Virginia Water Central

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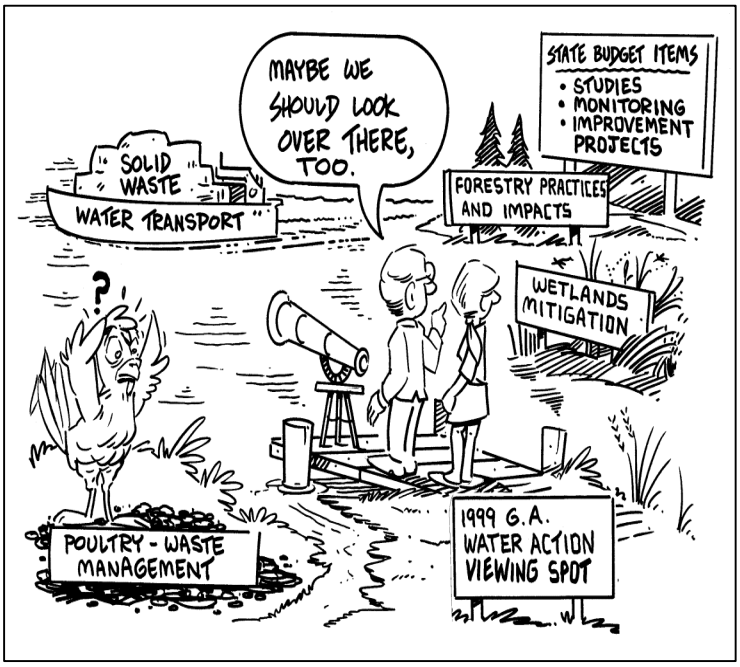
FEATURE ARTICLE

Expanding the "Viewshed" on State Water Legislation

Following water-related action in the Virginia General Assembly legislation is relatively simple for the few high-profile bills each session that garner media attention. But when over 100 water-related bills are considered in a single session, the public misses a great deal. In our last issue, we listed 115 water-related bills considered by the 1999 General Assembly, with a brief summary of each bill and its status. In this follow-up feature, a variety of individuals agreed to identify what they consider the most important or interesting legislation in the recent session. Our interviews tapped General Assembly members, professionals in business and industry, state-agency staff, non-profit group representatives, and one staff member from a federal agency. From the perspective of these sources, some lesser-known bills deserve a spot in our collective field of vision. *For a list of the sources consulted and their bill choices, please see page 4.*



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Bills in the Media Forefront

Three bills were mentioned several times, two of which have been in the mainstream media on numerous occasions. HB1207, Poultry Waste Management in the Chesapeake Bay Watershed, was carried over from 1998 and passed in 1999. This high-profile bill means that the disposal of poultry waste will be regulated for the first time ever in Virginia. The legislators we interviewed included this bill in their lists not only because of its ground-breaking impact, but because they said it took so much of their time. The same was true for three bills on

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barge-transport of solid waste: HB2430, HB2556, and SB1308. These bills banned trash transport on the state's major rivers and toughened regulations concerning the containers used on barges to haul trash. The constitutionality of the river-transport ban—in HB2556 and SB1308—remains in question and raised the issue to a national news level.

Bills on the Public's Periphery

Wetlands Mitigation Banks

SB582, Wetlands Mitigation Banks, was carried over from 1998 and passed in 1999. This bill allows compensation for damaging wetlands to be done using "bank credits," that is, by restoring wetlands elsewhere in the watershed. For instance, a company would not receive a permit to fill an acre of wetlands unless an acre of the same type of wetlands was created or restored elsewhere in the watershed. The law also allows for compensation to occur in a *nearby* watershed, under certain conditions.

This bill was very important to environmentalists concerned about maintaining the state's wetland acreage; to developers and the Virginia Department of Transportation (who often fill wetlands in their course of work); and to private companies—known as wetlands-mitigation bankers—who often restore wetlands, creating credits than can be purchased by those who receive fill permits.

Forestry Practices and Impacts

Paul Howe, executive vice president of the Virginia Forestry Association (VFA), said from his group's perspective HJ730 was the most critical thing that happened this session. This resolution called for a study of the economic and environmental impact of logging in the state. The study will undoubtedly touch on water-quality issues, such as streambank stability[1] and surface-water runoff from logging operations. The resolution for the study recognizes that the forests are integral in water quality and state that forests "filter air and water pollution; protect soil and water resources; provide fish and wildlife habitat…"

Howe also watched two ultimately *unsuccessful* bills closely. The first was SB1274, which would have required anyone applying a pesticide near a lake or pond to notify nearby residents in advance. The second, HB1830, would have required a specially trained logger on site for each logging job. The VFA—which represents more than 1,500 loggers, private landowners, and members of the forest products industry—opposed both bills. Howe said loggers feared the pesticide bill could have led to restrictions on herbicides, which loggers use to control which trees grow in their forestry operations. Howe and others called HB1830 unnecessary. "[We opposed it] mainly because we have a very widespread and well-attended logger education program already in place," Howe said.

Tom Reisdorf, the chairman of the Virginia Council of Trout Unlimited, said his group was disappointed that HB1830 failed. Trout Unlimited, with about 3,000 members statewide, focuses on the restoration and enhancement of cold-water fisheries habitats. "We consider the presence of a certified master logger to be beneficial to wildlife and water quality," Reisdorf said.

Trout Unlimited was pleased, though, with HJ730's passage, and the group plans to assist with the study. "Trout fisheries need shade and bank stability," Mr. Reisdorf said.[2]

Tributyltin, or TBT

TBT is used in paints on ship hulls to discourage marine growth. Extremely toxic to marine life, TBT enters the Chesapeake Bay in a variety of ways, including discharges from shipyards. HB2727 and its Senate twin SB1292 would have allowed the shipbuilding industry more than 12 years to meet the state's strict TBT standard. A compromise was reached between shipbuilders and the state, with these elements: Norfolk

[1] Streambank stability refers to the ability of plants, rocks, and other materials on the bank to reduce erosion of the bank from flowing water.

[2] Streamside shade helps keep water temperatures in the cool range that trout need. A stable streambank leads to less erosion-caused sediments that can impair water quality and habitat.

