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 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.

By Lyle S. Raymond
New York State Water Resources Institute
Center for Environmental Research
Cornell University
Michigan State University contact: Eckhart Dersch
Department of Resource Development

This bulletin was funded by the New York Soft Water Resources Institute, a unit of the Center for Environmental Research, Cornell University, and the state of New York Temporary State Commission on Tug Hill, Watertown, N.Y. Clifford Scherer, Department of Communications, Cornell University, served as faculty consultant. The bulletin was designed and illustrated by Lito Manto.

Many individuals contributed to the bulletin by their reviews and critical comments. These include members of the New York State Water Resources Institute staff and the Tug Hill Commission staff Todd Miller, U.S. Geological Survey; Cornell Cooperative Extension agents in the four counties included in the Tug Hill Commission's Jurisdiction; and representatives of the user public who generously gave their time to provide reaction to preliminary draft of this bulletin.

MSU is an Affirmative-Action Equal Opportunity Institution. Cooperative Extension Service programs are open to all without regard to race, color, national origin, sex or handicap. Issued in furtherance of Cooperative Extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Gail L. Imig, director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824. This information is for educational purposes only. Reference to commercial products or trade names does not imply endorsement by the Cooperative Extension Service or bias against those not mentioned. This bulletin becomes public property upon publication and may be reprinted verbatim as a separate or within another publication with credit to MSU. Reprinting cannot be used to endorse or advertise a commercial product or company.
SEPTIC SYSTEMS

CONTAMINATION EVIDENCE:
CWastewater shows above ground
CDetection of excessive bacteria, chemicals in well water tests

CAUSES:
CPoor installation and/or maintenance
CDisposal of household chemicals, such as paint thinners, into the system
COverloading the system with a garbage disposal unit
CUse of septic tank cleaning additives
CToo many closely-spaced septic systems in a limited area

PREVENTION:
CProper installation
CInspection and cleaning every 2-4 years, annually if garbage disposal unit is used
CDo not dispose of household chemicals into the system
CBan 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:
CPetroleum odor in well water
COther chemical odors
CDetection of chemicals in well water tests

CAUSES:
CImproper disposal of chemicals, oil, pesticides, other wastes and used containers
CLack of disposal facilities for small amounts of hazardous wastes

PREVENTION:
CPublic information/education
CDisposal facilities for small hazardous wastes generators
CEnforcement against improper waste disposal
HOUSE and GARDEN CHEMICALS

CONTAMINATION EVIDENCE:
Condition 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

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 feasible

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
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
PESTICIDES

CONTAMINATION EVIDENCE:
- Detection of pesticides in well water tests
- Effects on animals drinking water from nearby wells, springs or surface water
- Effects on plants watered with nearby well water
- 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 post 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

CONTOAMINATION 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

CONTOAMINATION 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

CONTOAMINATION 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

REFERENCES


