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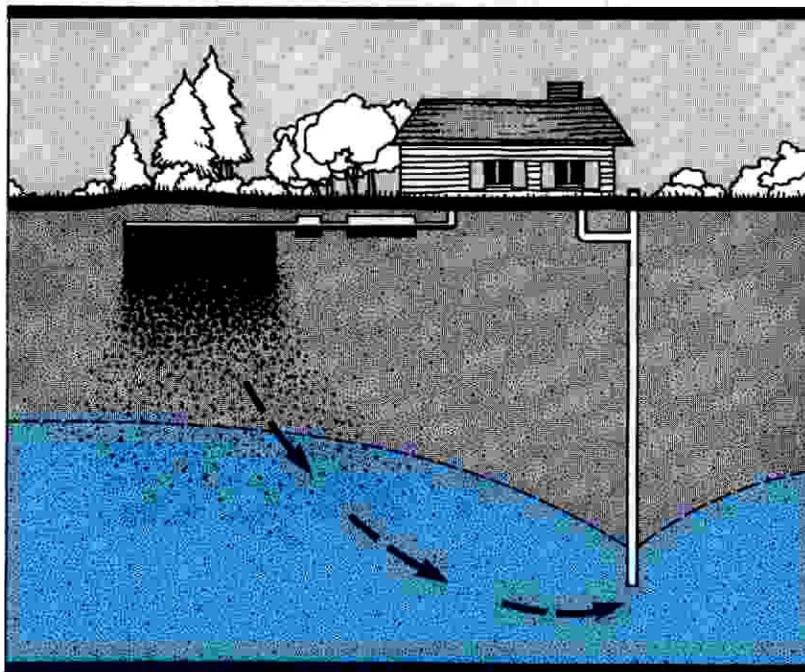
BULLETIN NO. 2

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GROUNDWATER CONTAMINATION

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CENTER FOR ENVIRONMENTAL RESEARCH
CORNELL UNIVERSITY



Become a groundwater contamination detective!

.....
What are the clues to potential contamination?
.....

How can contamination be prevented?

PURPOSE OF THIS BULLETIN

This bulletin will help the reader gain a better understanding of potential sources, causes and prevention of groundwater contamination.

Principal contaminants from each source are identified. Evidence that contamination is occurring is noted, followed by common contamination causes and means of prevention. It should be understood that these brief notations are in no way a substitute for specific investigations of possible contamination sources and means of contamination prevention or remedial action.

Proper land use management is the key to groundwater quality protection. Land use activities that result in contaminated groundwater can often be traced to lack of understanding of the potential for contamination, carelessness or negligence. Lack of understanding of the contamination potential may be a result of insufficient information.

The information in this bulletin should help local officials and citizens become better able to make more effective policy and individual decisions concerning groundwater contamination prevention.

THIS BULLETIN IS THE SECOND IN A FOUR-PART SERIES ON GROUNDWATER. OTHER BULLETINS IN THE SERIES FOCUS ON WHAT GROUNDWATER IS, AQUIFERS, AND OPTIONS FOR LOCAL ACTION.

ACKNOWLEDGMENTS

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Many individuals contributed to the bulletin by their reviews and critical comments. These include staff of the New York State Water Resources Institute and the Tug Hill Commission; Cornell Cooperative Extension agents; and representatives of the user public who generously gave their time to provide reaction to preliminary drafts of the bulletin.

SEPTIC SYSTEMS

CONTAMINATION EVIDENCE:

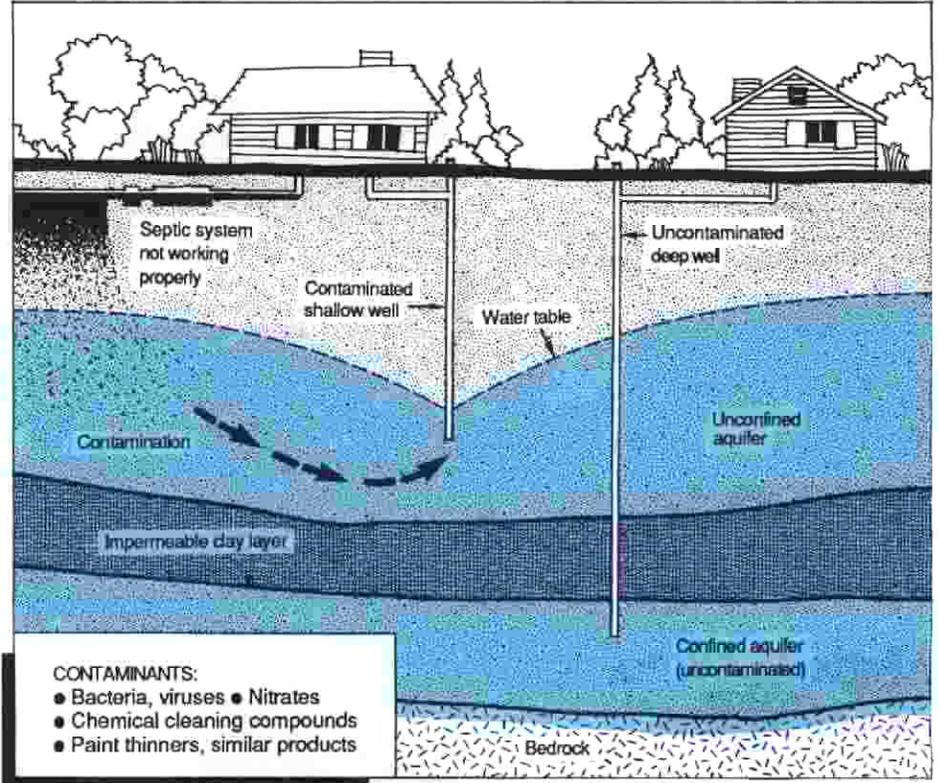
- Wastewater shows above ground
- Detection of excessive bacteria, chemicals in well water tests

CAUSES:

- Poor installation and/or maintenance
- Disposal of household chemicals, such as paint thinners, into the system
- Overloading the system with a garbage disposal unit
- Use of septic tank cleaning additives
- Too many closely-spaced septic systems in a limited area

PREVENTION:

- Proper installation
- Inspection and cleaning every 2-4 years, annually if garbage disposal unit is used
- Do not dispose of household chemicals into the system
- Ban hazardous cleaning additives for septic systems
- Develop local septic system codes
- Public sewers when feasible
- Public information/education



SMALL DISPOSAL PITS

Used for dumping or burning wastes by businesses and households

CONTAMINATION EVIDENCE:

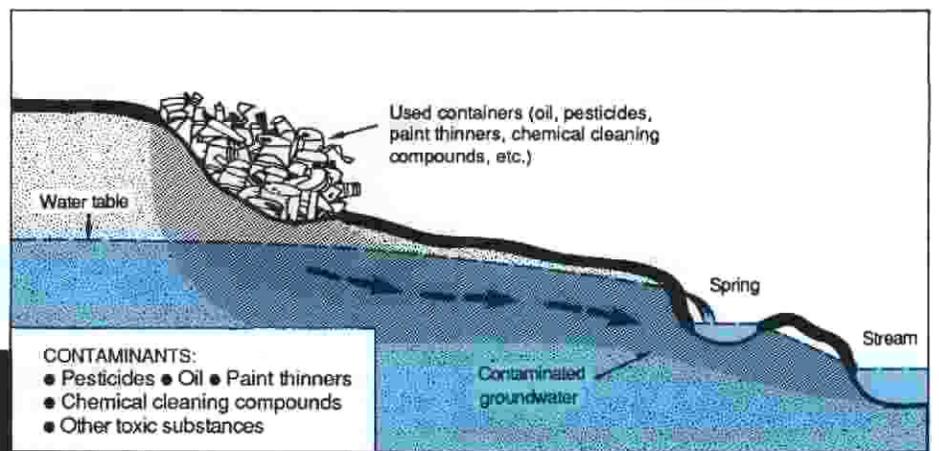
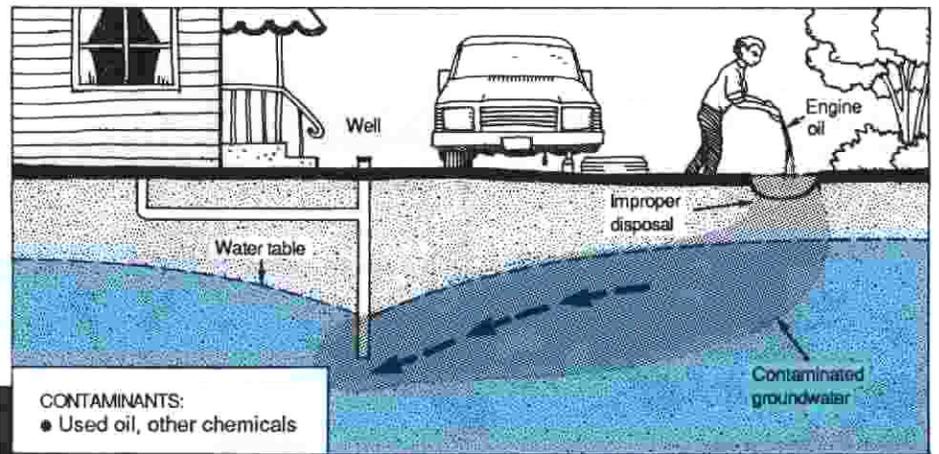
- Petroleum odor in well water
- Other chemical odors
- Detection of chemicals in well water tests

CAUSES:

- Improper disposal of chemicals, oil, pesticides, other wastes and used containers
- Lack of disposal facilities for small amounts of hazardous wastes

PREVENTION:

- Public information/education
- Disposal facilities for small hazardous wastes generators
- Enforcement against improper waste disposal



HOUSE and GARDEN CHEMICALS

CONTAMINATION EVIDENCE:

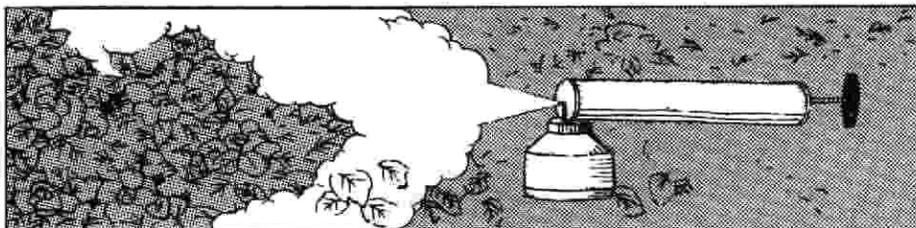
- Detection of chemicals in well water tests

CAUSES:

- Improper use and storage
- Improper disposal in backyard, ditches, low ground, septic systems, overgrown areas

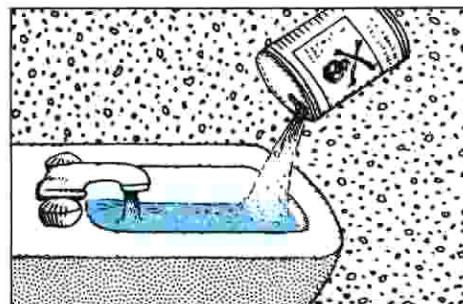
PREVENTION:

- Proper use
- Public information/education
- Provide local disposal facilities for unused chemicals and chemical containers
- Encourage use of less hazardous products



CONTAMINANTS:

- Paint thinners ● Pesticides
- Chemical cleaning compounds
- Floor care products ● Poisons
- Polishing and degreasing compounds
- Automotive products ● Acids
- Other toxic substances



STREAM INFILTRATION

CONTAMINATION EVIDENCE:

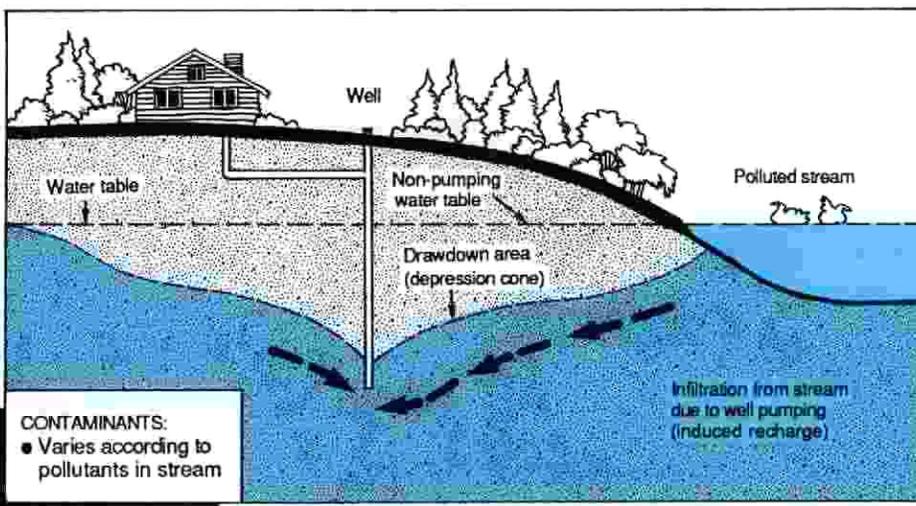
- Odors in well water
- Other changes in well water quality
- Detection of excessive bacteria, chemicals in well water tests

CAUSES:

- Polluted stream or lake water enters well

PREVENTION:

- Locate well away from stream or lake
- Test well water regularly for potential contaminants
- Change to public water supply if feasible



CONTAMINANTS:

- Varies according to pollutants in stream

DEICING SALTS

CONTAMINATION EVIDENCE:

