

WATER

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INTRODUCTION

WATER is the only common liquid on our planet. Next to air, it is the substance with which we are intimately acquainted. Its properties and behaviour are quite unlike those of any other liquid. the functions of water in nature are innumerable. It is the solvent par excellence. It is the medium in which life originated and in which all organisms still exist. The living cell consists largely of water and literally floats in water.

Today water problems are part of the national consciousness, and most of us are aware that the future development of a country is intimately related to the wise use of water resources. The same also holds true for developed and developing countries. This is why the supply of water raises so many political and social problems.

Water is a commodity which is reasonably plentiful now, but is going to get more and more scarce as population and as underground water sources are used up. The sensible thing to do is to make it expensive now, forcing users to develop new techniques for economizing it.

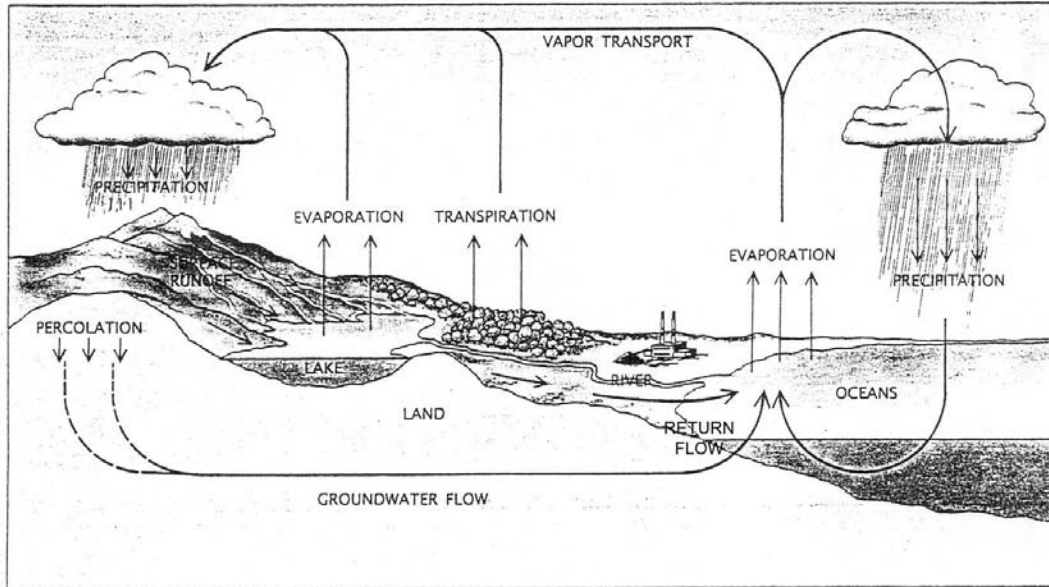
Contamination of surface water and ground water is resulting from industrial plant effluent, runoff from agriculture, urban and industrial areas, forestry, landfill leachates, poorly treated sewage, and long-range transport of airborne contaminants.

Most communities lose a significant portion (up to 30 per cent) of their treated drinking water in pipeline leaks, but to contend the loss is cheaper than repairing or replacing their systems.

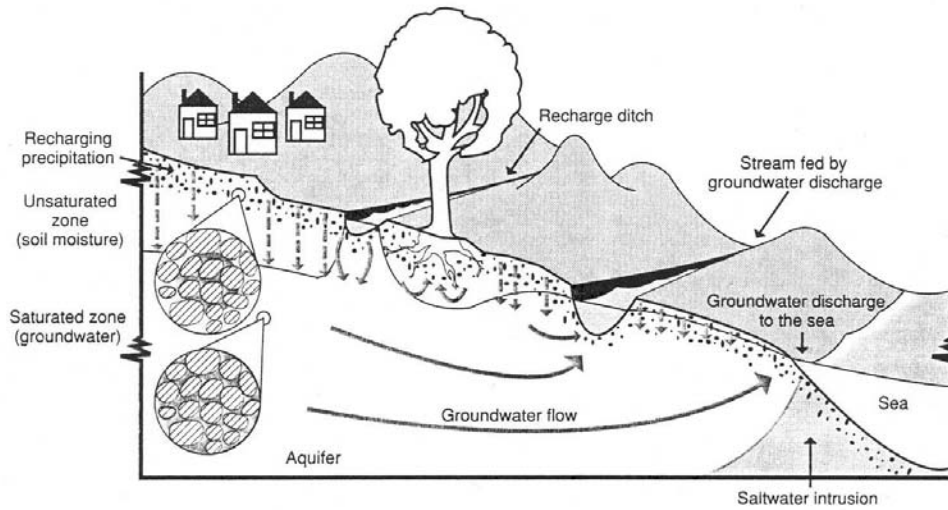
Industry uses water for:

- Processing
- Cooling
- Transportation
- Power generation
- Cleaning
- As a source of commercial fish
- For tourism and recreational purposes.

