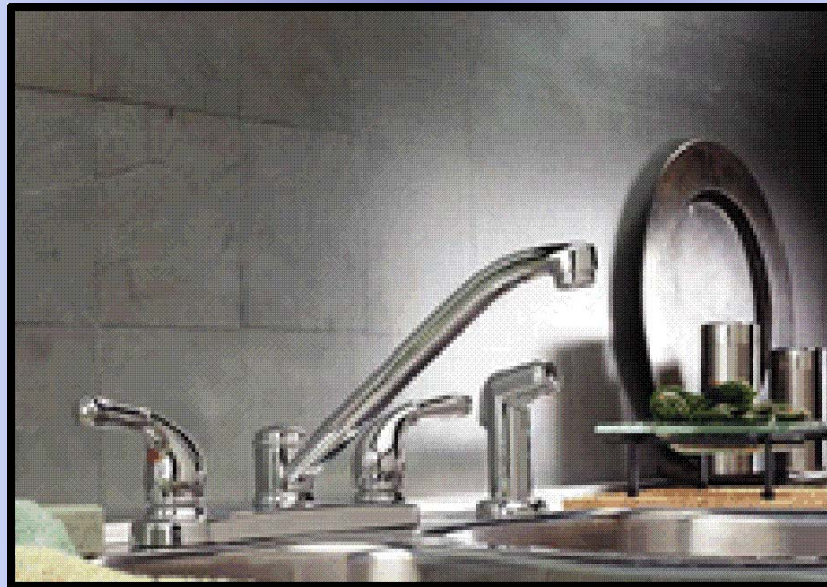


BACTERIOLOGICAL MONITORING



**Of the Public Water Supplies
of Newfoundland and Labrador**



PRESENTED BY

Roger Ledrew, Regional Director

Terry Battcock, Environmental Health Coordinator

AGENDA for Roger

- **Water Testing: Who are Involved?**
- **Sampling Frequency**
- **Sources of Contamination**
- **Potential for Contamination**
- **Microbiological Guidelines for Drinking Water**
- **Disinfection of Drinking Water**
- **Walkerton Statistics and Reaction**

THOSE INVOLVED

- **Communities**
- **Department of Health and Community Services, Public Health Laboratory Division**
- **Department of Government Services and Lands**
- **Regional Health and Community Services Boards**
- **Other Departments (e.g. Department of Environment and the Department of Municipal & Provincial Affairs)**

Who Collects the Samples and Monitors the Quality

- **36 Public Health Inspectors (EHO's) with the Dept. of Government Services and Lands**
 - **some municipalities (e.g. St. John's, Mount Pearl)**
 - **5 Regions and 15 Offices**
 - **Responsible for Bacteriological Water Quality Monitoring**
- **Linkage with the Medical Officer of Health**

Who Monitors Water Quality?

GSC Regional and Satellite Offices

Happy Valley - Goose Bay

Corner Brook

- Rocky Harbour
- Stephenville
- Port aux Basques
- St. Anthony

St. John's

- Harbour Grace

Gander

- Grand Falls - Windsor
- Lewisporte
- Springdale

Clareville

- Grand Bank
- Marystown

Sampling Frequency

Sampling frequency depends on:

- **Quality and number of water sources**
- **History of unsatisfactory samples**
- **Method of disinfection and adequacy of treatment**
- **Size and complexity of the distribution system**
- **Size of the population served**

*www.fedpubs.com/subject/health/drinkwater.htm

How Often Are Samples Collected?

- Samples are collected monthly. The provincial sample frequency standard is based on the *Guidelines for Canadian Drinking Water Quality*, 6th Edition. Chlorine residual testing is done in conjunction with sample collection.

