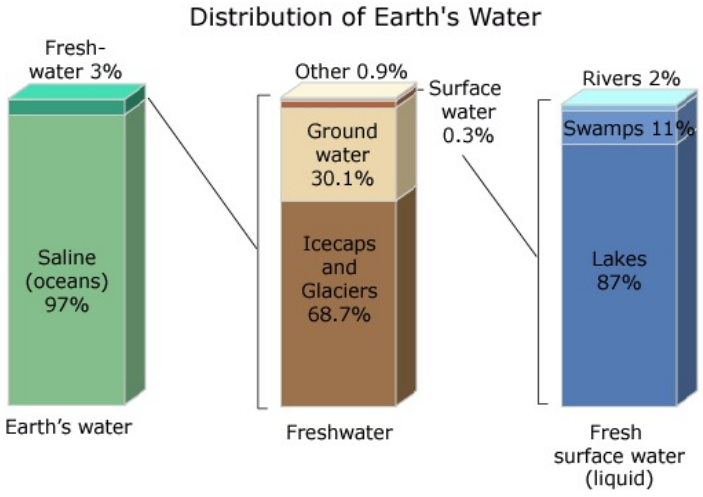
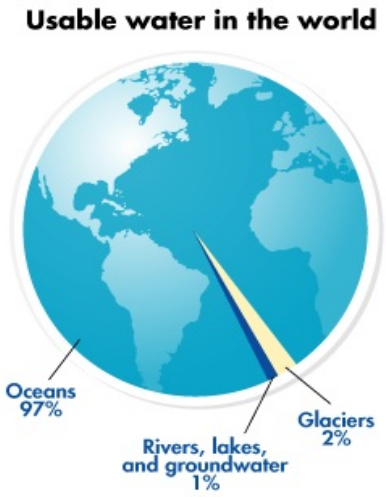
March 22 - World Water Day

Unit 4 : Water Use and the Environment

- Used for industry, recreation, survival, symbolic / ceremonial roles
- Historically shaped human settlement patterns
- Can dissolve more chemical substances than any other liquid....as it moves through organisms, the ground, the air (ppm definition....ex....”salt water”)
- A “finite” resource....WHAT DOES THIS MEAN ?
- The demand for water is at its highest yet..... growth of the human population, increasing agricultural and industrial uses.
- 1 in 6 humans don’t have safe clean drinking water
- Two biggest issues are water quantity and quality