Shipbuilding & Drydock Corporation (Norshipco) has until December 1, 2002, to meet the state's standard; Gov. Gilmore put $1.5 million in his budget to fund a TBT study; and both HB2727 and SB1292 were killed.

Norshipco Executive Vice President Jack Roper stated "the legislation helped bring focus to this controversial issue and the result was a win-win for jobs and environment." Barb Wrenn, director of land-use and environmental services for the Virginia Municipal League, said the compromise was extremely important. "If passed, [the TBT bills] could have hampered or even reversed considerable progress made in the bay's restoration."

Local Governments and Water Quality

The director of the Chesapeake Bay Local Assistance Department (CBLAD) said the most important legislation to his organization had the governor's backing, but not the legislature's. Michael D. Clower, whose agency offers planning assistance related to impacts on the Chesapeake Bay to 84 localities in the Tidewater region, said CBLAD lobbied for HB2650 and its twin bill in the Senate, SB1133, both of which failed. The bills would have allowed local governments across the state (specifically, outside of the Tidewater Virginia area) to get financial and technical assistance to develop and implement a voluntary program incorporating water quality into comprehensive plans, zoning ordinances, and subdivision ordinances. Clower said CBLAD will not seek to have the bill introduced again in 2000 but may do so in a few years.

Budgets Make Policy

Republican Delegate Robert S. Bloxom, the only member of the Virginia General Assembly from the Eastern Shore, is a member of the tri-state Chesapeake Bay Commission and the Virginia House of Delegates' Chesapeake and Its Tributaries Committee. What did he consider the most important water-related action of the 1999 session? "That's easy," he said, "it's the budget bill" [SB800]. "There were a lot of policy decisions [made during the session], but quite often the policies are decided by how the dollars flow," Bloxom said.

Del. Bloxom noted that there were several attempts to divert money from the Water Quality Improvement Fund into various programs. The fund, created in 1997, offers grants for pollution-reduction programs that, for the most part, go beyond mandated levels. According to John Kennedy, an environmental program manager in the Va. Dept. of Environmental Quality's Chesapeake Bay Office, the original purpose of the fund was to support nutrient reduction and the implementation of tributary strategies being developed for the Chesapeake Bay watershed. According to Del. Bloxom, in this session a "major policy decision," in the form of HB814, was made to keep the fund focused on its original and primary purpose.

How money is distributed by the state came up several times with other sources, as well. Grant programs and revolving loan funds, particularly, were noted. For example, Eric Bartsch, director of the Va. Dept. of Health's Office of Water Programs, watched with interest as HB2242 (Water Supply Assistance Grant Fund) made its way successfully through the legislature. Bartsch's office supported the bill, which establishes a fund for the State Board of Health to provide grants to assist waterworks owners and local governments in providing safe drinking water. Meanwhile, Jay Gilliam, the coordinator of the Save Our Streams program for the Virginia Izaak Walton League, praised the legislature for allocating $65,000 to a competitive-grant program for citizen water-quality monitoring.

Issues Not Yet in View

Issues like poultry-waste management in the Bay watershed—which involve years of debate and affect thousands of Virginians—rightly garner a healthy amount of public attention. But what other potentially high-impact issues may—for the moment—be lurking out of sight?

Ward Staubitz, Virginia district chief of the U. S. Geological Survey's Water Resources Division, had one answer. While he commended the state's strides in surface-

water quality improvement (noting the poultry-waste bill as an example), he said current *groundwater-protection* practices are not so proactive. The current use, availability, and vulnerability of groundwater are all "poorly understood," Staubitz said. "The state needs to take a more active role in defining and managing this undervalued resource."

Next year, will Virginia's legislators be debating groundwater or garbage barges? Waterworks or water planning? Tributyltin or too little rain? Perhaps attention will turn to an issue in *your* water-viewshed.

Key to Bill Numbers Referred to in this Article

(*italics* = *bill passed*; plain type = bill failed)

HB814 Water Quality Improve. Act; amendments
HB1207 Poultry-waste management
HB 1737 Claims; Canterbury Village subdivision
HB1830 Forestry; logger education
HB 2025 Health; waterworks
HB2242 Water Supply Assistance Grant Fund
HB2266 Submerged aquatic vegetation
HB2401 Estuarine and Coastal System
HB2430 Regulation of wastes transported on water
HB2432 Water Facilities Revolving Fund
HB2727 Tributyltin standard
HB2556 Water transport of wastes
HB2557 Solid waste management
HB2471 Solid waste management and enforcement
HB2574 Surface-water management area agreements
HB2650 Non-Tidewater area water-quality assistance
HJ 535 Study; forestry practices
HJ662 Study, wastewater reclamation and reuse
HJ730 Study, satellite chip mills
SB582 Wetlands mitigation banks
SB800 Budget bill
SB865 Solid waste management
SB1133 Non-Tidewater area water-quality assistance
SB1146 Small Business Env. Compliance Assist. Fund
SB1147 Virginia Water Facilities Loan Fund
SB1268 Water-permit fees
SB1274 Pesticide application
SB1292 Tributyltin standard
SB1308 Water transport of wastes
SB1309 Solid-waste management

