

## Lake

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time from Wilkes University valued at \$5,000.

The final portion of the costs will be paid with an \$8,000 grant from the state's Department of Environmental Resources, which has been budgeted for the 1991/1992 fiscal year, according to Councilman David Abod, who is also chairman of EVAC.

### The Nemesis

Harveys Lake's bouts with cyanobacteria are a symptom of a process all lakes go through as they fill in with sediment and disappear - eutrophication.

A eutrophic lake is rich in nutrients which promote plant growth. As the plants die, they fall to the lake's bottom and decompose. The decomposition also absorbs oxygen from the water and kills animals such as fish.

"Eutrophication is part of a lake's normal life span. But it should occur over 10,000 years. Man's influence can shorten that lifespan to hundreds, or tens of years," said Chris Holdren, an aquatic biologist for Coastal Environmental Services, Harveys Lake's consultant for the study.

The activities which speed along the death of a lake are the addition of nutrients to the lake and increased erosion of the surrounding area.

Those extra nutrients come from man, and chief among them is phosphorus.

Phosphorus is to cyanobacteria what spinach is to Popeye. It can be found in fertilizers, human waste, and detergents.

Outbreaks of cyanobacteria were recorded at Harveys Lake as early as 1895, but the problem is as old as civilization.

*The lake's water quality has improved greatly since sewers were installed in 1977*

Dr. Michael Case, an assistant professor at Wilkes University refers to the problem as "cultural eutrophication." An aquatic biologist, Case specializes in limnology, the study of lakes.

When Case teaches his water quality course at Wilkes, he reads a passage from the Bible, Exodus 7:

"Moses and Aaron did as the Lord commanded; in the sight of the Pharaoh and in the sight of his servants, he lifted up the rod and struck the water that was in the Nile, and all the water that was in the Nile turned to blood. And the fish in the Nile died; and the Nile became foul, so that the Egyptians could not drink water from the Nile." "And all the Egyptians dug around the Nile for water to drink, for they could not drink the water of the Nile."

"One interpretation of this passage is the blood red color is a type

of cyanobacteria. There are many species of cyanobacteria. The ones at Harveys Lake are only a few."

Like all planktons, cyanobacteria drifts with the current of the water. But it has several unusual characteristics that help it survive.

"They float on the surface of the water. Each individual cyanobacteria has a small gas-filled space," said Case. "Most other one-celled plants and animals don't have that so they could be anywhere in the water column."

"If you were another plant cell, five or ten feet down, would you get all the light that you needed?" asks Case.

As if that weren't enough to give it an edge, cyanobacteria secretes chemicals that inhibit the growth of other types of plankton which fish use for food, according to

*"Everybody likes a nice green lawn, but there's a trade off. You have a green lawn, you have a green lake too."*

David Abod

Chairman of the Harveys Lake Environmental Action Council

Russell James, aquatic biologist for EcoScience. And when cyanobacteria growth is heavy, it can clog the gills of fish and kill them.

Swimmers who come into contact with it may get a rash. A mouthful will make someone sick to their stomach. Livestock and pets have been killed by drinking water containing too much cyanobacteria.

This year, "the drought was one of the reasons there hasn't been an algae bloom," said James. "The reason Harveys Lake looks as good as it did this year was there was no runoff of fertilizers to feed the algae. It's the runoff that creates problems for the lake."

"It would be misleading to think that there's nothing wrong with the lake because this is a drought year," adds James.

In 1985 and 1987 James added 2,241 pounds of copper sulfate to Harveys Lake to treat it.

While the cyanobacteria can kill fish by leeching the water's oxygen, Dr. Case questions the treatment because it can prevent fish from reproducing.

In a soft-water lake like Harveys Lake, said Case, "the copper is toxic to fish eggs and very young fish, as well as aquatic insects which the fish eat."

Is copper in the lake now hurting the fish population?

"That will be something that will have to be taken up by the research," said Case.

In order to use the copper sulfate, James had to get permission from the Pennsylvania Fish Commission, DER, and EPA.

Because Harveys Lake has soft water, he used a concentration of copper which was less than half as strong as he would normally use in a hard-water lake.

"There's more copper typically in every household with copper pipes than there was in the lake after I treated it," said James.

### Why Harveys Lake?

Harveys Lake is a big lake - the largest by volume in the state.

Ironically, a relatively small tract of land (the watershed) drains into it, a fact that Dr. Case said helps make it more susceptible to outbreaks of cyanobacteria.

The watershed of the state's largest natural lake is not quite six times as large as the lake's surface area. Feeding water into the lake are several very small streams and springs in the lake's bottom. The lake's outlet, Harveys Creek, trickles more often than it roars.

A typical gallon of water that runs into the lake laden with nutrients will stay there for just over 3 years before it drains into Harveys Creek - plenty of time for the nutrients to feed a bloom of cyanobacteria.