Population Served

No distribution system or very small system serving less than 100 people

< 5,000

5000 - 90,000

> 90,000

of Samples per month

1 sample/month

4 samples/month

1 per 1000/month

90 + 1/ 10,000/month

* (2 x 2)

<http://www.gov.nf.ca/env/Env/waterres/Policies/PolicyList.asp>

Source of Drinking Water Contamination

Surface water:

- Source of most drinking water
- Constantly under threat from environmental contamination (e.g. runoff)
- Requires treatment prior to consumption

Groundwater:

- Tends to be purer, lesser potential for surface contamination
- Lesser need for treatment
- Subject to natural contamination
- Contamination longer lasting and more difficult to correct

Distribution System Contamination

- **Sewage leaks or improper connections**
- **Growth of microbes within the distribution system**
- **Accumulation of disinfection by-products**

Reasons for Disinfection Application

- **Assume water source contains pathogens**
- **Unacceptable microbiological quality (based on local conditions and experience)**

Potential for Microbiological Contamination

- **Significant source water quality deterioration (e.g., flooding, Badger disaster)**
- **Inadequate disinfection or disinfection residuals**
- **Unacceptable turbidities or particle counts (based on local conditions and experience)**

Microbiological Guidelines for Drinking Water

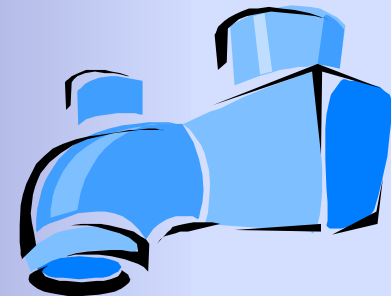
- **Need to control the presence of microbial pathogens**
- **Water-borne infectious diseases cause GI symptoms**
- **Generally non-life threatening in healthy adults. Infants, the elderly and immunosuppressed at increased risk**

Microbiological Guidelines for Drinking Water (con't.)

- **Not practical or technically feasible to monitor for all microbial pathogens**
- **Microbiological safety of water and guidelines are based on indicator organisms and effective treatment**

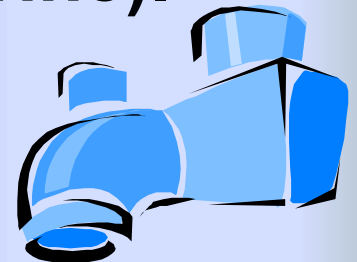
Disinfection of Drinking Water

- Water from public drinking water sources should be disinfected.
- Includes sources such as rivers, ponds, streams, lakes and groundwater wells.
- Most common method of disinfection is chlorination.



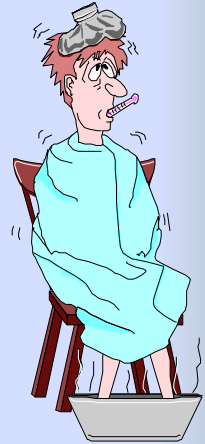
Disinfection of Drinking Water (cont.)

- **Disinfection will kill/destroy/inactivate many of the disease causing micro-organisms in water sources.**
- **Provide protection in the piping system should there be a leak, cross contamination, etc... (residual chlorine).**

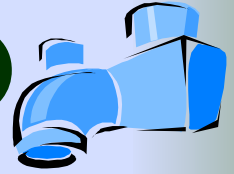


Microbial Contamination

- **Examples of Disease Causing Microorganisms Include:**
 - Giardia
 - Campylobacter
 - Enterohemorrhagic E. coli (e.g., E. coli O157:H7)
- **Examples of symptoms include:**
 - diarrhea, bloody diarrhea, vomiting, stomach cramps, chills
 - more severe symptoms(or illnesses) may develop such as kidney problems (e.g., HUS)
- **Most at Risk: Young, Elderly and Sick People.**



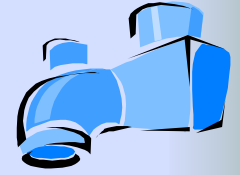
WALKERTON, ONTARIO



- **1346 reported cases of gastroenteritis with exposure to Walkerton water.**
- **Estimated that # of cases actually 2300**
- **65 people admitted to hospital**
 - **most were under the age of nine (55%)**
- **27 developed HUS**
 - **majority were between 1-4 years old (52%)**



Walkerton, Ontario (cont.)



