Safe Drinking-water Supplies

Risks and Responsibilities

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Three broad categories of drinking-water contaminants

Microbiological contaminants

Chemical contaminants

Physical contaminants

Four Broad Groups of Microbiological Contaminants

Bacteria

Viruses

Protozoa

Cyanobacteria

Gastro-enteric illness

Bacteria

- Small single celled organisms.
- Reproduce by binary fission
- Exponentially growth
- Some can be pathogens
- Animal or human faecal source.
- Usually cause an enteric disease.
- typhoid (*Salmonella typhi*)
- cholera (*vibrio cholera*)
- salmonella (various species)
- campylobacter (*Campylobacter jejuni*)

- Bacteria are destroyed by chlorine.

E. coli bacteria

- *Escherichia coli* or *E. coli*
- found in enormous numbers in the gut of mammals.
- *E. coli* are used as an indicator of faecal contamination of water.
- an **indicator organism**.
- testing for *E. coli* to demonstrate DWS compliance.

E. coli 0157:H7

- Produces a toxin which can cause kidney damage
- Was responsible for 7 deaths when the water supply at Walkerton, Ontario was contaminated in 2000

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Viruses

- Smaller than bacteria.
- Use a living cell to reproduce
- Hepatitis A
- Viruses are thought to be killed by chlorine

Protozoa

- Not considered to be a water contaminant 30 years ago.
- Key focus of drinking-water standards, particularly *Cryptosporidium.*
- In the environment they form a cyst or oocyst.
- Very resistant to chlorine.
- No medical treatment for Cryptosporidiosis
- Many deaths reported across the world associated with drinking water contaminated with protozoa.

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Cyanobacteria

- Emerging problem for drinking-water supplies.
- A kind of cross between bacteria and algae
- Blooms in a water column
- Mats on stones.
- Many different types.
- Some produce toxins and others do not.
- Release cyanotoxins when cells disrupted.
- Affect nervous system , the liver, or skin.

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Chemical contaminants

Four general groups.

- Naturally occurring chemicals.
- Chemical contaminants that are used in human activities.
- Chemicals that are added to water in the water treatment process.
- Chemicals, generally metals that can leach from plumbing or tap fittings.

Physical contaminants

- Particulates or organic material from the erosion of land or the decay of vegetation.
- When particulate material is at high levels in water, it is expected that microbiological contaminants will also be present.
- Particulate material in water is referred to as turbidity.
- Particles in water ‘use up’ chlorine and shield micro-organisms from treatment processes.

What could go wrong?

Milwaukee, Wisconsin

- March 1993
- 800,000 people on reticulated water supply
- Water taken from Lake Michigan
- Treatment plant failure
- Contamination of supply with *Cryptosporidium parvum*
- 400,000 cases ??
- 70 – 120 deaths

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What could go wrong?

Walkerton, Ontario, Canada

- May 2000
- 4,800 residents
- Contamination of source well, with bacterial pathogens from cattle manure (*E. coli* 0157)
- 2,300 Cases of illness
- 65 hospitalisations
- 27 developed HUS
- 7 deaths

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What could go wrong?

Walkerton, Ontario, Canada

Inquiry found these failures:

- Regulatory shortcomings
- Technology deficits
- Insufficient training and knowledge
- Privatisation of water testing
- Budget cuts to Ontario Ministry of the Environment
- Human negligence

What could go wrong?

Darfield, NZ

- August 2012
- 138 suspected cases of campylobacter
- A new deep groundwater source pump failed
- Supply was switched back to the previously used chlorinated shallow riverside bores
- Chlorination gas bottle was empty
- Chlorine empty alarm not wired into system

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Parts of the New Zealand drinking-water strategy

- Register of Community Drinking-water Supplies
- Public Health Grading of Drinking-water Supplies
- Priority 2 Programme
- Annual Review of Drinking-Water Quality in New Zealand
- WINZ Database
- Guidelines for Drinking-water Quality Management for New Zealand
- Drinking Water for New Zealand Web Page
- **Health (Drinking Water) Amendment Act**
- **Drinking Water Standards for New Zealand**
- Drinking Water Assistance Programme