About a quarter of the lake's watershed is residential development, housing 2,430 citizens in what most of that development is right on the lake, forming a tight ring around it, which means that nutrients from lawn fertilizers or septic systems that aren't connected to the sewer lines don't have far to go to reach the water.

Harveys Lake's health is important to people far away as well as those who live around it because its water eventually finds its way into homes in the Wyoming Valley.

"A lot of what we do is from periodic helicopter surveys. The boat houses, we kind of suspect that every one of these has a little Johnny in it," said Kenneth Anderson, manager of Forestry Operations for Pennsylvania Gas and Water Company.

As manager of Forestry for PG&W, part of Anderson's job is to make sure there isn't anything on the company's watershed which could contaminate drinking water. Harveys Lake is part of PG&W's watershed, as it feeds the Rice

Dam from Harveys Creek. The water is then carried over the mountain in canals to the Plymouth Relief Reservoir.

"Thank goodness that its far enough away that it isn't as bad as it could be," said Anderson.

According to Dr. Case, human waste contains large amounts of phosphorus, and it doesn't take much to cause an algae bloom.

"I don't think it would take many unconnected systems to push the lake towards eutrophication," said Case.

### Working for Change

The borough struck a blow against eutrophication when it completed a sewer system in 1977.

"Before that raw sewage ran into the lake," said Richard Boice, a borough councilman and executive director of the Harveys Lake Municipal Authority, which oversees the operation of the sewers. "The lake was closed more than once before that."

According to Bob Moase, area fisheries manager for the Pennsylvania Fish Commission, the lake's water quality has improved greatly since the sewers were installed.

"In the late sixties they suffered very significant fish kills of trout," said Moase.

Trout are more sensitive to oxygen depletion in lakes than most fish because they are adapted to the cold, bottom layer of water. In the summer, that bottom layer of water is trapped beneath the warmer water above, unable to circulate, and does not receive additional oxygen from the atmosphere.

Because there isn't much plant life to produce oxygen below 40 feet, the bottom level of water doesn't receive any additional oxygen to support fish until the winter, when all the water becomes one temperature and circulates freely.

While the trout appear to be declining somewhat in the lake,

## A cross section of Harveys Lake during a summer algae bloom

(Drawing not to scale)

The wind

In the summer, the water becomes separated into layers of different temperatures. The wind circulates the warmer top layer of water, adding oxygen to it. The lower levels are uncirculated and do not get additional oxygen.

### Blue-green algae (cyanobacteria)

Blocks sunlight from reaching lower parts of the water which inhibits the growth of other plankton, clogs fish gills, and secretes substance which also inhibits the growth of other plankton.

Upper layer (Eplimnion) Approximately 70 degrees  
Fish - Bass, Pickerel, Sunfish and Bluegills

Transitional layer (Thermocline)  
Temperature ranging from approximately 65 to 50 degrees  
Fish - Yellow Perch, Yellow Pike, Alewife, Walleye

Bottom layer (Hypolimnion)  
Temperature approximately 45 degrees  
Fish - Rainbow, Brown, Lake and Brook Trout

Sediment and decaying algae

### Decaying algae

Consumes oxygen in the lake's lower level, forcing the trout into the higher and warmer water which they are not adapted to.

### WHAT RESIDENTS CAN DO:

- Use a mulching lawnmower instead of fertilizer
- Make sure their septic system is connected to sewers
- Buy detergent that contains no phosphorus

### Searching for Clues

"Everybody goes to the doctor every year or two," said David Abod. "The lake hasn't seen the doctor since the Gilbert Study in 1981."

When the lake study starts, volunteers from EVAC will spend a year collecting water samples from Harveys Lake, its tributaries and storm sewers, searching for sources of nutrients. The volunteers will also collect sediment from the lake's bottom, and test fish tissue, looking for heavy metals, pesticides, and PCBs.

Residents of the borough will be mailed questionnaires with their tax notices asking them about problems and possible solutions at the lake.

Key questions that the study will have to answer are:

- How much water enters and exits the lake?
- How many nutrients does that water carry with it?
- Where do the nutrients come from?

### Looking Ahead

After the study is complete, the borough will design a plan to improve the lake.

"We're going to come up with some type of erosion control program," said David Abod. "We want to at least maintain what we have, and possibly improve the quality of the lake."

Reducing erosion will accomplish two things—help keep the lake from filling with sediment, and reduce the nutrients entering the water.

Some steps have already been

taken toward that goal. In the last three years, all but one of the borough's dirt roads has been paved with a tar and chip surface. Besides making for better driving, the surface is slowing the erosion of sediment into the lake.

"Phase I (the study) will determine what we do in Phase II," said Abod.

