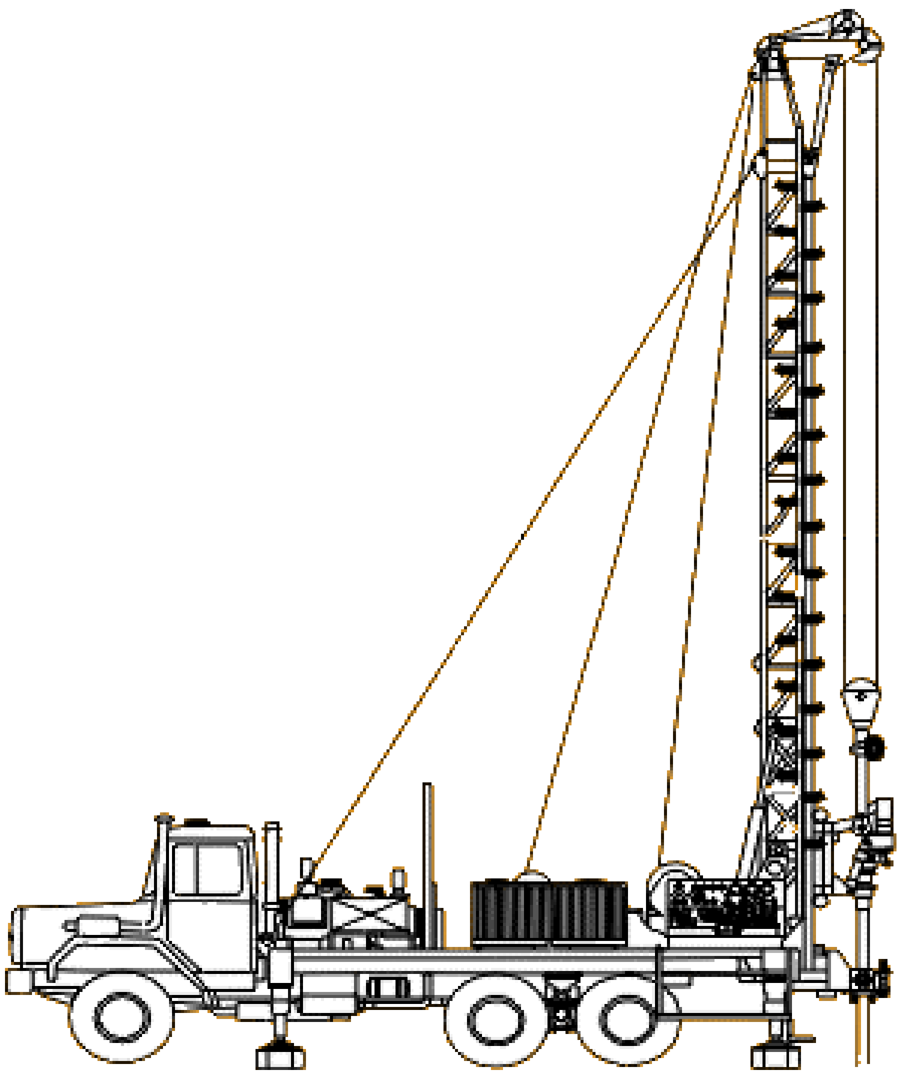
GROUND WATER AND WELLS

IN BALTIMORE COUNTY, MD



Preface

In Baltimore County, approximately 31,000 households (10% of the population) depend upon ground water as their source of potable water and use septic systems as a means of sewage disposal.

Some of the most common questions asked by County residents regarding their well water include:

- *"What is the quality of our well water in Baltimore County?" and*
- *"Is there enough ground water in Baltimore County to support current and future needs?"*

This booklet has been designed to answer these and other questions by relating some basic principles of local hydrogeology, clarifying well construction requirements, and explaining the County's ground water protection strategy.

The mission of the Ground Water Management Section of the Department of Environment Protection and Sustainability (EPS) is to manage and protect Baltimore County's ground water resources and domestic water supplies.

The Ground Water Management program derives its authority from the Baltimore County Code, State of Maryland Regulations (C.O.M.A.R.), and Federal Drinking Water Regulations (USEPA Office of Water). Specific regulations applicable to this publication include C.O.M.A.R. 26.04.04, which outlines well construction regulations; and Baltimore County Code 34-2 which contains provisions to protect buyers of property located in ground water-dependent areas by mandating standards for adequate well yield and water quality. Baltimore County Code 34-1 authorizes EPS to require hydrogeological studies where the subdivision of land is proposed.

In July 1993, the Baltimore County Council adopted a Ground Water Management and Protection Strategy as a formal Amendment to the County Master Plan. Great emphasis is placed on the ground water education element of the Strategy and it is recognized that protection of the resource is achieved by successful implementation of this component. This booklet was written to assist the public with their understanding of general ground water principles, regulations, and practices, which may help to alleviate some of the common misconceptions that exist. We hope that you find this informative and will strive to employ practices that will help to ensure that our ground water supply remains safe and adequate for both present and future generations.

