DEVELOPMENT OF ENVIRONMENTAL GEOLOGY LABORATORY MANUAL
AT ONONDAGA COMMUNITY COLLEGE

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Technique Keywords: environmental impact analysis

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Overview: Ms. Hill developed new laboratory exercises for an environmental geology lab manual, including:
topographic and soil map interpretation, contaminant transport in groundwater, surface water erosion and mine
drainage, and geologic environmental impact analysis of a solid waste landfill.

Introduction

My participation in the Great Lakes Research Consortium’s Ecosystem Dynamics program was to help prepare
an Environmental Geology laboratory manual. While not all of the lab manual could be developed from the
information gleaned from the 3 weeks spent at Oswego, several labs were developed from ideas put forth
during numerous talks with the UFE faculty and participants. The labs that were a direct result of the program
are included in this report and can be found in Appendix 1.

Laboratory Exercises Development and Overview

The laboratory exercises I developed included soils and soils usage, Niagara Falls/Buffalo-region geology,
surface water erosion and surface mine drainage, groundwater contamination from underground storage tanks,
and an environmental impact statement.

In addition to lab exercises, students also participated in two or three field trips. These were to an incinerator, a
closed landfill that is now a city park, a contaminated municipal water well field, a trip around Onondaga Lake
with emphasis on the water contamination and water flow ultimately into Lake Ontario, and to a local example
of karst topography with an emphasis on bedrock fracturing and groundwater flow in the fracture system.

The lab exercises were used during the summer and fall 1990 sessions and during the spring 1991 session.
About 120 students used the new labs. I revised the ones that seemed to work and developed new labs for those
that needed to be replaced. Three instructors, including me, have taught the labs. I relied heavily on feedback
from the instructors and the students, particularly those who were enrolled during the summer 1990 session.

One of the labs currently being developed is an exercise on groundwater quality near a landfill. The New York
State Department of Environmental Conservation gave me some water quality data from different landfills
throughout our region and I plan to incorporate it into a new lab exercise.

Soil Survey Lab

This lab teaches students how to use a county soil survey and map. The USDA Soil Conservation
Service gave us as many Onondaga County Soil Surveys as we needed, but I had trouble getting any surveys
from Oswego County just north of Syracuse. After much talking, I convinced to give me to ONE survey!
Niagara Falls Region

After visiting the Falls during the Buffalo trip, I was impressed by the amount of contamination that must be flowing over and under (regional groundwater flow) the Falls. I tried to incorporate this into the lab by having the students think about surface water flow, groundwater flow, fish in Lake Ontario, and how these are related to them if they eat fish from Lake Ontario. Many students had never considered how the contamination in the western part of New York State could affect their fish consumption in the central part of the state. They had also never realized how the geology (water flow and movement of contaminants into bodies of water) could affect them.

Surface Water Erosion and Surface Mine Drainage

These two exercises really don’t belong together, but they were both short enough to be completed in an hour. Only the surface water erosion portion of the exercise was a result of the GLED program. Students were required to interpret topographic maps of the Lake Ontario shoreline near Oswego, NY, and to answer questions about the spectacular bluff/drumlin erosion in this area.

Groundwater Contamination

This exercise required students to answer questions about contamination from underground storage tanks (e.g., gasoline tanks), to map contamination thickness, and to determine the direction of flow for contamination plumes. Most of the students during the summer session enjoyed this exercise, whereas the majority of the students during the fall session had trouble with the simple math. This lab was revised.

Environmental Impact Statement

The students were required to think (as much as one can require a student to think!) about the siting of a new landfill and the upgrade of an existing garbage transfer station (located within city limits) into a temporary sanitary landfill. The environmental impact statement lab is two or three lab sessions. The students were divided into groups of three or four by the instructor. These groups worked together to answer a set of questions pertaining to state guidelines on siting a landfill. The NYS Dept. of Environmental Conservation (DEC) was kind enough to give me one copy of their guidelines. The students were graded individually on the questions.

The next part of this exercise required the groups to decide whether or not the proposed transfer station upgrade into a temporary sanitary landfill could be permitted by the DEC. The students were told that the existing landfill would be closed before a new site could be chosen and prepared and, therefore, an interim landfill must be developed. Since their decision had to be based on soils data, surface water flow, groundwater flow and usage, and bedrock geology, the students in each group had to divide the work among themselves and then bring it all together to come up with a decision.

Student teams prepared a written report using the data provided, presented their conclusions to the class, and attended a mock public hearing where they played individual roles. The roles were picked out of a box and the students had about fifteen minutes to decide how they would handle the role. For this part of the lab, the students were graded as a group (written report) and individually (role playing/participation).

The mock hearing/role playing was a huge success in the 1990 summer session, but was beyond the capabilities of the 1990 fall session students. As a result, the lab was revised and the students are now required to answer more questions about the area in question then discuss them at a mock public hearing if time allows. There is no written report, but they must write a paragraph or two justifying their conclusions.

Results

Over 50% of the laboratory manual is new or revised material. The rest is revised labs that teach geologic principles. After preparing the new labs, it was very interesting to me to see the difference between the students who enrolled in the summer course and those who enrolled during the fall and spring sessions. Basically, the summer students were much more alert and interested and offered a great deal of specific feedback about what
they liked or didn’t like, how the lab should be changed, etc. The regular session students simply complained or didn’t bother to do the labs at all. Many students during the fall 1990 session copied their answers (including misspelled words and half-finished sentences!) from each other, without even thinking about the labs. The grading has since been changed to minimize this. I found that most (>90 %) of the summer students were genuinely interested in the environmental aspects of the new labs, but less than 25% of the regular session students seemed to show the same interest. This was very discouraging to me; it seemed as if all the work that went into these labs was wasted on many students.

