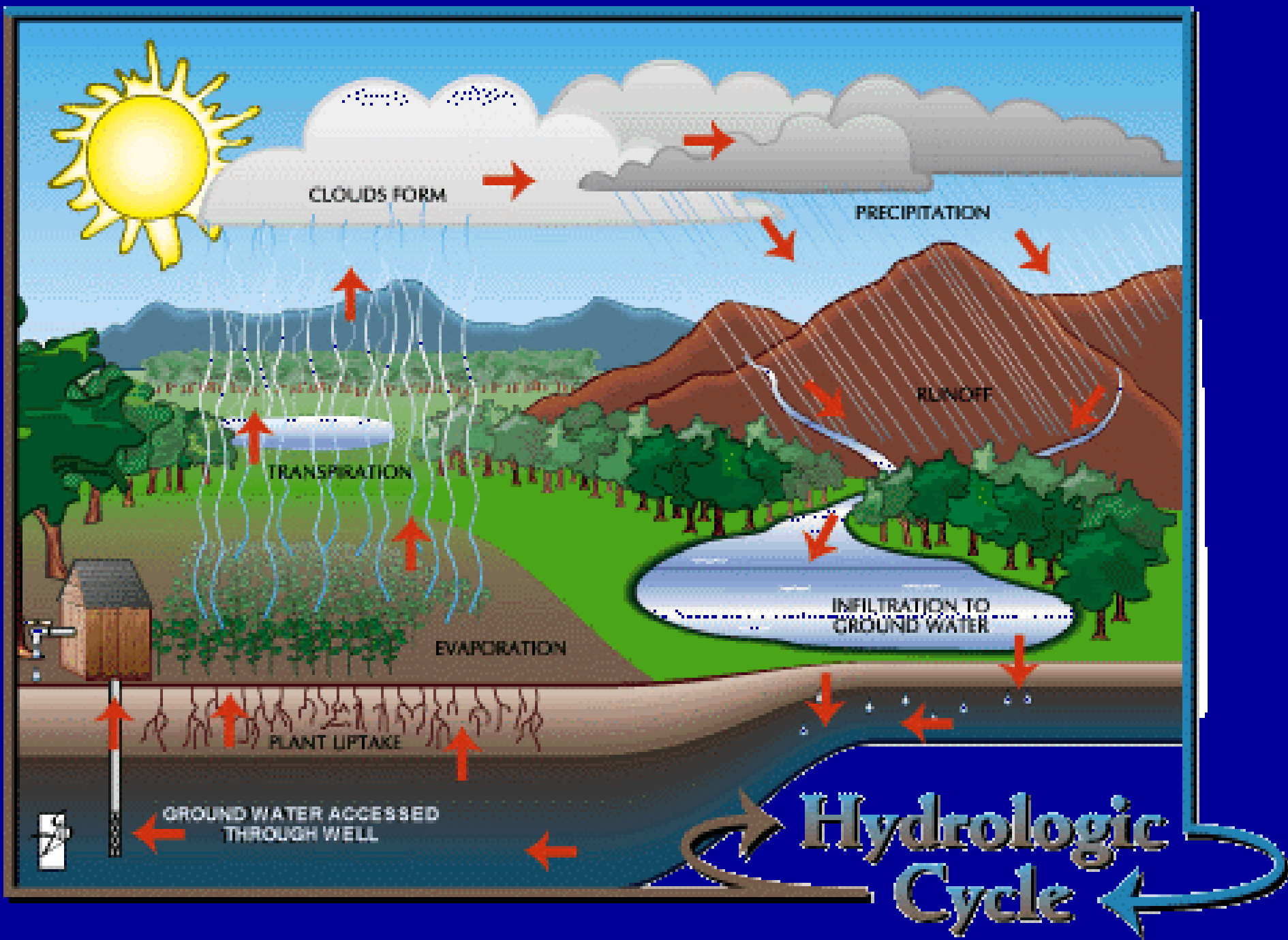


Basic Water Chemistry



New Mexico Rural Water Association
3413 Carlisle Blvd NE
Albuquerque, NM 87110
505-884-1031