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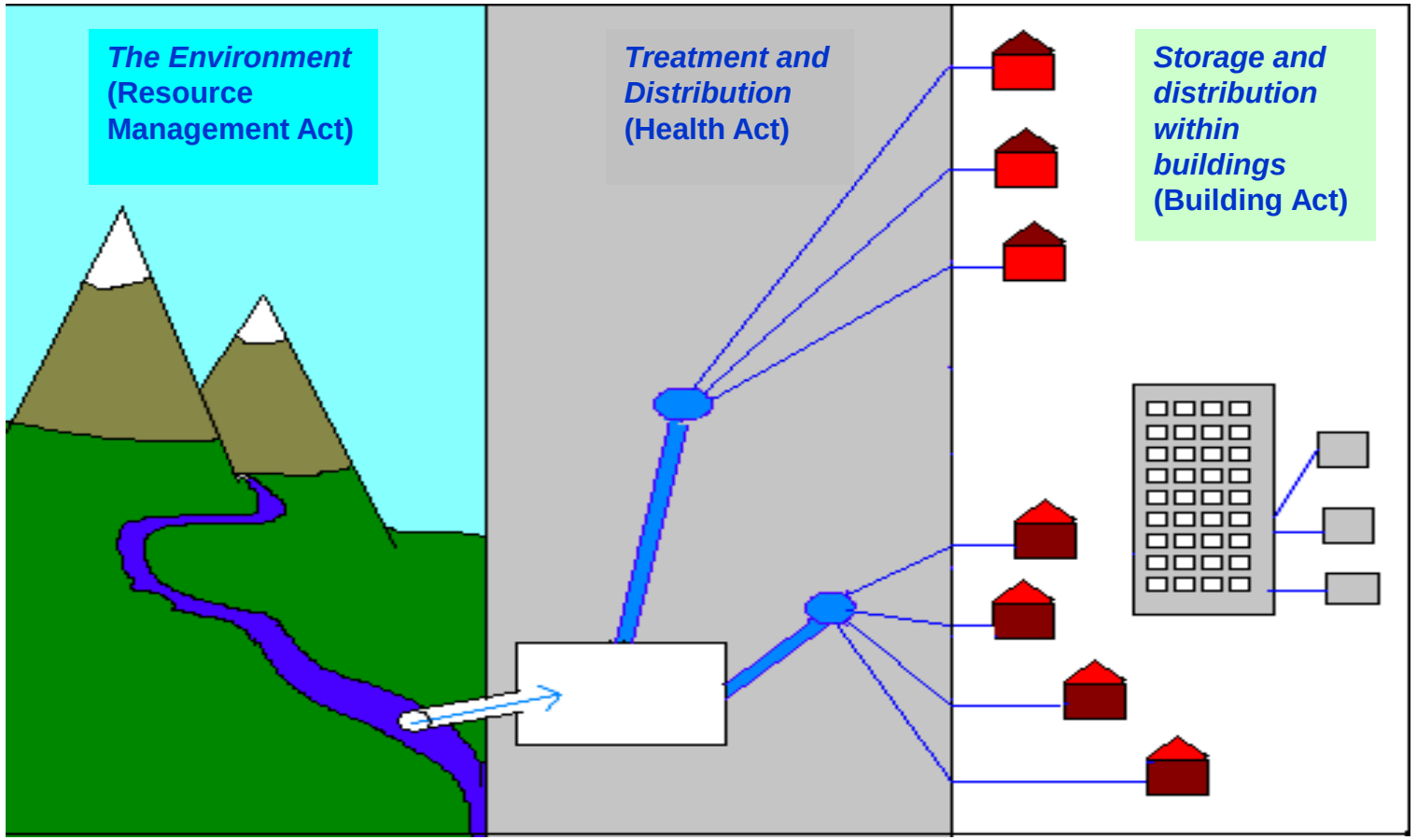
Health (Drinking Water) Amendment Act 2007



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What does the Act try to do?

"protect the health and safety of people and communities by promoting adequate supplies of safe and wholesome drinking water from all drinking water supplies"

Provides a legal framework for the regulation of drinking water quality in New Zealand.

How does the ACT do this?

- Defines things (Water supply, potable water, standards, DWA duties and powers)
- Places duties onto water suppliers
- All practicable steps, all reasonable steps

Water Supplier Responsibilities

- Supply adequate quantity of drinking-water to each point of supply (can be interrupted for repairs etc)
- May restrict supply (eg for unpaid accounts) but cannot remove supply
- Protect source water (ars)
- Comply with the Drinking-water Standards (aps)
- Monitor drinking-water
- Prepare and implement a Water Safety Plan

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Water Supplier Responsibilities

- Keep records and make them available
- Investigate complaints
- Take remedial action if standards breached
- Ensure risks of backflow are managed

The DWSNZ sections

1 Overview

2 Water Compliance Standards

3 Compliance and transgressions

4 **Bacterial** compliance criteria

5 **Protozoa** compliance criteria

6 **Viral** compliance criteria

7 **Cyanotoxin** compliance criteria

8 **Chemical** compliance criteria

9 **Radiological** compliance criteria

10 Small water supply compliance criteria

11 Tankered drinking water compliance criteria

12 Rural Agricultural drinking-water supplies

13 Compliance Criteria: Records

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Maximum Acceptable Values

MAVs

E. Coli – less than 1 per 100ml sample

Protozoa – less than 1 infectious (oo)cyst per 100 litre of sample

Boron 1.4mg/litre (excess lifetime cancer risk $1x10^{-6}$)

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Bacterial Compliance Criteria

E. coli **:**

- Used as an indicator organism for drinking-water contamination by faecal matter
- Must not be present in water leaving treatment plant, or in distribution zones
- If found, then an immediate response is required

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Bacterial Compliance Criteria

Coliform bacteria & *E. coli* rarely found in distribution system if free available chlorine (FAC) of 0.2 mg/l maintained.

- Supplies serving >500 may substitute FAC monitoring for some *E. coli* monitoring
- Full substitution OK for water leaving WTP and water in bulk distribution zone

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Bacterial Compliance Criteria

Separate criteria for……..

- Water leaving treatment plant
- Water in distribution zone
- Secure bore water

Secure Bore Water

4 Criteria

- Bore depth
- Residence time
- Sanitary borehead
- *E. coli* monitoring

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Protozoa Compliance Criteria

- Treatment plant only
- Based on probability that treatment process will have inactivated or removed the protozoa
- If the treatment process deals successfully with Cryptosporidium will deal successfully with any other protozoa

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Cyanobacteria Compliance Criteria

Cyanotoxins are chemical determinands but their monitoring requirements are different:

- Events relatively rare and monitoring is expensive
- DWSNZ compliance is achieved by the preparation and DWA approval of a management protocol

Water Safety Plans

What could go wrong?

What can be done to prevent it?

What needs to be checked?

What do you do if it does go wrong?

What needs to be fixed?

Write it all down

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