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BROOKHAVEN NATIONAL LABORATORY

2000 BNL Water Quality Consumer Confidence Report

This special supplement to the Brookhaven Bulletin is the Lab's second annual Consumer Confidence Report, which provides an overview of the water quality during calendar year 1999. Because the Lab is a drinking-water supplier, BNL is required by the federal Safe Drinking Water Act (SDWA) of 1976, as amended in 1996 to produce an annual report on the quality of its drinking water.

Last year, as in the past, BNL's tap water met all state drinking-water quality standards. The Lab's Plant Engineering (PE) Division, which is responsible for the Lab's drinking water, is proud to report that BNL's water system has never violated a maximum contaminant level or any other water-quality standard.

The report's purpose is to inform drinking-water consumers where their water comes from, what analytical tests are conducted to ensure its safety, what those tests reveal about the water, and how those results compare to regulatory standards.

In addition, the report reminds water consumers of the importance and need to protect drinking-water sources.

Among its other responsibilities, PE is committed to providing all employees, facility-users, guests, residents, and other visitors with a safe and reliable drinking-water supply while they are on site. To do so, PE regularly tests BNL's drinking water using approved independent laboratories and in-house testing, thereby ensuring that the Lab's drinking water meets all local, state and federal standards for drinking-water quality. In addition, PE works with BNL's Environmental Restoration Division and the Environmental Services Division to ensure that the Lab's potable water supply is not impacted by groundwater contamination on site.

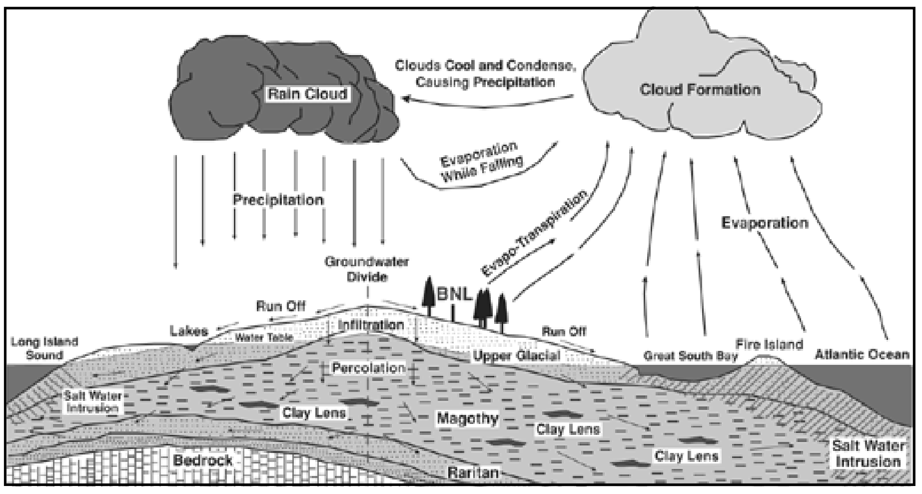
For additional information and/or copies of the complete analysis of 1999 drinking-water samples, contact: Ed Murphy, PE Division Manager, Ext. 3466 or etmurphy@bnl.gov; William Chaloupka, PE Assistant Manager of Operations & Environment, Ext. 7136 or chaloupka@bnl.gov; Bob Lee, Deputy Manager of the Environment Services Division, Ext. 3148 or blee@bnl.gov; or the Suffolk County Department of Health Services, (631) 853-2251.

Where Does Brookhaven Lab's Drinking Water Come From?

All of the water supplied to BNL comes from beneath the ground and, hence, is referred to as groundwater.

The water is stored beneath the ground in a sandy, geological formation known as an aquifer. Water in the aquifer originates as precipitation that slowly percolates down through the soil into the aquifer.

Hydrogeologists estimate that Long Island's aquifer system contains 70 to 90 trillion gallons of water, much of which is thousands of years old and entirely free of contamination. This is enough water to supply Long Island's population for centuries, even if it never rained or snowed again.



The depth of Long Island's aquifer system varies: at a depth of approximately 2,000 feet, it is at its deepest along the south shore.