YouTube : Water Facts
https://www.youtube.com/watch?v=laJYq_Mfk7Q



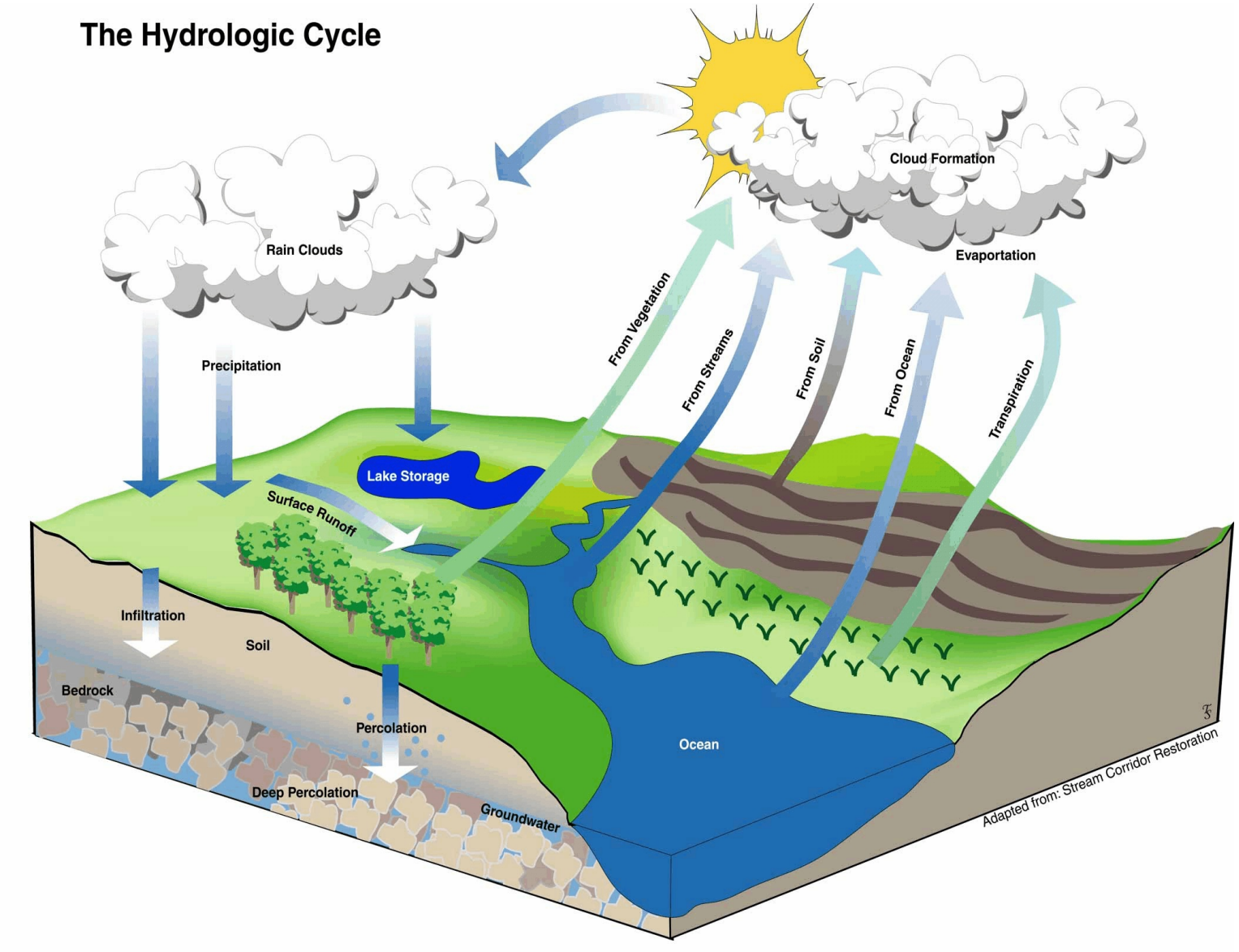


NL’s water covers about 8 % of our ground surface, we have a greater proportion of fresh water than most other Provinces.

NL is also the biggest per capita water users in the country. (Page 446-447)

The Water (Hydrologic) Cycle....

Identify sources of fresh water : surface water, groundwater, glacial ice / icebergs



Define / give examples of :

- Evaporation
- Condensation
- Precipitation
- Runoff
- Percolation
- Transpiration

Watersheds :

Define "watershed", and explain the jobs of one. Also define "drainage divides". Explain how a watershed is managed using what's called a "holistic approach".

A "watershed" is the total area of land where the surface water and groundwater drain into a common water body. Its roles are to:

collect -

purify -

store water -

A watershed is determined by the surrounding topography's highest points (called "drainage divides")

Ex. NL's largest...the Churchill River, drains over 92 000 sq km !

Activities anywhere in a watershed will affect water amounts in each part of the natural cycle, and the quality of that water (the watersheds "runoff").

Our runoff is so great that nutrient levels in our lakes and streams are relatively low.

Define " Oligotrophic" water

"Mesotrophic" water

"Eutrophic" water

"eutrophication"

Watersheds will run off into one or more of the following freshwater ecosystems.....

(higher points called "inlets", and lowest points "outlets")....page 453

1. Lakes / ponds - definitions ?

Defined by water depth, and the presence / absence of a "thermocline". lakes have layers with different temperatures, windy shores with rooted plants

Role :

Lakes serve as catchments after heavy runoff or precip - gradually releasing water through riversand streams...keeping their levels more constant

2. Rivers / streams -

Defined by width & flow rate

Define "riparian zone", know why they're important buffers and wildlife habitat.

"Riparian zones" - damp areas along side rivers or streams where special plant communities that can withstand occasional flooding may be found.