The Sources and Their Choices

1999 General Assembly legislation of most significance to people consulted for this article.

- **Eric Bartsch**, Va. Dept. of Health: HB1737, HB2025, and HB2242.
- **Del. Harry Blevins** (represents part of Chesapeake), Chesapeake and Its Tributaries Committee: HB1207 and SB582.
- **Del. Robert Bloxom** (represents Accomack, Gloucester [part], Matthews, and Northampton counties), Chesapeake and Its Tributaries Committee, and Chesapeake Bay Commission: HB814, HB1450, and SB800.
- **Michael Clower**, Chesapeake Bay Local Assistance Dept.: HB2650 and SB1133.
- **Sen. Emily Couric** (represents Albemarle, Greene, Madison, Nelson, and Orange counties and part of Charlottesville), Agriculture, Conservation and Natural Resources Committee: HB1207, HB1450, HB2430, HB2556, SB800 and SB1308.
- **Kathy Frahm**, Va. Dept. of Environ. Quality: HB1207, HB1450, HB2430, HB2471, HB2556, HB2557, HB2574, HJ662, SB582, SB800, SB865, SB1146, SB1147, SB1308, and SB1309.
- **Jay Gilliam**, Va. Izaak Walton League: SB800—in particular, $65,000 for a competitive-grant program to fund citizen water-quality monitoring.
- **Paul Howe**, Va. Forestry Assoc.: HB1830, HJ 535, HJ730, and SB1274.
- **Larry Land**, Va. Assoc. of Counties: SB800—in particular, $150,000 from the Water Quality Improvement Fund for a study of management options for animal-feeding operations.
- **Ann Pharr**, Newport News Shipbuilding: SB1268.
- **Terry Porter**, B. A. Mullican Lumber & Manufacturing Co.: HB1830.
- **Tom Reisdorf**, Trout Unlimited: HB1830 and HJ730.
- **Jack Roper**, Norfolk Shipbuilding & Drydock Corporation: HB2727 and SB1292.
- **Ward Staubitz**, U. S. Geological Survey: HB1207.
- **Sen. Patricia Ticer** (represents Arlington [part], and Fairfax [part] counties and Alexandria), Agriculture, Conservation and Natural Resources Committee: HB814, HB1207, HB2266, HB2401, HB2432, SB582, and SB1147.
- **Barbara Wrenn**, Va. Municipal League: HB814, HB1207, HB2727, and SB800.

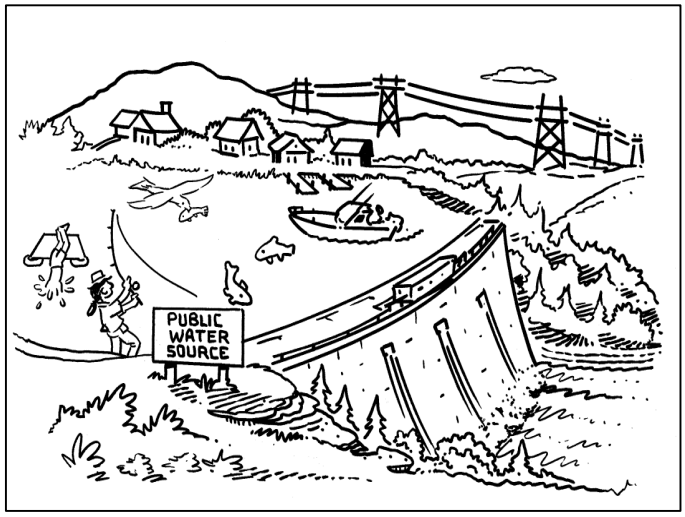
–By Lisa Garcia

SCIENCE BEHIND THE NEWS

Loch, Lac, or Reservoir: There's More to Lakes than Water

"Is the lake *healthy*?" Whenever people encounter or use lakes, this question is sure to arise.

Consider the November 19, 1998, article in the *Baltimore Sun*, headlined "Loch Raven Declared 'Healthy' Reservoir." The article noted that Loch Raven had accumulated less sediment than many had thought it would have by this time (it was constructed in 1923), effectively prolonging the life of the water supply and avoiding the costs of dredging. An engineer with the Maryland Geological Survey said the reservoir was "healthy from [his] standpoint." As in this article, people often define "health" of a lake in terms of *human uses* of the lake, which might be drinking water, hydroelectric power, recreation, flood control, or scenery for building sites.[3]



Some of What "Lacustrine" Means

Lakes meet other creatures' needs, too, providing aquatic and as well as land-based organisms with shelter, breeding areas, food, and, of course, water. But what a Yellow Perch or a pondweed needs from a lake may be very different from what humans need or want, so a lake that is healthy for human uses may not *necessarily* be healthy for other lake life.

Virginia state law, in accordance with the federal Clean Water Act, provides a framework for assessing a lake's health that encompasses both human and non-human lake uses. Under this framework, publicly accessible lakes in Virginia should support four designated uses: aquatic life, fish consumption, primary human contact (swimming or other water recreation), and drinking water supply (for lakes specifically designated as public-water supplies).

Given that these are all valid aspects of lake health, how does one decide if a given lake is "healthy"? The obvious answer is, check the water! Indeed, all of the lake values we've mentioned depend on the *quantity* and *quality* of the water. But just as a lake's water affects the many living things that depend on the lake, so too is the water affected by many influences. These influences include the lake's origin; the land in the lake's watershed; the lake sediments, which in a sense are the "land" under the water; the atmosphere; and living things in or around the lake. So, in diagnosing the present or future health of a lake, water is only part of the story.

Lake Origins

If, as a child, you wanted to build a "lake," how did you do it? Probably you either dug a little hole and filled it with water, or you blocked a tiny creek or other flowing water. Basins (*large* holes in the earth surface) and dams are two basic ways to slow down the force of gravity and turn flowing water into standing water (temporarily). Nature and humans both use these ways to make lakes.

Natural lakes can have various origins, such as glacier movement, wind action (in dry areas), dissolving of underground limestone, cut-offs by river channels (forming "oxbow" lakes), beaver activities, and even meteorites.

Continued after chart on next page.

[3] Whenever a lake is designated as a stored-water source for specific purposes, the lake can appropriately be referred to as a **reservoir**.

Facts About Virginia Lakes

•Virginia has over 300,000 acres of lakes and ponds; only two of these lakes are natural, Lake Drummond in the Great Dismal Swamp, and Mountain Lake in Giles County.

•There are 248 *publicly accessible* lakes in the state, covering 162,230 acres.

•There are 81 lakes or reservoirs exceeding 100 acres in Virginia; 46 are used for public water supply. Other uses include power generation, flood control, or recreation (including many of the 234,000 registered boats in Virginia, as of 1998).

•The ten largest reservoirs wholly or partially in the state range in surface area from 2,530 to 48,900 acres. Individual reservoirs are owned by American Electric Power Co., Appomattox River and Water Authority, Tennessee Valley Authority, U. S. Corps of Engineers, U. S. Forest Service, and Virginia Power.

•The following table compares some world-famous lakes to two Virginia lakes (in bold). For comparison to the depth and area values below, the 100 yards (300 feet) of a football field in the United States is equal to 91.2 meters; its area is 0.008 sq. km., equal to 0.003 sq. mi. (about 2 acres).

