RESEARCH AND DEMONSTRATION CENTER
ON-LOT SYSTEMS AND SMALL FLOW TECHNOLOGIES
DELAWARE VALLEY COLLEGE
DOYLESTOWN, PA

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Pennsylvania Dept. of Environmental Protection

Thomas J. Ridge, Govenor
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Executive Summary:

On-lot system technology components in use or under evaluation have reviewed nationally and internationally form published reports and direct contact with researchers, regulators, and industry. Six system technologies (A through F) were selected for study. These technologies consist of various primary treatment, secondary treatment, and soil based treatment components.

Technology A - Constructed wetlands
Technology B - Denitrification system coupled with at grade soil absorption
Technology C - Evaluation of four different types of sand filters
Technology D - Intermittent sand filter with time dosed soil distribution
Technology E - Intermittent sand filter with trickle irrigation
Technology F - Septic tank effluent with time dosed soil distribution

Full scale systems have been constructed on the campus of Delaware Valley College in the Fall of 1996. The technologies could provide options for 21 million acres in Pennsylvania. The technologies under study offer potential for communities to utilize non prime agricultural soils for on-lot wastewater systems. The project is due to conclude in the Fall of 1999. The following slides show construction of the various technologies.
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AERIAL VIEW OF THE CAMPUS WHERE SYSTEMS ARE LOCATED

SOIL PROFILE DESCRIPTIONS WERE WRITTEN FOR EACH LOCATION. DRAINAGE CLASSES INCLUDE WELL DRAINED MODERATELY WELL DRAINED, SOMEWHAT POORLY DRAINED, AND POORLY DRAINED

PROFILE BEING WRITTEN FOR TECHNOLOGY F

PROFILE BEING WRITTEN FOR TECHNOLOGY B

PERMEABILITY TESTING FOR EACH SITE INCLUDED BOTH PERCOLATION TESTING AND HYDRAULIC CONDUCTIVITY TESTING. HERE SITE D IS BEING TESTED.

TECHNOLOGY A - CONSTRUCTED WETLAND

Two cell wetland system. Each cell is approximately 17 feet by 17 feet. Designed for 400 gallons per day, the cell in the foreground is the infiltration cell and the cell in the background is the treatment cell.

TECHNOLOGY A - CONSTRUCTED WETLAND

Treatment cell in foreground is completely lined with 20 mil PVC liner.

TECHNOLOGY A - CONSTRUCTED WETLAND

Second cell is an infiltration cell. It is lined only along the edges. The bottom is open. The infiltration cell is filled with aggregate.

TECHNOLOGY A - CONSTRUCTED WETLAND

Here the first cell has now been filled with aggregate and the second cell has a mulch layer over the aggregate and is ready for planting.

TECHNOLOGY A - CONSTRUCTED WETLAND

System ready for planting. Effluent enters first cell from septic tank and is distributed by a header pipe buried along the full length of the first cell. The effluent then travels horizontally through the cell and into the second infiltration cell by way of the concrete flow control box in the center of the photo.

TECHNOLOGY A - CONSTRUCTED WETLAND

Completed system with plants. Flow is horizontal form treatment cell in foreground to infiltration cell in background.

TECHNOLOGY B - DENITRIFICATION SAND FILTER WITH AT- GRADE PRESSURE DISTRIBUTION

Small community system handling three homes. Each home has its own denitrification sand filter (foreground) with effluent then going to two at grade pressure distribution beds (background).

TECHNOLOGY B - DENITRIFICATION SAND FILTER WITH AT- GRADE PRESSURE DISTRIBUTION

Septic tank in foreground sends effluent to rock filter tank (left background). From rock filter tank effluent is pumped to sand filter tank (right background) for nitrification then back to rock filter tank for denitrification.

TECHNOLOGY B - DENITRIFICATION SAND FILTER WITH AT- GRADE PRESSURE DISTRIBUTION

Side view of one of systems. This site has three homes each with its own denitrification system feeding two common at grade pressure distribution beds.

TECHNOLOGY B - DENITRIFICATION SAND FILTER WITH AT- GRADE PRESSURE DISTRIBUTION

After passing through the denitrification systems the effluent is sent to at grade pressure distribution beds. Here vegetation has been removed and ridges and furrows are being placed in the bed on contour to prevent effluent migration downslope.

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TECHNOLOGY B - DENITRIFICATION SAND FILTER WITH AT- GRADE PRESSURE DISTRIBUTION

Close up of unit used to make ridges and furrows in the bed.

TECHNOLOGY B - DENITRIFICATION SAND FILTER WITH AT- GRADE PRESSURE DISTRIBUTION

Another view of bed after ridges and furrows have been made on contour.

TECHNOLOGY B - DENITRIFICATION SAND FILTER WITH AT- GRADE PRESSURE DISTRIBUTION

Here stone is being placed on a prepared bed.