- 7 people died, 5 with HUS
- organisms involved
 - E. coli O157:H7, Campylobacter

From The Investigative Report of the Walkerton Outbreak of Waterborne Gastroenteritis, October 10, 2000, Bruce-Grey-Owen Sound Health Unit

Post - Walkerton Reaction

- **Review of drinking water issues**
- **Introduction of New Standards**
- **Increased bacteriological monitoring & new bacteriological test methods**
- **Chemical water quality testing**
- **Increased funding for disinfection**

AGENDA for Terry

- **Pathogens Involved**
- **Provincial Disinfection Standards**
- **Monitoring Bacteriological Quality**
- **Indicator Organisms**
- **Drinking Water Testing Methods**
- **Provincial Bacteriological Standards**
- **Boil Water Advisories – What? Why? When?**
- **BWA - Application and Procedures**
- **Expectations for the Future**
- **Ensuring Accuracy**

Key Microbial Contaminants in Drinking Water

<u>Bacteria</u>	<u>Viruses</u>	<u>Enteric Protozoa</u>
<i>Shigella</i> spp.	Norwalk-like virus	Giardia lamblia
Campylobacter spp.	Rotavirus	Cryptosporidium parvum
E.coli 0157:H7	Caliciviruses	Microsporidium
Mycobacterium avium complex	Adenoviruses	
Legionella pneumophila	Hepatitis A	

Waterborne Enteric Infections

Contamination from human/animal wastes

- **Salmonella**
- **Shigella**
- **E. coli**
- **Campylobacter**
- **Hepatitis A**
- **Enteroviruses**
- **Norwalk virus**
- **Giardia**
- **Cryptosporidium**

Waterborne Non-Enteric Infections

Organisms indigenous to the environment

- **Pseudomonas**
- **Staphylococci**
- **Legionella**
- **Mycobacterium**
- **Vibrio**

Waterborne Parasitic Infections

GIARDIA

CRYPTOSPOIDICUM

CYCLOSPORA

- **Common in communities which use unfiltered surface water**
- **Cysts are highly resistant to disinfection**
- **Testing methodologies are cumbersome, costly, inconsistent and lack specificity and sensitivity**

Provincial Disinfection Standards

- **Continuous Disinfection** is required for community and public facility water systems.

Provincial Disinfection Standards

- Chlorine is the most common chemical used for disinfection, and, where used:
 1. All water entering the disinfection system or public facility, after a minimum 20 minute contact time, shall contain a residual disinfectant concentration of free chlorine of at least 0.3 mg/L, or equivalent CT value;
 2. A detectable free chlorine residual must be maintained in all areas in the distribution system.

Provincial Disinfection Standards (cont.)

- Water systems which are primarily disinfected by means other than chlorination, must be provided with a sufficient disinfectant as determined to be appropriate for that system.

Monitoring the Bacteriological Quality of Water

- **The necessity of using indicator organisms...**
 - **Not practical or technically feasible to monitor for all pathogens.**
- **Monitoring is one part of a multi-stage process to ensure the safety of drinking water (others are: source protection, treatment, training, etc..)**

Indicator Organisms for Bacteriological Quality

Total coliforms - Present in human and animal wastes, in soil and on vegetation.

- indicates re-growth or infiltration in the distribution system
- indicates potential for fecal contamination
- indicates treatment efficacy
- principle indicator of suitability of water for domestic and industrial purposes
- density of coliforms indicate the degree of pollution
- potentially unsafe for drinking

Indicator Organisms for Bacteriological Quality

Fecal coliforms - present in human and animal waste.