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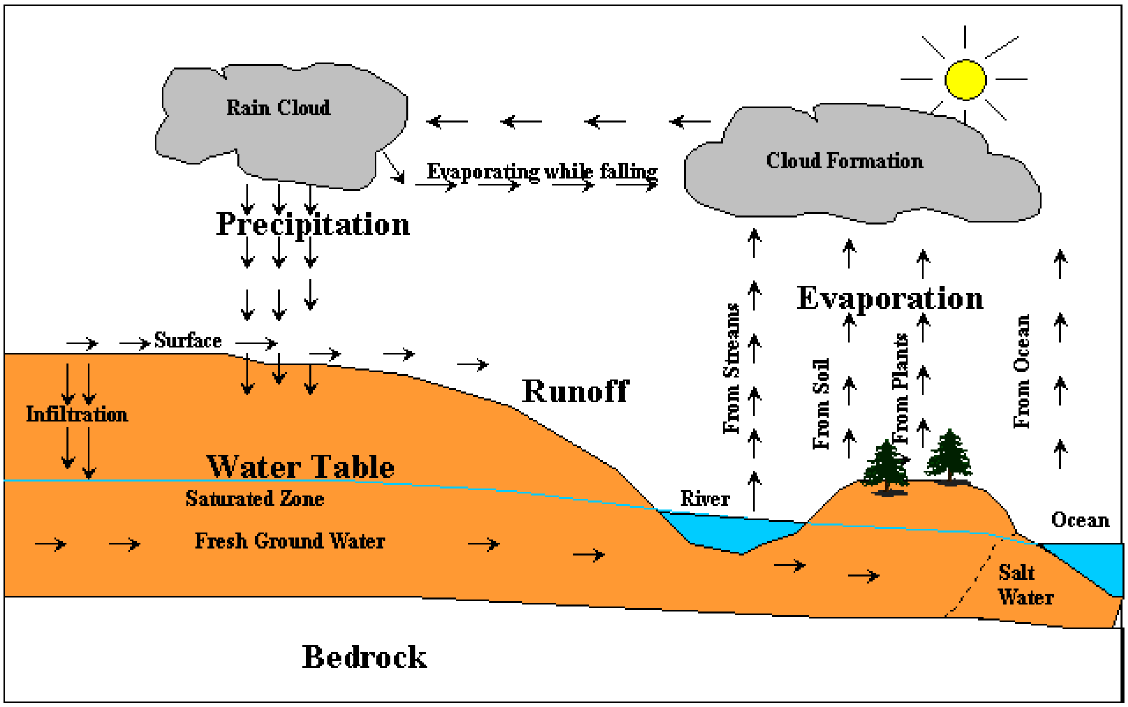
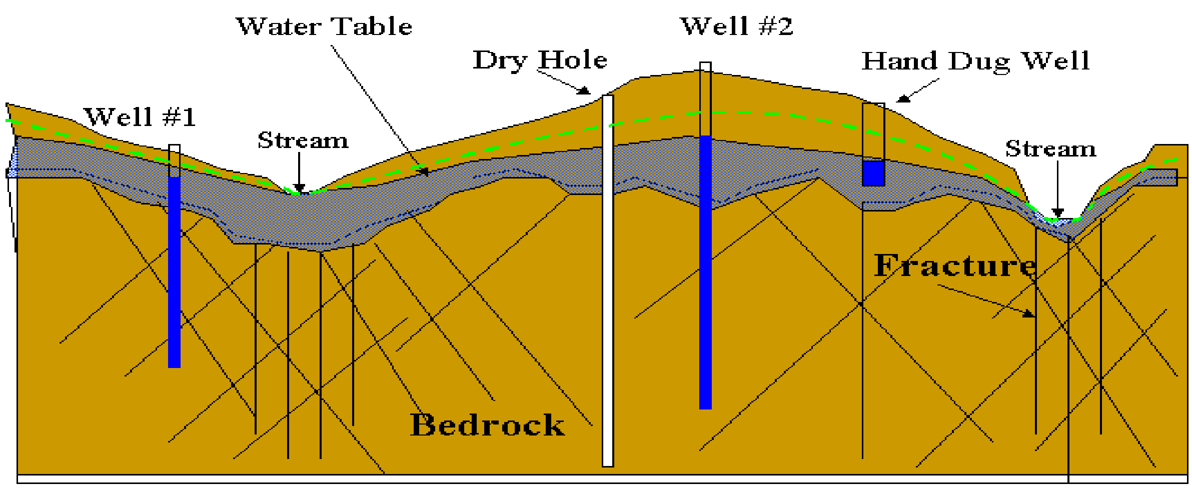


Hydrogeology

Beneath the surface of the earth is a vast supply of water that has been estimated to be more than 66 times the quantity found in streams and freshwater lakes worldwide. **Hydrogeology** is the study of the movement of this water within the earth termed **ground water**. Ground water is one component of the **hydrologic cycle** that describes the continuous circulation of water between the atmosphere, subsurface, and surface water bodies such as streams, lakes, and oceans.

Figure 1 illustrates schematically how water that evaporates from land, surface water, and vegetation returns to the earth in the form of precipitation. Some of this precipitation (approximately 25%) infiltrates into the soils and reaches the **water table**. The water table is defined as the depth below which openings in the rock and earth materials are completely filled with water (i.e., saturated). Ground water flows through pores, fractures, and voids in the earth and discharges to surface water bodies at lower elevations.

Figure 2 - The Water Table



The depth to ground water varies seasonally and is usually shallower in the winter and spring and deeper in the summer and early fall. As illustrated in Figure 2, the ground water surface conforms approximately to surface elevations; notice it is slightly deeper on ridges and shallower in low - lying areas. A **spring** marks a point where the water table naturally intercepts the land surface. A **well** is a man-made opening that penetrates to some depth below the water table to explore for, obtain or monitor ground water.

The quantity (yield) and quality of water that can be obtained from a particular well or spring is largely dependent on the underlying geology. Geologic formations that are able to transmit water at rates fast enough to supply reasonable amounts to wells are called **aquifers** and are commonly developed for water supplies. Aquifers can be generally classified into two types: **alluvial aquifers** which consist of "unconsolidated" silt, sand, gravel, and clay; and **bedrock aquifers** which consist of fractured "consolidated" rock such as granite, gneiss, sandstone, marble and limestone. Ground water resides within the pore spaces and fractures of the aquifer materials. The occurrence of ground water in "underground rivers or lakes" is largely a myth that alludes to areas underlain by **carbonate bedrock aquifers** such as limestone and marble, where ground water may dissolve bedrock along fractures and bedding planes creating large openings or **solution cavities** through which water may travel. Figures 3, 4, and 5 illustrate cross-sections of three types of aquifers.