Their roles....

"Wildlife corridors" -

usually contain unique vegetation and

wildlife species....microecosystem within a larger surrounding area.

"Buffer zones" -
shade impact and temp, erosion prevention, may allow for special biodiversity

3. Wetlands - page 453

Defined as any area saturated by surface water. 20 % of NL. They store water to prevent flooding and erosion down stream. 4 types....

Define : bogs
fens
marshes
swamp
peatlands
peat

4. Estuaries - meeting of fresh and salt water
"Brackish"

Watershed Management :

There's been a major watershed management paradigm shift....from focussing just on the water to a more "holistic" watershed management approach.....

Using the best info you have and working with the users of a watershed
Mapping one, identifying threats to water quality, and making a sustainable plan on how to use a watershed.....plan might include.....??

Water Quality :

Define “water quality”, “water quality index”,

Is water of “good” quality ? Depends on what its used for.....industry ? Wildlife ? Agriculture ? Recreation ?

Drinking water: Has the highest standards and has many tests for chemicals, radiation, and microorganisms.

Recreational use: Water has to be safe for swimming, boating and other activities. Many tests are still used.

As an aquatic environment:

Water has to be safe for the plants and animals that live there.

Agricultural use: Water has to be safe for crops and or livestock.

For most of Canada.....

Municipalities test their own water and report to a Provincial Regulatory body.

In NL..... The Provincial Government does the testing !

Results of lab tests are then categorized as being either excellent, good, fair, marginal, or poor using a tool called the Water Quality Index (WQI) made by the Canadian Council of Ministers of the Environment (CCME).

The water quality index changes the data from many tests into a word that is easily understandable by the general public.....

Excellent (100-95):
Conditions are very close to pristine levels.

Good (94-80):
Water quality is protected with only a minor degree of threat.

Fair (79-65):
Water quality is usually protected, but occasionally threatened or impaired.

Marginal (64-45):
Water quality is frequently threatened or impaired.

Poor (44-0):
Water quality is almost always threatened or impaired.

What Are We Testing for ?

Physical condition, chemicals, dissolved substances, nutrient levels, trace metals, page 466 chart.....identify the physical, chemical, and biological things affecting water quality.

1. Physical Parameters:

Turbidity:
Particles suspended in the water (cloudiness)

Color:
Organic materials in the water can give it color. Some of the water in NL has a "tea" color because of the compounds from decomposing plant material. (tannins)

Temperature:
The temperature of the water affects many of the chemicals in the water, in particular oxygen. The warmer the water the less animal life it can support.

Total Solids:
All the stuff that is in the water. Both the material that is floating in it and the stuff that is dissolved in it.

Taste and Odor:
Some substances in the water can make it taste different or make it have a smell. Chemicals such as sulfur compounds or methane for example could cause the water to have a smell.

2. Chemical Parameters:

Dissolved Oxygen:
The amount of oxygen that is in the water for the living things to use.

Salinity:
How salty the water is. Some living things need the water to be salty some need it not to be.

pH:
A measure of how acidic the water is. If the pH is off by a little it can have a serious effect on the organisms.

3. Biological Parameters:

Pathogens:
Things in the water (usually organisms) that will cause illness. Bacteria, Protists, Viruses, Worms.

_____Bacteria- E. coli being the most common one that we hear about. E. coli is commonly found in the intestines of warm blooded animals. Most strains are harmless and can help the individual by providing vitamin K. However some can be harmful and can cause: Vomiting, Diarrhea, Nausea, and Intestinal irritation.

Protozoa- These are single celled animals some of which can cause: Diarrhea, Gas, Cramps, Upset stomach, Nausea. Giardia is an example of these, it causes "Beaver fever"

Virus- Hepatitis for example which can cause: Fatigue, Joint aches, Abdominal pain, Vomiting, Loss of appetite, Dark urine, Fever, Enlarged liver, Jaundice.

Parasitic Worm- Tapeworm is the most common example. Symptoms include: Abdominal discomfort, Diarrhea Constipation, Malnutrition, Weight loss, Seizures.