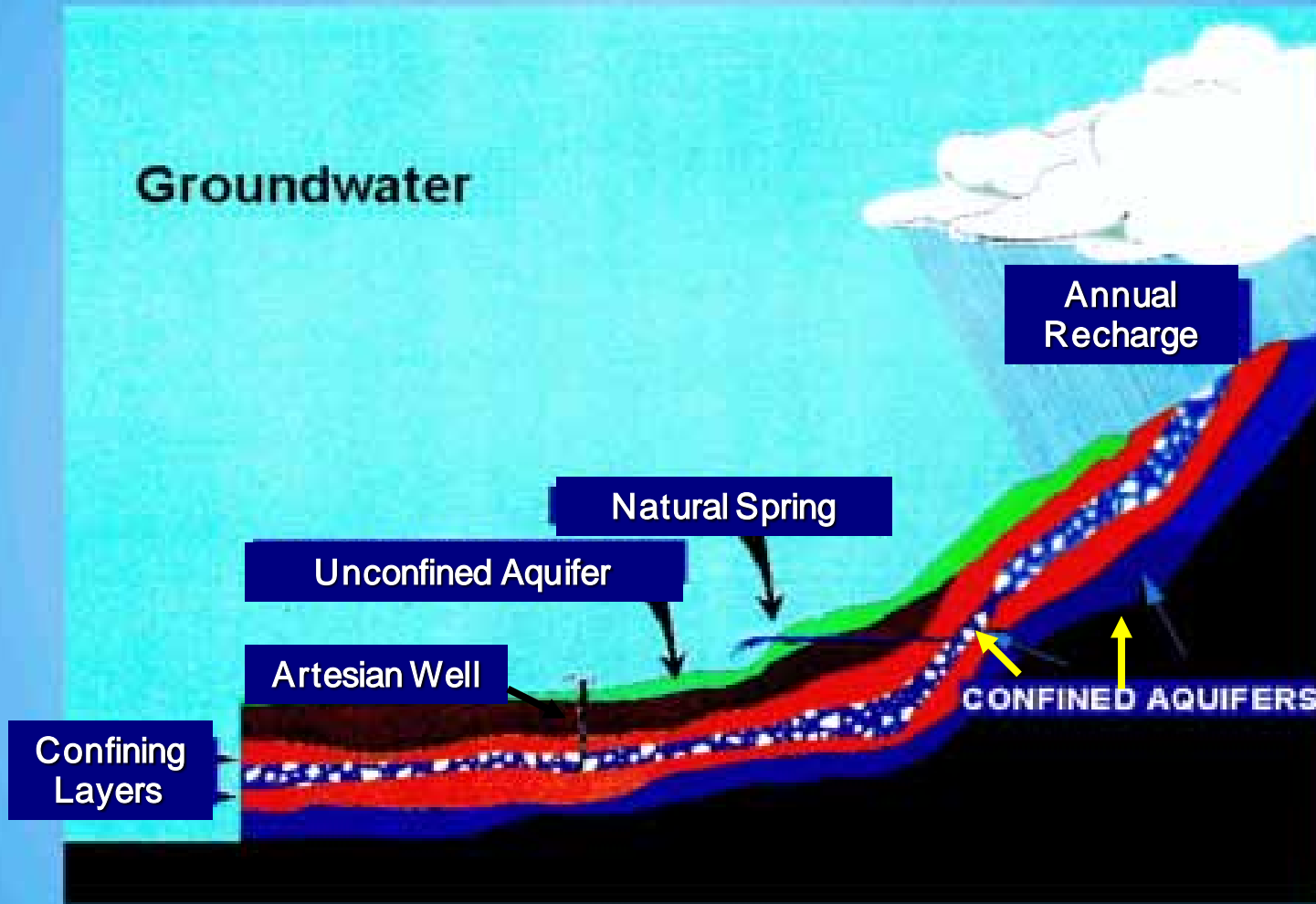
Source Water

Groundwater: Drilled wells, springs

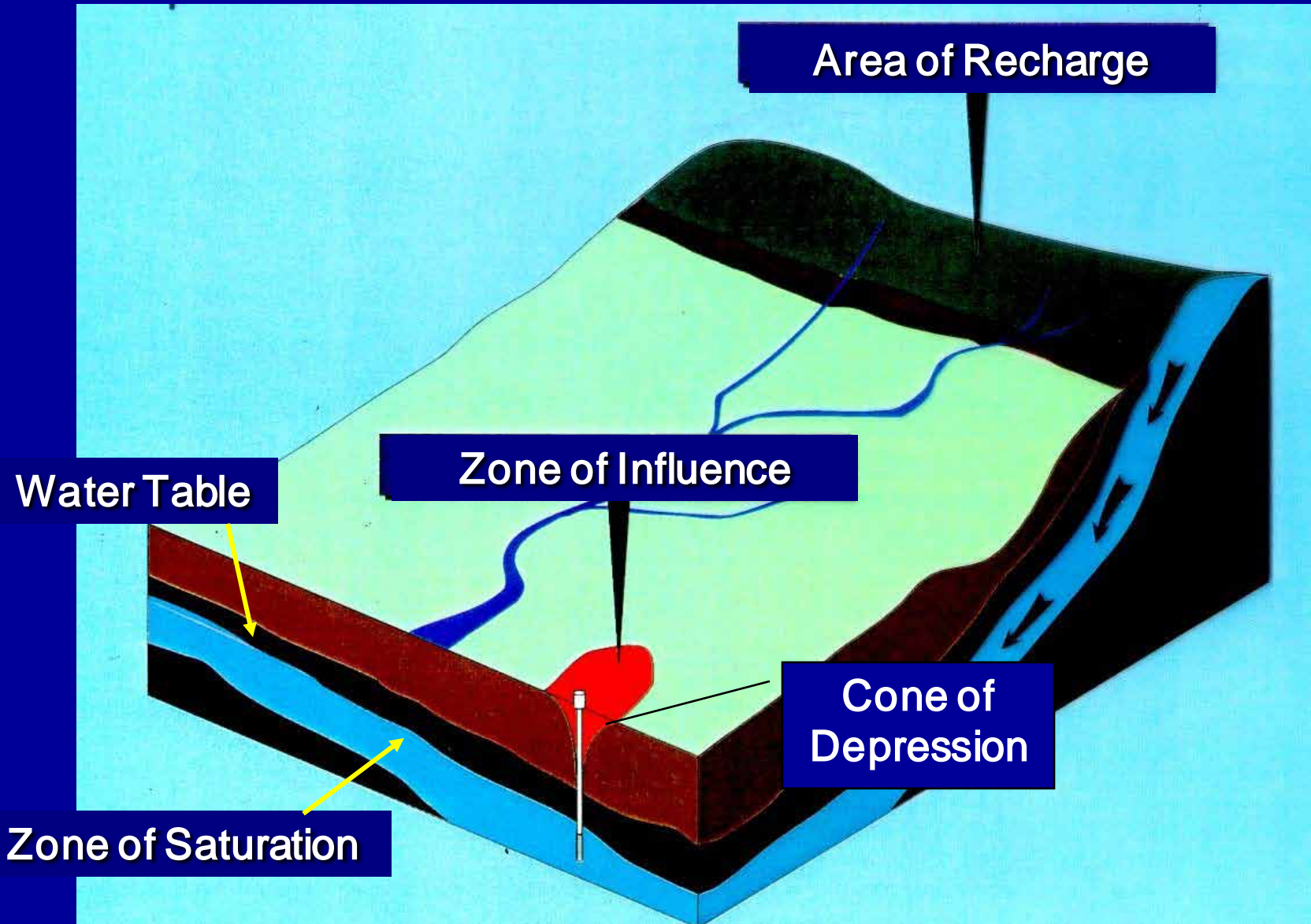
Surface water: Lakes, rivers, streams

Groundwater under the direct influence of surface water (GUDISW): Shallow wells influenced by surface water

Aquifer Classification



Well Site Anatomy



GUDISW

“Groundwater under the direct influence of surface water”