Figure 3 - Alluvial Aquifer

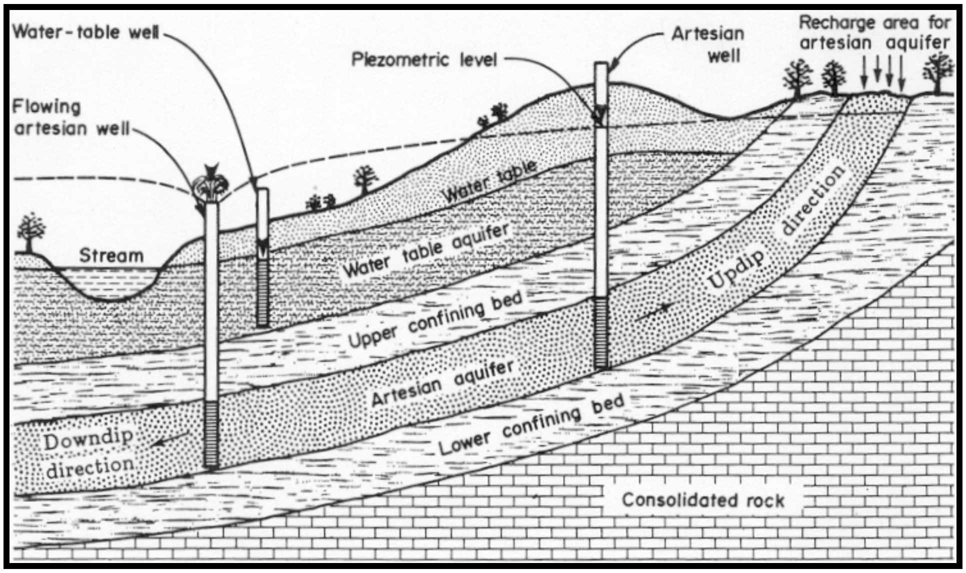


Figure 4 - Bedrock Aquifer

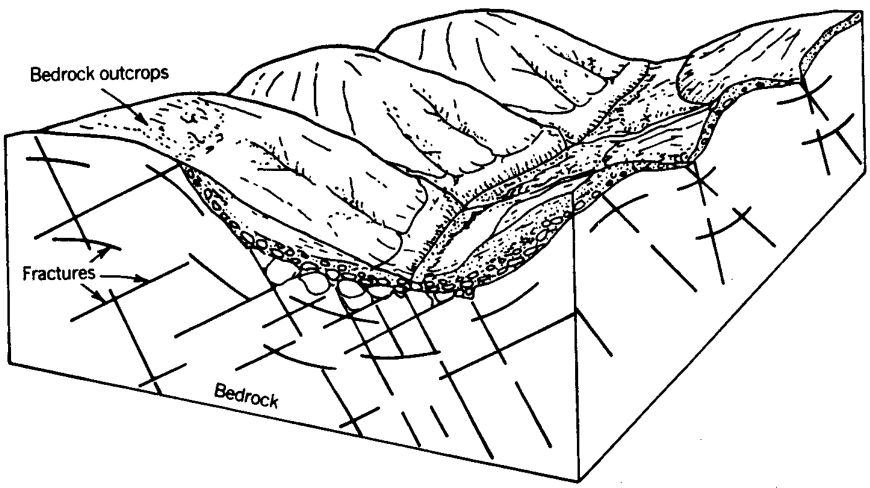


Figure 5 - Carbonate Bedrock Aquifer

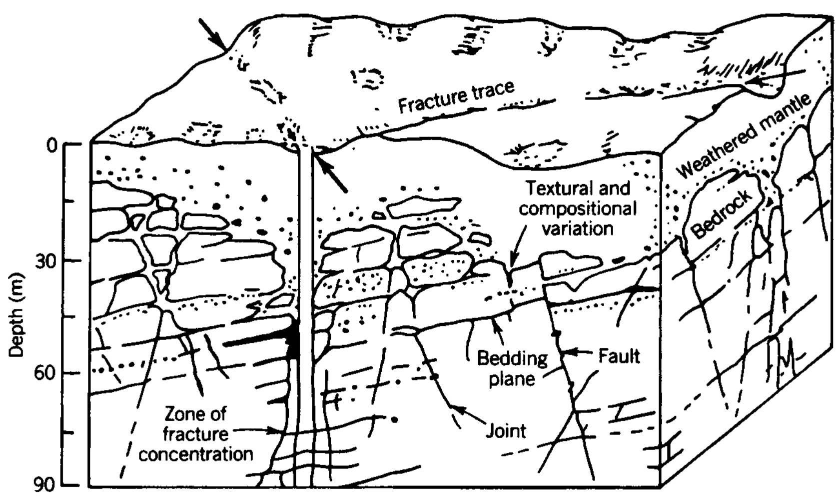


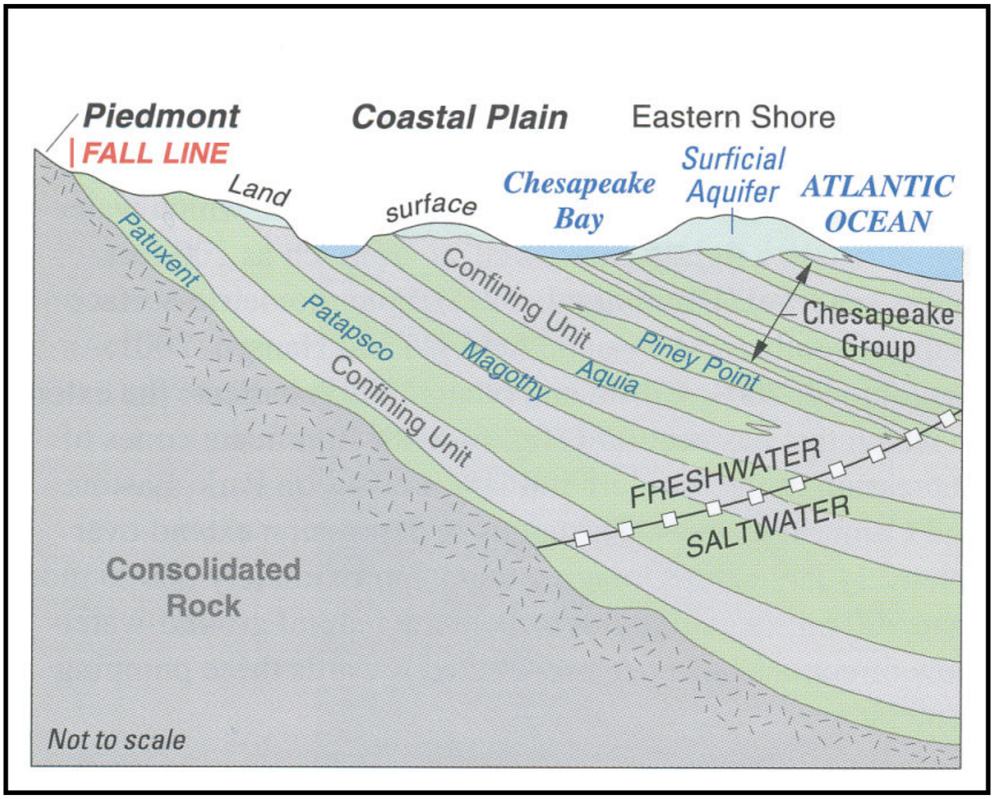
Figure 6 - General Geologic Areas of Baltimore County

Geologic formations composed of sandstone, or unconsolidated sand and gravel are usually the most productive aquifers, while those composed of clay and shale are generally poor aquifers. The yield of bedrock aquifers may vary considerably and depends on the degree of fracturing in the rock and how these fractures are interconnected. Wells in the marble aquifers in Baltimore County have some of the highest yields due to presence of numerous fractures and solution cavities that have high capacities to hold and conduct water. In contrast, some wells in the areas of the County underlain by schist have relatively low yields, due to the weathering characteristics and/or the degree of fracturing in the rock. Bedrock wells in Baltimore County typically yield from 1 to 15 gallons per minute (gpm).

Baltimore County is underlain by both alluvial and bedrock aquifers (see Figure 6). Approximately 80% of the County consists of an area known as the **Piedmont** that is underlain by consolidated rocks such as schist, marble, gneiss, quartzite, and granite. Piedmont topography is characterized by broad, undulating uplands that are dissected by deep, narrow stream channels. The Piedmont rocks generally underlie areas northwest of the **Fall Line** which lies roughly along the Interstate 95 corridor.

Unconsolidated layers of gravel, sand, silt, and clay underlie the other 20% of the County, known as the **Coastal Plain**. These materials have been eroded from the Piedmont uplands by streams, and deposited as a "wedge" of sediment on top of the bedrock material in the southeast portion of the County. Coastal Plain topography is characterized by relatively flat conditions, gently sloping to the southeast. The relationship between the two areas is illustrated schematically in Figure 7, a geologic cross-section.