Lake	Location	Max. Depth	Average Depth	Surface Area
Lake Baikal	Russia	1637 meters/ about 1 mile (world's deepest)	730 meters/ 2395 feet	81,900 sq. km/ 31,500 sq. mi.
Lake Superior	USA	406 meters/ 1332 feet	147 meters/ 483 feet	82,420 sq. km./ 31,700 sq. mi.
Lac Leman (Lake Geneva)	Switzerland and France	310 meters/ 1017 feet	Data not found	584 sq. km./ 222 sq. mi.
Loch Ness	Scotland	230 meters/ 755 feet	132 m/ 433 feet	52 sq. km./ 20 sq. mi.
Lake Eire	USA	64 meters/ 210 feet	19 meters/ 62 feet	25,766 sq. km./ 9,910 sq. mi.
Smith Mountain Lake	Bedford, Franklin, Pittsylvania co.'s	64 meters/ 212 feet	17 meters/ 55 feet	84 sq. km./ 32 sq. mi.
Mountain Lake	Giles County	31 meters/ 102 feet	9.7 meters/ 32 feet	0.2 sq. km./ 0.07 sq. mi.

Sources (see References section for full citation of publications):
Beaty and Parker, 1994; van der Leeden, 1998; Irkutsk (Russia) State Univ. Web-site: **www.baikal.ru**; U. S. EPA Great Lakes Web-site: **www.epa.gov/glnpo**; a geography of Switzerland Web-site: **www.ethz.ch**; and North American Lake Management Society Web-site: **www.nalms.org**.

Continued from Page 5

The major cause of natural lakes, however, are geological forces. A widespread type of geologically formed lake is glacial lakes, which form in depressions within a glacier, as the result of glacial ice damming a river or stream, or where an ice block left by a receding glacier has melted. Natural lakes can also form in karst-geology regions as a result of the land sinking or giving way and then filling with water.[4] Other potential geologic lake-builders are volcanic activity, movement in the earth's crust (including earthquakes), and landslides.

The most common origin of **artificial lakes** is the damming of rivers and streams, creating what is called an **impoundment**. Artificial lakes can also be formed as a result of mining, when either rainwater or an underground spring fills a cavity left by the mining operations.

Two important features resulting primarily from a lake's origin are the *size* and

[4] Karst-geology areas, including much of western Virginia, are underlain by limestone bedrock that readily dissolves over time. Florida has numerous natural lakes formed in dissolved limestone.

shape of the lake. A lake's size is usually described by the surface area, the depth, or the volume (the amount of water the lake can hold.). A key measurement is the **average** (or mean) **depth**, which helps indicate the shape of the lake basin (for example, whether it is mostly wide and shallow or narrow and deep). A lake's surface shape, known as its **shoreline development**, determines how much shoreline there is relative to the surface area or volume of the lake. For example, a nearly circular lake formed by a glacier has less shoreline relative to its area than does an impoundment of a large river, which has many branches and channels.

Whatever a given lake's origin, it will last only a *relatively* short time—that is, *only* thousands or millions of years, which, in geologic terms, is a short time. As soon as a lake forms, it starts to receive **sediments**: soil particles and other materials transported by water from the land. Sediments accumulate and will, over time, fill in the lake entirely.[5] (In general, an impoundment will fill up with sediments much faster than a natural lake, because the impoundment has a greater incoming flow). As one lake scientist put it, "Once formed, [lakes] are doomed."[6]

Still, a lot can happen in a few thousand or million years. During a lake's life, events constantly occur outside and within the lake that determine the lake's particular characteristics. As noted above, these events occur on land, in the atmosphere, in the water, and in living things.

Lakes and the Land

The type of rocks, soil, vegetation, and land formations found in a lake's **watershed** (the land area from which water drains into the lake) help determine what type and amount of sediments will reach the lake. Deposition of sediments in turn changes the lake's original shoreline shape and, as the lake fills with sediment, its volume. From a human perspective the longer the lake lasts the longer it can be used as a resource. Thus, as in the Loch Raven case noted on page 5, a lake that is filling slowly can be considered healthier than one that is filling quickly, or that is nearly filled.

Land formations, or **topography**, dictate the surface area and contours of a lake's watershed. Two features are of particular interest are the area of the watershed compared to the area of the lake itself—a larger watershed area means more water and accompanying sediments reach the lake; and the changes in elevation—greater slopes lead to greater and faster runoff of surface water, again increasing the potential amount of materials reaching the lake.

Lakes and the Atmosphere

To paraphrase an enterprising space-ship engineer on TV, "Lakes can't defy the laws of physics, captain." The climate of a lake's geographic location is the "engine" that provides two of the most important physical aspects of a lake—light and heat. Sunlight is the major energy source in lakes, used by plants and algae to produce the organic material that supports all of a lake's other organisms (with oxygen generated at the same time). The depth to which sunlight can penetrate results from the light-absorbing or –reflecting properties of the lake water and the materials in the water. Light penetration controls how far from shore rooted or submerged plants are found and how deep into the water suspended algae is found.

The deeper light can go, the clearer water looks. A commonly used measurement of light transmission is **Secchi depth**, which can range from less than a meter to about 40 meters (in the clearest lakes).[7] Secchi depth can change seasonally within a given lake.

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[5] This natural process, where a lake changes gradually from a body of open water to a wetland to dry land, is known as **succession**, and is analogous to the transition of land environments in Virginia from bare rock to field to forest.

[6] Cole, G. A. 1979. *Textbook of Limnology*. 2nd Edition. C. V. Mosby, St. Louis.

[7] Secchi depth is, essentially, the depth at which a black-and-white-painted disc (the Secchi disc), submerged on a rope, becomes no longer visible. This simple test was developed by and named for a 19th-Century Italian oceanographer.

Much of the sunlight reaching a lake gets converted to heat, and this is usually the main source of a lake's heat (although some additional heat can come from sediments and water entering the lake, the air above the lake, and water-vapor condensation at the lake surface). Different living things have different temperature ranges that they can tolerate, so heat in the lake is vital biologically. But heat is also a water *mover*. Within the lake, cold water is denser and heavier than warm water, so heat differences can cause vertical movements of water. Outside of the lake, winds generated by the sun and the atmosphere cause waves and surface currents.

The atmosphere, of course, also determines how much water reaches the lake through precipitation directly to the lake, to its tributaries, or via groundwater. Through its influence on heat, wind, currents, and water flowing in from tributaries, the atmosphere controls the distribution of water throughout a lake; and, where water goes, so go the materials dissolved or suspended in the water. The amounts and locations of such materials determines a lake's chemical environment, one of the most closely watched aspects of lake health.

