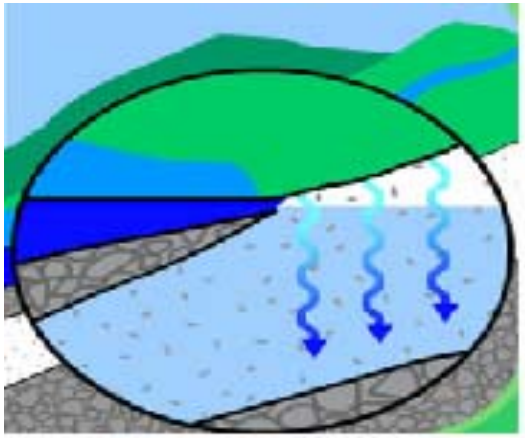
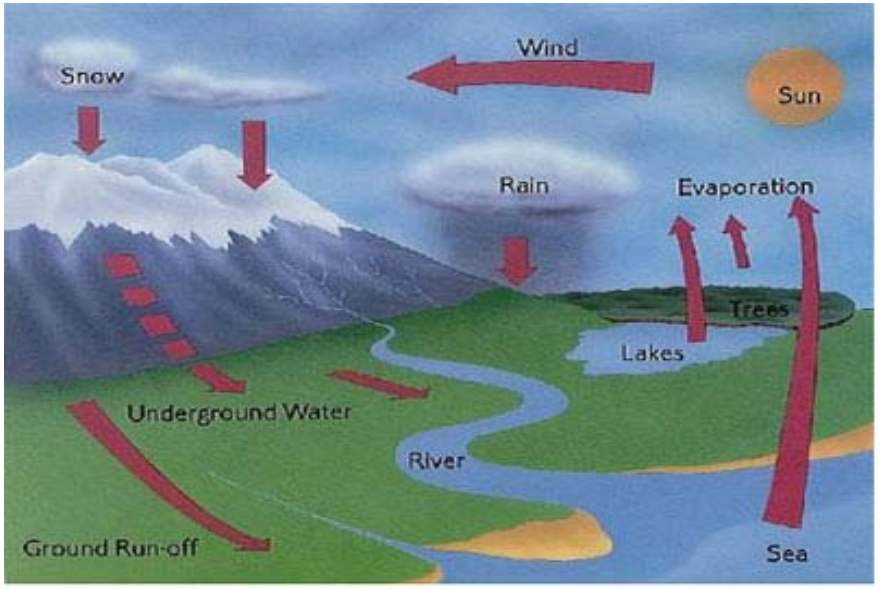
Ground Water Pollution

What is Groundwater ?