- indicates fecal/sewage contamination
- E. coli is the definitive indicator of fecal contamination
- high risk, should not be consumed without treatment
- definitive indicator of pathogens

Bacteriological Water Quality Testing Methods

- Two new test methods introduced in December/2000.
- Testing:
 - Newfoundland Public Health Laboratory
 - regional laboratory sites
 - Government Service Centre

Regional Testing Sites

- Corner Brook
- Gander
- Grand Falls – Windsor
- Goose Bay – Happy Valley
- Clarenville

Bacteriological Water Quality Testing Methods

Colilert:

- **Qualitative presence-absence test**
- **Simultaneous detection of total coliforms and E. coli**
- **Yellow color – total coliform**
- **Fluorescence – E. coli**
- **35°C incubation period for 24 hours**

Bacteriological Water Quality Testing Methods

Coliblue:

- Quantitative membrane filtration method
- Simultaneous detection of coliforms and *E. coli* with enzymatic chromogenic indicators
- **Red colonies - Coliforms**
- **Blue colonies - *E. coli***

Provincial Bacteriological Standard

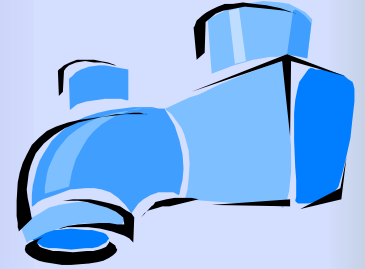
- **Total coliform bacteria and *E. coli* are used as indicators of the microbiological quality (& safety) of drinking water.**
- **Results are compared to a provincial standard.**
 - **Based on the *Guidelines for Canadian Drinking Water Quality***

Provincial Bacteriological Standard

- **No sample should contain *E. coli*.**
- **No consecutive sample from the same site should contain total coliforms.**
- **Not more than 10% of samples from a set of samples should show the presence of total coliforms.**

**UNSATISFACTORY
SAMPLE RESULTS WILL
MOST LIKELY
LEAD TO A
BOIL WATER ADVISORY**

What is a Boil Water Advisory?

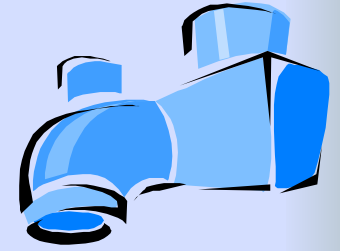


Based on the recommendation of Environmental Health Officer (EHO) with the GSC.

- Bacteriological analysis (e.g., total coliform)
- Chlorine residuals

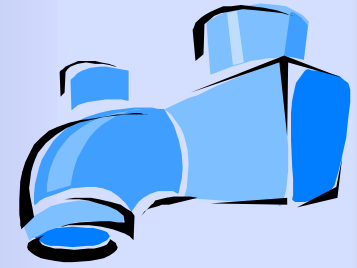
...The owner/operator (e.g., community council office) is advised to immediately implement a Boil Water Advisory.

What is a Boil Water Advisory?



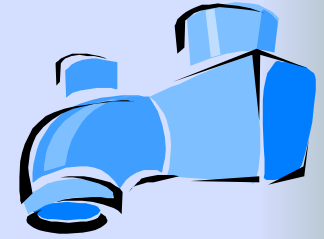
Recommendation/warning by the water system owner/operator to water consumers that they should not consume water without boiling the water first.

Why are Boil Water Advisories Necessary?



- Disease causing microorganisms can enter a water system from:
 - **SOURCE WATER** (e.g., lake, stream, pond, well)
 - **THE DISTRIBUTION SYSTEM** (e.g., cross connection, leaks, etc.)
- These organisms can cause gastrointestinal illnesses and more severe illnesses.

When are Boil Water Advisories Necessary?



- There is indication that drinking water is not microbiologically safe.
- The drinking water is not adequately disinfected (e.g., chlorinated).