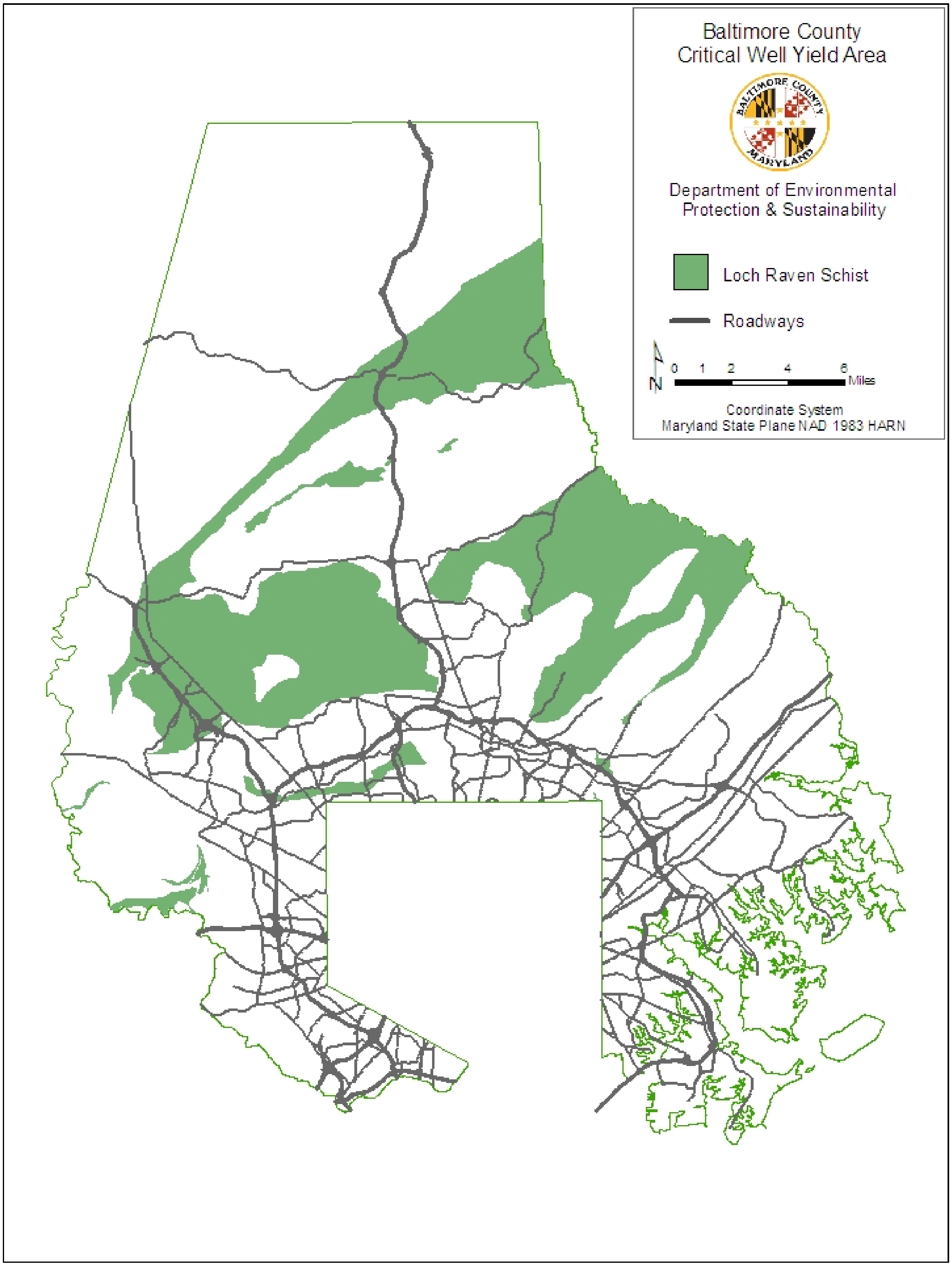
Figure 7 - Generalized Cross Section of the Piedmont and Coastal Plain



The large number of domestic wells in active use in Baltimore County (approximately 31,000) attests to the adequate quantity of ground water available. In fact, the County currently uses less than 6% of the estimated 70 billion gallons of water that replenishes underlying aquifers each year through precipitation. This annual recharge of ground water represents over three times the capacity of the Pretty Boy Reservoir.

Despite the ample supply of recharge to ground water, there are some formations in which drilling wells with suitable yields is more difficult. Specifically, areas underlain by Loch Raven Schist have been identified as **critical yield areas** in Baltimore County (see Figure 8). Due to a lower degree of fracturing in these rocks, there is a higher probability of drilling a dry hole. Since it is difficult to predict the location of a bedrock fracture from the surface, it may be necessary to drill in several locations in order to attain an adequate well yield. The number and size of fractures generally decreases with depth, so deepening a dry hole or poor producing well may not always ensure better well yield.

Figure 8 - Baltimore County Critical Well Yield Area



Well Siting Requirements

Prior to drilling a well, a **well permit** application must be submitted by a **licensed master well driller** to be reviewed and approved by the Ground Water Management office. A well permit number is then issued to the driller in the form of a metal **identification tag** that is permanently affixed to the well casing after completion.

Before drilling, the well site must also be approved by Ground Water Management. Minimum **Siting Criteria** for wells as required by COMAR and COBAR are as follows:

- ***10 ft. from property line;***
- ***15 ft. from road or dedicated road right-of-way;***
- ***30 ft. from a building foundation;***
- ***100 ft. from sources of contamination and sewage disposal areas in the Piedmont;***
- ***50 ft. from sources of contamination and sewage disposal areas in the Coastal Plain;***
- ***100 ft. from wells on neighboring properties;***
- ***100 ft. from stormwater management infiltrative devices; and***
- ***50 ft. from stormwater management non-infiltrative devices.***

Occasionally, a well may need to be replaced if it goes dry or becomes contaminated. In siting a well, EPS may consider variances to siting criteria, due to existing conditions such as small lot size, location of existing structures, and utilities. **All drilling locations must be approved by EPS prior to drilling.**

Well Construction

It is important that every well be constructed in accordance with prescribed regulations to insure a safe, potable and adequate supply. Construction of a new well may not proceed until a well construction permit has been issued to a licensed driller, the location meets all applicable setback requirements and the proposed well site has been field inspected and approved by this Department. Figure 9 is a cross-sectional sketch depicting typical construction of a Piedmont well.

In the Piedmont region, the air rotary percussion drilling method is most commonly used. This method uses a high pressure hammer-bit that can drill a 300 ft. deep hole in a few hours.

Most Piedmont wells are constructed with a minimum 6-inch diameter casing (either steel pipe or Schedule 40 PVC). The casing is used to line the uppermost, weathered bedrock, or **saprolite** portion of the well and prevents these materials from collapsing into the hole. Casing must be seated at least 2 feet into competent bedrock and be no less than 20 feet in length. The lower part of a Piedmont well is not typically cased - the borehole remains open to receive ground water that flows into the well from fractures found within the formation.

