Wetland Echoes

An environmentally friendly wetland system teaches students in an Iowa school about wastewater technology

By Scottie Dayton

Echo Alternative High School was built in Tiffin, Iowa, in 2003 to demonstrate earth-friendly technology. The building is designed for solar gain and has groundwater heat source wells and a rain garden that collects water from the roof drains. The municipal sewer, however, is miles away, and hooking to it would require a lift station.

Shocked by the cost of connecting to the sewer, environmental science teacher Ellen Hartz asked her 30 pupils to research different onsite alternatives on the web. They chose a system that sends effluent from a septic tank to a wetland plant area for further treatment to remove organics, nutrients and pathogens and produce clean, odorless water.

The students also found EarthView Environmental LLC online. Based in Coralville, Iowa, the company specializes in wetlands, soils, and onsite system design. Professional soil specialist Judy Krieg designed the system, considered innovative because it was not in the current code.

Scott Wallace, P.E., from North American Wetland Engineering of White Bear Lake, Minn., approved the plans. The Tiffin City Council, however, had never received a request to install a vertical-flow wetland in a concrete container, and had to pass a special ordinance allowing it to be constructed within the city limits.

Despite various challenges with the site, the installation was completed successfully, and the unit meets its treatment objectives.

Site conditions

Soils range from poorly drained silt loam to silty clay loam. The soils were compacted in places and graded during the school's construction. The area has a 2 to 5 percent slope and a seasonal high water table at three feet.

Uplands to the north drain south into Clear Creek. The school, elevated on a pad, is built in lowland drainageways leading to the large creek, which has been contaminated by farm runoff and inadequate septic systems.

System components

Krieg designed the system for a maximum of five staff and 45 students at a flow rate of 11 gpd/person, for a total of 550 gpd. The school has no gym, showers, or cafeteria. The system's major components are:

- 1,000-gallon one-compartment concrete septic tank. All tanks from Iowa Mobile Concrete, Williamsburg, Iowa.
- 500-gallon one-compartment concrete septic tank.
- Two-piece Dyno2 wetland treatment unit sized to handle 600 gpd, from Reactor Dynamics Inc., Forest Lake, Minn. An influent

System Profile

Location:	Tiffin, Iowa
Facility served:	Echo Alternative High School
Designer:	Judy Krieg, EarthView Environmental LLC, Coralville, Iowa
Installer:	B & L Zimmerman Construction Ltd., Parnell, Iowa
Site conditions:	Poorly drained silt loam to silty clay loam soil, compacted and graded. Seasonal watertable at three feet
Type of system:	Dyno2 wetland treatment unit, Reactor Dynamics Inc., Forest Lake, Minn.
Hydraulic capacity:	600 gpd

On the Echo school site, Bill Zimmerman mans the backhoe while an employee fine-tunes the excavation and Rick Wagner works on the pump. Judy Lissick from North American Wetland Engineering/Reactor Dynamics photographs the installation.

The second polishing wetland, installed after the Dyno2 wetland system. This cell discharges to the rain garden.

"We were completely bordered by the building pad elevation, sidewalk, drainageway, and utilities, so adapting the site was challenging. Fortunately, the unit's compact design made it a perfect application."

Bill Zimmerman

filter and pump chamber are in the bottom half; the wetland cell sits on top. The footprint is 7 by 18 feet.

- Two 1/2-hp low-head pumps and control panel from Reactor Dynamics.
- Two 1801 HIP effluent filters (in second septic tank and treatment unit) and floats, all from Zabel Environmental Technology, Crestwood, Ky.

The middle manhole of the Dyno2 unit shows the high-water alarm float and the top of the yellow brush-like filters.

System operation

Wastewater from the entire building drains to the treatment system. All fixtures are low-flow, and the kitchen is not active. Wastewater gravity flows through the septic tank, then into the bottom half of the treatment unit for secondary treatment. A bypass valve periodically directs a portion of the aerated circulating liquid through a 2-inch PVC pipe to the wetland cell on top, where aquatic plants provide insulation and odor control.

Water enters the lined wetland cell through a pressure distribution system running across the front at the root zone. As liquid migrates to the far end, Forced Bed Aeration technology accelerates the treatment from the bacteria and plants in the vertical-flow wetland system. The oxygen-rich environment enhances the root biomass, enabling it to remove 70 percent of total nitrogen. The treated water is time dosed via a flow-control valve to another wetland cell. (A second polish assures that the liquid meets all requirements for open discharge.)

The contractor designed and installed a water-level control box outside the polishing cell to adjust water levels or completely drain the reservoir to occasionally kill the plants. They are replaced with young ones bedded in fresh organic material. The leveling structure also allows water to gravity-flow onto the surface of the rain garden. During high-water events, overflow is directed to an adjacent drainageway. The rain garden is not part of the Dyno2 system.

Top photo, the Dyno2 wetland unit is visible to the right of the school door. Middle photo, the effluent disposal site. Bottom photo, the control panel pedestal.

Installation

Bill Zimmerman of B & L Zimmerman Construction Ltd. in Parnell, Iowa, installed the system during two days in August 2003.

The city code for sewer pipe installation mandates a minimum depth of 4 feet, the level at which the sewer left the school. To accommodate the Dyno2 system, the pipe should have exited at no more than 30 inches. "These units are very restrictive to building sewer invert elevations, since the exposed top of the unit must be flush with the finished grade," says Zimmerman. "We can always lower building sewers, but it's difficult and expensive to elevate them."

A drainageway parallel to the building created space restrictions, compounded by the electrical service bisecting the site. Therefore, Zimmerman had to turn the building sewer 90 degrees before installing the first septic tank, cross the electrical service, install the second septic tank, turn 180 degrees back over the electrical, and install the treatment unit. The tanks were bedded on 6 inches of limestone rock. Zimmerman then crossed the sidewalk, which was within five feet of the system, and installed the polishing cell.

"We were completely bordered by the building pad elevation, sidewalk, drainageway, and utilities, so adapting the site was challenging," Zimmerman says. "Fortunately, the unit's compact design made it a perfect application."

The polishing filter is a PVC-lined pit filled with 15 tons of rock. Wetland cells are rated on the available volume within the rock (22 percent in this case). An 8-inch layer of peat moss and compost, able to sustain the plant-bacteria ecosystem in cold climates, covers the rock. Students planted aquatic plants and grasses in the wetland cells and rain garden. To prevent erosion (resulting from the final grade) from contaminating the polishing cell, a limestone block retaining wall was built around two sides.

Maintenance

EarthView Environmental technicians do the maintenance and yearly inspections. The latter consist of measuring the sludge and scum in the tanks, checking the treatment unit controls, cleaning the filters, and sampling the effluent. ■