Along the north shore, the aquifer is at its most shallow at 600 feet.

The Long Island aquifer system is made up of three primary formations which lie one on top of the other.

At BNL, from the shallowest to the deepest, these aquifer layers are:

- **Glacial:** From the surface to about 150 feet down, the Glacial formation contains the youngest or newest water in the groundwater system. Virtually all private wells on Long Island draw their water from this portion of the aquifer, as do all six of the Lab's drinking-water wells.
- **Magothy:** From about 150 feet to a depth of 1,000 feet, the Magothy formation is the largest of the three layers and holds the most water, much of which is hundreds of years old. The Suffolk County Water Authority draws water from here.
- **Lloyd:** From 1,000 to about 1,450 feet, the Lloyd formation is largely untapped. It contains the oldest water, some of which is more than five thousand years old.

How Does BNL Supply Its Drinking Water? The Supply System Described

The Lab's drinking-water supply system is the only source of what is called potable water for the on-site transient and resident population of approximately 3,500 people.

In 1999, the amount of potable water produced was 784 million gallons, which equals, on average, 65 million gallons per month or 2.2 million gallons per day. Due to demand, flow varies from 45 million gallons per month, which is 1.5 million gallons per day, to over 97 million gallons per month, or 3.2 million gallons per day.

In addition to being consumed by the people on site, potable water is used within cooling towers and for cooling various pieces of on-site equipment, such as the main-magnet heat exchangers for the Alternating Gradient Synchrotron.

To produce this water, the Lab employs a drinking-water supply system, the centerpiece of which is the Water Treatment Facility (WTF). It is located on Upton Road in Bldg. 624.

Designed to remove iron and manganese from the Lab's source water, the WTF was constructed in 1963 and has undergone a series of upgrades over the years. The most recent upgrade came in 1995-96, when the aeration tower and a new clear well were added (see following list).

The Lab's drinking-water supply system is made up of the following:

Potable-Water Supply Wells

There are six drinking-water wells on site: Wells numbered 4, 6 and 7 are located west of Upton Road and supply water to the WTF. Wells numbered 10, 11 and 12 are located along East Fifth Avenue, are equipped with activated carbon filters, and, because they pump water that is low in iron, supply water directly to the system.

Water is drawn using electrically driven, vertical turbine deep-well pumps, each having an auxiliary drive engine and a design rating of 1,000 gallons per minute (gpm).

Water Treatment Facility (WTF)

The Lab's WTF employs the following components to perform the functions described:

- **Aeration tank**: reduces carbon dioxide gas and aids in oxidation.
- **Rapid-mix tank**: mixes treatment chemicals that are added to the water.
- **Retention tank**: holds the water long enough to allow chemicals enough time to react and form "floc." Flocculation is a process by which very small hydroxide particles stick together to form larger, more easily settled particles called floc.
- **Slow-mix tank:** mixes gently to aid in the formation of floc.
- **Rapid-sand filter:** removes iron floc by passing water through eight filter cells containing sand and anthracite.
- **Wet well with lift pumps:** stores filtered water before it is pumped into the aeration towers.
- **Aeration towers:** remove any volatile organic compounds (VOCs) by spraying the water down over whiffle ball-like fill while air flows upward through the water spray.
- **Clear well:** stores the finished water, before final chlorination and distribution.

Water-Treatment Chemicals

- **Sodium hypochlorite:** kills bacteria and oxidizes iron. Iron removal by oxidation and filtration reduces the water's iron concentration from groundwater's 3-4 milligrams per liter (mg/l) to the "finished" water's 0.03 mg/l. To accomplish this, the ferrous iron that is dissolved in groundwater is readily oxidized to form insoluble ferric hydroxides which flocculate and settle.
- **Lime:** raises the water's pH and softens the water.
- **Polymer:** aids in the flocculation process.

Water Storage Tanks

- **300,000-gallon tank:** was built by Pittsburgh-Des Moines Steel for the U.S. Army in 1941, when the site was Camp Upton. Located on Upton Road next to Police Headquarters, Bldg. 50, this tank is 124 feet to the high-water level, and its bowl is 40 feet in diameter.
- **1,000,000-gallon tank:** was built by Chicago Bridge & Iron in 1985 and is located by the intersection of Cornell and North Sixth Street. The bottom of the tank is 126 feet above land surface, and the bowl is 75.5 feet in diameter.