Abod compares trying to guess the cost of any measures the borough decides upon before the study is complete to "putting the cart before the horse," but he expects that the borough will apply for EPA grants to cover those costs.

Possible measures include improving the storm drains around the lake, and dredging part of it to increase its depth.

On a personal level, residents can help improve the quality of the lake's water in several ways.

"Any of the liquid fertilizer companies are some of the biggest culprits," said Abod. "We've been looking for the past year for something that might be safer to use."

Albert Timko, treasurer of EVAC and a biologist and horticulturalist, recommends that residents use a lawn mower which mulches the grass clippings as a substitute for fertilizer.

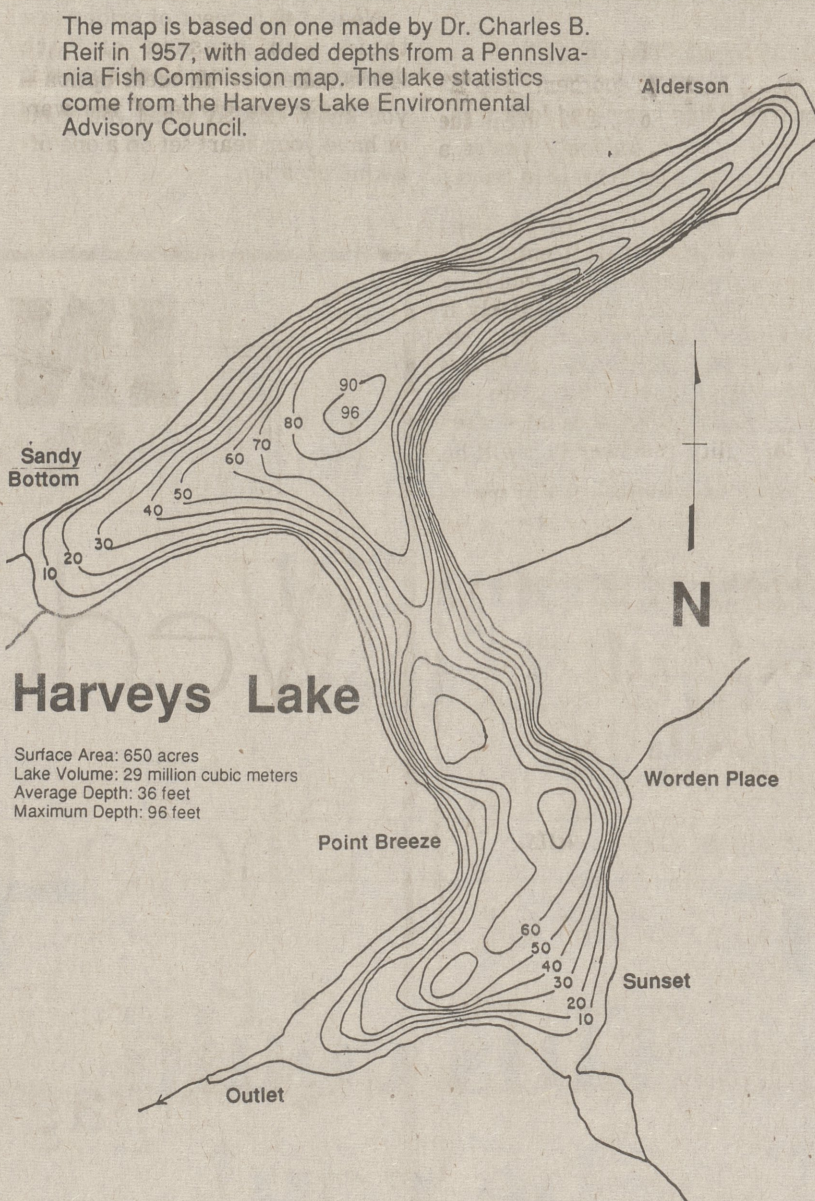
They can be sure that their septic system is connected to the sewer, and they can buy detergent without phosphorus in it, since detergents usually contain large amounts of phosphorus.

*Harveys Lake is big, but it depends on a relatively small watershed area*

"In Canada, you can't buy a detergent with phosphorus in it," said Dr. Case.

"The real goal is for people to feel they've made the lake a better place," said Case. "They should make some changes in the way they operate so in the year 2000 they can say we're part of a sustainable biosphere."

"Everybody likes a nice green lawn, but there's a trade off," said Abod. "You have a green lawn, you have a green lake too."



Scale: 1 inch equals approximately 1,600 feet

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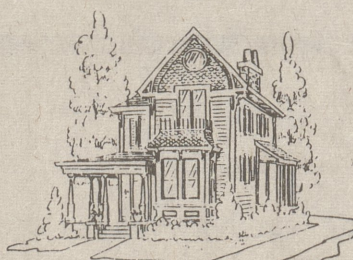
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