Shallow wells and springs which are recharged by surface water

GUDISW can contain the impurities that surface water contains, which also means more complex treatment methods.





Influenced by surface water?

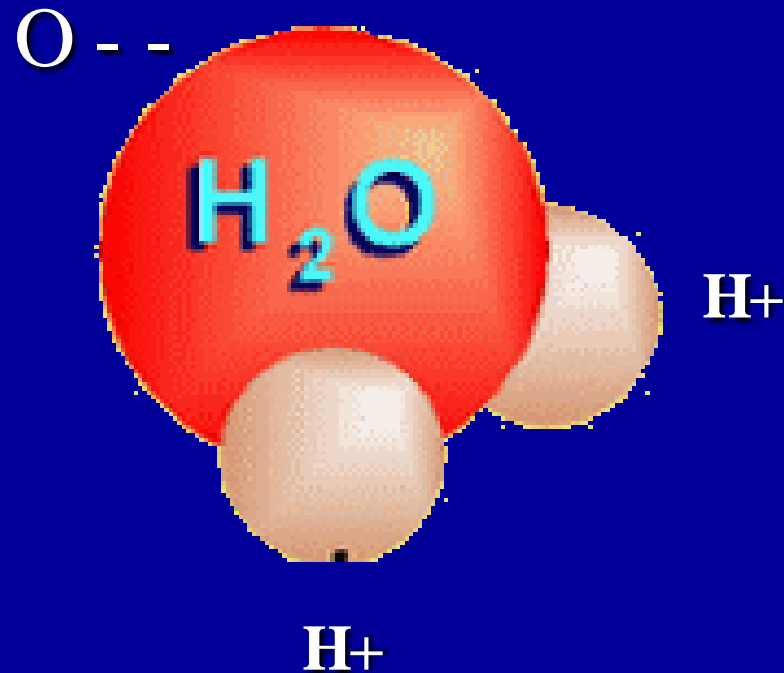
- Is water quality same as for lake?
- Does turbidity increase/decrease with lake level?
- Does well level increase/decrease with lake level?
- Is *Cryptosporidium* or *Giardia* present?