Carbon Filters

To remove VOCs, carbon adsorption filters are installed on wells numbered 10, 11 and 12, the three wells that discharge directly to the drinking-water distribution system.

Distribution Piping

The site has approximately 45 miles of drinking-water distribution pipe. The piping is a mix of cast iron dating from the site's World War II Camp Upton days, transite, plastic, and cement-lined ductile iron. When drinking-water distribution pipe is added or replaced, cement-lined, ductile-iron pipe is used.

BNL's Water System Statistics

Owned by the U.S. Department of Energy and overseen the DOE's Brookhaven Group, Bldg. 464, BNL's water system serves a population of approximately 3,500 people and is identified as federal public water system no. 5111891.

	capacity	
facility	**English units**	**metric units**
• Water Treatment Facility	6,000,000 gal./day	22,710,000 l/day
• Each of the six wells	1,200 gal./min.	76 l/s
• Storage tank #1	300,000 gal.	1,152,160 l
• Storage tank #2	1,000,000 gal.	3,790,00 l
• Activated carbon filters on wells #10, 11, & 12		
carbon	40,000 lbs.	18,144 kg
flow	1,000 gpm	63 l/s
• Air stripping using 2 packed towers		
water flow	2,400 gal./min.	151 l/s
air flow	11,250 scfm	5.309 m^3/sec.
• Clear well	250,000 gal.	947,500 l
• Distribution system	45 mi.	72 km
• Pressure	55 to 70 psi	379 to 483 kPa

Lead in Pipes

All in-service drinking-water fountains on site produce water that does *not* exceed the drinking-water standard for lead. However, some of BNL's drinking-water fountains were taken out of service and remain out of service because what comes out of the spout exceeds the drinking-water standard for lead. This is *not* because the Lab's potable water contains lead. This *is* as a result of the past practice of using solder containing lead to join copper pipe, such as the cooling coil, within the fountain. Regardless, if you are concerned about lead in your drinking water, then let the tap run for at least two minutes before consuming the water.

BNL's Commitment to Its Drinking-Water Consumers: Safe, Reliable Drinking Water

BNL's Drinking Water Is in Full Compliance With All Regulations

In 1999, BNL's drinking water was in full compliance with all county, state and federal regulations.

To ensure that tap water is safe to drink, the U.S. Environmental Protection Agency (EPA) and the New York State Department of Health Services (NYSDHS) have prescribed regulations that limit the amounts of certain contaminants in water provided by public water systems, such as BNL's. To provide the same protection to those who drink bottled water, the U.S. Food & Drug Administration and NYSDHS have established regulations to limit contaminants in bottled water.

Each drinking-water contaminant has an allowable maximum contaminant level (MCL). Drinking water that exceeds MCLs for one or more compounds is in violation of the law.

No MCLs were reached or exceeded by BNL's drinking water in 1999, and there were no violations of any government regulations. Of the more than 80 drinking water contaminants for which testing is required, only the nine compounds listed in the table (center, below) were detected in the Lab's drinking water in 1999.

Understanding Water Contents

While Long Island draws its drinking water from wells tapping into the aquifer (see "Where Does Brookhaven Lab's Drinking Water Come From?" on page 1), other sources of tap and bottled drinking water include rivers, lakes, streams, ponds, reservoirs, and springs. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals, and, in some cases, radioactive material. And, water can pick up substances resulting from human activity or the presence of animals.

Contaminants that may be present in water include:

- **Microbial contaminants:** bacteria and viruses, which may come from sewage, livestock operations, and wildlife.
- **Inorganic chemical contaminants:** dissolved salts and metals, which can occur naturally or result from: storm-water runoff, industrial or domestic wastewater discharges, oil and gas production, mining, and/or farming.
- **Pesticides & herbicides:** substances for eliminating problem insects and plants, respectively; may come from a variety of sources, such as agricultural operations, storm-water runoff, and/or residential uses.
- **Organic chemical contaminants:** natural and synthetic compounds, including what are called volatile organic compounds (VOCs); these chemicals are by-products of industrial processes and petroleum production, and can also come from gas stations, storm-water runoff, and septic systems.
- **Radioactive contaminants:** can be naturally-occurring, or from oil and gas production, mining activities, nuclear facilities, etc.