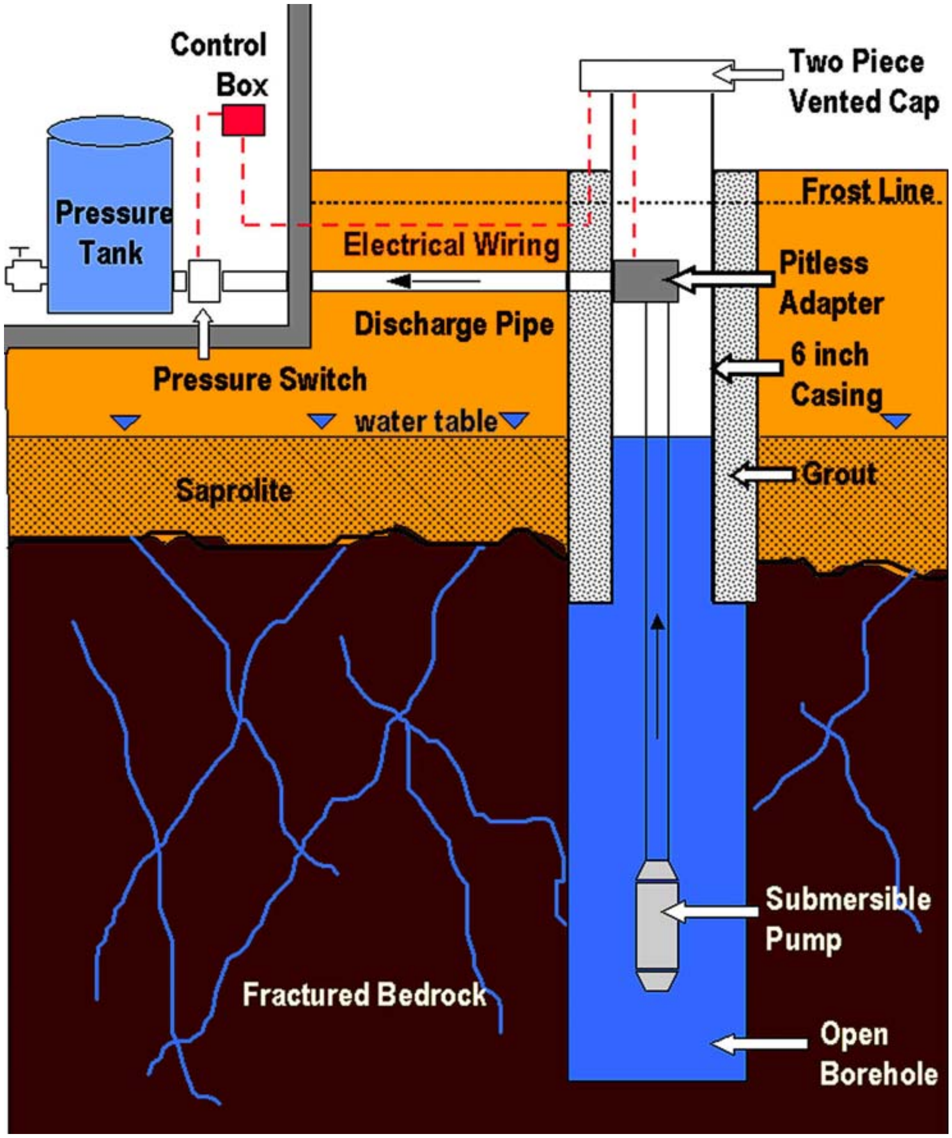
Coastal Plain wells are usually drilled by the mud rotary method, in which high density drilling fluids, commonly referred to as “muds,” are used to keep the unconsolidated sediments from caving in while drilling. A 4-inch diameter PVC casing is installed inside the entire borehole to prevent the unconsolidated aquifer materials from collapsing into the hole. The portion of the well adjacent to the selected water-bearing zone is **screened** (i.e., a casing with open slots) to allow water from the aquifer to flow into the well. The area between the casing and the borehole wall is known as the **annular space**. The annular space is filled with sand across the screened interval to prevent the well screen from clogging with fine sediment. The annular space above or in between screened intervals is filled with **grout**.

Grout is required for wells in both the Piedmont and Coastal Plain and may consist of Portland cement, bentonite clay or mixtures of both. Proper grouting provides a watertight seal that prevents against potential contamination to the well from surface water or shallow ground water. For bedrock wells, grout must be pumped into the annular space from the bottom of the casing to the land surface and the grouted depth may not be less than 18 feet.

Occasionally, a well drilling attempt will not yield any water. The unsuccessful attempt or **dry hole** must be properly abandoned and sealed by the well driller. The abandonment is usually performed when the successful well is grouted because grouting material is typically used for sealing dry holes.

Lastly, the well casing may not terminate less than 8 inches above final grade and have a screened, vented cap. The vent allows for pressure changes within the well due to pumping. Upon well completion, the well driller will attach the metal identification tag to the casing. It is recommended that you keep your well accessible for maintenance / repairs and provide adequate protection should it be located in close proximity to a driveway.

Figure 9 - Typical Well Construction in the Piedmont



Geothermal Wells

The trend toward "Green Building" has increased the popularity and use of geothermal heat pumps. These systems take advantage of the nearly constant temperature of the ground and are designed to use the earth as a heat source in the cooler months and heat sink in the warmer months.

Closed loop heat pump systems operate by circulating fluid into the ground through a closed network of piping. Two polyethylene tubes that are connected at the bottom by a U-shaped coupler are installed vertically in each 6" diameter borehole (typically 200-300 feet deep). The borehole is filled with grout providing a thermal connection between the pipes and the surrounding formation as well as protecting the ground water from contamination. Each loop is filled with a heat exchange fluid (typically an ethanol based product) and tied into the main system through a manifold. Vertical closed-loop geothermal wells are typically spaced 15' apart and are subject to many of the same setback requirements as drinking water wells.

It should be noted that it is common and often economically advantageous to convert unsuccessful well drilling attempts (i.e. dry holes) into geothermal wells.

Well Rehabilitation / Hydrofracturing

If there is so much ground water, why does a producing well occasionally go dry or see a decline in performance? A number of possibilities may account for this occurrence, including:

- Temporary lowering of the water table during a drought period (this is more common in hand-dug or shallow wells less than 100 feet);
- Excessive pumping from a nearby well (minimum well distances are recommended to avoid this problem);
- An increase in water consumption that exceeds the well yield;
- Clogging of water-bearing fractures with fine sediment or oxidized minerals; or
- Fracture collapse/failure caused by settling of the formation.

Unfortunately, most of these problems arise without warning and are usually beyond the control of the well owner. In the event that the function of your well becomes impaired, it is generally best to contact a **Licensed Well Driller** or **Master Plumber** first to determine if the problem is associated with the well pump, circuit breaker, pressure tank or some other defect in the distribution system. If these are all ruled out as potential problems, then your situation may be attributed to a physical problem with the well and will require further evaluation by the licensed professional. Depending upon the findings, severity of the problem and site conditions (slope, accessibility, lot size, etc.), your corrective options may be limited. Many residents will simply choose to drill a replacement well on their property.

An alternative solution may include a well rehabilitation technique know as **Hydrofracturing**. This method is used to increase the yields of low-production wells where the fracture/joint systems have become constricted and water no longer flows adequately through these structures. Hydrofracturing has been used in the USA since the late 1980's primarily for rehabilitation of domestic supplies. It is accomplished by pumping a large volume of water down the borehole under high pressure (1,000-2,500 psi) whereby tight fractures in the rock are flushed out and opened up resulting in better flow between nearby fractures and the borehole. This technique is employed for both new and reworked wells and has been successful in enhancing the yield of many failing/marginal wells.

Well Yield

A **yield test** is performed by the well driller before the new well is connected to the house. State and County law requires that all wells for domestic use yield a minimum of 1 gallon per minute (gpm), as determined by the methods outlined below.

To conduct a yield test, a pump is placed in the well along with a water level indicator tape. The **static** (non-pumping) water level is recorded. The well is then pumped at a high rate (at least 8 gpm) to remove the **storage** in the well column. Water level readings and pump discharge flow rates are recorded every 15 minutes. Once the water level stabilizes, the pump is adjusted to maintain a constant water level, so that the amount of water being pumped out is equal to the well recharge. This test is known as the **recovery rate** pump test. The test continues for 6 hours if the well is producing less than 4 gpm. Should the well yield over 4 gpm, the test may be terminated after 3 hours.