Water -

“The Universal Solvent”

- Solids
- Microorganisms
- Gases
- Chemicals
- Minerals



Source Water Characteristics

Physical characteristics:

Water characteristics that can be seen, smelled or tasted, generally the basis for customer complaints.

Chemical characteristics:

Calcium, magnesium, iron, arsenic, hydrogen sulfide. Some of these characteristics may be seen, smelled or tasted, but are of a chemical origin.

Biological characteristics:

Microorganisms that are living in the water.

Physical characteristics

Turbidity:

The cloudy appearance of water caused by the presence of suspended or colloidal matter.

- **Suspended solids, colloidal in size.**
- **The property of water that causes light to be scattered or absorbed.**
 - **Problems**
 - **Taste**
 - **Odor**
 - **Hiding place for microorganisms**
 - **Interfere with disinfection**

**The reading is in NEPHELOMETRIC TURBIDITY UNITS or
NTU's**

Physical characteristics

Taste and odor:

Can be caused by gases such as hydrogen sulfide, organic material, iron or algae.

Color:

Caused by organic material, such as vegetation.
(Tundra tea)

Common Groundwater Characteristics:

ü Iron

ü Manganese

ü Fluoride

ü Calcium

ü Sulfate

ü Magnesium

ü Arsenic

ü Hydrogen sulfide

ü Nitrate

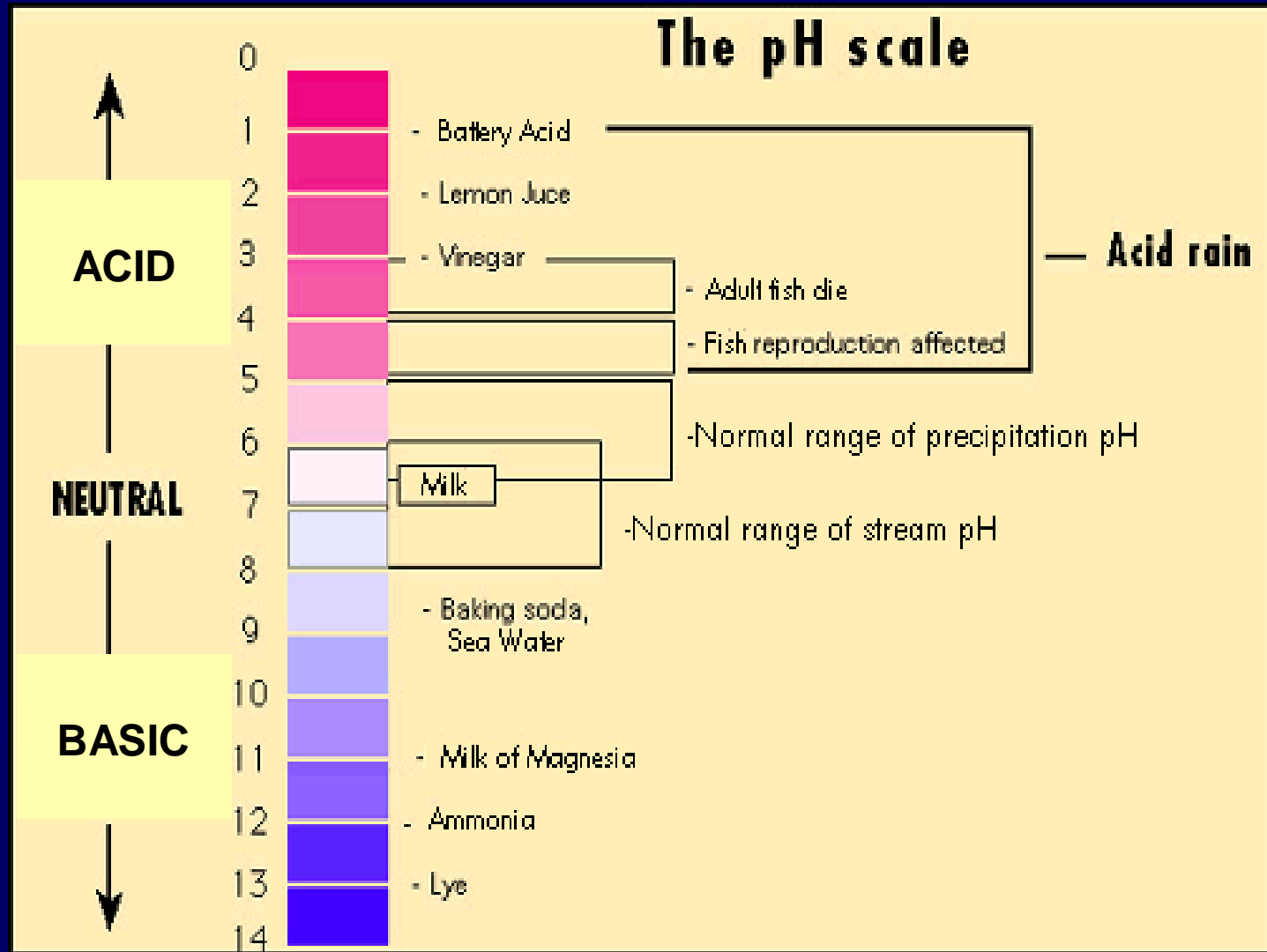
ü Radiological
contaminants

Common Surface Water Characteristics

- ü Turbidity
- ü Biological
- ü Chemical
- ü Physical
- ü Living organisms
- ü Radiological contaminants
- ü Industrial/ commercial
- ü Sediment
- ü Decaying animal/ vegetation
- ü Hydrocarbons

Surface water changes depending on human activity, climatic changes and seasonal disturbances.

pH – power of Hydrogen



Concentration of Hydrogen ions compared to distilled water

Examples of solutions at this pH

10,000,000	pH = 0	Battery acid, Strong Hydrofluoric Acid
1,000,000	pH = 1	Hydrochloric acid secreted by stomach lining
100,000	pH = 2	Lemon Juice, Gastric Acid Vinegar
10,000	pH = 3	Grapefruit, Orange Juice, Soda
1,000	pH = 4	Tomato Juice Acid rain
100	pH = 5	Soft drinking water Black Coffee
10	pH = 6	Urine Saliva
1	pH = 7	"Pure" water
1/10	pH = 8	Sea water
1/100	pH = 9	Baking soda
1/1,000	pH = 10	Great Salt Lake Milk of Magnesia