Freshwater Quality and Human Activities :

Sustainable human activity has to consider the impacts on water quality. Logging, mining, agriculture, and other activities can have huge impacts on quality.

Urbanization -

Diverting water flow (storm drainage)
Chemical runoff
Pesticide / fertilizer use / lawn care
Increased water demand
Exhaust / business emissions
Road salts / snow dumping

Forestry -

Harvesting, replanting, ROAD CONSTRUCTION, and long term management plans have to consider WQ.

Roads - can divert natural flows, increase surface compaction and surface runoff patterns, add sediment to water, road washouts, blocked culverts (or improperly installed

Any loss of vegetation alongside streams / rivers can lead to significant temperature changes, affecting many plant / animal parts of a food web.

Mining impacts generally depend on....

A. The mineral being mined may have negative impacts (ex. Lead)

B. extraction process: (strip, pit, or underground mining)

C. reclamation, treatment, and mitigation techniques being used

D. local site conditions and climate Including rainfall amounts - leaching rates).

Depending on the mining process of a particular business / site, we may see.....

- Impacts on the surface runoff, groundwater flow and the watertable.
- Acid mine drainage changing water pH
- Diverting water to use for the mining process
- Piles of waste rock, tailings mud, dust, etc can be moved by rain and flooding and can get into the water systems.

Hydroelectric Development -

(Dams and Reservoirs)

1. Upstream changes from a valley to a reservoir (a terrestrial to an aquatic environment). Each type has separate flora and fauna. This results in a loss of habitat for some species and a gain for others. It may also affect species at risk.

2. Reservoirs can change the surrounding climate if they are large enough !

3. The river changes from a flowing to a larger standing body of water with different temperature ranges and nutrient and oxygen levels. The river below the dam changes due to changes in quantity and flow rates. Water quality below the dam changes and sediment transport is reduced. The river changes its flow pattern and rate, which can result in less flushing in downstream areas in the summer. There is an increased release of greenhouse gases (CO_2 and methane) into the atmosphere from decomposing plants and animals killed by flooding the reservoir.

4. Bioaccumulation of pollutants, mercury in fish, for example, increases due to the

sudden death of large forested areas, plants release held nutrients.

5. Dams / gate structures can obstruct migrating fish.

Agriculture -

Pesticide and fertilizer runoff changing chemical makeup of nearby water and groundwater contamination - eutrophication and fish kill events. Animal feces can introduce pathogens.

Recreation -

Soaps, bug sprays, oil/gas residue, smokes, shallow water turbidity, swimming

Protecting Human Drinking Water :

making water safe is a challenge for such a widespread, small town rural population like NL - driving force behind Provincial level testing.

First, recognize where we get our drinking (potable) water from...
(be able to list the main sources of drinking water in Newfoundland and Labrador...)

(i) surface water (ponds lakes rivers)

- expensive to build and maintain water infrastructure and carry water distances though !

(ii) groundwater :

reached using wells (dug and deeper drilled)
Water quality affected by rock types and speed of water movement, usually cooler year round - with fewer pathogens - naturally filtered by aquifers) HV-GB uses a “well field” as its supply.

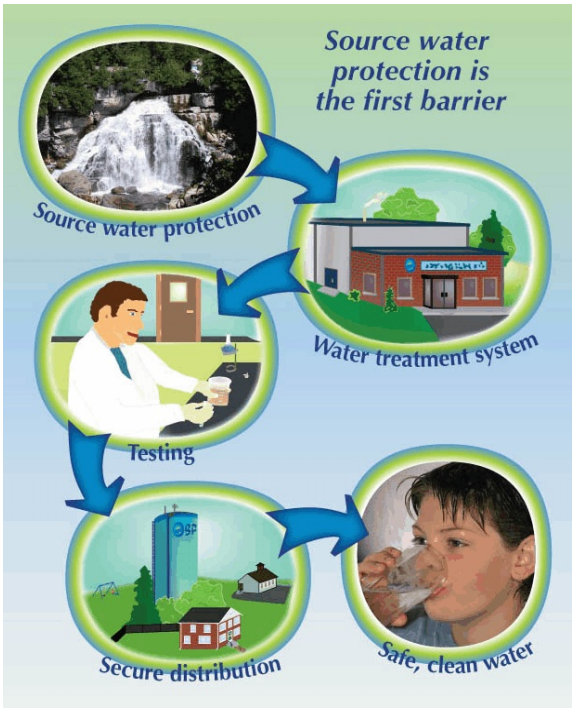
(iii) “spring” water

The "multi-barrier approach"