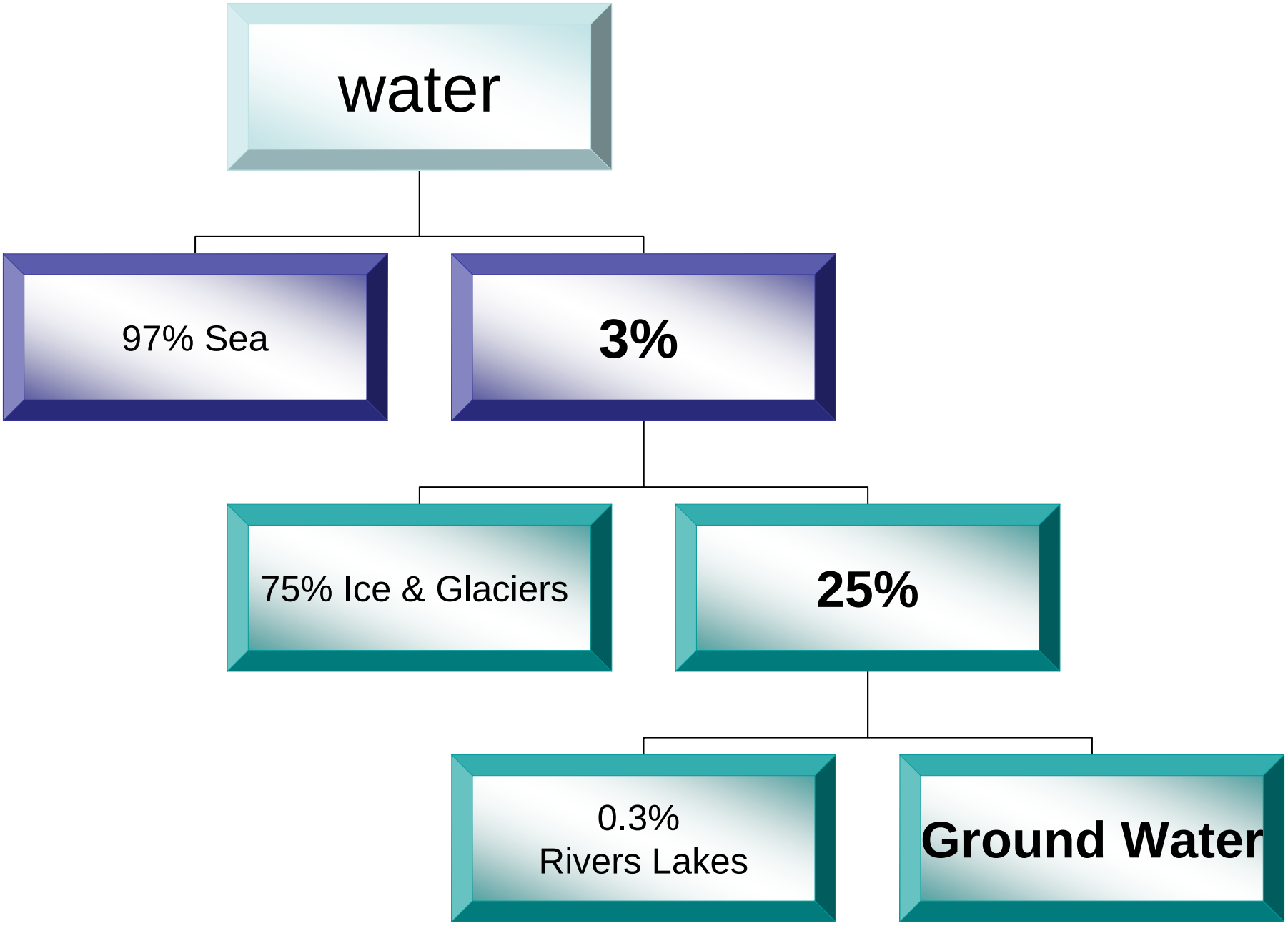
- water that exists in the pore spaces and fractures in rock and sediment beneath the Earth's surface
- a long-term reservoir of the natural water cycle





www.voelckerconsultants.co.uk/contaminated%20...

- originates as rainfall or snow
- moves through the soil
- back to surface streams, lakes, or oceans


water
97% Sea
3%
75% Ice & Glaciers
25%
0.3%
Rivers Lakes
Ground Water

Ground Water Contamination ?

- Pure water: contains essential chemical elements and minerals of water at very low levels and do not pose a significant risk to health.

- Pollution: occurs when waste products or other substances change the chemical or biological characteristics of the water and degrade water quality so that animals, plants or human uses of the water are affected.

- Pollutants: include plant nutrients, bacteria, viruses, pesticides, herbicides, hydrocarbons (including petrol and oil), heavy metals and other toxic chemicals

