Activity 11: Aquifer Maps and Maine Ground Water

Maine Geological Survey

Objectives:

Students will develop an understanding of the dynamics of ground water; they will understand the interrelations between ground water and surface water; they will also increase their knowledge of surficial and bedrock geology. They will use this information to make sound decisions about siting locations for industries/business that may have an impact on water quality. Students will be able to define and use correctly the following terms:

- soil moisture
- zone of saturation
- gravity flow
- capillary fringe
- water-bearing rock
- aquifer (2 types)
- ground water
- water table
- overburden
- recharge area
- zone of aeration
- discharge area
- infiltration
- percolation

Time:

This activity is designed to last for two 45 minute class periods.

Background:

Ground water is one of our most critical resources. As populations, economic growth, and material disposal problems continue to increase, the demands placed on ground water supplies will increase accordingly. The danger and actuality of pollution or contamination of these supplies will also increase. People in all walks of life, from the private citizen to those in the highest levels of government are making decisions that will have long term significance for all of us.

South of Baxter State Park, at least 65% of Maine bedrock is metamorphic in nature; it has been altered into a brittle and hence, fractured and broken material. It is capable of holding a significant reserve of water. Igneous bedrock may or may not be anywhere near as fractured and may hold much less volume of water by comparison. Surface sediment deposits, mostly created by glaciation, can also contain great reserves of water.

When rain falls to the ground it either evaporates, runs off into streams and rivers, or infiltrates either the surface sediment deposits or the bedrock. A cross section of a typical portion of Maine ground shows a number of places of significance in terms of water placement. See Figure 1.

The two most important locations for this ground water are in the coarse sand and gravels found in the overburden, and the highly fractured, crystalline bedrock. The former is referred to as a sand and gravel aquifer while the latter is called a bedrock aquifer. Generally, an aquifer is a geologic deposit that carries a useful volume of water to wells and springs. Virtually all of Maine's usable water occurs in these two types of aquifers. Surface water bodies, such as Sebago Lake, are continually replenished by these aquifers. Recharging of these aquifers by natural precipitation is cyclic, with intense recharge taking place in periods of high rainfall, and virtually no recharge taking place during droughts or periods of low rainfall.

Contamination of sand and gravel aquifers can take years to flush out since ground water percolates very slowly through the soil (as compared to surface flow). See Activities #5 (A Percolation Revelation) and #32 (The Percolation Rate of a Soil). Contaminated bedrock aquifers may be impossible to clean or purge, depending upon the nature of the contaminants. In these cases, well heads are destroyed to prevent further use of the contaminated water.

Materials:

All students will need a copy of Figure 1, pens, and notebooks. Each group of four students will need a copy of Aquifer Map #11 (covering parts of Androscoggin, Cumberland, and Sagadahoc Counties) for Part 2 of this exercise. This can be obtained from the Maine Geological Survey website. Teachers may wish to use aquifer maps which cover their own geographic area. Questions may need to be modified accordingly.

Procedure:

PART I. Using an overhead or board diagram of Figure 1 and making certain that students have their own copies in front of them, discuss the water equation: Precipitation = evaporation + infiltration + runoff. Focus on the infiltration aspects of the equation and look at options for the water once it is in the soil. You may wish to analyze stream flow feeding the water table in the soil in times of drought, or other specialized aspects of ground water behavior. This part will take about 1 period.

PART II. Divide the class into groups of four, each with a copy of Hydrogeologic Data For Significant Sand And Gravel Aquifers Map #11. You may wish to use a map that corresponds to your own area; check your map for the nature and availability of existing aquifers. If you use your own map you may wish to rewrite some of the student questions. Have the students locate the information required and then use this information to answer the questions. Closure can be provided by having each group present its choice of site for a landfill dump; this will probably take additional time.

Follow-Up:

This activity serves as a good introduction for either Activity #36 (Wetlands) or Activity #3 (Ground Water and Development Siting). Activity #36 requires about 4 weeks of school time; Activity #3 requires 4 days.

References:

Ground Water Handbook for the State of Maine, by W.B. Caswell (Maine Geological Survey, Bulletin #39, 1987).

This activity was developed by Alan Lane and Grant Connors, working independently, in conjunction with the CREST 1991 intern program.

Name_____

Activity 11: Aquifer Maps and Maine Ground Water

Maine Geological Survey

Student Sheet

Purpose:

To use aquifer maps to obtain information about local water supplies and threats to these supplies.

Materials:

Each student will need pens and a notebooks; each group of four students will need a copy of the "Hydrogeologic Data for Significant Sand and Gravel Aquifers Map #11".