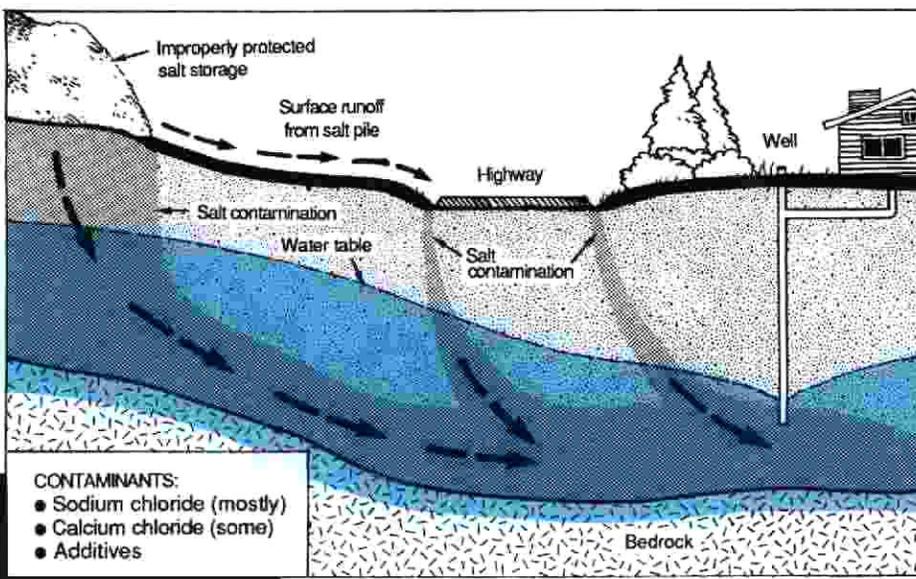
- Salty taste in well water
- High chloride level in well water tests

CAUSES:

- Runoff from salt storage piles and highways

PREVENTION:

- Proper protection of salt storage piles
- Minimize use
- Use alternative deicing materials



CONTAMINANTS:

- Sodium chloride (mostly)
- Calcium chloride (some)
- Additives

LANDFILLS

CONTAMINATION EVIDENCE:

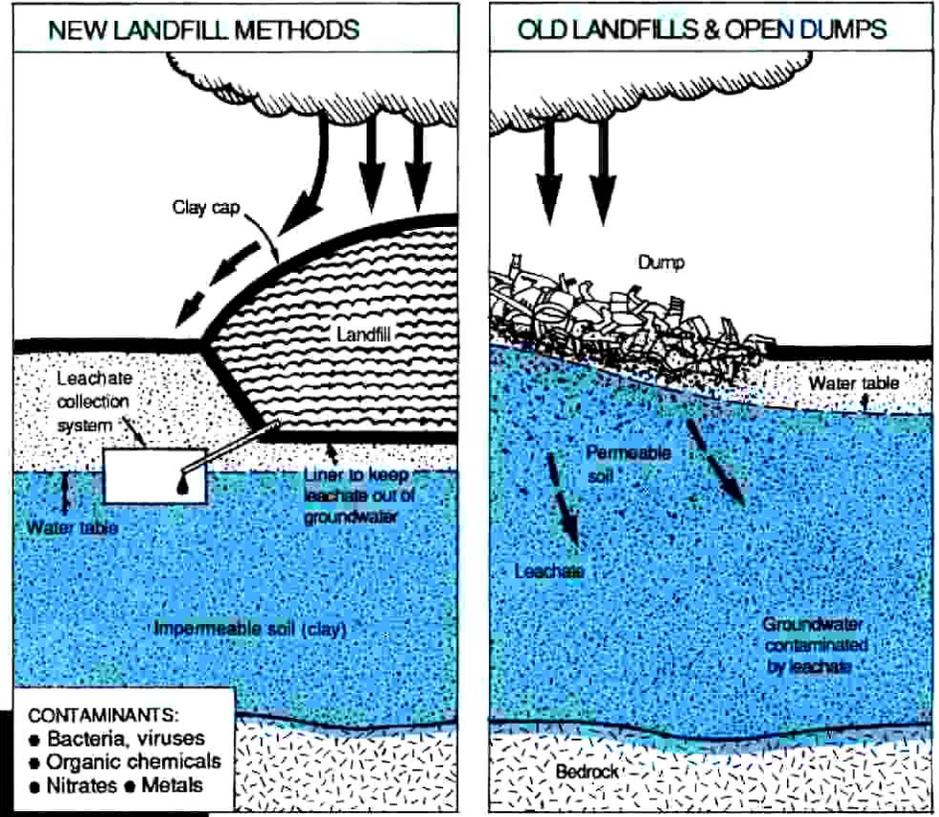
- Observed leachate runoff
- Seepage into nearby surface water
- High levels of bacteria, organic chemicals, metals, nitrates in well water tests

CAUSES:

- Lack of control over leachate movement
- Permeable soil
- Leaky landfill cover
- No liner or liner failure
- Poor management
- Lack of control over hazardous wastes disposal

PREVENTION:

- Proper design, maintenance, and operation
- Avoid sensitive groundwater areas
- Regular inspection and groundwater monitoring
- Ban hazardous wastes from landfill unless designed for this purpose
- Reduce waste by promoting recycling



STORAGE LAGOONS

Used by industries, farms, municipalities, mining operations, oil/gas producers

CONTAMINATION EVIDENCE:

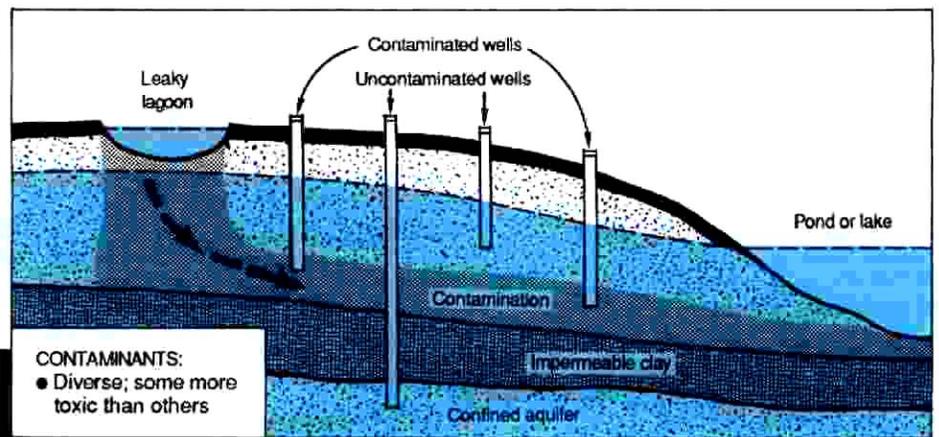
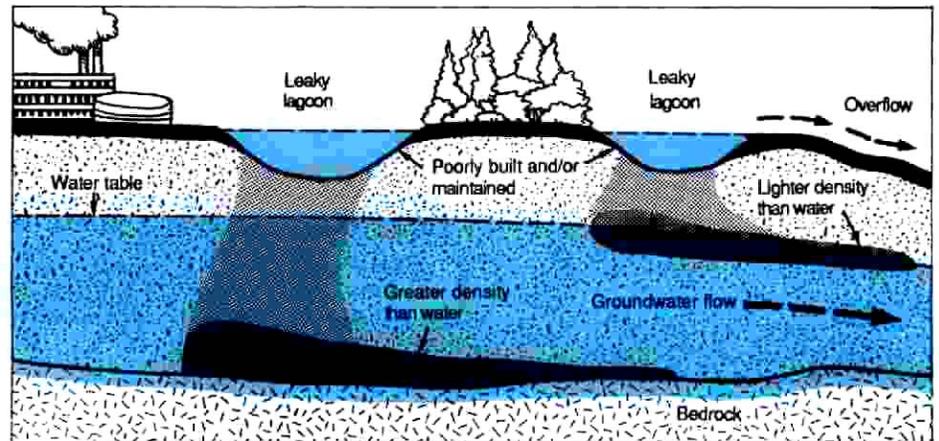
- Spills
- Changes in color, taste, odor of well water
- Unhealthy or dead vegetation near lagoon
- Greener and more vigorous plant growth near lagoon
- Detection of excessive bacteria, chemicals in well water tests