1/10,000	pH = 11	Ammonia solution
1/100,000	pH = 12	Soapy water
1/1,000,000	pH = 13	Bleaches Oven cleaner
1/10,000,000	pH = 14	Liquid drain cleaner

Hardness

§ Calcium

§ Magnesium

Hard water:

Water that requires lots of soap to get any suds.

Soft water:

Water that reacts with soap to produce a slimy residue.

Soft water = 0 – 75 mg/l

Moderate = 75 – 150 mg/l

Hard = 150 – 300 mg/l

Very hard = Over 300 mg/l

What are the major problems associated with hard water?

Calcium carbonate build up in pipes and plumbing fixtures



What is the major problem with soft water?

With no hardness pipes have no coating leaving them at risk for Corrosion.

Corrositivity:

Tendency of water to dissolve metal.

Corrosive water can bring metals into solution such as lead and copper.

Corrosive water is based on :

ü **pH**

ü **Temperature**

ü **Hardness**

ü **Total dissolved solids**

ü **Alkalinity**

Iron and manganese

Iron:

Reddish brown color, can stain clothes and plumbing fixtures.

Manganese:

Brownish, blackish color, also stains clothes and plumbing fixtures.

Iron and manganese are considered nuisance constituents in water. They can also cause some taste and odor problems.

Iron and Manganese Removal Methods:

ü Aeration

ü Ion exchange

ü Sequestering agents

ü Potassium permanganate/greensand

ü Cartridge filters

**ü Addition of chlorine followed by cartridge
filtration**

Dissolved gases found in water may include:

- ü Oxygen = bubbles in the water**
- ü Carbon dioxide**
- ü Methane gas = Tastes like garlic, explosive.**
- ü Hydrogen sulfide = Smells like rotten eggs.**
- ü Radon = Suspected carcinogen, can accumulate, buildup.**

Biological Characteristics of Water

**Disease-causing organisms are called
Pathogens. Water-borne pathogens include:**

§ Bacteria

§ Protozoa

§ Viruses

Biological Characteristics of Water

Bacteria:

Single celled organisms Range in size from 0.5 – 2 microns wide and 1-10 microns long

(micron = metric unit of measurement equal to 1 thousandth of a millimeter)

It would take one thousand bacteria lying side by side to reach across the head of a straight pin

Bacteria are the most common microorganism in water.