Chemicals in the Lake

In *The Natural History of Lakes* (1987; pp. 28-29), Mary Burgis and Pat Morris write,

> "It is probably true to say that no lake contains pure water. Apart from rain (or snow) falling on the surface of the lake, all the water in a lake has run over or through the rocks and soil of its [watershed]. On the way [the water] takes up chemicals...."

Aquatic organisms are immersed in water, so they are continually exposed to whatever chemicals are in water. "Chemicals" in a lake are not only the substances that people consider pollutants. Beginning with water itself, naturally occurring substances and their chemical properties play an important part in biological and geological processes. In the case of these essential chemicals, living things have a range of tolerance and of preference—that is, some level of the chemical is essential, but too much or too little can be harmful. For non-essential substances (such as a herbicide), organisms also vary in their tolerance: Low levels *may* cause no harm, but above a certain level, damage occurs.

The Virginia Dept. of Environmental Quality's (VA DEQ) lake-monitoring program, begun in the early 1970s, measures several factors to estimate a lake's health; the table on the following page lists and briefly explains these factors. Most are related to chemicals or chemical processes that are essential to life, potentially toxic, or both.

One *non-chemical* factor routinely monitored is fecal coliform bacteria, a *biological* factor that indicates a lake's suitability for human contact (drinking or swimming). Bacteria are a prime example of our fourth aspect of lake health: what's living in the lake.

The Life in Lakes

Along with sunlight, the materials that enter a lake from its watershed or from the air provide the means for life in the lake to survive, grow, and reproduce. Besides the water itself, these life-supporting materials include gases that dissolve in the water, such as oxygen and carbon dioxide; materials important for their physical qualities, such as sediments and stones for plant attachment, fish breeding, etc.; and essential dissolved chemicals, such as nitrogen and phosphorus, known as **nutrients**.

At any given time, a given lake will support a given mix of organisms going through their life cycles: plants and algae; animals that depend on plants or algae for food; and bacteria and other organisms that break down (or decompose) dead organisms. The particular mix for a given lake and time will depend on the non-living factors influencing the lake as well as the influences of living things on one another—such as who eats whom, who takes whose habitat, or who uses whose oxygen.

Growth and reproduction by all of a lake's organisms make up a lake's **biological**

Continued after chart on next page.

Factors Monitored in Va. Dept. of Environmental Quality's Lake-monitoring Program (as of 1996 report)

Lake Water-quality Factor	Type of Factor	Importance
Dissolved Oxygen	Chemical	An essential element; aquatic organisms have a range of tolerance/preference for the level of oxygen dissolved in the water.
Temperature	Physical	Organisms have a range of temperature tolerance and preference; temperature affects chemical reactions in water and living things; temperature determines how much oxygen water can hold.
pH and Alkalinity	Chemical	Indicates the acidity of the water; organisms vary in their tolerance/preference range. Alkalinity is a measure of the capacity for the water to resist changes in pH.
Nitrogen	Chemical	An essential element for all living things; in excess, it causes a range of water-quality problems.
Phosphorus	Chemical	Same as for nitrogen.
Organic Carbon	Chemical	An essential element; measurement helps estimate the amount of biological growth or production.
Chlorophyll A	Chemical and biological	The primary substance that allows plants and algae to capture energy from the sun; measurement helps estimate the amount of biological growth or production.
Salinity, Conductivity, and Hardness	Chemical	Three ways to measure the level of substances dissolved or suspended in water; levels help indicate amount of materials reaching the lake from land or air and the suitability of water for various uses.
Metals (water and sediments)	Chemical	Some are essential elements; all can be toxic in excess.
Pesticides/ herbicides (water and sediments)	Chemical	Toxic above a certain level, which varies depending on the chemical and the organisms affected.
Fecal coliform bacteria	Biological	Found in the intestines of birds and mammals; not harmful themselves, their presence indicates contamination by feces and potentially the presence of harmful bacteria or viruses.

Continued from page 8.

production, the amount of organic (carbon-based) materials the organisms generate over a given time. From a human perspective, a lake's biological health depends on how much production is occurring and, especially, *on how this production affects the balance of living things in the lake.*

A Lake-diagnosis Concept

Through years of study of lakes worldwide, lake scientists have learned how a lake's biological production is related to the factors influencing a lake, and to a lake's suitability for various uses by humans and by other organisms. Scientists use biological production to group lakes by **trophic status**, a commonly used evaluation of a lake's health. This term may be unfamiliar, but you might recognize this related one: **eutrophication**, or the development of a **eutrophic** lake. A eutrophic lake has a relatively high level of biological production; an **oligotrophic** lake, on the other hand, has relatively low production. In its 1996 water-quality report, VA DEQ classified Virginia's lakes by trophic status, as follows: 10 percent were classified in the oligotrophic range, 52 percent eutrophic, and 32 percent mesotrophic (a medium level of production).

Eutrophication can be caused by an increase in nutrients in a lake. This can happen naturally (usually over a long time) or from human causes. *Cultural eutrophication* refers to the process of nutrients in sewage, industrial discharges, or

runoff reaching a lake and contributing to eutrophication.

Besides their respective production levels, eutrophic and oligotrophic lakes typically have certain physical, chemical, and biological characteristics. Some of the more important ones are noted below:

Oligotrophic Lake (*low biological production*)	**Eutrophic Lake (*high biological production*)**
Relatively deep	Relatively shallow
Relatively clear water	Relatively unclear water
Poor in plant nutrients	Rich in plant nutrients
Sediments low in organic matter	Sediments high in organic matter

Eutrophic conditions affect (or reflect) the balance of living things in a lake. One important consequence is that eutrophic lakes usually develop excessive levels of algae; among other effects, excessive algae reduce water clarity and ultimately reduce the dissolved oxygen available to fish and other organisms. People rarely view highly eutrophic lakes as "healthy." (In Maine, for example, a one-meter change in water clarity has been seen to affect lake-front property value by up to $200 per foot of frontage.) Highly oligotrophic lakes, however, have their own limitations; for example, such lakes typically don't produce much fish.