In addition to the yield test, Maryland State Well Construction Regulations require that a new well system be able to deliver 500 gallons in a 2 hour period once per day. Therefore, a lower yielding well must be drilled to an adequate depth to provide the required storage. (For a 6-inch diameter well casing, there are approximately 1.5 gal / ft. storage. Therefore, a 1 gpm well with a static water level of 30 ft. must have a depth of at least 300 ft.).

An alternative yield testing procedure must be used when dealing with a supply in which a submersible pump has been installed and connected to the distribution system. In these cases, the contractor performing the test shall provide a testing manifold, consisting of an inlet for connection to the pressure line from the well and a tee with a gauge for measuring pressure changes. The yield test duration and flow rate recordation requirements remain the same as previously described. The 500 gallon, 2-hour demand requirement does not apply to existing systems.

Water Distribution System

If an adequate well yield is attained, a water distribution system is installed to supply water from the well. In most applications of modern well construction, **submersible pumps** are used (see Figure 9). Submersible pumps are installed inside the well, unlike jet pumps that have the motor and much of the pump assembly outside the well. The submersible pump is suspended from a **pitless adaptor** to a predetermined depth to allow maximum drawdown (drop in water level). This drawdown depth is based on the total well depth, yield and static water level, as well as the size of the motor and pump.

The pitless adaptor is a water-tight, sanitary, flanged connection for the pump. It is installed on the well casing below the frostline, between the pump and the discharge line. The discharge line runs underground to the pressure tank that is usually located in the house. The flanged connection allows for easy removal of the pump from the well for service. The pressure tank and pressure switch control the operation of the pump and maintain the pressure in the water distribution system.

Upon completion of well construction activities, the well must be disinfected according to the procedures outlined below:

1. Installation of the water supply system including the well pump, pressure tank and distribution lines, should be completed prior to disinfection.

2. Calcium hypochlorite, designated as 65% available chlorine by weight, should be used for well disinfection. A dosage of 1 tablespoon of calcium hypochlorite for every 10 ft. depth of standing water in the well should be applied. Calcium hypochlorite is available commercially under several trade names, such as, H.T.H., Perchloron, or Pitt-Chlor. Any chlorine disinfecting chemicals

designated as "stabilized" should not be used.

3. The chlorine is applied directly into the well. A hose should be connected to the discharge side of the pressure tank and the water re-circulated back into the well for 30 to 60 minutes. The inside of the casing should be washed down with this chlorinated water.
4. After recirculation of the chlorinated water, the vented well cap should be replaced. All taps should be opened until a chlorine odor is detected at each location, and then remain closed for 24 hours.
5. After the desired contact time, flush the treated water through a garden hose. This water should not be discharged into the septic system.
6. Flushing should be regulated in accordance with the well yield and available water in the well.
7. After all residual chlorine has dissipated; the water should be tested for potability.

Natural Ground Water Quality

The natural water quality in aquifers varies with the local rock type. Parameters of concern in Baltimore County include **radionuclides, hardness, pH, iron** and **manganese.**

Naturally occurring **radionuclides**, including **radium** and **uranium**, have been detected in ground water at levels above the US EPA Drinking Water Standards in areas underlain by the Baltimore Gneiss and Setters Gneiss Formations. It is recommended that homeowners first get their water tested to determine if water treatment is needed. More detailed information concerning radionuclides, testing requirements, and treatment options is available in our booklet entitled *"Radionuclides and Your Well Water: A Homeowner's Guide."*

Hardness generally refers to the presence of calcium and magnesium ions in water, which are typically found at higher concentrations (problematic) in some of the more prominent valleys of Baltimore County that are underlain by marble (e.g. Greenspring Valley, Caves Valley, and Long Green Valley). Hardness is usually associated with the effect that it has on the function of soap and detergent. Soap lathers easily in "soft" water that contains lower concentrations of calcium and magnesium; **hard** water does not lather easily due to higher concentrations of these minerals and it tends to leave insoluble residues in bathtubs, sinks, and clothing. In addition, hard water causes scale to incrust water heaters, boilers, and pipes thereby reducing their capacity and heat transfer properties. A general scale of hardness is as follows:

Concentration

mg/l	***gpg grains/gal***	***Description***
0-17	0-1	Soft
17-60	1-3.5	Slightly hard
60-120	3.5-7	Moderately hard
120-180	7-105	Hard
Over 180	Over 105	Very hard

The **pH** is a measure of how corrosive or acidic water is. Values of pH less than 7.0 indicate acidic water; values above 7.0 indicate alkaline water. Water at a pH of 7.0 is neutral. Natural ground water typically has pH values ranging from 6.0 to 8.5 depending on the geology of an area. Acidic water is often present in certain "crystalline" rock types, such as quartzite, gneiss, and schist. In limestone or marble valleys, ground water is usually alkaline. Water with a pH less than 6.0 is corrosive by nature and may damage metal pipes and fixtures.

Finally, the presence of **iron and manganese** in ground water can give the water a disagreeable taste and may stain items that it comes in contact with. Treatment for the reduction of these minerals should be considered when concentrations exceed 0.3 mg/l and 0.05 mg/l, respectively. Iron may also support the growth of iron bacteria, the presence of which may create clogging problems with the water bearing fractures, thereby, adversely effecting well yield.

Potential Sources of Contamination

A wide range of sources, some of which are discussed below, may cause contamination of ground water.

Improperly stored, transported or disposed chemicals such as solvents and degreasers, which are commonly used at **industrial facilities**, pose a threat to ground water quality. If spilled, these materials can permeate quickly through the soil column and leach into the ground water, readily contaminating large areas.

Underground storage tanks (USTs) pose a similar problem that is unfortunately more widespread. USTs containing gasoline and heating fuels may be found in industrial, commercial, agricultural and residential settings. Tanks with a capacity in excess of 1,100-gallons must be registered with the Maryland Department of the Environment and are subject to State oversight. However, there are many unregistered, unregulated tanks, currently serving residential properties, which may eventually fail and leak product into the ground water.

Baltimore County Law requires that unused residential tanks be pumped out and removed by a MDE certified tank removal contractor. Older tanks that are still in use should be integrity-tested once every 5 years to determine if they are leaking. Over the years many water supplies in Baltimore County have been contaminated by leaking underground storage tanks, resulting in costly remediation and the installation of water treatment systems for neighboring well water supplies.

The practice of applying **de-icing salt** to roads during winter storm events represents another threat to ground water quality. Once applied, road salt or sodium **chloride** (the predominant form of salt used in Baltimore County) is easily dissolved by precipitation and may leach into ground water. Impacts to drinking water wells from chlorides are generally localized and depend upon where storm water run-off is directed and the proximity of the well to the road. A bitter taste may be imparted to the supply and increased corrosion of metal pipes / fixtures may be observed where chloride concentrations exceed the USEPA established **secondary maximum contaminant level (SMCL)** of 250 mg/l. A SMCL is a non-enforceable guideline regarding contaminants that may cause unpleasant effects (such as taste, odor or color) but is not a concern for human health. In some cases, road salting has also been responsible for increasing levels of sodium in drinking water supplies. Elevated levels of sodium do represent a health concern for those individuals with high blood pressure, and accordingly, the USEPA has set a health advisory of 20 mg/l for this contaminant.