TECHNOLOGY B - DENITRIFICATION SAND FILTER WITH AT- GRADE PRESSURE DISTRIBUTION

Pressure distribution pipe within bed area.

TECHNOLOGY B - DENITRIFICATION SAND FILTER WITH AT- GRADE PRESSURE DISTRIBUTION

Soil cover being placed over beds.

TECHNOLOGY C - SAND FILTER BANK

Construction of different types of sand filters for effluent treatment.

TECHNOLOGY C - SAND FILTER BANK

Interior view of sand filter.

TECHNOLOGY C - SAND FILTER BANK

Sand filter bank during construction. Gravity, upflow, intermittent, and recirculating sand filters are being tested. Also round, rectangular, and rectangular two compartment septic tanks are being tested. Some septic tanks also have filters installed at the outlet.

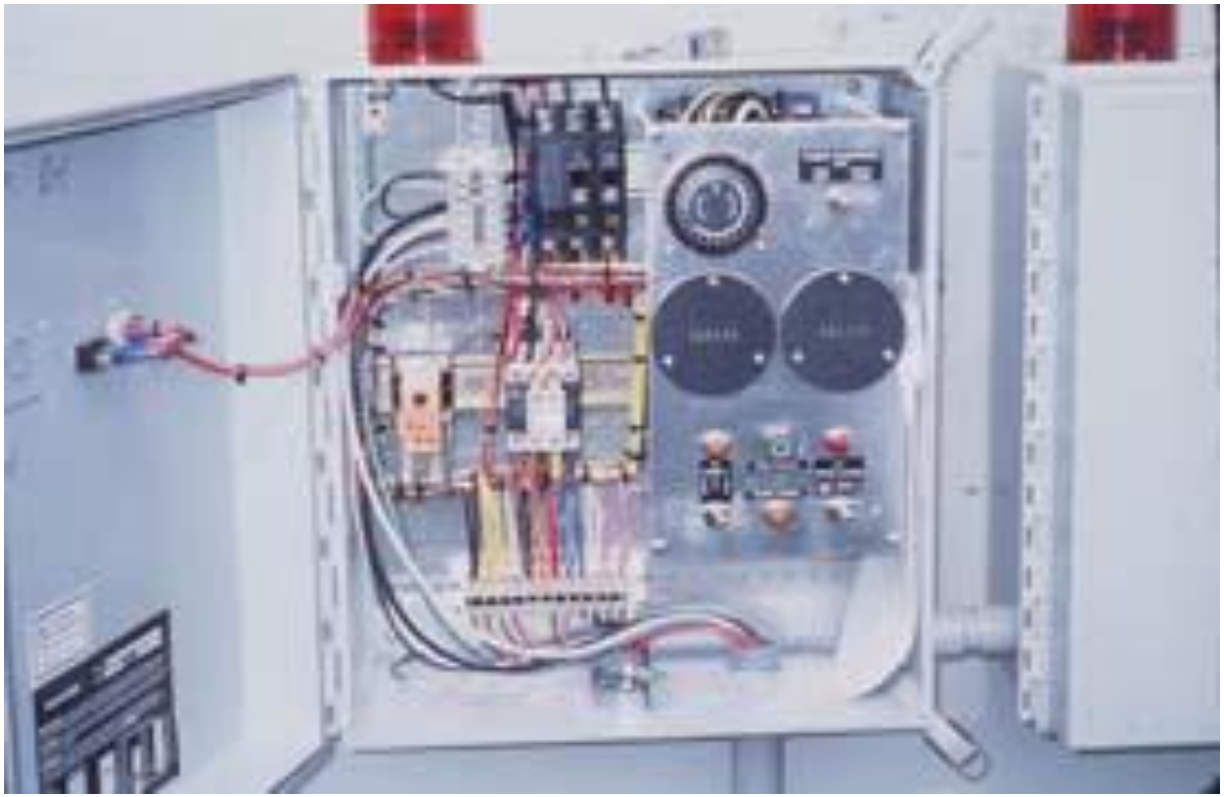
TECHNOLOGY C - SAND FILTER BANK

Sampling box for sand filters being installed in foreground.

TECHNOLOGY D - SOMEWHAT POORLY DRAINED SOIL WITH SAND FILTER EFFLUENT AND AT GRADE PRESSURE DISTRIBUTION

Stone being placed in bed. Bed construction similar to Technology B.

TECHNOLOGY D - SOMEWHAT POORLY DRAINED SOIL WITH SAND FILTER EFFLUENT AND AT GRADE PRESSURE DISTRIBUTION



Beds are time dosed as opposed to demand dosed. Time of day and amount of dose can be adjusted with this controller. Currently beds are dosed four times per day at 70 gallons per dose.

TECHNOLOGY D - SOMEWHAT POORLY DRAINED SOIL WITH SAND FILTER EFFLUENT AND AT GRADE PRESSURE DISTRIBUTION

Completed beds on somewhat poorly drained soils. Three beds have been constructed on this wooded site.