Step1: Protecting supplies, monitoring activities in protected watersheds, treating water, regularly testing water (492)

Step 2: water monitoring, collection, reporting, planning responses to issues, operator education and training

Step 3: R & D, public education, laws, setting/ changing standards



When an issue arises, a boil advisory or boil order may be issued by a municipality.

Boil water Advisories - issued by Prov. Govt. when local samples fail guideline requirements. (no chlorination happening, not enough chlorine added to Town water, system broken, or higher bacteria numbers)

☐ **be able to identify the phases of treating municipal water.**

i) pre-treatment (screening to remove debris)
(sedimentation)
(flocculation/coagulation, filtering floc and sediment)

ii) treatment (chlorination or ozonation of stored water as a disinfectant, or irradiating with ultraviolet light) **494-495** !! "residual concentration" and THM's produced when organic matter reacts with residual chlorine (494)

iii) post treatment (fluoridation for tooth care, water softening- hard water has lots of Ca and Mg, scaly pipe buildup, poor dissolving of soap)

☐ **be able to describe alternate methods of water treatment. Include: (i) boiling, (ii) carbon filtering, (iii) distillation, and (iv) reverse osmosis**

How is Water Naturally Cleaned ?

Physical processes :

- filtering materials (aquifers).....sand, soil, porous rock filter out some contaminants
- clay particle adhesion (444)
- freezing or evaporation (leaves contaminants behind)

Biochemical processes:

- decomposers transform remains or wastes in water into non-harmful products

Wetland reabsorption

- wetland plants (cattails for ex) can absorb and hold onto materials (nutrients / dissolved metals, some chemical contaminants) from water before the cleaned water goes elsewhere, plants might even be harvested and used for other purposes (maybe compost ?)

Solar Radiation :

- a natural irradiator, most effective near the equator, depending on turbidity and bacteria type....simply exposing water to intense solar radiation reduces bacteria numbers

Dealing with Wastewater :

- ☐ **list sources of wastewater. Include: (i) municipal (ii) industrial**
- ☐ **indicate the impacts of untreated wastewater on freshwater and marine ecosystems**

Municipal - grey water (contains detergents / soaps)
black water (sewage)
Adds a LOT of microorganisms to water
If untreated, adds a lot of N and P to aquatic ecosystems ⇨ eutrophication issues occur

Often both, along with storm runoff, are processed together
Only about half of the Provinces residents use septic tanks or municipal waste treatment sites !

Industrial - could contain any number of a pile of chemical contaminants, depending on the activity. Requires testing (before and after treatment) before any water can be released into the environment

□ **describe the disposal and treatment methods for municipal and industrial effluent. Include:**

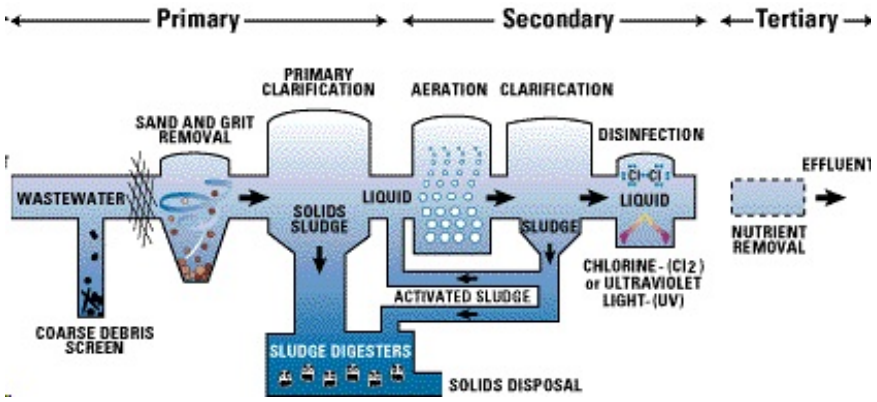
(i) treatment plants (499)