Basic and Necessary Precautions

- **Bring drinking water to a rolling boil (100⁰C) for at least 1 minute.**
 - **Drinking**
 - **Cooking**
 - **Brushing Teeth**
 - **Washing Vegetables & Fruit**
 - **Making ice, coffee, tea, juices and other drinks from concentrate or powders**
 - **Making infant formula and cereal**

Reasons for Issuing a BWA

- Water supply has no disinfection system.
- Chlorination system is turned off by operator, due to taste.
- Chlorination system is turned off by operator, due to perceived health risks.
- Chlorination system is turned off by operator, due to lack of funds to operate.

Reasons for Issuing a BWA (cont.)

- Disinfection system is off due to maintenance or mechanical failure.
- Disinfection system is off due to lack of chlorine or other disinfectant.
- Water distribution system is undergoing maintenance or repairs.
- A cross connection is discovered in the distribution system.

Reasons for BWA (cont.)

- Inadequately treated water was introduced into the system due to fireflows, flushing operations, minor power outage or other pressure loss.
- Water entering the distribution system or facility, after a minimum 20 minute contact time does not have a free chlorine residual of at least 0.3 mg/l or equivalent CT value.

Reasons for BWA (cont.)

- No free chlorine residual detected in the water distribution system.
- Insufficient residual disinfectant in water system disinfected by means other than chlorination.
- Total coliform or *Escherichia coli* (E.coli) detected AND repeat samples cannot be taken as required.

Reasons for BWA (cont.)

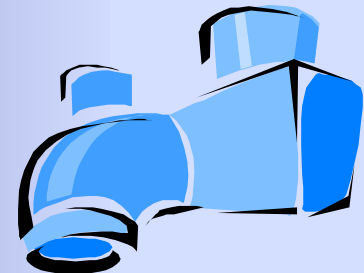
- Total coliforms detected and confirmed in repeat sample.
- *Escherichia coli* (E. coli) detected in an initial sample(s) is considered extensive and the water system has other problems.
- *Escherichia coli* (E.coli) detected and confirmed in repeat sample.
- Viruses detected (e.g., Hepatitis A, Norwalk).
- Protozoa detected (e.g., Giardia, Cryptosporidium).

BOIL WATER ADVISORIES

Other Reasons for Implementing

- Evidence of waterborne disease outbreak in the community through surveillance.
- Water supply system integrity compromised due to disaster (e.g. contamination of water source from flooding, gross contamination from sewage or agricultural waste, major power failure, etc.).

- **REMEMBER WALKERTON**



Application of a Boil Water Advisory (*E. coli*)

- If the bacteriological test reveals the presence of *E. coli*, re-sampling of the site, as well as up and downstream locations, should be carried out by the EHO within 24 hours.
- However, a BWA may be recommended before the re-sampling results are known depending upon the extent of the *E. coli* contamination in the initial testing, combined with knowledge of other problems pertaining to the system.
- Regardless, if the repeat test reveals presence of *E. coli*, a BWA is recommended.

Application of a Boil Water Advisory (Total Coliforms)

- If the bacteriological test reveals the presence of total coliforms, but no *E.coli*, resampling of the site, as well as up and downstream locations, should be carried out by the EHO as soon as practically possible.
- If the consecutive test confirms the presence of total coliforms, but no *E.coli*, a BWA is recommended for water systems that have only disinfection, but no additional water treatment.
- Regardless, remedial action shall commence in consultation with the water system operator.

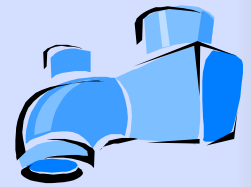
Application of a Boil Water Advisory

- If repeat samples cannot be taken as per the last two slides, a BWA is recommended.
- BWA may be rescinded upon correction of the condition(s) which led to the BWA. At least two consecutive sets of samples must meet the bacteriological and disinfection standards.