Biological Characteristics of Water

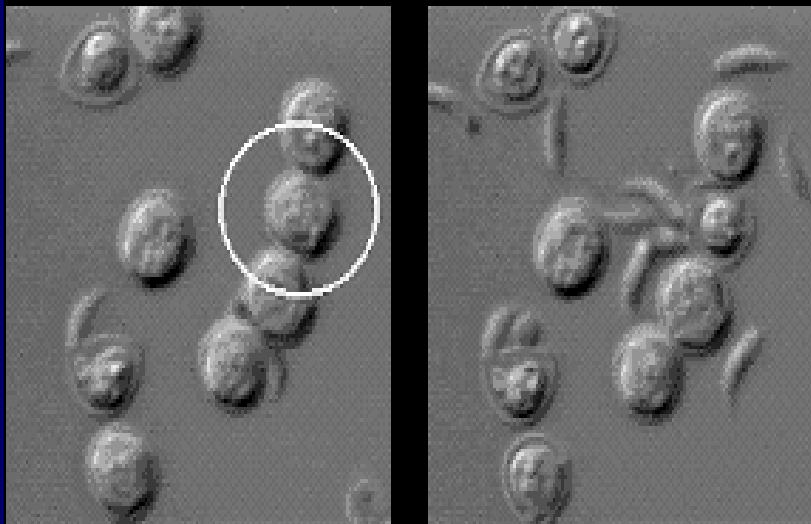
Diseases caused by Bacteria

- **Typhoid Fever**
- **Gastroenteritis**
- **Cholera**
- **Tetanus**
- **Botulism**

Biological Characteristics of Water

Protozoa:

- Size
 - Giants of the microbial world
 - One celled animal-like organism
 - From 10m to 20 , to 400 to 500 m
 - Grouped by locomotion system



Cryptosporidium

Protozoa go through a life cycle, in which one phase they are in the resting or cyst phase, which makes them hard to kill with Chlorine.

Biological Characteristics of Water

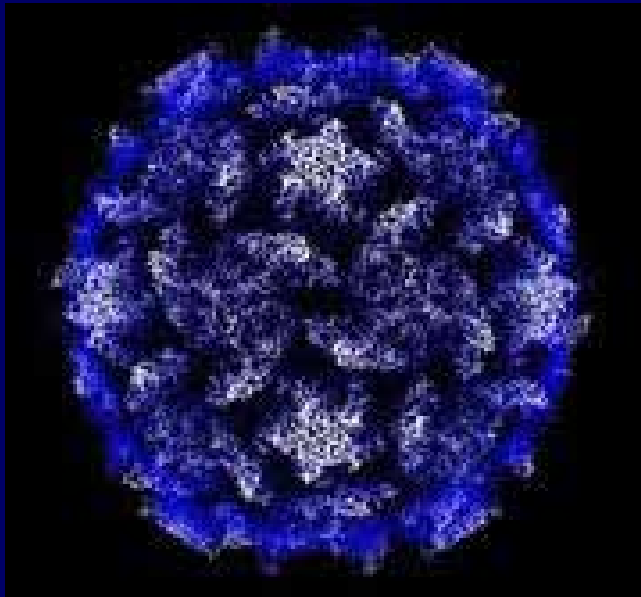
Diseases Caused by Protozoa:

- Giardia
- Cryptosporidium
- Amoebic Dysentery

Biological Characteristics of Water

Viruses:

- **Size – 0.02 to 0.25 microns in diameter**
 - **Midgets of the microbial world**
- **Difficult to destroy by normal disinfection practices**
- **Need a Host**



Polio virus

Biological Characteristics of Water

Diseases caused by Viruses

- **Viral Gastroenteritis**
- **Small Pox**
- **Poliomyelitis**
- **Infectious Hepatitis**
- **SARS – severe acute respiratory syndrome**

Indicator Organisms

Coliform Bacteria

Hearty organism that provides the first “clue” of possible presence of pathogens in water supply

Fecal Coliform

Originates from the intestinal tracts of warm-blooded animals

Indicates presence of contamination from fecal matter

Drinking Water Protection Program (DWPP)

Source Water Assessments

A report or study that identifies those factors that can affect the source water quality and how to mitigate them.

Groundwater Protection

Establishes min separation distances between drinking water sources and potential sources of contamination.

Wellhead Protection

Program designed to prevent contamination in and around the area of the well.

What are some pollutants and contaminants you may find in your Surface water source?

- q Wastewater treatment effluent**
- q Animal wastes**
- q Industrial discharges**
- q Recreational contaminants (boats, wave runners)**
- q Surface water runoff flowing into the water source can pick up many types of contaminants.**

Surface water requires more complex treatment processes to make it safe for public consumption.

What are some protective measures that can be taken for surface water?

Q Educate people

Q Try to keep potential contaminants out of the surface water.