CAUSES:

- Poor installation and maintenance
- Overflows
- Seepage
- Liner failure
- Structural collapse
- Location in sensitive groundwater area

PREVENTION:

- Proper installation and maintenance
- Locate away from sensitive groundwater areas



UNDERGROUND STORAGE TANKS

CONTAMINATION EVIDENCE:

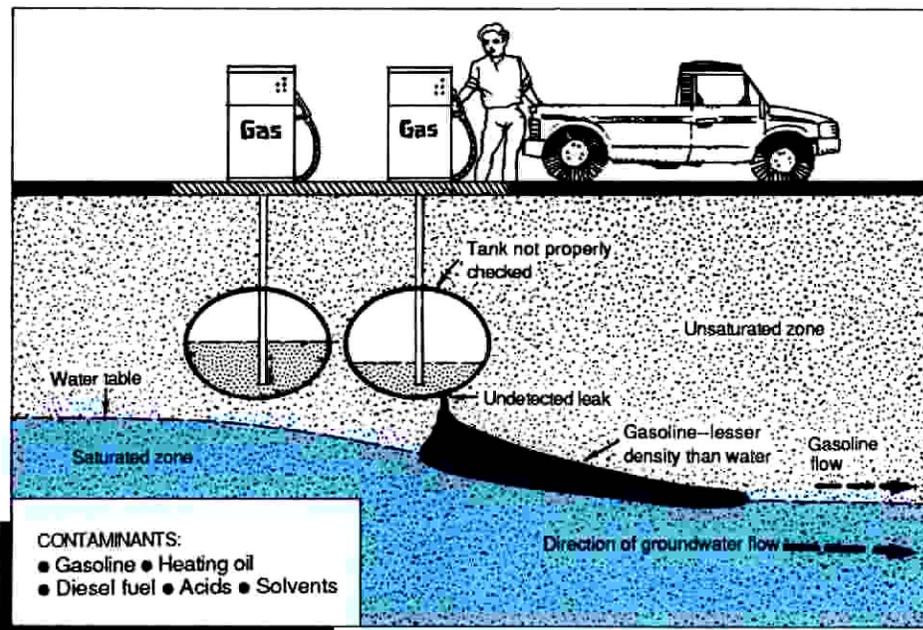
- Petroleum odor in wells or basements
- Tank inventory losses
- Spills
- Detection of leaks

CAUSES:

- Corroded tanks
- Poor installation and/or maintenance
- No testing for tank leaks
- Poor inventory control
- No leak backup containment
- Deterioration of abandoned tanks

PREVENTION:

- Proper installation, maintenance, leak testing and inventory control
- Permit compliance
- Leak backup containment
- Removal of abandoned tanks or filling with inert material



FERTILIZERS

CONTAMINATION EVIDENCE:

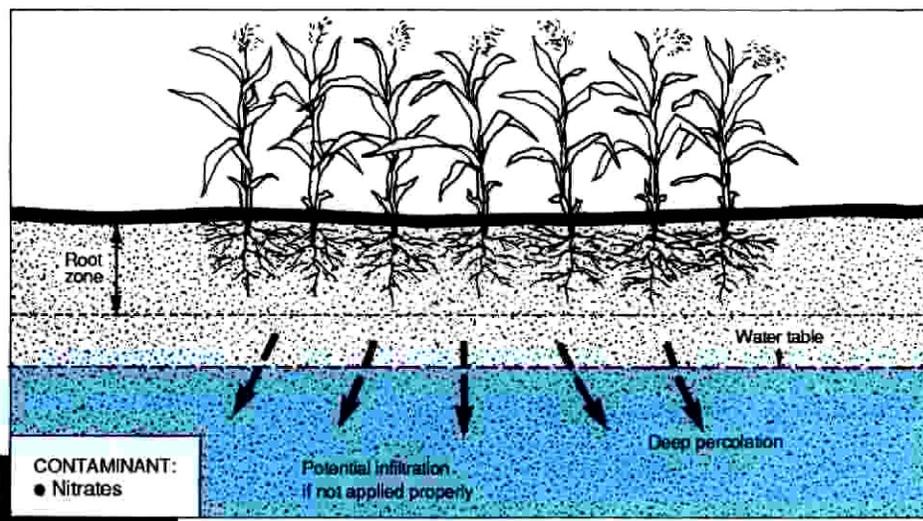
- High nitrate level in well water tests

CAUSES:

- Overfertilization
- Ill-timed application

PREVENTION:

- Careful adjustment of fertilizer application to plant needs and timing for maximum growth benefit
- Storage of animal manure to facilitate land spreading at appropriate times



LAND APPLICATION Sludges and Wastewater

CONTAMINATION EVIDENCE:

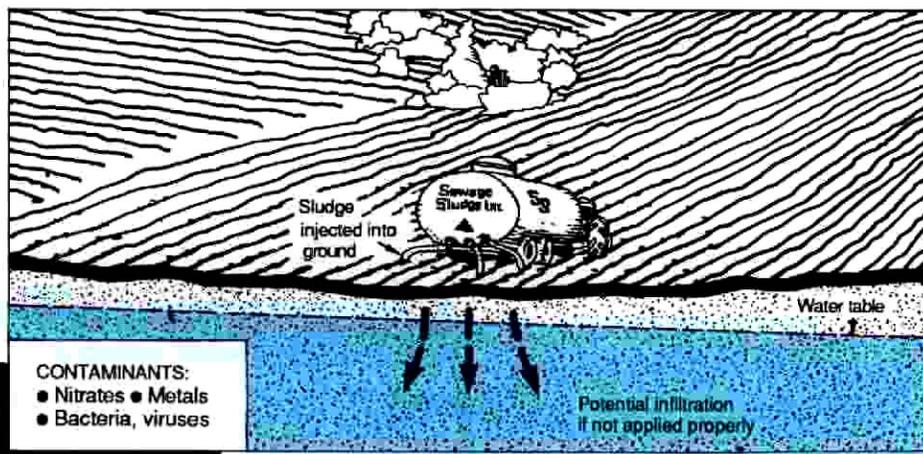
- High bacteria, nitrate levels in well water tests

CAUSES:

- Improper application methods
- Inappropriate soils for application

PREVENTION:

- Compliance with permit requirements



PESTICIDES

CONTAMINATION EVIDENCE:

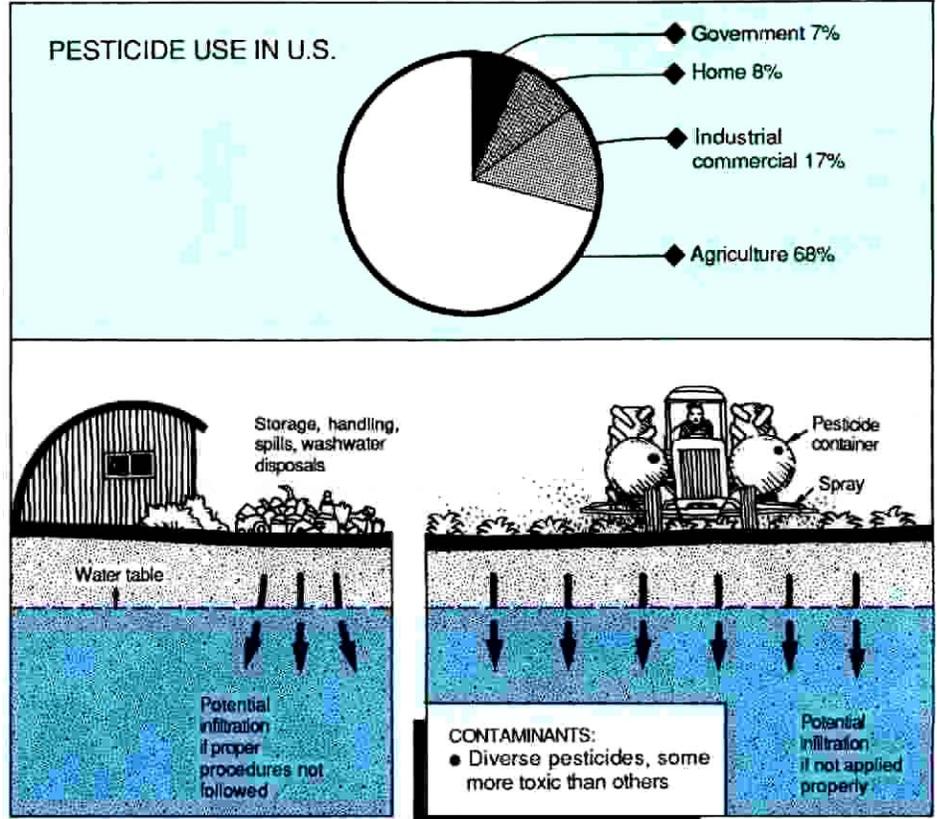
- Detection of pesticides in well water tests
- Ill effects on animals drinking water from nearby wells, springs or surface water
- Ill effects on plants watered with nearby well water
- Ill effects on aquatic life

CAUSES:

- Excessive or ill-timed application
- Improper storage
- Leaching through the soil
- Improper disposal of excess pesticides and rinsewater

PREVENTION:

- Follow use instructions
- Compliance with pesticide certification requirements
- Reduce pesticide use in recharge areas for water wells
- Encourage alternative pest control methods
- Public information/education



HAZARDOUS MATERIALS

CONTAMINATION EVIDENCE:

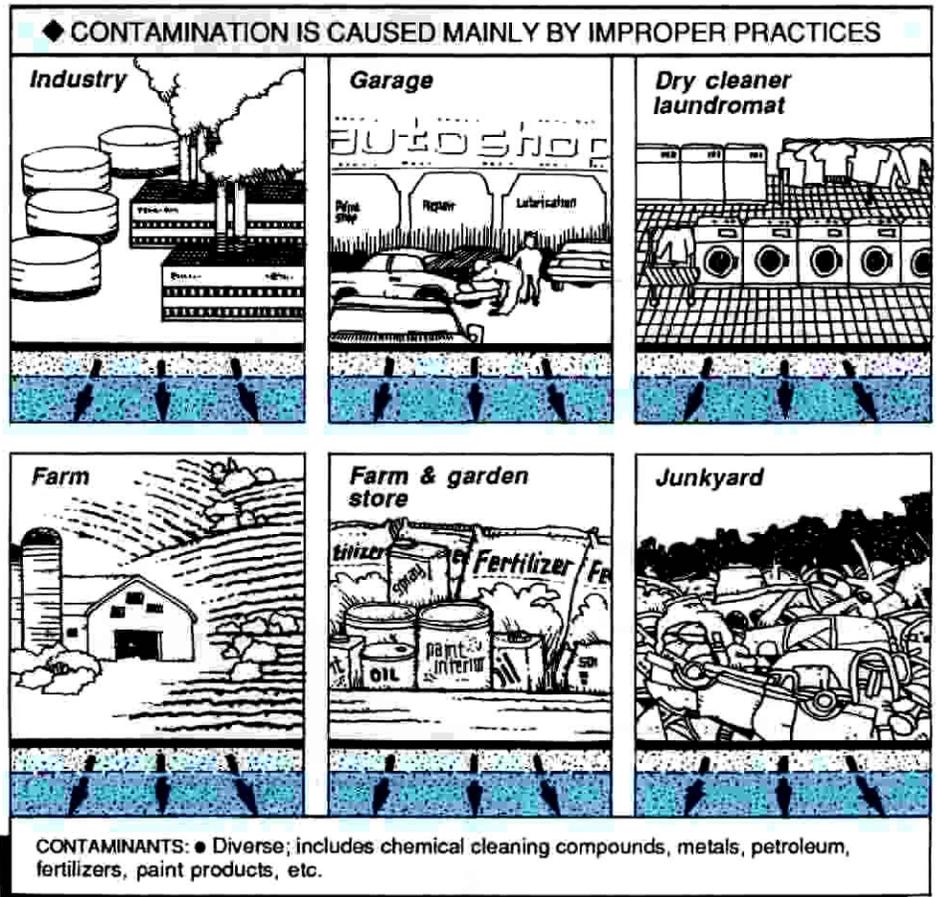
- Spills
- Detection of chemical solvents, metals, nitrates, other chemicals in well water tests

CAUSES:

- Improper storage, handling, use, and disposal
- Spills
- Leaks

PREVENTION:

- Proper storage, handling, use and disposal
- Spill prevention and containment measures
- Compliance with laws and regulations
- Zoning to locate heavy users of hazardous materials away from sensitive groundwater areas
- Public information/education



TRANSPORT and TRANSFER SPILLS

CONTAMINATION EVIDENCE:

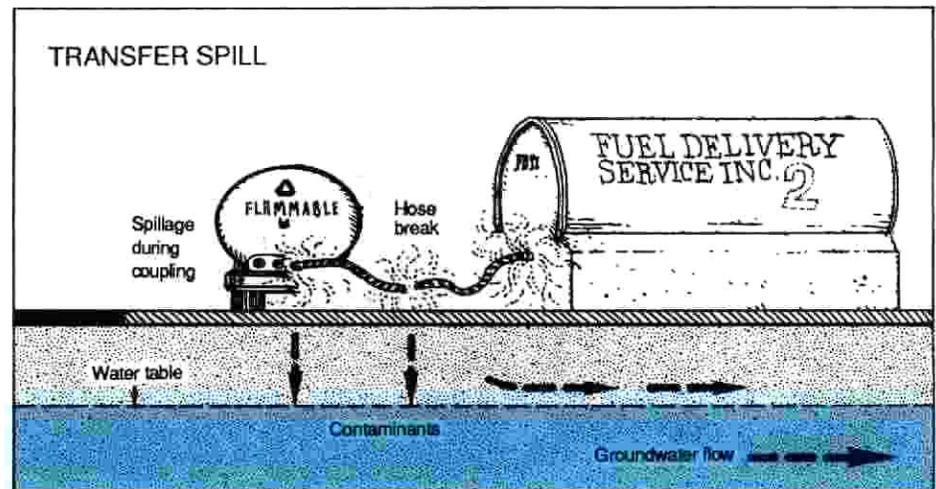
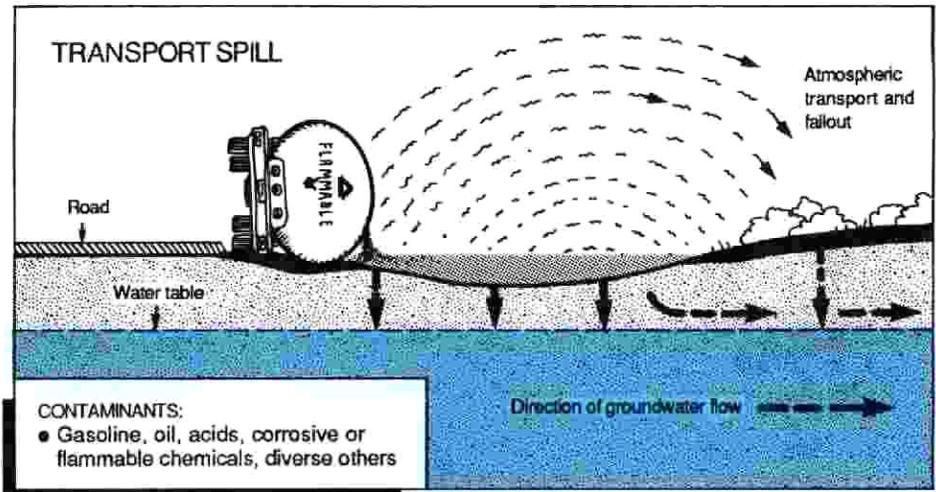
- Spills

CAUSES:

- Accidents
- Inadequate maintenance
- Lack of proper training
- Inadequate provisions for spill containment
- Inadequate spill cleanup procedures

PREVENTION:

- Proper design, installation and maintenance of transfer facilities
- Adequate spill containment and cleanup procedures
- Compliance with permit requirements
- Training programs



PIPELINES

CONTAMINATION EVIDENCE:

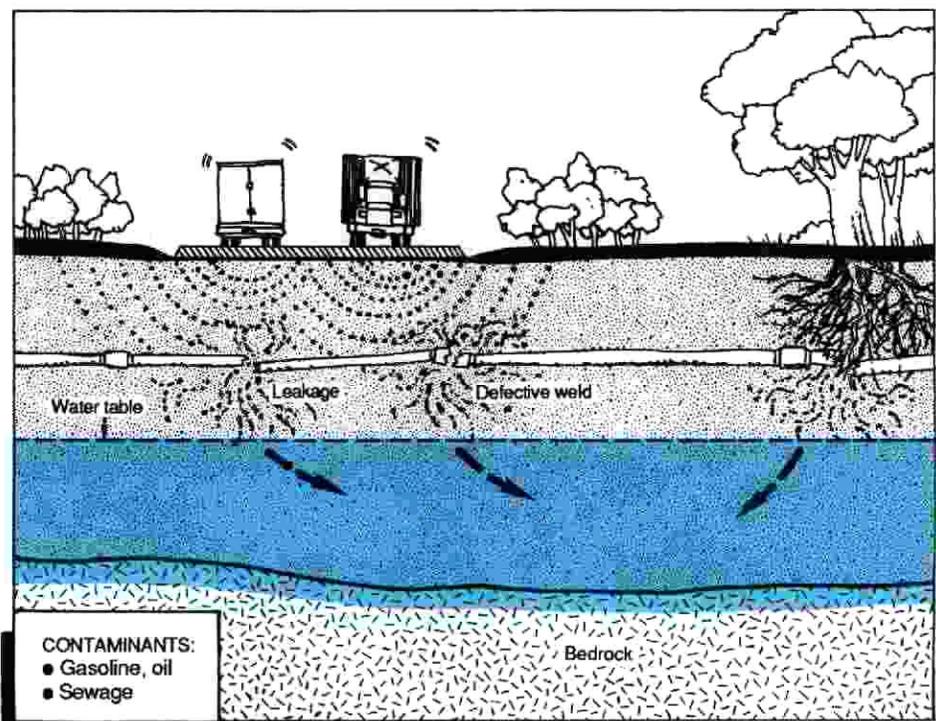
- Odors in basement or well water
- Pipeline flow losses
- Detection of pipeline leaks through inspections
- Detection of excessive bacteria, chemicals in well water tests

CAUSES:

- Corrosion
- Defective welds
- Vibrations from heavy vehicles
- Displacement by tree roots
- Poor installation
- Poor maintenance and inspection

PREVENTION:

- Proper installation
- Regular inspection and maintenance



WELLS

Wells are potential pathways for contaminants to enter groundwater

CONTAMINATION EVIDENCE:

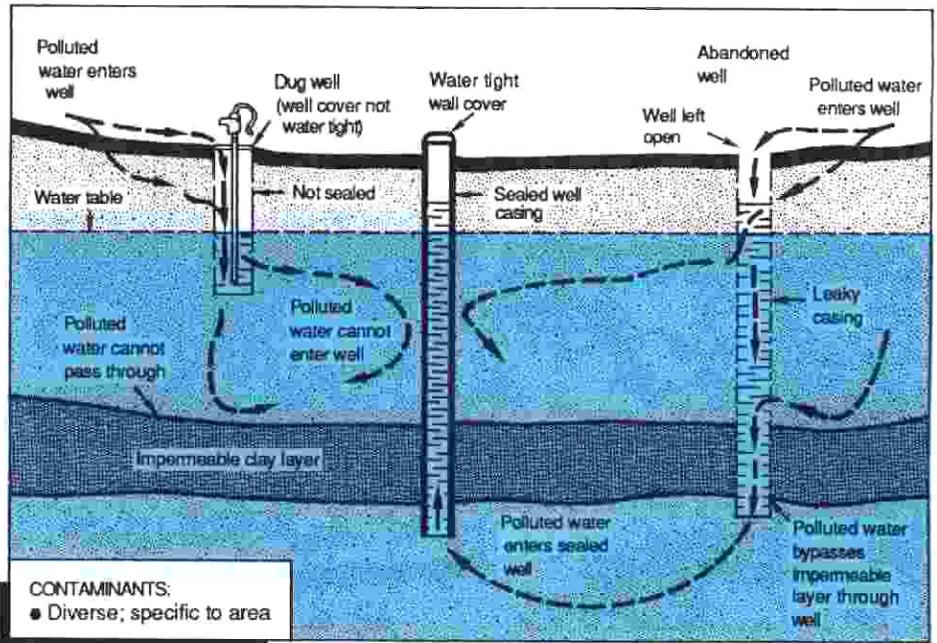
- Detection of high bacteria levels in well water tests
- Well water turbidity
- Detection of other contaminants in well water