Most lakes fall somewhere between highly eutrophic and highly oligotrophic, resulting in a capacity to support multiple uses. For example, a recent report on Smith Mountain Lake stated that the lake currently has an "ideal balance" of water quality for swimming and aesthetics and nutrient-induced productivity to support fish.

A "Clean Bill of Health" for a Lake

Lake users—swimmers, boaters, anglers, home-buyers, regulators, dragonfly-watchers, and others—all like to know the results of their lake's latest check-up. Their perspective will determine what "healthy," or "healthy enough," means. "Clean" is only one standard of lake health; others include safe; clear; long-lasting; full (for water supply or power generation); not full (for flood control); open (for boating); or biologically productive.

A wide array of human activities depend on lakes; an equally wide array of factors affect a lake and whether it can support such activities. If you're consulting a "lake doctor," therefore, be prepared to talk about more than water.

References and Further Reading

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Further Reading on the World Wide Web

The U. S. EPA's Great Lakes Program: **www.epa.gov/glnpo**.
The University of Wisconsin-Madison's Center for Limnology: **limnology.wisc.edu**.

—By Dinesh Gupta and Alan Raflo
Dinesh, a 1999 Virginia Tech graduate, was an intern at the Water Center in Spring, 1999.

IN AND *OUT OF* THE NEWS
Newsworthy Items You May Have Missed

The following summaries are based on information in the source or sources indicated at the end of each item. Selection of this issue's items concluded May 14, 1999.

If you have access to the Internet, you can follow water-related news with the "Daily News Update" at the Water Center's Web site (the Web address is listed on the last page of this newsletter).

•A *Virginia Wildlife* writer has compiled a list of **Virginia's 10 best trout streams**. Check for one near you! Big Wilson Creek, Grayson County; Buffalo Creek, Rockbridge County; the Jackson River, Bath County; Little Stoney Creek, Giles County; the Rapidan River in Shenandoah National Park, Madison County; the Rose River in Shenandoah National Park, Madison County; Smith Creek, Rockingham County; the Smith River below Philpott Dam, Henry County; Stewarts Creek, Carroll County; and Whitetop Laurel Creek, Washington County. (*Virginia Wildlife*, March 1999)

•**Arsenic standards** for drinking water should be tightened, according to the National Research Council, in order to reduce the risk of bladder and lung cancer. The limit for drinking water—10 parts per billion (ppb)—was set in 1942, but now scientists estimate the risk of bladder cancer at one in 1,000 for people consuming water with arsenic at that level. The overall cancer risk may be as high as one in 100, some members of the panel said. A 1995 U. S. EPA assessment indicated that some 32 million residents of western states drink water containing from 2 to 50 ppb of arsenic. (*Washington Post*, 3/24/99)

•Neither farmers nor environmentalists appear to be happy with the **U. S. EPA's new plan for controlling polluted runoff from animal feedlots**, and lawsuits are expected as the agency develops regulations., Some environmentalists say the strategy doesn't adequately protect the environment, while agriculture industry sources question whether EPA has the right to require feedlot operators to get Clean Water Act discharge permits. The strategy places some responsibility on businesses that own the animals as well as on individual farmers who raise them. (*Inside EPA's Reinvention Report*, 3/24/99)

•Sixteen Midwestern and mid-Atlantic states are trying to reach a consensus on **interstate transfer of solid waste**. The effort, which may become the basis for federal waste legislation, emerged when House Commerce Committee Chairman Thomas Bliley (R-Va.) said he was unwilling to consider any interstate waste legislation until the states reach such a consensus. New York's Fresh Kills landfill is preparing to close, causing Virginia and some other waste-importing states to fear huge increases in waste shipments. The U. S. Supreme Court has ruled that states may not restrict interstate waste shipments, so only federal legislation can authorize limits. (*Inside EPA's Reinvention Report*, 3/24/99)

•In a survey of 450 people in three counties near Charlotte, North Carolina, 59 percent said they would **pay a small monthly fee to protect water** in Mountain Island Lake, the drinking-water source for 600,000 people. (See the related news item in the April 1999 *Water Central*). Pollsters found that drinking water ranked third among major concerns, behind schools and crime. (*Charlotte Observer*, 3/25/99)

•Two decades ago, the **North Fork of the Holston** (in Scott, Smyth, and Washington counties), was so severely polluted with mercury that a local resident recalls "dipping it up with a spoon." Now the river has emerged as one of the best smallmouth bass streams in southwestern Virginia. Contamination remains, however, so a fishing ban has now been replaced by an advisory. (*Virginia Wildlife*, March 1999)

•**Bedford County officials will begin testing groundwater for leacheate** at a dairy farm bordering an old county landfill. The county has already determined that unacceptable levels of methane, presumably from decomposing trash, has seeped onto the farm. The 40-acre landfill was closed in 1993 after it failed to comply with new government regulations. (*Roanoke Times*, 3/27/99)

A brief look at an Ohio landfill-groundwater pollution case shows just how complicated such situations can become. The cost of cleaning the landfill where Butler County companies disposed of toxic chemicals and other trash until 1990 has been estimated at $9.1 million. Six major polluters agreed to pay for the cleanup but are suing *85 others* to help foot the bill. (*Associated Press*, 3/30/99)

•**Beds of tree bark and with resident bacteria can reduce pollution** from dairy-operation wastewater, a Wisconsin study shows. Such wastewater contains milk fat, detergents, acids, phosphorus, and nitrogen. When bacteria in streamwater digest these substances, they can consume enough oxygen to deprive other aquatic organisms of the essential element. The first test of wastewater flowing from a bark bed at an Ozaukee County farm found nearly all the nitrogen and 75 percent of the phosphorous had been digested. (*Milwaukee Journal-Sentinel*, 3/30/99)

•The **new Highpoint Water Treatment Plant** began providing a group of Smith Mountain Lake residents with tap water from the 30-year-old lake on March 31. The $1.2-million treatment plant was built to provide water to a subdivision with inadequate wells. Processing 60,000 gallons per day now, it could become a major supplier of a million gallons a day. (*Roanoke Times*, 3/31/99)