As a result, water from any source is often "finished," or treated to remove substances or reduce their concentration, before that water is fit for human consumption (see "How Does BNL Supply Its Drinking Water?" on page 1). Regardless, drinking water, including bottled water, may reasonably be expected to contain at least small amounts of contaminants. The presence of contaminants, however, does not necessarily indicate that the water poses a health risk.

Some people may be more vulnerable to disease-causing microorganisms or pathogens in drinking water than others. People whose immune systems are compromised may be particularly at risk of infections. Those people include: cancer patients who are undergoing chemotherapy, people who have undergone organ transplants, persons with HIV/AIDS or other immune system disorders, and some elderly people and infants.

These people should seek advice from their health-care providers about drinking water. Guidelines from the EPA and the U.S. Centers for Disease Control on ways to lessen the risk of infection by cryptosporidium, giardia, and other microbial pathogens is available from the EPA's Safe Drinking Water Hotline, (800) 426-4791.

More information about drinking-water contaminants, potential health effects, etc. can be obtained from the EPA at www.epa.gov/safewater on the World Wide Web; or from the NYSDHS at www.health.state.ny.us.

Analytical Data
Organic Compounds, Micro-Extractables

With one exception noted below and discussed (table, right), the following were not detected (ND) in the finished water distributed from the Water Treatment Facility, or in carbon-filtered water drawn from BNL wells number 10, 11 and 12.

compound	level	µg/l
Dichlorodifluoromethane	ND	5
Chloromethane	ND	5
Vinyl Chloride	ND	2
Bromomethane	ND	5
Chloroethane	ND	5
Fluorotrichloromethane	ND	5
1,1-dichloroethene	ND	5
Dichloromethane	ND	5
trans-1,2-dichloroethene	ND	5
1,1-dichloroethane	ND	5
cis-1,2-dichloroethene	ND	5
2,2-dichloropropane	ND	5
Bromochloromethane	ND	5
1,1,1-trichloroethane	0.5	5
Carbon Tetrachloride	ND	5
1,1-dichloropropene	ND	5
1,2-dichloroethane	ND	5
1,1,2-trichloroethane	ND	5
1,2-dichloropropane	ND	5
Dibromomethane	ND	5
trans-1,3-dichloropropene	ND	5
cis-1,3-dichloropropene	ND	5
1,1,2-trichloroethane	ND	5
Trihalomethanes	ND	100
1,1,2,2-tetrachloroethane	ND	5
1,3-dichloropropane	ND	5
Chlorobenzene	ND	5
1,1,1,2-tetrachloroethane	ND	5
Bromobenzene	ND	5
1,1,2,2-tetrachloroethane	ND	5
1,2,3-trichloropropane	ND	5
2-chlorotoluene	ND	5
4-chlorotoluene	ND	5
1,3-dichlorobenzene	ND	5
1,4-dichlorobenzene	ND	5
1,2-dichlorobenzene	ND	5
1,2,4-trichlorobenzene	ND	5
Hexachlorobutadiene	ND	5
1,2,3-trichlorobenzene	ND	5
Benzene	ND	5
Toluene	ND	5
Ethylbenzene	ND	5
m-xylene	ND	5
p-xylene	ND	5
o-xylene	ND	5
Styrene	ND	5
Isopropylbenzene	ND	5
n-propylbenzene	ND	5
1,3,5-trimethylbenzene	ND	5
tert-butylbenzene	ND	5
1,2,4-trimethylbenzene	ND	5
sec-butylbenzene	ND	5
p-isopropyltoluene	ND	5
n-butylbenzene	ND	5
methyl tert. butylether	ND	50

The Nine Compounds Detected In BNL's Drinking Water in 1999

Inorganic contaminants regulated in the drinking-water distribution system

substance	MCLG	MCL	BNL water
• **nitrates**	10 mg/l	100 mg/l	0.25-0.59 mg/l

major sources in drinking water: Runoff from fertilizer use; leaching from septic tanks, and/or sewage; erosion of natural deposits.

possible health effects: Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, then may die. Symptoms include shortness of breath and blue baby syndrome.

