simple compost pile in the owner's yard and using the finished compost on ornamental plants.

It is possible to use the ET greenhouse for the production of various ornamental horticultural crops or to start tree seedlings. The installation of a small ultraviolet disinfection unit could enable food crops to be grown.

There are none of the odors usually associated with sewage detectable within the greenhouse, due in part to the use of an aerobic unit in place of the septic tank and in part by the aeration that occurs from the spray system inside the greenhouse.

## Permitting

The Sundrive System is considered an alternate on-lot design in Pennsylvania, with Central Office review required by the PADEP. Act 537 revisions are not required for existing tax lots. Approvals in New Jersey and other states have been on a case by case basis.

## Benefits

- Enables use of desirable, but otherwise unbuildable sites
- Zero liquid discharge, provides maximum degree of groundwater protection.
- System and components are easily observed and accessible for any necessary repairs to maintain continued, long term functioning.
- Possible use for the production of desirable horticultural crops.

## Drawbacks

- ET systems are expensive, about 1½ times the cost of a spray irrigation system as installed in PA.
- ET systems, as well as many other alternate systems require more maintenance than conventional septic systems.

## Other Features

- ET systems can be used for both residential and small commercial applications.
- It may be possible to use combination of ET plus soil absorption for sites where very slow perc rates are the problem.
- Sundrive Greenhouse Systems can be adapted for community wastewater systems with the return of highly treated, disinfected effluent for use as flushwater and for landscape irrigation. Final effluent disposal could be ET, or discharge to ground or surface water.