TECHNOLOGY E - DRIP OR TRICKLE IRRIGATION

Wooded site on slopes ranging from 14 to 21 percent. Soils are moderately well drained.

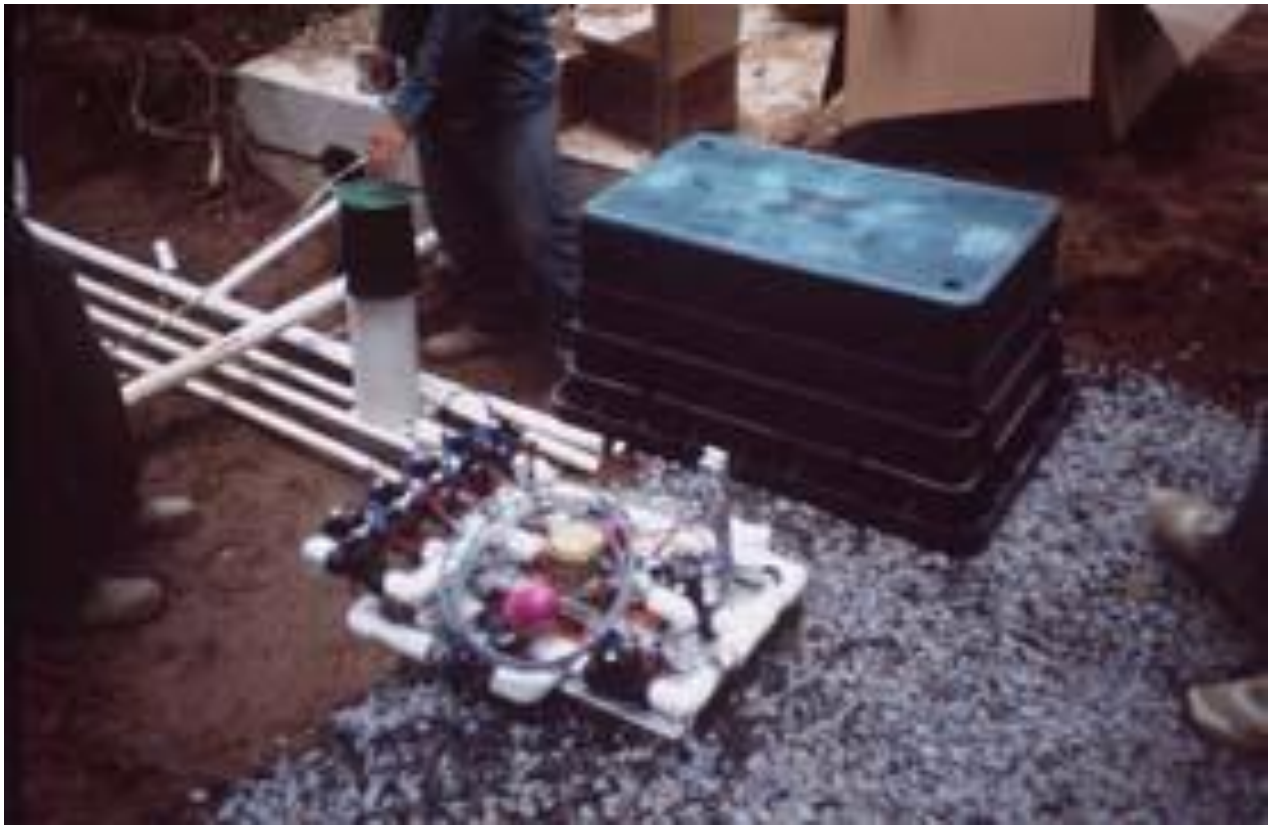
TECHNOLOGY E - DRIP OR TRICKLE IRRIGATION

Installation of trickle irrigation tubing using vibratory plow. Site receives 400 gallons per day sand filter effluent. Emitters occur every two feet in tubing. System doses 10 times per day. Three systems have been constructed.

TECHNOLOGY E - DRIP OR TRICKLE IRRIGATION

Tubing has been installed over one site. Look closely and you can see ends of tubing still to be connected in the foreground of picture. Minimal site disturbance during installation.

TECHNOLOGY E - DRIP OR TRICKLE IRRIGATION



Controller being installed for trickle irrigation system.

TECHNOLOGY F - WELL DRAINED SITE WITH AT GRADE PRESSURE DISTRIBUTION

Site receives septic tank quality effluent. Bed construction shown in the photo. Three beds were constructed.

TECHNOLOGY F - WELL DRAINED SITE WITH AT GRADE PRESSURE DISTRIBUTION

Beds being covered with soil.

TECHNOLOGY F - WELL DRAINED SITE WITH AT GRADE PRESSURE DISTRIBUTION

Three completed beds.

SAMPLING

Installation of zero tension lysimeters at one, two, three, and four feet beneath the beds. All beds have two lysimeters at each depth.