the Bulletin

BROOKHAVEN NATIONAL LABORATORY

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Bulletin Special Supplement

2001 BNL Water Quality Consumer Confidence Report

This special supplement to The Bulletin is Brookhaven National Laboratory's third annual Consumer Confidence Report, which provides an overview of the water quality during calendar year 2000. 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. 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 state standards. In addition, the report reminds water consumers of the importance and need to protect drinking-water sources.

Among its other responsibilities, BNL's Plant Engineering (PE) Division 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. 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 BNL's 2000 drinking-water samples, contact those below. This report is also available on the Web at www.bnl.gov/bulletin.

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How Does BNL Produce Its Drinking Water?

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 2000, BNL produced approximately 723 million gallons of potable water, which equals, on average, 60 million gallons per month or 1.98 million gallons per day. Due to demand, flow varies from 37 million gallons per month, which is 1.23 million gallons per day, to over 77 million gallons per month, or 2.6 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 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

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 time to react and form "floc." Flocculation is a process whereby 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:** stores filtered water before it is pumped into the aeration towers.
- **air-stripping 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 to 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.

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.

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; 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; the bowl is 75.5 feet in diameter.

Water-Distribution Piping

The site has about 45 miles of drinking-water distribution pipe, which 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 by the DOE's Brookhaven Group in Bldg. 464, BNL's water system serves a population of approximately 3,500 people and is identified as federal public water system no. 5111891.

facility	capacity English	capacity metric
• Water Treatment Facility	6,000,000 gal./day	22,710,000 l/day
• Each of the six wells	1,000 gal./min.	76 l/sec.
• 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 gal./min	63 l/sec.
• Air stripping using 2 packed towers —		
• water flow	2,400 gal./min.	151 l/sec.
• air flow	11,250 scfm	5.309 m³/sec.
• Clear well	250,000 gal.	947,500 l
• Distribution system	45 mi.	72 km
• Pressure	55 to 70 psi	379 to 483 kPa

2001 BNL Water Quality Report

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

Last year, as in the past, BNL's drinking water was in full compliance with all county, state and federal regulations.

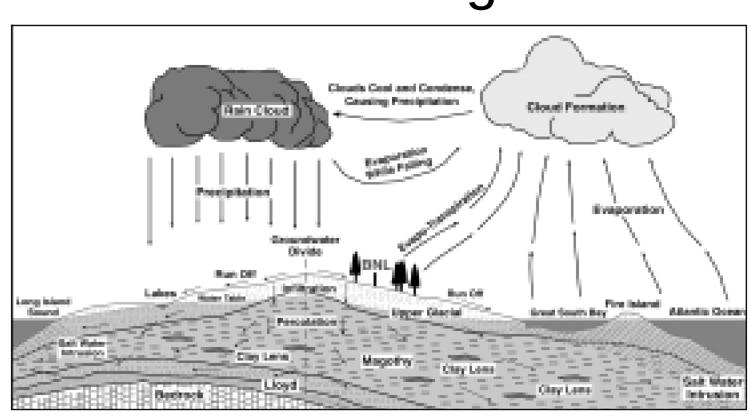
In fact, the Lab's Plant Engineering (PE) Division, which is responsible for the Lab's drinking water, is proud to report that BNL's water system has not violated a maximum contaminant level or any other water-quality standard.

To ensure that tap water is safe to drink, the EPA and the New York State Department of Health (NYSDOH) 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 regulated MCLs were reached or exceeded by BNL's drinking water in 2000, and there were no violations of any government regulations. Of the more than 80 drinking water contaminants for which testing is required, only the ten compounds listed in the table (see page 2) were detected in the Lab's drinking water in 2000.

What Is the Source Of BNL's Drinking Water?



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 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 (see graphic above), 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.

Understanding the Contents of Your Drinking Water

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. 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 run-off, and/or residential uses.
- **Organic chemical contaminants:** natural and synthetic compounds, including 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.

Because of the presence of contaminants, source water 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 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.

Guidelines from the U.S. Environmental Protection Agency (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, etc. can be obtained on the World Wide Web from the EPA at www.epa.gov/safewater; or from the NYSDHS at www.health.state.ny.us.

Why Are Some BNL Water Fountains Out of Service? Why Is Bottled Water Provided in Some Work Areas?

Some drinking-water fountains on site have been taken out of service and remain out of commission due to the fact that the water that comes out of the spout exceeds the drinking-water standard for the element lead. But this is *not* because the Lab's drinking water from the source or the Water Treatment Facility contains excessive amounts of lead. In fact, the Lab's drinking water on average contains less than 1.8 micrograms per liter of lead. As set by the U.S. Environmental Protection Agency (EPA), the maximum contaminant level (MCL) for lead is 15 micrograms per liter.