- Fence off**
- Zoning laws**

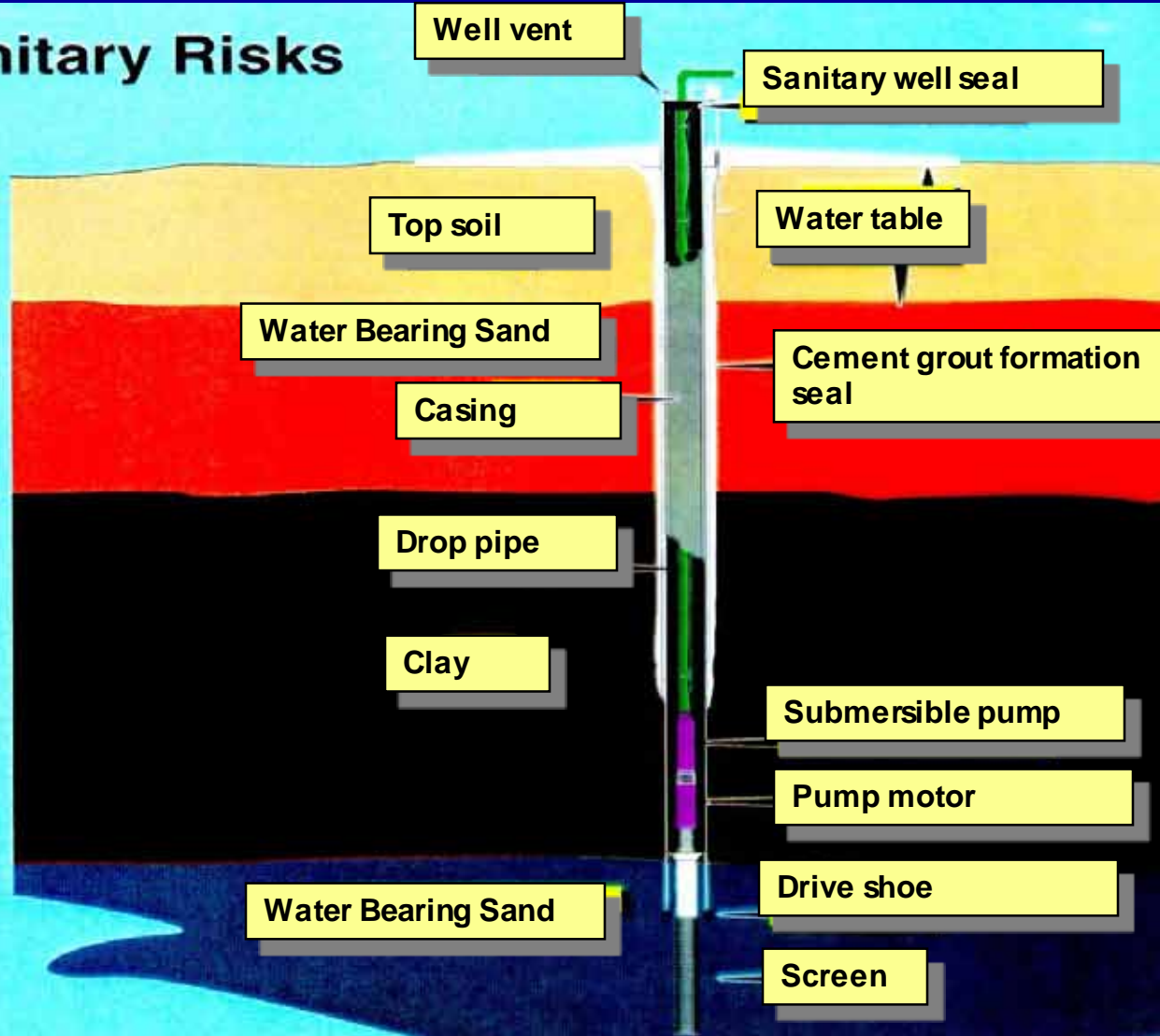
Wells

- q **Dug wells** 2 ft diameter, hand dug
- q **Driven well** Drive lengths of pipe into the ground
- q **Bored well** Large auger 50-70 ft
- q **Drilled well** Drilled, can go as deep as 1,000 ft, casing, screen.