- MCL: Maximum Contaminant Level, quoted for every substance

Water Quality Criteria

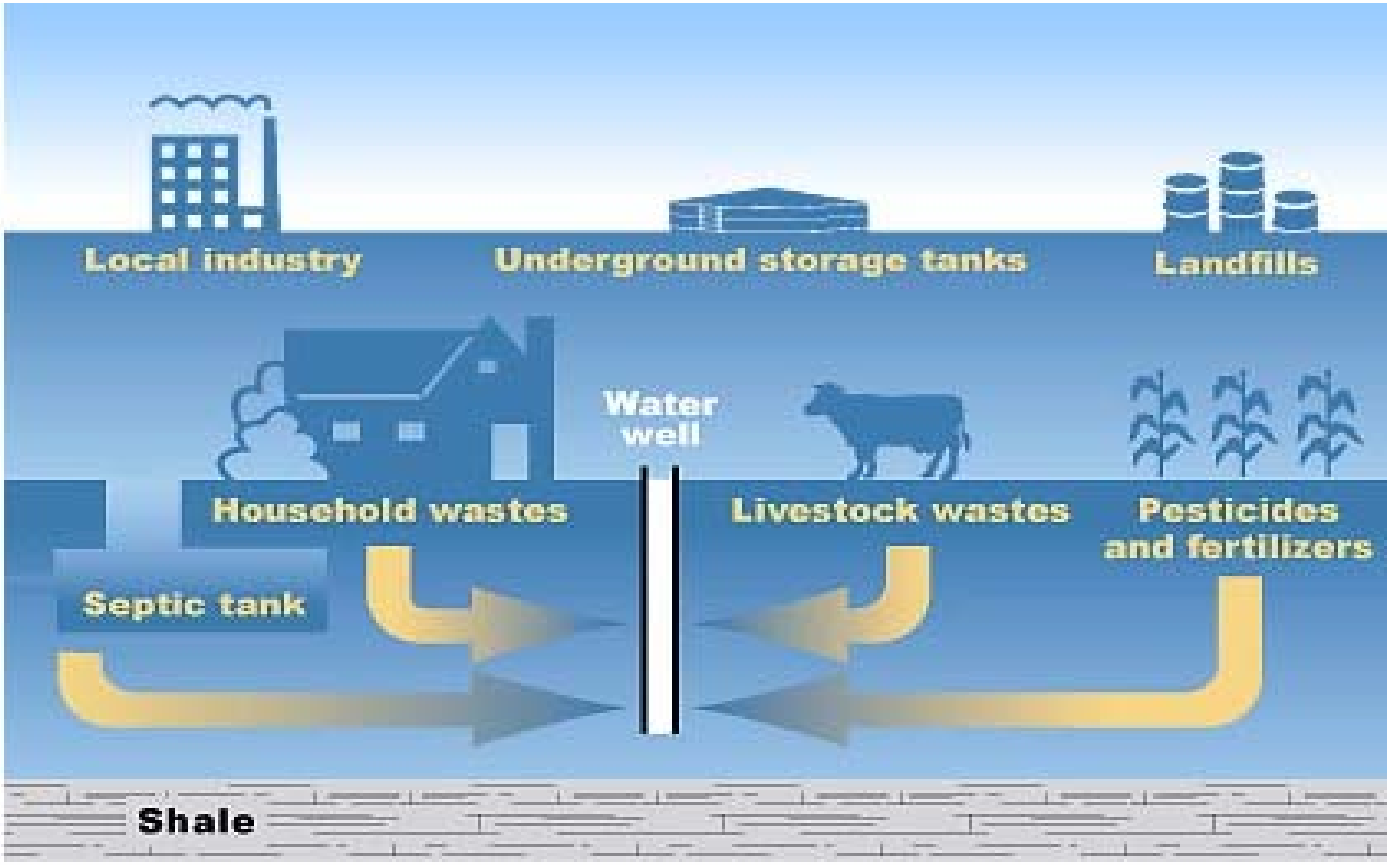
Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	1. Total Coliforms OrganismMPN/100ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6mg/l or more 4. Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organized)	B	1. Total Coliforms Organism MPN/100ml shall be 500 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 5mg/l or more 4. Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	1. Total Coliforms Organism MPN/100ml shall be 5000 or less 2. pH between 6 to 9 3. Dissolved Oxygen 4mg/l or more 4. Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	1. pH between 6.5 to 8.5 2. Dissolved Oxygen 4mg/l or more 3. Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	1. pH between 6.0 to 8.5 2. Electrical Conductivity at 25°C micro mhos/cm Max.2250 3. Sodium absorption Ratio Max. 26 4. Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