CAUSES:

- No well casing or leaky casing
- Well cover not watertight
- Open abandoned wells
- Groundwater movement from contaminated to uncontaminated wells

PREVENTION:

- Watertight well cover
- Tight well casing
- Tight plumbing connections
- Identify and seal open abandoned wells



INACTIVE MINING SITES

CONTAMINATION EVIDENCE:

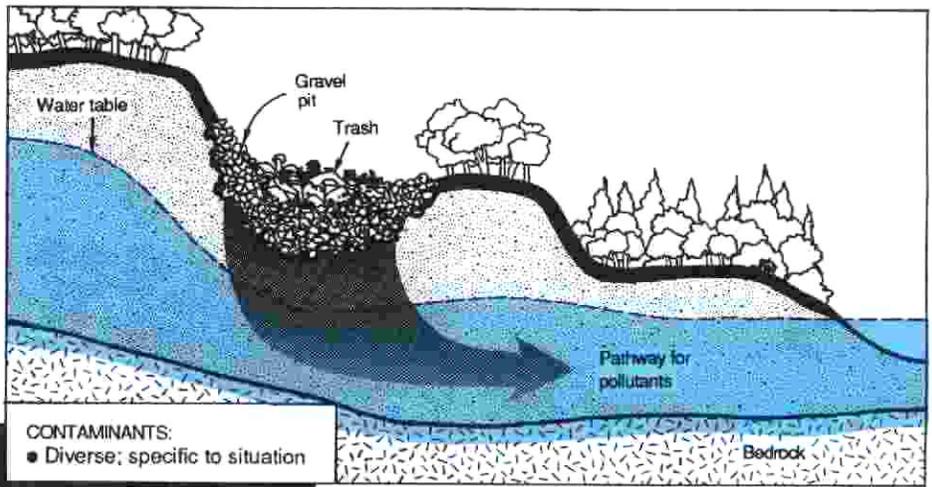
- (Potential) Dumping of wastes in inactive mining pits

CAUSES:

- Rapid infiltration of contaminants due to loss of topsoil filtering capacity

PREVENTION:

- Close unused mining pits by restoring topsoil cover
- Vigilance against waste dumping in inactive mining pits



ANIMAL LOTS

CONTAMINATION EVIDENCE:

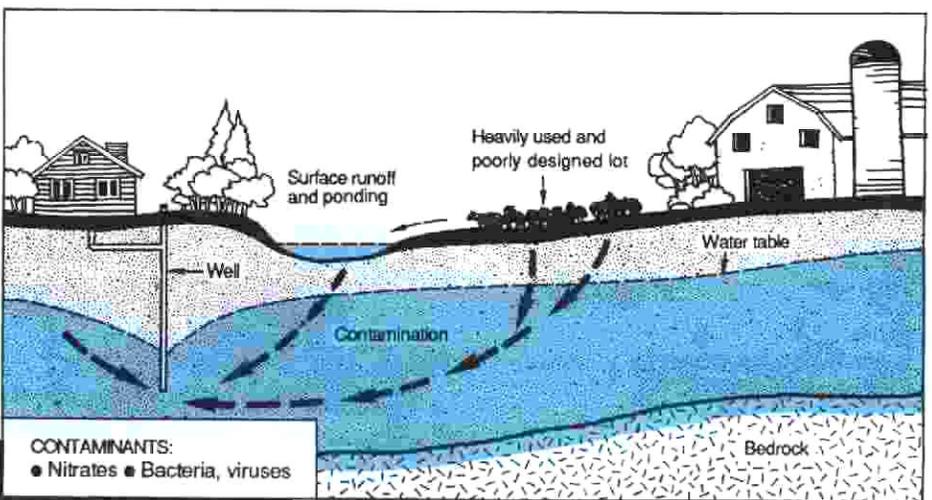
- High bacteria, nitrate levels in well water

CAUSES:

- High animal density
- Shallow depth to water table
- Poor lot drainage
- Failure to regularly clean lot

PREVENTION:

- Proper siting and design
- Control animal density
- Regular cleaning of lot



URBAN RUNOFF

CONTAMINATION EVIDENCE:

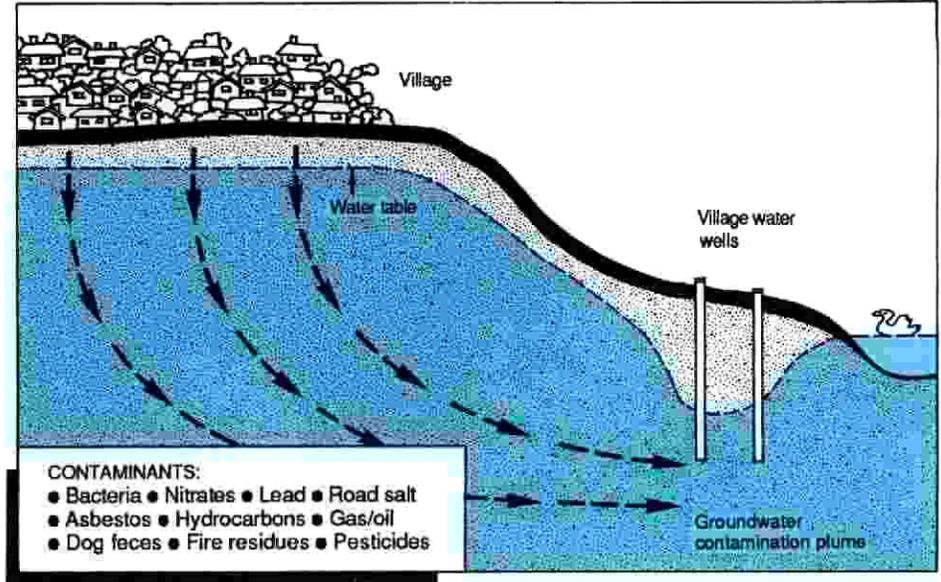
- Detection of chemicals, metals, nitrates, petroleum, etc. in well water

CAUSES:

- Spills
- Random waste disposal
- Abandoned commercial/industrial sites
- Motor vehicle emissions
- Fires

PREVENTION:

- Public information/education
- Street sweeping
- Anti-dumping codes
- Vegetated collection and infiltration basins for street runoff
- Clean up abandoned commercial/industrial sites
- Proper cleanup of fire sites



CONSTRUCTION EXCAVATION

CONTAMINATION EVIDENCE:

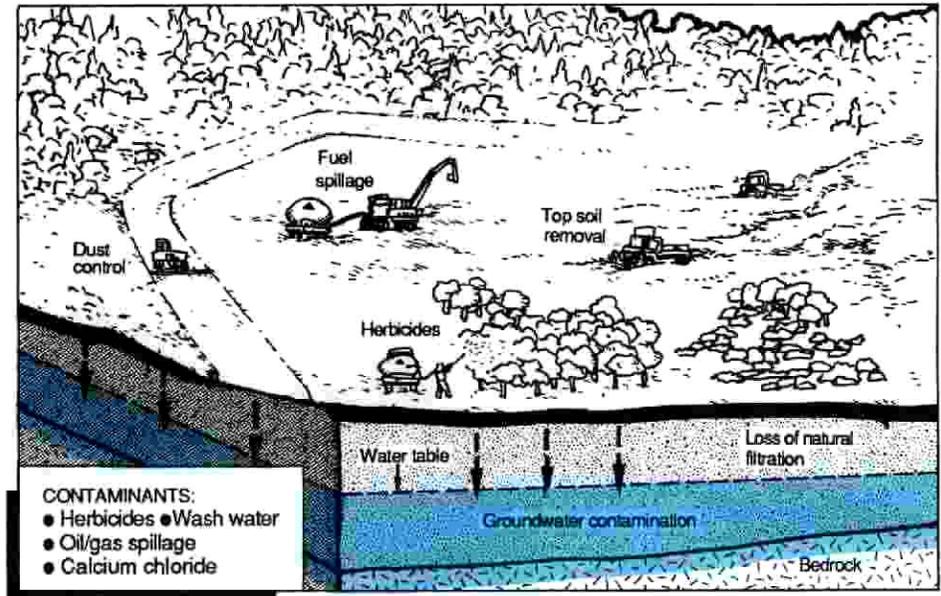
- Spills
- Changes in color, taste, odor, turbidity of water in nearby wells

CAUSES:

- Fuel, chemical spills
- Road dust control runoff
- Excessive and/or improper use of chemicals

PREVENTION:

- Spill containment and cleanup procedures
- Follow recommended practices for safe use of fuels and other hazardous substances



CEMETERIES and ANIMAL BURIALS

CONTAMINATION EVIDENCE:

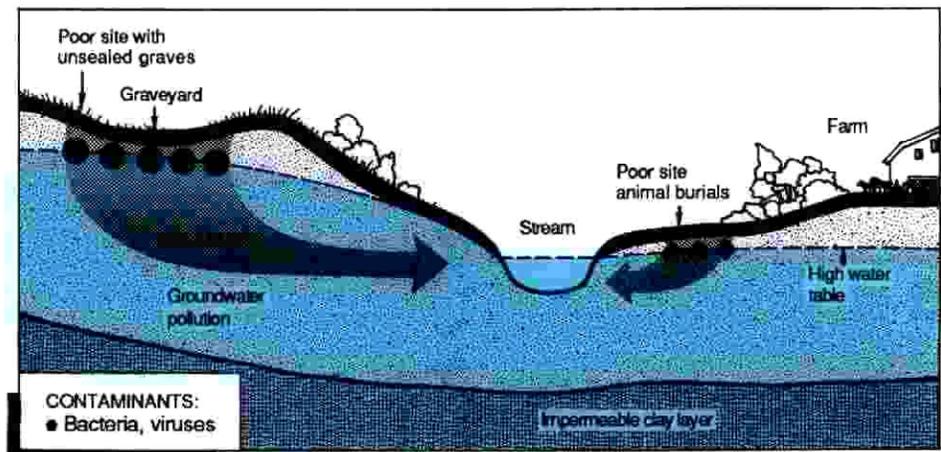
- Detection of high bacteria levels in nearby well water tests

CAUSES:

- High water table

PREVENTION:

- Avoid high water tables for burial sites
- Use watertight caskets in cemeteries with high water tables



ATMOSPHERIC POLLUTANTS

CONTAMINATION EVIDENCE:

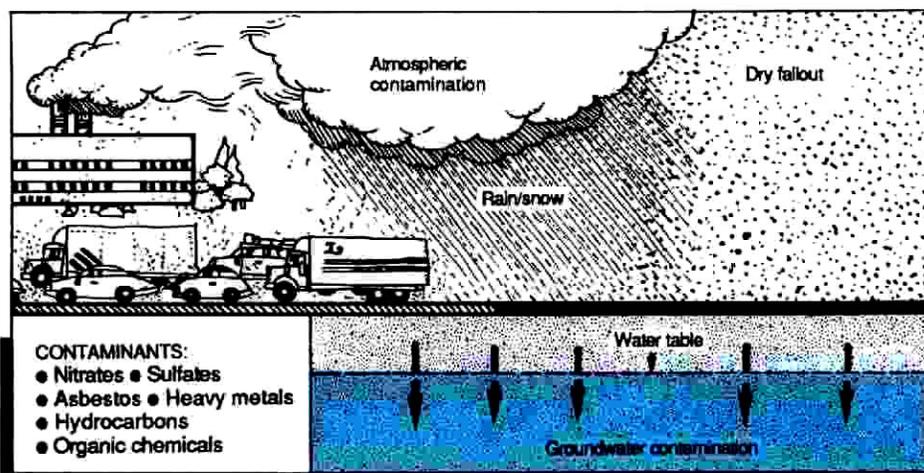
- Detection of elevated levels of sulfates, nitrates, heavy metals, asbestos, hydrocarbons, other chemical compounds in well water tests

CAUSES:

- Emissions from motor vehicles, power plants, industries

PREVENTION:

- Federal and state emission controls



NATURAL SUBSTANCES

CONTAMINATION EVIDENCE:

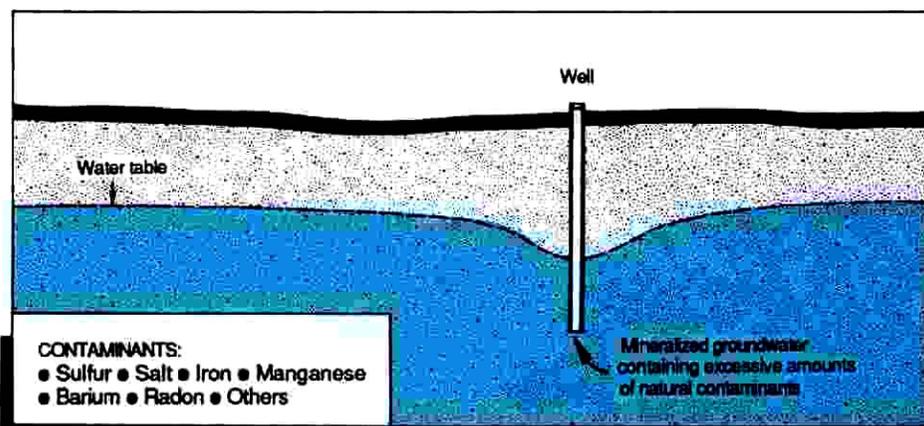
- Bad taste or odor in well water
- Stains on water fixtures
- Detection in well water tests

CAUSES:

- Natural origin

PREVENTION:

- Avoid areas where natural groundwater problems exist, if feasible
- Use water treatment devices
- Change to public water supply, if feasible



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