Organic contaminants regulated in the drinking-water distribution system

substance	MCLG	MCL	BNL water
• **1,1 trichloroethane**			
U.S. EPA	200 µg/l	200 µg/l	0.5 µg/l
NYSDOH	5 µg/l	5 µg/l	0.5 µg/l

major sources in drinking water: Discharge from metal degreasing sites and other factories.

possible health effects: Some people who drink water containing 1,1,1 trichloroethane in excess of the MCL over many years could experience problems with their liver, nervous system, or circulatory system.

Radioactive contaminants

substance	MCLG	MCL	BNL water
• **beta/photon emitters**	0 pCi/l	50* pCi/l	2.6-7.9 pCi/l

major sources in drinking water: Decay of natural and man-made deposits.

possible health effects: Certain minerals are radioactive and may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta and photon emitters in excess of the MCL over many years may have an increased risk of getting cancer.

**Note: The U.S. EPA and New York State consider 50 pCi/l to be of concern for beta particles.*

Unregulated contaminants

substance	MCLG	MCL	BNL water
• **chlorides**	—	250 mg/l	12.6-21.4 mg/l

major sources in drinking water: Naturally occurring or indicative of road-salt contamination.

possible health effects: No health effects. The MCL for chloride is the level above which the taste of water may become objectionable. In addition to the adverse taste effects, high chloride concentrations in water contribute to the deterioration of domestic plumbing and water heaters. Elevated chloride concentrations may also be associated with the presence of sodium in drinking water.

substance	MCLG	MCL	BNL water
• **iron**	—	300 µg/l	30-50 µg/l

major sources in drinking water: Naturally occurring.

possible health effects: Iron has no health effects. When iron reaches 1,000 µg/l, a substantial number of people will notice the bitter astringent taste of iron. At this concentration, it also imparts a brownish color to laundered clothing and stains plumbing fixtures with a characteristic rust color. Staining can result at levels of 50 µg/l, which is lower than those detectable to taste buds. Therefore, MCL of 300 µg/l represents a reasonable compromise, as, at this level, adverse aesthetic effects are minimized. Many multivitamins contain 3,000-4,000 µg/l of iron per capsule.

substance	MCLG	MCL	BNL water
• **sodium**	—	—	9.6-14.0 mg/l

major sources in drinking water: Naturally occurring, or due to road salt, water softeners, and/or animal waste.

possible health effects: Water containing more than 20 mg/l of sodium should not be used for drinking by people on severely restricted sodium diets. Water containing more than 270 mg/l of sodium should not be used for drinking by people on moderately restricted sodium diets.

substance	MCLG	MCL	BNL water
• **sulfates**	—	250 mg/l	7.8-13.0 mg/l

major sources in drinking water: Naturally occurring.

possible health effects: High concentrations of sulfate in drinking water can have three effects: first, water containing appreciable amounts of sulfate tends to form hard scales in boilers and heat exchangers; second, sulfates affect the taste of water; and, third, sulfates can act as a laxative if intake is excessive. The laxative effect of sulfates is usually observed in transient users of a water supply, as people who are accustomed to high sulfate levels in drinking water do not respond adversely. Diarrhea may result from sulfate levels greater than 500 mg/l, but, typically, from levels nearer 750 mg/l.

*Contaminants regulated at the drinking-water consumers' tap***

substance	MCLG	at 90th percentile	# BNL samples exceeding AL	value at 90th percentile
• **copper**	0 mg/l	1.3 mg/l	0 out of 20	0.05 mg/l

major sources in drinking water: Corrosion of household plumbing.

possible health effects: Copper is an essential nutrient, but some people who drink water containing it in excess of the action level over a relatively short time could experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level (AL) over many years could suffer liver or kidney damage. People with Wilson's disease should consult their personal physician.

substance	MCLG	at 90th percentile	# BNL samples exceeding AL	value at 90th percentile
• **lead**	0 µg/l	15 µg/l	0 out of 20	1.8 µg/l

major sources in drinking water: Corrosion of household plumbing.

possible health effects: Infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development. Children could show slight defects in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure.