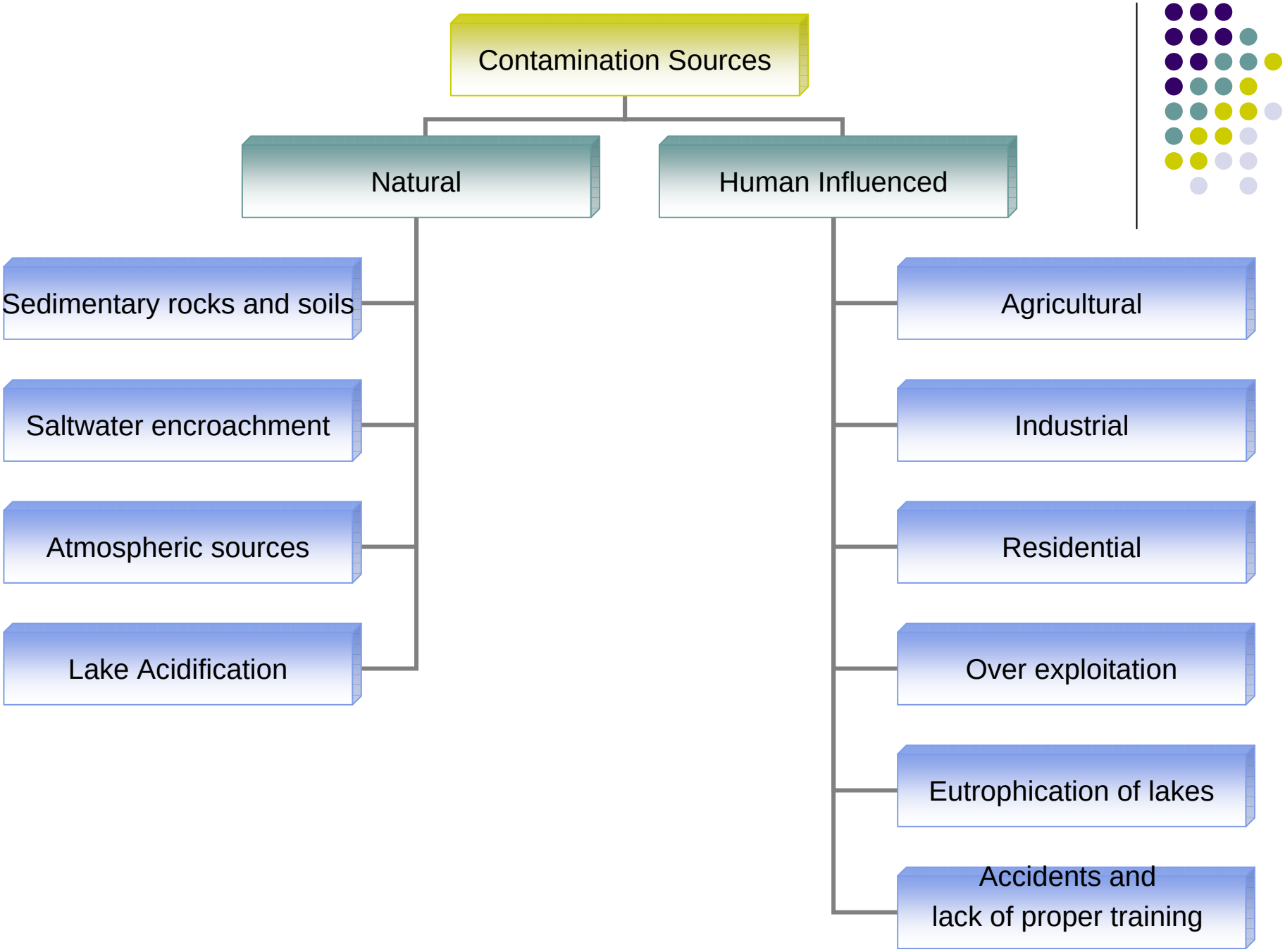
Pollutants

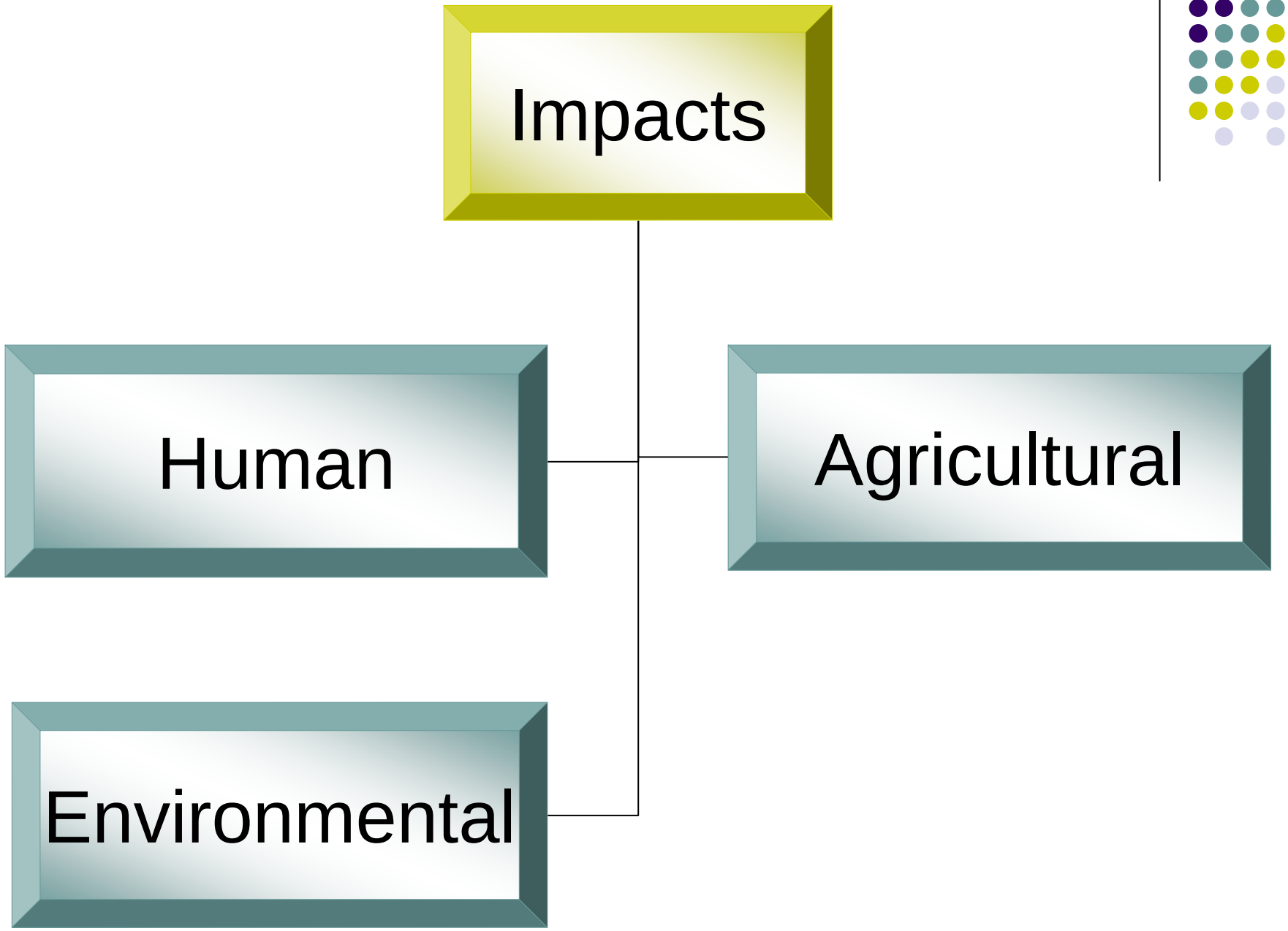
- Undesirable chemical constituents– organic (e.g., Benzene, Carbon Tetrachloride, Cis-1,2-Dichlorethylene, Styrene etc.) and

  inorganic (e.g., chloride, sulphate, iron, manganese, sodium, potassium)
- Total hardness and total dissolved solids
- Toxic constituents (typical, not complete list) - nitrate, arsenic, chromium, lead, cyanide, copper, phenols, dissolved mercury.
- Undesirable physical characteristics - taste, colour and odour.
- Pesticides and herbicides - chlorinated hydrocarbons and others
- Radioactive materials - various forms of radioactivity
- Biological - bacteria, viruses, parasites and so on
- Acid (low pH) or caustic (high pH)

Sources of Contamination




Contamination Sources
Natural
Human Influenced
Sedimentary rocks and soils
Saltwater encroachment
Atmospheric sources
Lake Acidification
Agricultural
Industrial
Residential
Over exploitation
Eutrophication of lakes
Accidents and
lack of proper training


Impacts
Human
Agricultural
Environmental

Effects On Human

- Water-born diseases
- Effects due to high concentration of salts and heavy metals
- Using contaminated agricultural and livestock products
- Increase the cost of production for industries which use extra treatment of the ground water
- Corrosion effects in pipe lines, boilers and other water carrying equipments