Agricultural operations utilizing pesticides, herbicides and fertilizers may impact ground water quality when applied for an extended period of time. Elevated nitrate levels in ground water are commonly found in areas that have been intensely farmed over a long duration. Nitrate levels exceeding 10 mg/l in drinking water must be reduced by a treatment system.

Pesticides and herbicides marketed as **lawn chemicals** for residential applications must be applied in strict accordance with the manufacturers' instructions. Often, homeowners, believing "more is better" over-apply the lawn chemicals. These chemicals may eventually enter and adversely affect ground water quality if not applied responsibly. In 1995, the Maryland Geologic Survey conducted a comprehensive study of ground water quality in the Piedmont region of Baltimore County and concluded that while some pesticides were detected, they were only found to be present at trace concentrations and were well below any established drinking water standards.

Septic systems represent another possible source of ground water contamination. Ideally, the effluent which leaves the septic tank and enters the field system (i.e. absorption trenches or seepage pits) is cleansed naturally as it infiltrates through the soil before recharging the ground water. However, if chemicals such as oils, greases, paint, paint thinners and other toxic chemicals are improperly disposed through a septic system, they may not be filtered by the soil column and may contaminate ground water. Proper disposal of these chemicals will prolong the life of the septic system, and prevent contamination of the ground water.

Most septic systems are not designed to treat nitrogen wastes and consequently they may serve to increase the amount of nitrates introduced into the ground water. Maryland Well Construction Regulations specify that wells be at least 100 ft. from septic systems and septic reserve areas, in order to minimize the possibility of bacteriological, nitrate or other types of contamination of drinking water supplies.

It should be noted that recent advances in wastewater treatment technology are now being employed on the residential scale and will certainly help to improve the quality effluent that is discharged to the soil. These enhancements almost always incorporate the use of an **aerobic treatment unit (ATU).** ATU's utilize oxygen and re-circulation of wastes between the ATU and septic tank to reduce the concentration of pathogens, nitrates and other contaminants before being released to the field system.

A more detailed discussion of septic systems is available in our booklet entitled *"Onsite Sewage Disposal Systems: A Guide to Maintenance."*

Water Quality Testing Requirements

The current **water quality testing** required for **Use and Occupancy** approval, and transfer of property in Baltimore County, includes **bacteriological, nitrate, turbidity** and **sand**. **Radiological** testing is also required if the well is located in an area underlain by the Baltimore or Setters Gneiss formations. Other water quality parameters (i.e. volatile organic compounds, pesticides, herbicides, metals, etc.) may be required on a case-by-case basis if EPS has reason to suspect that constituents may be present at levels potentially detrimental to human health. A laboratory **certified** by the State of Maryland must conduct these analyses. Lab data must be submitted to Ground Water Management for Use and Occupancy approval for new residences.

The **bacteriological** test checks for the presence of coliform and fecal coliform bacteria. The water sample must be collected by a state certified sampler. The sample is stored in a sterilized bottle, iced, and must be analyzed within 24 hours of collection. The initial (presumptive) test is completed after a 24-hour incubation period. The second confirming test requires an additional 24-hour incubation period.

Often, a <u>positive</u> bacteriological test indicates an improper chlorination procedure, or reveals a defect in well or plumbing construction. After a thorough check of the construction, a second chlorination may be necessary. Should the first bacteriological test be positive, Baltimore County requires two consecutive negative tests prior to approval of the water supply.

The USEPA has established **maximum contaminant levels (MCLs)** in drinking water for many chemicals that pose human health risks. The MCL for **nitrate** is 10 milligrams per liter (mg/l). Sources of nitrate in ground water include fertilizers, organic animal wastes and septic systems. Studies have found that excessive consumption of nitrates above 10 mg/l may result in methemoglobinemia, or "blue baby syndrome" in infants. For this reason, it is recommended that infants and pregnant women use a filtered supply, or use an alternate source of water, should the nitrate levels exceed 10 mg/l.

New water supplies exceeding this level must be treated to reduce the amount of nitrates to acceptable levels. In such cases, Baltimore County requires only one tap (usually the kitchen) to be filtered with a reverse osmosis unit (R/O). While whole-house R/O systems are available, caution must be exercised in choosing to install one. Because of their inherent inefficiency, these systems create a significant amount of wastewater that may overload the septic system. If you are considering installing a whole house R/O system, it is recommended that you contact Ground Water Management to discuss.

Turbidity is a measure of "cloudiness" in the water, usually due to excessive dissolved minerals such as iron or manganese. Also, high turbidity may be the result of improper well construction, which allows surface water and dissolved particles, to enter the well. Improper placement of well screens may also be a cause. Corrections to the well should be made if defects are found.

The standard for turbidity is 10 Nephelometer Turbidity Units (NTU). If the standard is exceeded, an iron test is required to determine whether the turbidity is attributable to high iron, or a defect in well construction.

The lab report indicates whether **sand** is absent or present in the water supply. The pump being located too close to the bottom of the well, whereby sediments are disturbed when the pump is activated, causes most sand problems. If sand is present immediately following a well installation, it may often dissipate with use. Raising the pump may also help to eliminate the problem.

<u>Water Treatment</u>

Should water treatment be necessary, the type of treatment system installed on a water supply is dependent upon the source of the problem. There are many treatment companies that sell a wide variety of systems. To evaluate water supply problems, an independent laboratory should analyze water samples in order to assure objective results.

Table 1 lists some typical problems that may be encountered when using a private well water supply. This chart serves as a general guide; specific water quality problems should be evaluated individually.

There may be some concern with the amount of lead leaching from new brass fixtures (e.g. faucets, fittings and pumps). It is recommended that water that is in contact with the fixture for an extended period of time (e.g., overnight) be flushed out prior to use. Generally, this reduces the amount of lead in water to levels below the MCL.

Regular Maintenance and Testing

Prevention of ground water contamination is the best, and the least expensive way to protect your water supply. Wise use of lawn chemicals, removal of existing USTs and awareness of what chemicals are going into the septic system will greatly reduce the possibility of contamination on a localized scale.

It is recommended that water supplies be tested every year or two to determine any changes in water quality. If work has been done on the plumbing distribution system, or if the well pump has been replaced, it is recommended that the well be disinfected. A bacteriological analysis is also recommended at that time and should be performed by a MD Certified Private Laboratory.

Water Conservation

Ground water is a precious resource and residents who depend upon it for all domestic water needs must be extra cautious with respect to overuse and irresponsible consumption. In 1995, amendments to the National Plumbing Code began mandating the use of low volume flush toilets (1.6 gallons/flush) as required by the National Energy Policy Act. Since then, low-flow plumbing fixtures including toilets, faucet aerators, showerheads and flow restrictors have been developed that save substantial amounts of water and are readily available at reasonable prices.

Other water saving tips include:

- Turn off the faucet while brushing teeth and shaving.
- Refrigerate water for drinking instead of letting water continue to flow until it is cold enough to drink.
- Operate dishwasher and washing machines only when they are fully loaded.
- Use a broom instead of a hose for cleaning driveways and walks.
- Water gardens and lawns during the coolest part of the day; after dawn or before sunrise.
- Consider high efficiency appliances (dishwashers, washers, water softeners, etc.) when making a new purchase.
- Install “rain barrels” at the end of each downspout to collect and store water for outdoor irrigation.