Well Components

Wells - Specific Sanitary Risks

Domestic Wells



Well Logs

A written report produced by the well driller during the drilling and includes:

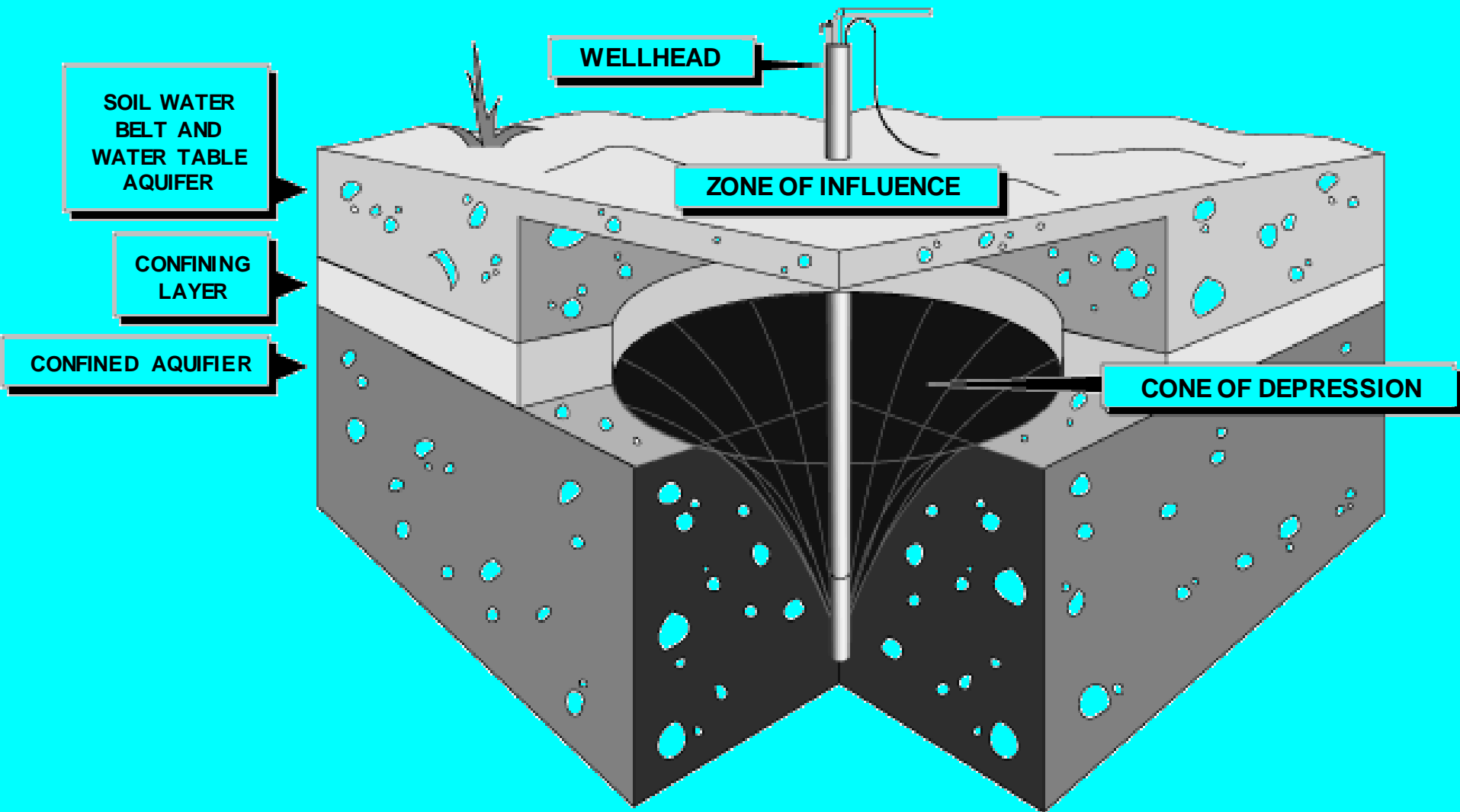
- q A description of the geologic material that was encountered during drilling
- q The depths at which they occurred
- q The depth to groundwater
- q Total well depth
- q The length, diameter, wall thickness, and type of casing
- q Location and type of casing perforations or screen
- q Location and type of grouting
- q Notify SEO, NMED
- q <http://www.ose.state.nm.us>

Wellhead Protection Program

What are some protective measures that can taken to protect wells from Pollutants?

- Q Keep your well house clean**
- Q Don't store lawnmowers, weed eaters, paint, or anything else that can contaminate your well in the well house.**
- Q Make sure the sanitary seal is secure and no contaminates can get into the well.**
- Q If you don't have a well house, protect your well from contamination by not allowing old cars, snow machines or wheelers from parking near the well head. Old vehicles tend to leak oil, transmission fluid, brake fluid and antifreeze.**

Wellhead Protection Area



PAK-TANK
MANUFACTURED BY THE COMPANY

12-1374











Well abandonment

Abandoned wells pose a contamination threat to the aquifer it is drilled in.

The open well casing serves as a direct conduit for contaminants to get into.

The aquifer may have other wells drilled in it which can become contaminated.

NMED/SEO has well abandonment procedures available to the public.