Inorganic contaminants found in ground water

Contaminant	Potential health and other effects
Arsenic	Causes acute and chronic toxicity, liver and kidney damage; decreases blood hemoglobin. Possible carcinogen.
Chloride	Deteriorates plumbing, water heaters, and municipal water-works equipment at high levels. Above secondary maximum contaminant level, taste becomes noticeable.
Chromium	Chromium VI causes liver and kidney damage, internal hemorrhaging, respiratory damage, dermatitis, and ulcers on the skin at high concentrations.
Copper	Can cause stomach and intestinal distress, liver and kidney damage, anemia in high doses. Imparts an adverse taste and significant staining to clothes and fixtures. Essential trace element but toxic to plants and algae at moderate levels.
Cyanide	Poisoning is the result of damage to spleen, brain, and liver.
Dissolved solids	May have an influence on the acceptability of water in general. May be indicative of the presence of excess concentrations of specific substances not included in the Safe Water Drinking Act, which would make water objectionable. High concentrations of dissolved solids shorten the life of hot water heaters.
Fluoride	Decreases incidence of tooth decay but high levels can stain or mottle teeth. Causes crippling bone disorder (calcification of the bones and joints) at very high levels.
Hardness	Decreases the lather formation of soap and increases scale formation in hot-water heaters and low-pressure boilers at high levels.

Iron	Imparts a bitter astringent taste to water and a brownish color to laundered clothing and plumbing fixtures.
Lead	Affects red blood cell chemistry; delays normal physical and mental development in babies and young children. Causes slight deficits in attention span, hearing, and learning in children. Can cause slight increase in blood pressure in some adults. Probable carcinogen.
Manganese	Causes aesthetic and economic damage, and imparts brownish stains to laundry. Affects taste of water, and causes dark brown or black stains on plumbing fixtures. Relatively non-toxic to animals but toxic to plants at high levels.
Mercury	Causes acute and chronic toxicity. Targets the kidneys and can cause nervous system disorders.
Nickel	Damages the heart and liver of laboratory animals exposed to large amounts over their lifetime.
Nitrate (as nitrogen)	Toxicity results from the body's natural breakdown of nitrate to nitrite. Causes "bluebaby disease," or methemoglobinemia, which threatens oxygen-carrying capacity of the blood.
Nitrite (combined nitrate/nitrite)	Toxicity results from the body's natural breakdown of nitrate to nitrite. Causes "bluebaby disease," or methemoglobinemia, which threatens oxygen-carrying capacity of the blood.
Selenium	Causes acute and chronic toxic effects in animals--"blind staggers" in cattle. Nutritionally essential element at low doses but toxic at high doses.

Silver	Can cause argyria, a blue-gray coloration of the skin, mucous membranes, eyes, and organs in humans and animals with chronic exposure.
Sodium	Can be a health risk factor for those individuals on a low-sodium diet.
Sulfate	Forms hard scales on boilers and heat exchangers; can change the taste of water, and has a laxative effect in high doses.
Thallium	Damages kidneys, liver, brain, and intestines in laboratory animals when given in high doses over their lifetime.
Zinc	Aids in the healing of wounds. Causes no ill health effects except in very high doses. Imparts an undesirable taste to water. Toxic to plants at high levels.

Organic contaminants found in ground water

Contaminant	Potential health and other effects
Volatile organic compounds	Can cause cancer and liver damage, anemia, gastrointestinal disorder, skin irritation, blurred vision, exhaustion, weight loss, damage to the nervous system, and respiratory tract irritation.
Pesticides	Cause poisoning, headaches, dizziness, gastrointestinal disturbance, numbness, weakness, and cancer. Destroys nervous system, thyroid, reproductive system, liver, and kidneys.
Plasticizers, chlorinated solvents, benzo[a]pyrene, and dioxin	Cause cancer. Damages nervous and reproductive systems, kidney, stomach, and liver.

Microbiological contaminants found in ground water

Coliform bacteria	Bacteria, viruses, and parasites can cause polio, cholera, typhoid fever, dysentery, and infectious hepatitis.