BOIL WATER ADVISORIES

Procedures to Issue Advisory

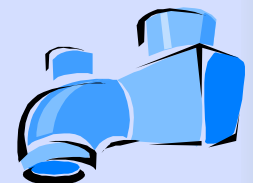
- Environmental Health Officer (EHO) Notifies Operator (e.g., municipal council) by phone.
 - Provides direction for operator
- Follow-up with letter.



BOIL WATER ADVISORIES

Community's Role

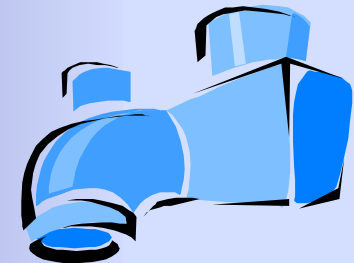
- Once evidence is available that makes a BWA necessary, (e.g., notified by GSC) it is paramount that the message to boil drinking water gets to consumers.



BOIL WATER ADVISORIES

Community's Role -Notification

- Post warning boil water notices.
- Broadcast/print advisory on/in local media.
 - Radio & Television
- Place boil water notice in all mail boxes.
- Phone schools, health care facilities, personal care homes, etc...
- Do this on a regular basis.



WARNING!

Do Not Drink This Water



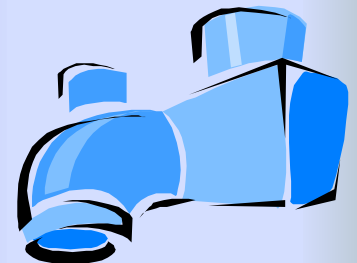
GOVERNMENT OF
NEWFOUNDLAND AND LABRADOR

Department of Health and Community Services

BOIL WATER ADVISORIES

Procedures to Remove BWA

- 2 consecutive sample sets are negative for total (fecal) coliform organisms.
- the cause of the problem has been remedied (examples):
 - disinfection (chlorination) resumed
 - residuals in the distribution system.

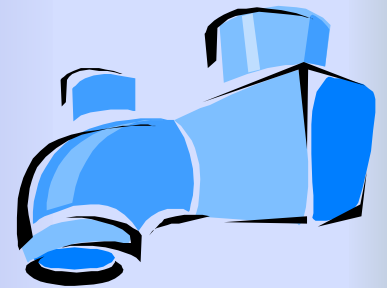


BOIL WATER ADVISORIES

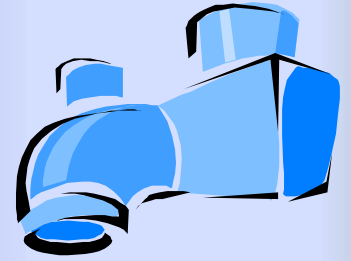
Procedures to Remove BWA

Where a disease has occurred, the outbreak is over and there is no further incidence linked to water system.

Work with officials of the Government Service Centre, Regional Health and Community Services Board, Depts of Environment and Municipal and Provincial Affairs to ensure that drinking water is properly disinfected.



Why are Boil Water Advisories Necessary?



**Prevent waterborne
Communicable Disease Outbreaks
(or to limit an outbreak that
has already begun)**

Expectations for the Immediate Future

- A minimum of two daily chlorine test done on a water supply by maintenance personnel
- Reliable chlorine testing equipment for the community maintenance personnel and the EHO's.
- Consistent readings for both parties (EHOs and Maintenance Personnel)
- A regular calibration of equipment (i.e., once per week) for both parties. (a policy for EHO's is to be drafted).

Ensuring Accuracy

Calibration of Chlorine Test Kits

- The need for a reliable standard (factory-made standards).
- Regular calibration of equipment (weekly basis)
- Consistent calibration methodology applied on equipment
- The same type/brand of chlorine test kit product should be used throughout the province to ensure that consistency is strengthened.

*Infectious diseases
caused by pathogenic
bacteria, viruses, and protozoa or
by parasites are the most common
and widespread health risk associated
with drinking-water.*

World Health Organization, Geneva, 1993