It is also very important to repair dripping faucets and leaking toilets as quickly as possible. It is estimated that leaking plumbing fixtures can waste up to 200 gallons per day. Water conservation not only benefits the water supply, it will also help to extend the life of your septic system by decreasing sewage loads.

Transfer of Property on a Private Water Supply

The **Baltimore County Well Law** (Baltimore County Code 34-2) protects buyers of properties served by private water supplies and requires an adequate water supply for new construction.

The law distinguishes between an **improved lot**, which has at least one dwelling and a vacant or **unimproved lot**.

An improved lot without public water may not be conveyed unless it has a private water supply meeting yield and water quality testing requirements. The code requires that the water supply produce a minimum yield of 1 gpm and be tested for the presence of bacteria, nitrates, turbidity, and sand. Yield test results are valid for three years from the test date. Water quality tests are valid for 180 days.

When transferring an improved property on a private water supply, the buyer has the option to waive the yield and chemical quality tests. <u>The bacteriological test may not be waived under any circumstance.</u>

In order to transfer an unimproved lot served by a private water supply, only a yield test is required. The yield test may be waived on an unimproved lot with the exception of those lots located in the **critical yield area**. However, a building permit will not be issued unless the property has a water supply meeting the minimum yield requirements.

The **critical yield areas** in Baltimore County, as discussed in the Hydrogeology section of this booklet, are underlain by the historically low-yielding Loch Raven Schist bedrock formation (see Figure 8). However, for lots in the water critical area, the yield waiver is allowed, if; (1) the lot is conveyed to an owner of a contiguous lot; or (2) the conveyance is a subdivision, or a piece thereof, for the purpose of resale; or (3) the lot is not to be used for residential purposes for 5 years.

Table 1 GROUND WATER QUALITY: PROBLEMS & SOLUTIONS

PROBLEM	POSSIBLE CAUSES	WATER QUALITY TEST	FEDERAL DRINKING WATER STANDARD	POSSIBLE SOLUTIONS
Gastro-intestinal illness; nausea, diarrhea.	Presence of coliform/ fecal coliform bacteria due to surface water or shallow ground water infiltration	**BACTERIA**	0 or <1 (present/absent)	Check to ensure that well cap is secured tightly. Insects can enter well head and introduce bacteria. Have well driller or plumber check pitless adaptor to ensure that it is not leaking. Chlorinate well. If problems persist contact Ground Water Management. If well head is buried, raise casing above ground. Springs and hand dug well should be replaced with a new drilled well.
Blueish skin tone in infants (from lack of oxygen in blood). (Dangerous)	Methemoglobinemia - "blue baby syndrome" due to excessive levels of nitrate.	**NITRATE**	10 ppm (MCL)	Use an alternate water source for infants/pregnant women. Install reverse osmosis filter on supply tap.
Cloudy water	Excessive dissolved mineral content, poor well development or influence of shallow ground water.	**TUBIDITY**	10 NTU	Check iron, manganese levels. If new well, pump off for several hours to see if cloudiness dissipates. Check pump level in well-raising pump may alleviate problem. If high turbidity noted during or immediately after rain events, consider drilling a new well (bacteria may also be a problem in this case). Consult water quality professional about appropriate type and size of filter.
Red-brown staining in toilets, laundry discoloration, metallic taste.	High dissolved iron. Iron bacteria.	**IRON**	0.3 ppm (SMCL)	Water softening may be effective for relatively low concentrations. Oxidation/filtration or Chlorination may be needed for higher concentrations. Consult water quality professional about appropriate type and size of filter.
Black/gray staining in toilets, and metallic taste.	High dissolved manganese	**MANGANESE**	0.05 ppm (SMCL)	Treatment techniques for iron are generally the same for manganese. Consult water quality professional about appropriate type and size of filter.
Presence of small sand, gravel particles.	Declining static water level. Mineral fines in fracture. Oversized pump.	**SAND**	absent/present	Raise pump further from the well bottom.
Developmental & learning disabilities, low birth weight.	Lead solder in plumbing, lead pipes, brass faucets, pumps.	**LEAD**	.015 ppm Action level	Flush pipes for several minutes before drinking. Install activated carbon filter.
Blue-green staining on fixtures.	Acidic water leaching copper from pipes.	**COPPER**	1.3 ppm Action level	Install neutralizer to raise pH.
Sheen on water, odor of gasoline or other fuels.	Leaking underground fuel tanks.	**VOLATILE ORGANICS**	Standards Vary- call Ground Water Management to Report	Tight-test underground tanks, and remove leaking tanks. Install activated carbon filter. Drill new well in unaffected area.
Bone cancer or stomach cancer.	Radioactive metal that occurs naturally in trace amounts.	**RADIUM**	15 pCi/l (MCL) for gross alpha particle activity. (Indicates presence of radioactive substances including Radium)	Install reverse osmosis, ion exchange water softener or lime softening water conditioner. Conduct 2nd gross alpha test to verify unit's effectiveness.
Salty taste, corrosion of pipes.	Possibly road salt, salt storage. Agricultural effluents.	**CHLORIDE**	250 (SMCL)	Install diversions to keep runoff away from well. Install reverse osmosis filter. Drill new well in unaffected area.

MCL = Maximum Contaminant Level. Established by E.P.A., this is the permissible level of a contaminant in water that is delivered to any user of a public water system. Levels above the MCL may cause adverse effects on the health of persons. **ppm** = parts per million = mg/l. **pCi/l** = picocurie per liter.
SMCL = Secondary Maximum Contaminant Level. These are non-enforceable levels that have been established for taste, appearance, and/or odor.
NOTE: This table provides only general information. Feel free to contact Ground Water Management and/or your private water installer if you experience ground water quality problems.

<u>REFERENCE NUMBERS</u>

<u>Department of Environmental Protection and Sustainability:</u>

Ground Water Management (well locations, water quality problems, septic problems, septic reconstruction, percolation tests, use and occupancy permits, underground storage tanks) ***410-887-2762***

<u>Maryland Department of the Environment</u>:

Cooperative Extension Services - Home and Garden Center (pesticides, lawn care):

1-800-342-2507

Soil Conservation District: 410-666-1188

Hazardous Materials and Oil Spills Emergency Response: 1-800-633-4686

Oil Control Program – UST's: 410-537-3442

Individual Drinking Water Supplies/Wells: 410-537-3784

<u>U.S. Environmental Protection Agency:</u>

Safe Drinking Water Hotline: 1-800-426-4791

Radon Information Hotline: 1-800-872-3666

<u>Other Booklets Available from EPS:</u>

"Building with Well and Septic"

"Onsite Sewage Disposal Systems: A Guide to Maintenance"

"Radionuclides and Your Well Water: A Homeowner's Guide"

**** NOTE ** These booklets and additional information can be found on our website:**

www.baltimorecountymd.gov/Agencies/environment/groundwatermgt/index.html

<u>REFERENCES:</u>

The Quantity and Natural Quality of Ground Water in Maryland, Maryland Department of Natural Resources, Water Supply Division 1987

Physical Geology, 7th Edition, Sheldon Judson, 1987

Physical and Chemical Hydrogeology, Patrick A. Domenico, Franklin W. Schwartz, 1990

Ground-Water Quality in the Piedmont Region of Baltimore County, Maryland: Maryland Geological Survey Report of Investigations No. 66, Bolton, D.W., 1998