Radiological contaminants found in ground water

Gross alpha-particle activity	Damages tissues and destroys bone marrow.
Combined radium-226 and radium-228	Causes cancer by concentrating in the bone and skeletal tissue.
Beta-particle and photon radioactivity	Damages tissues and destroys bone marrow.

Agriculture Impacts

- Salts in soil or water reduce water availability to the crop to such an extent that yield is affected
- Relatively high sodium or low calcium content of soil or water reduces the rate at which irrigation water enters soil to such an extent that sufficient water cannot be infiltrated to supply the crop adequately from the irrigation to the next
- Certain ions (sodium, chloride, or boron) from soil or water accumulate in a sensitive crop to concentrations high enough to cause crop damage and reduce yields
- Excessive nutrients reduce yield or quality; unsightly deposits on fruit or foliage reduce marketability; excessive corrosion of equipment increases maintenance and repairs
- Effects the production from live stocks

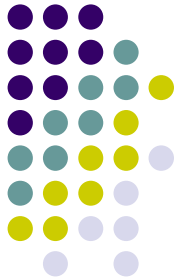
Environmental Impacts

- Eutrophication of lakes and rivers
- Contamination of rivers and lakes due to leakage of contaminated groundwater in rivers and lakes
- Change the microbiological balance of soil
- Change of arable land to barren land due to use of contaminated groundwater

Indian Scenario of Groundwater Pollution

Pollutant	State	Place of occurrences
Salinity (Inland)	Maharashtra	Amravati, Akola
	Bihar	Begusarai
	Haryana	Karnal
	Rajasthan	Barmer, Jaisalmer, Bharatpur, Jaipur, Nagaur, Jalore & Sirohi
	U.P.	Mathura
Salinity (Coastal)	Andhra Pradesh	Vishakapatnam
	Orissa	Puri, Cuttak, Balasore
	West Bengal	Haldai & 24 Pargana
	Gujarat	Junagarh, Kachch, Varahi, Banskanta & Surat
Flouride	Kerala	Palaghat Krishna, Ananipur, Nellor, Chittoor.
	Andhra Pradesh	Cuddapah, Guntur and Nalgonda
	Gujarat	Banskanta, Kachch & Amreli
	Haryana	Hissar, Kaithal & Gurgaon
	Orissa	Bolangir, Bijapur, Bhubaneshwar and Kalahandi
	Punjab	Amritsar, Bhatinda, Faridkot, Ludhiana & Sangrur
	Rajasthan	Nagaur, Pali, Sirohi, Ajmer & Bikaner
	Tamil Nadu	Chengalput, Madurai
	U.P.	Unnao, Agra, Aligarh, Mathura, Ghaziabad, Meerut & Rai Baraili
Sulphide	Orissa	Balasore, Cuttak & Puri
Iron	U.P.	Mirjapur
	Assam	Darrang, Jorhat, Kamrup
	Orissa	Bhubaneshwar
	Bihar	E. Champaran, Muzaffarpur, Gaya, Manger, Deoghar & Madubani
	Rajasthan	Bikaner, Alwar, Bharatpur
	Tripura	Dharmnagar, Kailasanar, Ambasa, Amarpur & Agartala
	West Bengal	Madnipur, Howrah, Hoogly and Bankura
Maganese	Orissa	Bhubaneshwar, Athgaon
	U.P	Muradabad, Basti, Rampur & Unnao
Arsenic	West Bengal	Malda, Murshidabad, Nadia, 24 Pargana
Nitrate	Bihar	Patna, East Champaran, Palamu, Gaya, Nalanda, Nawada and Banka
	Andhra Pradesh	Vishakapatnam, East Godvari, Krishna, Prakasam, Nellor, Chittoor, Anantpur, Cuddapah, Kurnool, Khamam and Nalgonda
	Delhi	Naraina, Shehadr (Blocks)
	Haryana	Ambala, Sonepat, Jind, Gurgaon, Faridabad & Hissar
	Himachal Pradesh	Kulu, Solan, Una
	Karnataka	Bidar, Gulbarge and Bijapur
	Madhya Pradesh	Sehore, Bhopal & (West & Central Part of state)
	Maharashtra	Jalna, Beed Nanded, Latur, Osmanabad, Solapur Satara, Sangli and Kolhapur
	Punjab	Patiala, Faridkot, Firozpur, Sangrur & Bhatinda
	Rajasthan	Jaipur, Churu, Ganganagar, Bikaner, Jalore, Barmer, Bundi and Sawaimadhopur
	Tamil Nadu	Coimbatore, Penyar and Salem
	West Bengal	Uttar Dinajpur, Malda, Birbhum, Murshidabad, Nadia, Bankura and Purulia.
Chloride	Karnataka	Dharwad, Belgaum
	Madhya Pradesh	Bhind, Shagapur and Sehore
	Maharashtra	Solapur, Satara, Amravati, Akola & Buldana
	Rajasthan	Barmer, Jaisalmer, Jodhpur & Jalore
	West Bengal	Contai, Digha, Haldia
Zinc	Andhra Pradesh	Hyderabad, Osmania University campus
	Delhi	R.K. Puram
	Rajasthan	Udaipur
Chromium	Punjab	Ludhiana