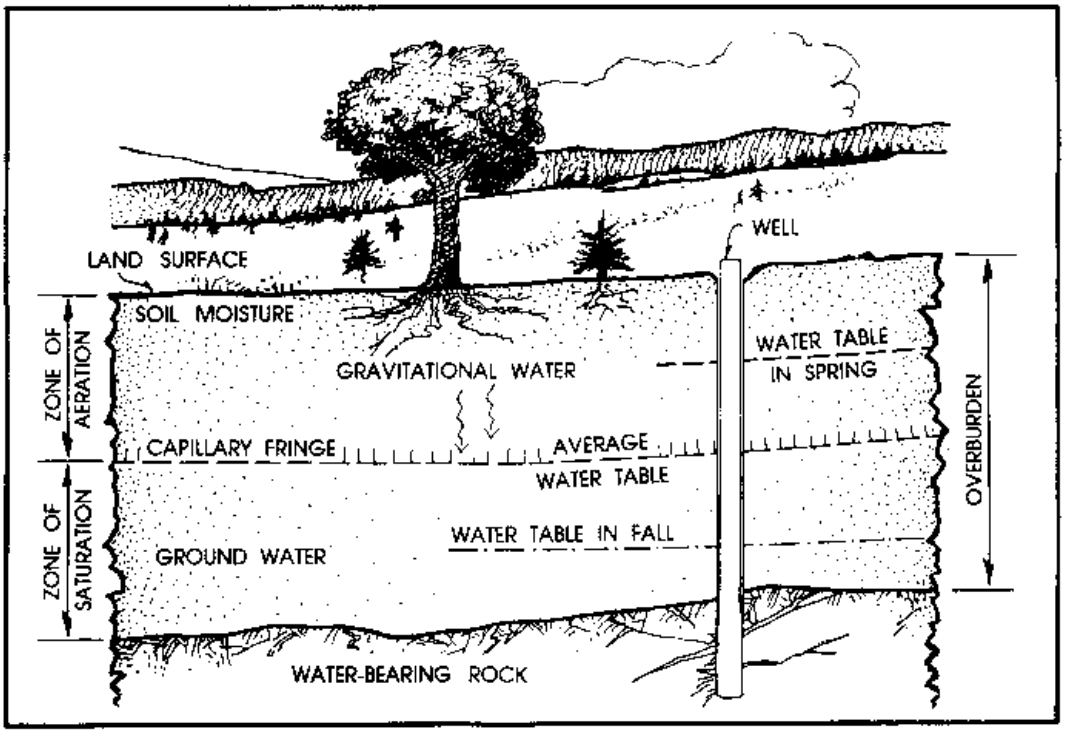

Figure 1. Divisions of subsurface water (*from W. B. Caswell, 1987)*

PART I:

In this part of the activity you will learn about the nature and behavior of ground water here in Maine. You will need to have a working knowledge of the basic terms that apply to ground water. Examine Figure 1 and define the terms listed below it.

Zone of aeration –

Zone of saturation –

Water table –

Bedrock aquifer –

Sand and gravel aquifer –

Recharge area –

Discharge area –

Percolation –

What does the Capillary fringe do? Does the "fringe" have different locations in the soil during the course of the year? Explain.

PART II.

Take a few minutes to study the map entitled Hydrogeologic Data for Significant Sand and Gravel Aquifers Map #11 (hereafter referred to simply as Map #11). Locate the legend, scale, and generally familiarize yourself with this map. Use the map to find the information requested in the following.

Map #11 covers parts of _____, _____, *and* _____*Counties.*

The word hydrogeologic means: hydro _____ *geologic* _____

USGS stands for _____
while DOT stands for _____

gpm stands for _____

Using the legend, write the symbols that represent the indicated map features

Gravel pit –

Minimum depth to bedrock –

Test boring –

Depth to water table –

Spring –

Dug well –

Potential source of contamination –

Yield –

Minimum thickness of sand and gravel –

Gravel well –

Depth to till –

Driven point –

Drilled well –

Marine deposits over sand and gravel aquifer –

Bedrock outcrop –

10 - 50 gpm –

Observation well –

500 + gpm –

PART III:

Using Map #11, obtain the following information.

A. Find the number of wells, yield, and depth to water table for the wells of the Brunswick-Topsham Water District.

WELL#	YIELD (gpm)	DEPTH TO WATER TABLE (meters)

B. Provide data from at least three test borings near the Brunswick-Topsham water district.

C. Record the data available about the Yarmouth Water District.

PART IV:

A. Summarize the data on the Gray/New Gloucester aquifers and water supplies.

B. Itemize and discuss the contamination threats to the Gray/New Gloucester aquifers.

C. Are salt piles a threat to water supplies? Explain.

PART V:

List 5 possible threats to the Androscoggin River between Lewiston and Lisbon.

1.

2.

3.

4.

5.

Optional: If directed to do so by your teacher, research the McKin Superfund site in Gray. Be prepared to discuss this in class.