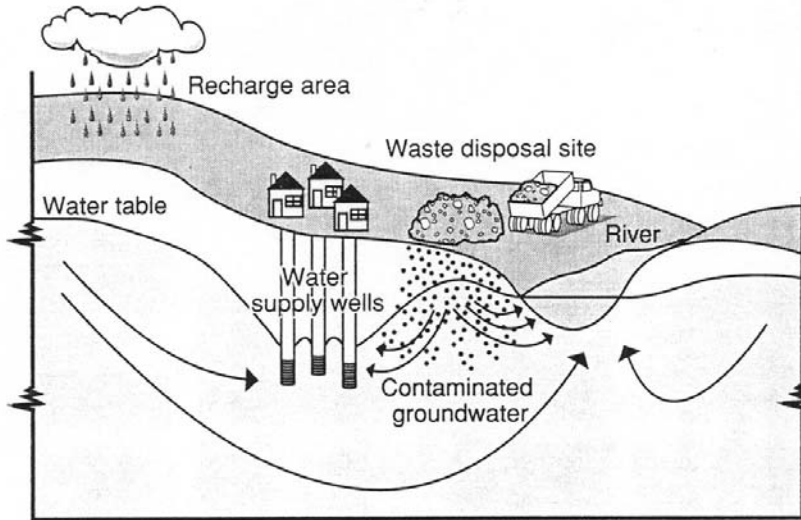
GLOBAL WATER CYCLE



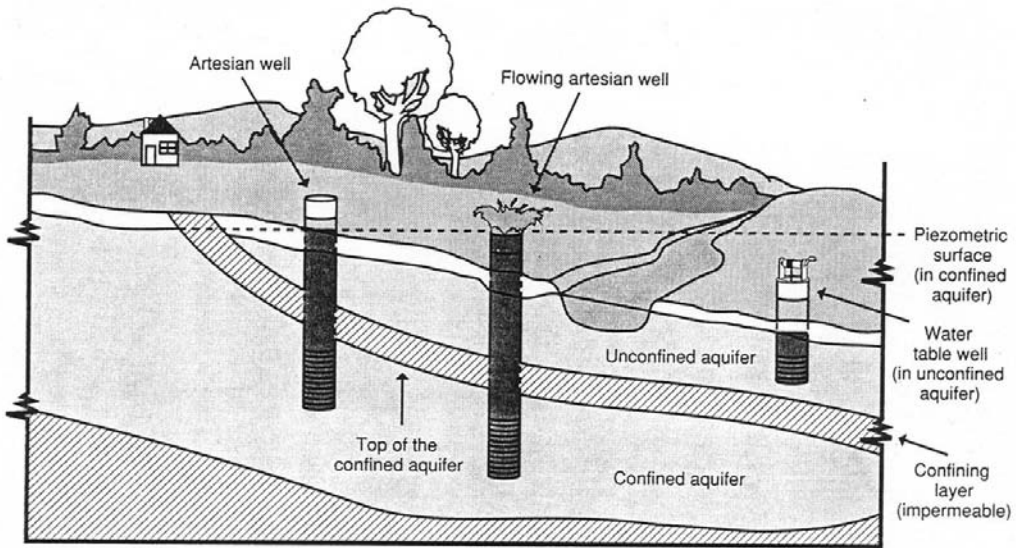
GROUNDWATER FLOW



GROUNDWATER CONTAMINATION FROM A WASTE DISPOSAL SITE



AQUIFERS AND WELLS



AVERAGE DAILY HOUSEHOLD WATER USE (PER CAPITA)

United States	425 litres
Canada	350 "
United Kingdom	200 "
Sweden	200 "
France	150 "
Germany	150 "
Israel	135 "

GROUNDWATER - NATURAL HIDDEN TREASURE

It is sometimes thought that water flows through underground rivers or that it collects in underground lakes. Groundwater is not confined to only a few channels or depressions in the same way that surface water is concentrated in streams, rivers, and lakes. Rather it exists almost everywhere underground. It is found underground in the spaces between particles of rock and soil or in crevices and cracks in rock.