•Warning that **invasions by non-native species** threaten ecological, economic, and human health, President Clinton in February signed an executive order requiring federal agencies to work together to prevent harm to natural ecosystems from exotic species. The order allocates $29 million next year to help federal agencies prevent the introduction of exotic species, control the spread of those here, and restore native species. Purple loosestrife, the gypsy moth, and the oyster pathogen MSX (a single-celled animal, or protozoan) are examples of troublesome exotic species. (*Bay Journal*, April 1999)

Meanwhile, in response to concerns over the introduction of invasive, non-native species, the U. S. EPA will study whether ocean vessels should be required to have wastewater discharge permits for their ballast water, which can harbor non-native species. EPA chose at this time not to lift a current Clean Water Act exemption that allows ships to dump ballast water into U.S. waters without such a permit. (*Water Policy Report*, 4/14/99)

•The Va. Dept. of Environmental Quality reports that **industrial chemical releases decreased 8.6 percent** in 1997, down almost 5 million pounds from 1996. Of the 52 millions pounds of chemicals released, about 90 percent was released to air, 8 percent to water, and 2 per cent to land. (*Associated Press*, 4/6/99)

•A large poultry farm in Arkansas is testing **a new technology to reduce polluting runoff** by separating dry and liquid manure. The system, which converts dry waste into pellets, reduces the land needed for waste disposal and creates a more gradual release of nutrients to the soil, according to Arrowwaste, the company applying for a patent on this technology. (*Inside EPA's Reinvention Report*, 4/7/99)

•Six Virginia conservation and environmental organizations asked Gov. Gilmore to intervene to stop **drainage of non-tidal (seasonally wet) Virginia wetlands**. Drainage of several thousand acres in eastern Virginia followed a federal appeals court ruling in June, 1998, that the U.S. Army Corps of Engineers has no authority to regulate sand mining, land clearing, and ditching in such wetlands. (The ruling did not affect tidal wetlands, such as salt marshes.) The Gilmore administration is reportedly studying the extent of drainage and possible responses. (*Richmond Times Dispatch*, 4/13/99)

•A type of **alga that produces a metal-binding protein** may help clean up toxic metal contamination in the Great Lakes. Researchers at Ohio State University and in Thunder Bay, Ontario, have shown that genetically-altered *Chlamydomonas reinhardtii*, a common species, can extract lead, cadmium, mercury, and other metals from contaminated water. According to the researchers, practical application is at least a year away. (*Associated Press*, 4/12/99)

•North Carolina Governor Jim Hunt has a plan **to phase out all hog-waste lagoons** in his state within a decade, and state senators are seeking to extend a moratorium on the growth of large hog farms. They are concerned with that existing and abandoned hog lagoons threaten water quality. Hunt said small farmers would be eligible for some public help

in making the conversion from waste lagoons, but that the hog industry would bear a significant part of the cost. The announcement came three days after 1.5 million gallons of waste spilled from a lagoon at a Duplin County farm. (*Associated Press*, 4/21 and 4/23/99)

•After years of requests to state, local, and federal governments, residents of **Wise County's Stone Mountain no longer have to haul their drinking water**. On April 23, the county's Public Service Authority opened the valves on the community's $1.3-million public-water project. (*Associated Press*, 4/26/99)

•Under a **new U. S. EPA credit-trading system** being pilot-tested this summer, companies that clean up a mining site receive pollution-reduction credits that they can apply to discharges at other facilities in the same watershed, if the trade results in a net improvement. Any increases in pollutant discharges would not be allowed to exceed water-quality standards or degrade overall water quality in a watershed. Companies may be attracted to the idea because removing mining waste from an abandoned mine may be cheaper than installing new technology to decrease pollutants from an operating facility. Under the program, companies receive limited, temporary relief from Clean Water Act and Superfund liability during the cleanup. (*Inside EPA's Water Policy Report*, 4/28/99)

•**Estuary and beach water-quality bills** have been moving in the 106th Congress. The House passed the Beach Environmental Assessment and Coastal Health Act (H.R. 999), which would require states to establish new water-quality standards to protect beach goers from waterborne pathogens. In the Senate, John Chafee (R-RI) introduced legislation creating an Estuary Habitat Restoration Council and giving states $315 million to implement water-quality plans developed under the EPA's National Estuary Program. A similar bill is under consideration in the House. (*Water Policy Report*, 4/28/99)

Meanwhile, after finding high bacteria levels in the Myrtle Beach surf in early May, the South Carolina Dept. of Health and Environmental Control is seeking funds to widen its ocean-testing program. The department issued warnings May 2 against swimming along 25 miles of beach at the resort city. (*The State* [Columbia, SC], 5/4/99)

•Reported **oil and chemical spills in Maryland dropped by 50 percent** over the past five years, according to U. S. EPA data. The number of incidents fell from 923 in 1994 to 458 last year, while such reports increased slightly nationwide during the same period. The data is collected under the Emergency Response Notification System. Some interest groups see the data as proof of heightened environmental awareness among businesses, while others question the reliability of the reporting system, suggesting that some companies might not be reporting spills. (*Capital News Service*, 5/4/99)

•**Mercury contamination of fish South Fork-Shenandoah River** has been increasing, according to a study from 1992-96 by Old Dominion University's Applied Marine Research Lab. Discovered in 1977, the river's mercury problem resulted from releases from 1929-1950 at a DuPont synthetic-fibers plant in Waynesboro. A Va. Health Dept. advisory—warning people not to eat more than ½ pound of fish per week—remains in effect for 103 river miles (this includes the South River and the So. Fork Shenandoah), from the plant site to the Page/Warren county line. Small children and pregnant women, however, are advised not to eat *any* mercury-contaminated fish. (*Associated Press*, 5/6/99; and *Virginia Water Quality Assessment*, Va. Dept. Env. Quality, Dec. 1996)

•A mysterious **new disease that has been killing water birds** in South Carolina, Georgia, and Arkansas has now claimed eagles, coots, and ducks around Woodlake in North Carolina. Scientists working on the problem, who suspect a toxin rather than a pathogenic organism, have found only one common feature: all birds were discovered on artificial waterways. Wildlife managers across the country have been asked to look for birds that exhibit uncoordinated behavior, characteristic of the disease. (*Washington Post*, 5/10/99)