***Note: Sampling was done in 1997 and will be repeated in July 2000.*

Definitions of Terms

- **Maximum contaminant level (MCL)**: The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to what is called the maximum contamination level goal (MCLG) as possible.
- **Maximum contamination level goal (MCLG):** The level of a contaminant in drinking water below which there is no known or expected risk of health. MCLGs allow for a margin of safety.
- **Treatment technique:** A required process intended to reduce the level of a contaminant in drinking water.
- **Action level (AL):** The concentration of a contaminant which, if exceeded, then triggers treatment or other requirements that a drinking-water supplier must follow.
- **Milligrams per liter (mg/l):** Equals one part of liquid per million parts of liquid, or parts per million (ppm).
- **Micrograms per liter (µg/l):** Equals one part of liquid per billion parts of liquid, or parts per billion (ppb).
- **Picocuries per liter (pCi/L):** A measure of radioactivity in water.
- **Millirems per year (mrem/yr):** A measure of radiation absorbed by the body.
- **Million fibers per liter (MFL):** A measure of the presence of asbestos fibers longer than 10 micrometers.
- **Nephelometric turbidity unit (NTU):** A measure of the clarity of water. Turbidity in excess of 5 NTU is just noticeable to the average person.
- **90th percentile value:** A percentile is a value on a scale of 100 that indicates the percent of a distribution that is equal to or below it. The 90th percentile is equal to or greater than 90 percent of the lead and copper values detected at your water system. The values reported for copper and lead represent the 90th percentile.

Analytical Data
Inorganic Chemicals, Bacteria, Radiation

The following are the average values detected in the finished water distributed from the Water Treatment Facility or in carbon-filtered water drawn from BNL wells number 10, 11 and 12.

compound	average	standard
Water-Quality Indicators		
Tot. coliform	ND	ND
Color	< 5 units	15 units
Odor	0 units	3 units
Cyanide	<10 µg/l	NS
Conductivity	236 µmhos	NS
Chlorides	16.8 mg/l	250 mg/l
Sulfates	9.1 mg/l	250 mg/l
Nitrates	0.40 mg/l	10 mg/l
Ammonia	<0.02 mg/l	NS
pH	8.1-8.5 SU	NS
Methylene blue active substances	<0.04 mg/l	NS
Metals		
Antimony	<5.9 µg/l	6 µg/l
Arsenic	<3.0 µg/l	50 µg/l
Barium	<0.2 mg/l	2 mg/l
Beryllium	<3.0 µg/l	4 µg/l
Cadmium	<5.0 mg/l	5 mg/l
Chromium	<0.01 mg/l	0.1 mg/l
Fluoride	<0.1 mg/l	2.2 mg/l
Iron	0.03 mg/l	0.3 mg/l
Lead	<1.0 µg/l	15 µg/l
Manganese	<0.01 mg/l	0.3 mg/l
Mercury	<0.2 µg/l	2 µg/l
Nickel	<0.04 mg/l	0.1 mg/l
Selenium	<5.0 µg/l	50 µg/l
Sodium	10.7 mg/l	NS
Thallium	<1.9 µg/l	2 µg/l
Zinc	<0.02 mg/l	5 mg/l
Radioactivity		
Gross alpha	<0.86 pCi/l	15 pCi/l
beta	<3.27 pCi/l	50 pCi/l
tritium	<339 pCi/l	20,000 pCi/l
strontium-90	<2.12 pCi/l	8 pCi/l
Other		
Asbestos	< 0.42 M.fibers/l	7 M.fibers/l
Calcium	11.6 mg/l	NS
Alkalinity	60.3 mg/l	NS

<: less than the detection limit.
NS: drinking-water standard not specified.
ANR: analysis not required.
ND: not detected.
SU: standard units.