Runs water through a series of steps..... towns might not have such a system, or not include all of the following features :

Screening - **removing larger items not broken apart**

Primary treatment - **removing "biosolids", creating a septic sludge - dried, treated further**

Secondary treatment- **wastewater treated with aerobic bacteria and air, let them break down organic material to nutrients, then filter out PO4, NO?, NH3. May be chlorine and/or UV treatments. Plants might even be used to absorb trace metals.**



(ii) lagoons (containment system)

Lined shallow pond(s) holding wastewater for months, where natural decomposition happens**....**stinky and hazardous !

(iii) constructed wetlands

Heavy equipment creates a trench , lined with sand / gravel, planted with aquatic plants. Creates aquatic habitat, doesn't work well with industrial contaminants or in colder climates. Low maintenance, lots of effort up front to build.

Advantages and disadvantages of constructed wetlands and lagoon sewage treatment methods:

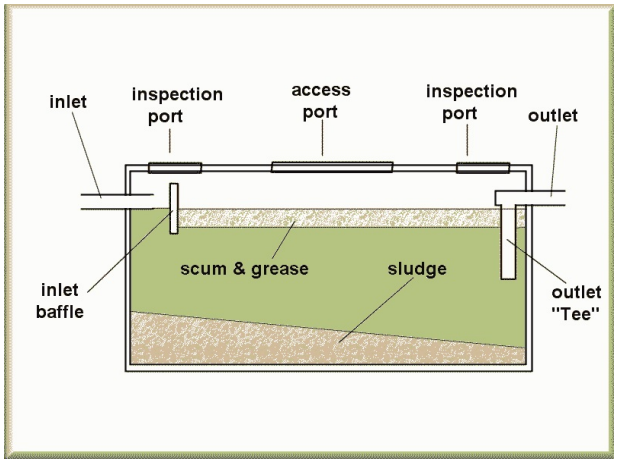
Advantages	Disadvantages
1. Relatively maintenance free	1. Requires a large land area
2. Cost effective, requires less maintenance	2. Not efficient with wastewater with lots of chemicals or industrial waste.
	3. Does not eliminate bacteria

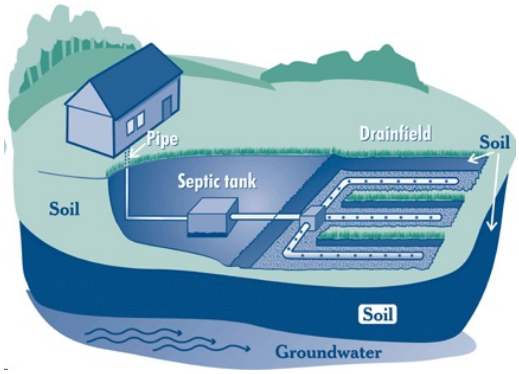
Nature of Things : Save My Lake (Lake Winnipeg, MB)
https://www.youtube.com/watch?v=-eaUihTvwyI

(iv) septic systems

Must meet NL standards. Anaerobic bacteria work to break down organic material. Develops 3 layers over time: scum, liquid, and sludge. On to distribution box, out through distribution pipes into a disposal field.....at least 30m from surface water. (502)

Sewage is flushed into A holding / treatment Septic Tank, where anaerobic bacteria do their thing.





Then eventually drains through the outlet pipe into a "dispersion field" shown here →

(v) out houses

Standards, page 503

1. Distance above groundwater, water table or bedrock - 1m
2. Distance from building 7.5 m
3. Distance from embankments and property boundaries - 4.5 m
4. Distance from drilled wells - 16 m
5. Distance from dug wells, springs or surface water - 30 m