The water from the now out-of-service fountains exceeds this standard is because solder containing lead was used to join copper plumbing piping, such as the cooling-coil piping within drinking-water fountains. The use of lead solder was common worldwide, but was banned in the U.S. in 1986 by the EPA. Since that time, lead-free solder has been used at BNL. In those work areas where water fountains have been taken out of service and in work areas that have no plumbing installed, bottled water is provided.

Ten Compounds Detected in BNL's Drinking Water

Inorganic contaminants regulated in the drinking-water distribution system —

substance	*MCLG*	*MCL*	*BNL max.*
• **BARIUM**	2.0 mg/l	2.0 mg/l	0.02 mg/l

detection date: July 2000.
major sources in drinking water: Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits.
possible health effects: Some people who drink water containing barium in excess of the MCL over many years could experience and increase in blood pressure.

substance	*MCLG*	*MCL*	*BNL max.*
• **NITRATES**	10 mg/l	100 mg/l	0.6 mg/l

detection date: January 2000.
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, may die. Symptoms include shortness of breath and blue baby syndrome.

Organic contaminants regulated in the drinking-water distribution system —

substance	*MCLG*	*MCL*	*BNL max.*
• **1,1,1-TRICHLOROETHANE**			
U.S. EPA standard	200 µg/l	200 µg/l	0.5 µg/l
NYSDOH standard	5 µg/l	5 µg/l	0.5 µg/l

detection date: January and October 2000.
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 max.*
• **BETA/PHOTON EMITTERS**	0 pCi/l	50* pCi/l	5.2 pCi/l

detection date: January and October 2000.
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 max.*
• **CHLORIDES**	—	250 mg/l	23.2 mg/l

detection date: January and July 2000.
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 max.*
• **IRON**	—	0.3 mg/l	0.35 µg/l

detection date: January and July 2000.
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 mg of iron per capsule.

substance	*MCLG*	*MCL*	*BNL max.*
• **SODIUM**	—	—	32 mg/l

detection date: January and July 2000.
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	11.6 mg/l

detection date: January and July 2000.
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 consumers' tap** —

substance	*MCLG*	*AL at 90th percentile*	*# BNL samples exceeding AL*	*value at 90th percentile*
• **COPPER**	1.3 mg/l	1.3 mg/l	0 out of 20	0.073 mg/l

detection date: July 2000.
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*	*AL at 90th percentile*	*# BNL samples exceeding AL*	*value at 90th percentile*
• **LEAD**	0 µg/l	15 µg/l	2 out of 20	10.2 µg/l

detection date: July 2000.
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 2000 and will be repeated in July 2003.*

Analytical Data

Organic Compounds, Micro-Extractables

With one exception as noted and discussed (see table at 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	*BNL max.*	*MCL 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

ND: not detected.

Analytical Data

Inorganic Chemicals, Bacteria, Radiation

The following are the maximum values detected in BNL's finished water. Radioactivity data are from BNL potable-water well heads.

compound	*BNL max.*	*MCL*
Water-Quality Indicators		
tot. coliform	ND	ND
color	5 units	15 units
odor	0 units	0 units
cyanide	<10 µg/l	NS
conductivity	221 µmhos	NS
chlorides	23.2 mg/l	250 mg/l
sulfates	11.6 mg/l	250 mg/l
nitrates	0.6 mg/l	10 mg/l
nitrites	<0.1 mg/l	1.0 mg/l
ammonia	<0.1 mg/l	NS
pH	7.6 SU	NS
methylene blue active substances	<0.08 mg/l	NS
Metals		
antimony	<5.9 µg/l	6.0 µg/l
arsenic	<3.0 µg/l	50 µg/l
barium	0.02 mg/l	2.0 mg/l
beryllium	<3.0 µg/l	4.0 µg/l
cadmium	<5.0 µg/l	5.0 µg/l
chromium	0.002 mg/l	0.10 mg/l
fluoride	<0.1 mg/l	2.2 mg/l
iron	0.35 mg/l	0.3 mg/l
lead	2.2 µg/l	15 µg/l
manganese	0.2 mg/l	0.3 mg/l
mercury	<0.2 µg/l	2.0 µg/l
nickel	0.004 mg/l	0.1 mg/l
selenium	<5.0 µg/l	50 µg/l
silver	<1.0 µg/l	100 µg/l
sodium	32 mg/l	NS
thallium	<1.9 µg/l	2.0 µg/l
zinc	0.03 mg/l	5.0 mg/l
Other		
asbestos	< 0.70 MFL	7 MFL
calcium	10.5 mg/l	NS
alkalinity	60.4 mg/l	NS
Radioactivity		
gross alpha	1.3 pCi/l	15 pCi/l
beta	13.1 pCi/l	50 pCi/l
tritium	<353 pCi/l	20,000 pCi/l
strontium-90	<0.7 pCi/l	8 pCi/l

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

Term Definitions

- **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. Reported copper and lead values represent the 90th percentile.

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