Many terms are used to describe the nature and extent of the groundwater resources. The level below which all the spaces are filled with water is called the WATER TABLE. Above the water table lies the UNSATURATED ZONE. Here the spaces in the rock and soil contain both air and water. Water in this zone is called SOIL MOISTURE. The entire region below the water table is called the SATURATED ZONE, and water in this saturated zone is called GROUNDWATER.

Although groundwater exists everywhere under the ground, some parts of the saturated zone contain more water than others. An AQUIFER is an underground formation of permeable rock or loose material which can produce useful quantities of water when tapped by well.

SOURCES OF CONTAMINATION THAT CAN CAUSE GROUNDWATER CONTAMINATION POINT SOURCES

- On-site septic systems.
- Leaky tanks or pipelines containing petroleum products.
- Lakes or spills of industrial chemicals at manufacturing facilities.
- Underground injection wells (industrial wells).
- All landfills have this potential.

- Livestock wastes.
- Leaky sewer lines.
- Chemicals used at wood preservation facilities.
- Mill ash from coal-fired power plants.
- Sludge disposal areas at petroleum refineries.
- Graveyards.
- Road salt disposal of liquid wastes.
- Runoff of salt and other chemicals from roads and highways.
- Spills related to highway and railway accidents.
- Cold tar at old gasification sites.
- Asphalt production and equipment cleaning sites.

NON-POINT (distributed) SOURCES

- Fertilizers on agricultural land.
- Pesticides and herbicides on agricultural land and forests.
- Contaminants in rain, snow, and dry atmosphere fallout.

CANADIAN WATER PROFILE

- Canada holds 20 percent of the world's fresh water, but has only 9 percent of the world's fresh renewable water, the rest is "fossil water", a legacy of the melting pleistocene ice sheets.
- About 7.6 percent of Canada is covered by fresh water; The nations rivers and lakes contain enough water to flood the entire country to a depth of more than two metres.
- Approximately 90 percent of Canadians live within 150 miles of the southern border, but 60 percent of total river discharge runs north.
- In 1984 only 2164 of Canada's 3250 communities had sewers. Of these communities, only 1442 (or 44 percent) had some kind of sewage treatment facility.
- Canadians are the world's second largest users of water. The average daily household use is 350L per person Municipalities, agriculture, transportation, energy, recreation, and industries including oil, pulp and paper, and mining, are major water-using sectors in Canada.
- One in four Canadians relies on groundwater for his or her domestic water supply, and the remainder rely on surface water. Both sources of water are coming under increasing threats to both quality and supply.
- Although no national drinking water monitoring programs exist, regional studies to date (1991) indicate that the quality of most Canadian drinking water meets Canadian Drinking Water Guidelines. There is an Ontario Provincial Monitoring Program known as Drinking Water Surveillance Program.
- Approximately 57 percent of Canadians (1980-81 data) are served by wastewater treatment plants, compared with 73 percent of Americans, 86.5 percent of Germans, and 99 percent of Swedes.

REGIONAL WATER INTAKE BY REGIONS OF CANADA, 1986 (MCM per year)

Region	Thermal Power	Manufact.	Munici.	Agri.	Mining	Region Total
Atlantic	2,490	858	338	13	212	4,011
Quebec	986	1,521	1,483	89	52	4,131
Ontario	19,967	3,763	1,600	166	100	25,596
Prairies	1,867	357	674	2,688	132	5,718
B.C.*	54	1,384	616	603	97	2,754
NATIONAL	25,364	7,983	4,711	3,558	593	42,210
% Total	60.2	18.9	11.2	8.4	1.4	100

* Sectoral data for the territories are included with B.C. Region. Data for some sectors have been extrapolated and rounded.

PERCENTAGE OF POPULATION RELIANT ON GROUNDWATER, 1981

(Municipal, Domestic, and Rural use only) AND
**ESTIMATED Annual GROUNDWATER USE BY PROVINCE AND SECTOR,
1981**

(Some values derived from previous years)

	%	MCMs
Alberta	27	150
British Columbia	22	75
Manitoba	24	75
New Brunswick	64	60
Newfoundland	29	15
Northwest Territories	1	10
Nova Scotia	45	50
Ontario	23	400
Prince Edward Island	100	18
Quebec	17	230
Saskatchewan	54	120

Yukon	63	3
CANADA	26	57

ONTARIO WATER PROFILE

- Almost 25 percent of Ontarians rely on wells for household water.
- Northern Ontarians alone could lose up to \$230 million in income from tourism each year as a result of acid rain.
- In August 1987 all beaches in Toronto were posted as unfit for swimming because of the risk to health posed by pollution.