•Roanoke declared May 23 as a **citywide day of prayer for rain** to replenish Carvins Cove, the city's main reservoir. Citizens were being asked to voluntarily limit water use. The reservoir was 18.4 feet below full pond level in mid-May, a time when the highest demand and

probably the driest season are still ahead. (*Roanoke Times*, 5/10 and 5/18/99)

•The U. S. EPA has added the Chesapeake Bay and 82 other water bodies to **Virginia's list of "impaired waters**." Virginia officials tried to keep the bay off the list, citing continued cleanup efforts. The list now includes 810 lakes, streams, and rivers. The federal Clean Water Act requires states every two years to give EPA a list of impaired and to prepare a restoration plan, known as a Total Maximum Daily Load (TMDL) plan. (Please see the Feature in the October 1998 *Water Central* for an explanation of TMDLs.) (*Hampton Roads Daily Press*, 5/13/99)

–Compiled by Su Clauson-Wicker

N O T I C E S

Federal Evaluation of the Virginia Coastal Program

On **November 15-19, 1999**, NOAA's Office of Ocean and Coastal Resource Management will review Virginia's Coastal Program to determine how effectively the Va. Dept. of Environmental Quality (DEQ) and other agencies have implemented the program since 1996. The evaluation team will meet throughout Virginia's coastal zone with state officials, local governments, non-governmental organizations, and the general public. For more information, contact Laura McKay, DEQ Coastal Program Manager at (804) 698-4320.

Commission Studying the Future of Virginia's Environment

This General Assembly-mandated group will meet **September 17, 1999**, at Kiptopeke State Park, Northampton County. Since 1997, the commission has focused on parks and land conservation, solid waste, the Water Quality Improvement Act, and a plan for Virginia's natural resources. For more information, contact Shannon Varner at (804) 786-3591; TDD (804) 786-2369.

Virginia Water Research Symposium, Richmond. November 14-16, 1999

Sponsored by the Water Center, the purpose of this forum is to increase communication between researchers and professionals in government and private sectors, so that they may work together in developing effective water-resource management policies and techniques. The symposium will be held at the Holiday Inn, South Kroger Center in Richmond. For more information and to register, please contact Judy Poff (540) 231-8030; or e-mail: jupoff@vt.edu Registration received before September 15 will be $90, after September 15 - $130. A one-day fee of $60 is available (after September 15, $75).

CORRECTIONS FROM PREVIOUS ISSUES OF *WATER CENTRAL*

1) The "In and *Out of* the News" section in the April 1999 issue (p. 12) mentioned a "January-July 1998 drought." This period actually was exceptionally wet; the drought—still ongoing—began in July 1998.

2) The same section of the April 1999 issue (p. 13) incorrectly identified the source of the item on the Metropolitan Water District of Southern California and MTBE as *Business Wire* on 3/12/99; the correct date for this source was 3/9/99.

FOR THE RECORD
Sources for Selected Water Resources Topics

Water Use

Every five years the U. S. Geological Survey (USGS) publishes a report on estimated water use nationwide. The latest report is USGS Circular 1200, *Estimated Use of Water in the United States in 1995*. The report is available at the USGS Web-site, **water.usgs.gov**, and at many public libraries. To request a copy of the report (a limited number of copies are available), or to find out what other information the USGS has on water use in Virginia, contact Donna Belval at (804) 261-2633; e-mail: dlbelval@usgs.gov.

Virginia Statistical Abstract, published by the Weldon Cooper Center for Public Service at the University of Virginia, has data on water use for irrigation, public supply, industry, and hydroelectric generation in the United States, Virginia, and surrounding states. The book is available at many public libraries. To purchase a copy, contact the Center at 918 Emmet Street, Ste. 300, Charlottesville, 22903-4832; (804) 982-5704; TDD (804) 982-HEAR; e-mail: cps-pubs@virginia.edu; Web-site **www.virginia.edu/coopercenter/**.

Information on Water Conservation

WaterWiser™, a Web-site on water conservation, is a joint project of the American Water Works Association (AWWA), the U. S. EPA, and the U. S. Bureau of Reclamation. The site, at **www.waterwiser.org**, has conservation tips as well as general information on water use, such as average household use.

The Winter 1998 issue of *On Tap*, published by the National Drinking Water Clearinghouse, was devoted to water conservation. The issue includes articles on the U. S. EPA's *Water Conservation Plan Guidelines*, potential water savings from repairing or replacing fixtures, and a conservation-resource section. Contact the NDWC at West Virginia University, P. O. Box 6064, Morgantown, WV 26506; (800) 624-8301; Web-site **www.ndwc.wvu.edu**.

Upcoming "For the Record" Schedule

1999

August – Water Maps
October – Wetlands
December – Water Law

2000

February – Following the Va. General Assembly
April – State Water Regulatory Processes
June – Tracking Federal Water Legislation and Regulations

Schedule subject to change

TEACHING WATER
For Virginia's K-12 teachers

This Issue and the Virginia Standards of Learning

Water Central welcomes comments on the applicability of articles to the standards listed or to others not listed.

Abbreviations: **BIO**-biology, **ES**-earth science, **LS**-life science; **CH**-chemistry; PH-physics

Feature Article
Science: 4.5, 4.8, 6.11, LS.12, ES.7, ES.9, ES.11
Social Studies: 7.4, 12.6, 12.8, 12.13

Science Behind the News
Science: 3.6, 3.9, 3.10, 3.11, 4.5, 4.8, 6.8, 6.9, 6.11, LS.4, LS.7, LS.9, LS.11, LS.12, ES.7, ES.8, ES.9, BIO.9, CH.6, PH.4
Social Studies: NONE

For the Record
Science: K.10, 1.8, 3.10, 4.8, 6.11, LS.12, ES.7, ES.9
Social Studies: 10.5, 10.9, 10.10
Computer/Technology: 5.3, 8.4

Virginia Water Central

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YOU GET THE LAST WORD

Please answer the following questions to let us know whether the newsletter is meeting your needs. Please mail this page to the Water Center address listed in the box to the left, or e-mail your responses to water @vt.edu. Thank you.

1. Would you rate the content of this issue as good, fair, or poor?

2. Would you rate the appearance as good, fair, or poor?

3. Would you rate the readability of the articles as good, fair, or poor?

4. Is the newsletter too long, too short, or about right?

5. Do the issues come too frequently, too seldom, or about right?

6. Please add any other **comments** you wish to make.

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