Present Efforts Against Contamination



1. Identification of contamination sources

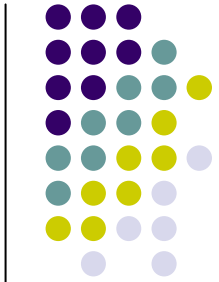
2. Setting water quality standards for particular uses.

- monitoring water quality to detect contamination
- declaring water source protection areas
- planning controls to limit the types of land uses permitted
- relocating potentially contaminating activities
- Managing activities to minimize their impact (e.g. waste disposal, transport of hazardous chemicals)
- identifying and cleaning up contaminated sites
- changing land use to minimize the risk of contamination

3. Some Acts

- 1974- The Water (Prevention and Control of Pollution) Act establishes an institutional structure for preventing and abating water pollution. It establishes standards for water quality and effluent. Polluting industries must seek permission to discharge waste into effluent bodies. The CPCB (Central Pollution Control Board) was constituted under this act.
- 1977- The Water (Prevention and Control of Pollution) Cess Act provides for the levy and collection of Cess or fees on water consuming industries and local authorities.
- On December 10, 1996, the Supreme Court directed the Union ministry of environment and forests (MEF) to empower the Central Ground Water Board (CGWB) under the ministry of water resources to initiate penal action under the Environment Protection Act, 1986, against overexploitation of groundwater. This led to the creation of CGWB. But in the past three years, CGWB has invited a lot of criticism. It is quite clear from the case studies that pollution control authorities are not capable of dealing with the groundwater crisis.

4. Miscellaneous:

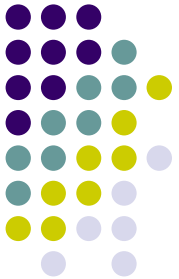


- Proper design, maintenance, and operation of waste disposal units.
- Avoid sensitive groundwater areas for use of septic systems or disposal pit etc.
- Regular inspection and groundwater monitoring.
- Ban hazardous wastes from landfill unless designed for this purpose
- Reduce waste by recycling.
- Using less harmful materials for agricultural and industrial purposes.
- Leak backup containment.

FUTURE ASPECTS

- Team/organization
- Citizen
- Business and agriculture
- Education
- Government
- Declaring a ‘proclaimed’ area under an Act of Parliament
- Proper protection of salt storage and minimize use of salt by using alternative deicing materials.
- Collection and study of present data can be analyses to establish current conditions and to make future condition predictions.

What we should do ?



- Use pesticides and fertilizers on your garden with care.
- Never tip paint, chemicals or oil into street drains.
- Store, handle and dispose of chemicals safely.
- Plant local native plants in your garden and road verge to save water and fertilizers.
- Whether we choose to drive to the corner store rather than walk or ride a bicycle will determine how much we personally contribute to acid and hydrocarbon emissions to the atmosphere (and ultimately to global fresh water supplies)

Conclusion

- In developing country like India, we don’t have enough resources to fulfill the basic need of drinking water. In this stage we can’t expect a hard action, either politically or financially.

- Prevention and awareness is the best way to prevent groundwater contamination. This can be achieved by individual awareness and group action of society so that our ground water sources can be used by the generation to come.

- If we are not able to take an initiative action, at least than, we should support an organization or committee which is working in this direction, if any.

Thank You

Please any..... ?