SOME OF THE POSSIBLE METHODS TO PREVENT LOSS OF WATER

(1) New mulching methods applied to reduce evaporation from solid surfaces, thereby making more water available for transpiration by the plants.

(2) Research on the physiology of water uptake and transport in plants, and on plant genetics, to lower transpiration without a proportional reduction in growth.

(3) Development of salt-tolerant crops to reduce the amounts of irrigation water needed to maintain low salt concentration in the solution around the plant roots.

(4) Lowering the water loss by seepage from irrigation canals and percolation from fields by the development of better linkings from canals and better irrigation practices.

(5) Control of useless water loving plants that suck water through the canals banks and transpire it to the atmosphere.

(6) Encourage industries to use air cooling systems than the use of water cooling systems.

(7) Development of high-yield grains which use much less water per ton than classic varieties.

(8) Spraying crop plants with impervious coatings to reduce water loss.

(9) Waterproofing sandy soils to prevent drain through has been successful in increasing crops as much as 400% with the same rainfall. A special plow is used to lift the soil so that melted asphalt can be layered in overlapping impermeable strips 32 inches wide and 2 feet below the surface. In Israel, waterproofing the surface by compacting with chemicals increases run off to basins or other fields on slopes below. Barren slopes in many places have been coated with asphalt or

concrete as thin as 1/8 inch, to catch rain water which is then conducted to catch basins for irrigation.

(10) Hydroponics - Vegetables and melons can be profitably grown in four or five crops per year using hydroponics, the growth of plants without soil in large, shallow concrete tanks containing gravel, water and added nutrients. Although much water is still necessary per unit weight of crop, the largest losses of ordinary irrigation are prevented. Such concentrated agriculture is very expensive in terms of water and labour requirements. Production is high in the tropical areas and offers a major opportunity to many developing countries.

(11) Use of drip irrigation

(12) In the urban and rural areas, use of water meters in the water supply system.

POTABLE WATER

Safest water means potable water, containing not more than 500 parts per million (ppm) or 500 mg/l or 0.05% dissolved solids; it also means water from which microbiological and toxic materials are removed. Water with over 1000 ppm or 1000 mg/l of dissolved solids is unfit for human consumption; however, some people do survive with much higher concentration of salts, as do also some land animals.

For proper metabolism, body requires chemical elements in very small (trace) quantities; various types of food provide these elements; in addition water is another source to do that.

As mentioned above, 0.05% dissolved solids contain trace elements. As of 1972, out of 90 naturally occurring elements, about 22 seem to be essential for the human body functions. The elements are H, C, N, O, F, Na, Mg, Si, P, S, Cl, K, Ca, Cr, Mn, Fe, Co, Cu, Zn, Se, Mo, and Iodine. The mysteries of human body chemistry are revealed through medical research, new elements are added to the above list.

Most consumers stress on obvious aesthetic parameters, i.e. turbidity, colour, taste, odours, and laundry staining. Earthly, musty, or moldy tastes and odours in drinking water are usually caused by the presence of organic compounds and algae. Certain organic compounds are released when the algae cells are burst during chlorination; also during reproduction, algae produces taste and odour causing compounds; and natural die-off of the cells as the water temperature decreases. Taste and odour reduction is difficult. At best, it is possible to reduce the level and frequency of complaints. It is not possible to completely eliminate or removal all tastes and odours in the treated water, the reason is as follows.

Generally water leaving water treatment plant is dosed with sufficient chlorine to maintain the desired residual in the system. As a minimum, it is recommended that a measurable chlorine residual be maintained throughout all areas of the distribution system. The maintenance of a chlorine residual helps prevent water quality deteriorated within the system, and preserves the bacteriological quality of the water to the consumer's tap. Laundry staining is sometimes caused by an excess of Iron, Copper, and Manganese than normally desired,

For specification of safe drinking water, refer to Ontario Drinking Water Objectives (ODWO), a publication of Ontario Ministry of the Environment.

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