The environmental geology laboratory enrolls about 45 students per semester during the regular session and about 30 students during the two summer sessions. For the summer session, the environmental impact statement preparation, presentation, and mock hearing were the highlight of the course. The students really enjoyed doing the project and many commented on how much went into something like this in “real life.” For the regular session students, though, the environmental impact statement was boring. Part of this may be due to the fact that it is presented at the end of the semester and students are generally tired of all schoolwork by then. Part of it may also be due to the difference in the abilities of the students who enroll in a community college during the summer, but attend a 4-year institution during the regular session and those who are full-time community college students during the regular sessions.
ENVIROMENTAL GEOLOGY
LABORATORY EXERCISE 4

SOILS AND SOIL USAGE

SOIL SURVEY OF ONONDAGA COUNTY, NEW YORK

1. Read “HOW TO USE THIS SOIL SURVEY” found on the inside of the front cover.
   a. What information is used to make the soil map sheets?
   b. Where can one find the explanation of the map symbols?
   c. Where would scientists and others find out how soils are formed? What page is this section on?
   d. Where would community planners and others read about soil properties for areas of interest? What page is this section on?

2. Turn to the section that explains how soils are formed.
   a. How are soils formed?
   b. Read the sections that explain each of the five factors.

   In Onondaga County, what living organism had more influence on soil formation than any other living organism?

   What is parent material? What does parent material determine?

3. Read “Morphology of the Soils”
   a. What are soil horizons?
   b. How many horizons do most soils contain?
   c. In your own words, briefly explain the major features of each horizon.

4. Turn to the “Geology” section.

   When were nearly all of the parent materials of the soils of Onondaga County deposited?

5. Find the south shore of Onondaga Lake on the Index map.
   a. On which soil map sheet is it located?
   b. Turn to that sheet and locate the Barge Canal Terminal. What is the symbol for the soil type located under the sewage treatment plant and “Oil City?” What type of soil does this symbol indicate?
   e. Read about this soil under the “Description of Soils.” Briefly explain this type of soil.
   f. On the same map sheet, locate the Allied Waste beds near the word “Geddes.” These are the same hills examined on the topographic map and aerial photos in the previous lab. What is the soil type on these hills?
   g. Read about this in the “Description of Soils.” What are the major hazards preventing establishment of vegetation on these hills? How long does it take for vegetation to begin to grow on these hills?

6. a. On which map sheets is the Cicero State Game Management area?
   b. Find the Cicero Swamp on one of these map sheets. What is the soil type for the swamp?
c. Find this soil under the soil descriptions. After reading the description of this soil, read about its soil series, located just previous to the soil description.

Of what does this series consist?

How many horizons are in the representative profile of this soil? How does this differ from your answer for question 3b?

7. Locate the area in which you live on the index map. If you do not live in Onondaga County, use OCC for this question.

a. Turn to that soil map sheet. Using the roadways, find the approximate location of your residence. What is the soil type where you live?

b. Describe that soil using the soil descriptions as a guide.

c. Find the section in this survey labeled “Town and Country Planning.” What do the soil limitations “slight,” “moderate,” and “severe” mean?

d. What is the limitation rating for your soil for
   i. Dwellings with basements?
   ii. Septic-tank absorption fields?
   iii. Lawns and landscaping?

e. Do you have a basement where you live? Are you having any leakage problems? If so, why?
The Niagara Falls region of New York and Ontario is internationally famous for its spectacular waterfalls and the accompanying gorge of the Niagara River. Flowing from Lake Erie (located to the south of this map), the Niagara River forms the Niagara Falls region and continues north, emptying into Lake Ontario. This relatively short waterway is the outlet for four of the five Great Lakes. The falls are formed from the erosion of the rocks by the Niagara River. As the rocks erode and fall into the lower Niagara River, the falls retreat to the south.

GEOLOGY MAP, NIAGARA FALLS REGION

This map represents the geology in the Niagara Falls Region. The different colors on the map represent different rock types and ages. Examine this map and answer the following questions.

1. Going from the north to the south, do the rocks become geologically younger or older? Why?
   What is the name of the oldest rock type in this area?

2. What is the name of the island that separates Horseshoe Falls from the American Falls?

3. What is the age and type of the most abundant rock located on this island and at Niagara Falls, New York?

   This type of rock has numerous fractures (joints) in it which allow the water to seep into the subsurface. Some of this water flows toward the Falls where it acts as an agent of erosion, causing large blocks of the rock to break off and fall into a talus (rubble) pile at the base of the American Falls.

4. Assuming that Niagara Falls has canals that contain toxic liquids, where might these liquids flow if they are allowed to seep into the ground and the underlying bedrock?

5. If the former erosion rate by the Niagara River was six feet per year, about how long ago were Horseshoe Falls and American Falls a single falls located at the present site of Rainbow Bridge?

6. Approximately 50% of the water of the Niagara River is diverted to hydroelectric power plants in both the United States and Canada before it reaches the falls. As a result, the current erosion rate is about 2 feet per year.

   Locate the aqueducts in the town of Niagara Falls. Locate their intakes on the Niagara River. How far does the water have to travel from its intake until it reaches the power plant located near the reservoir along Military Road?

7. For one day in 1848, an ice blockage on the Niagara River near Buffalo, New York stopped the water flowing to the American Falls. If such an event were to happen this year, what would be one environmental result?

8. Where would toxic liquids end up if they were allowed to flow into the surface waters of the Niagara River and over the Falls?

Fish concentrate some toxic chemicals. If you fish in Lake Ontario, would the events which occur to the surface water in the Niagara Falls region affect you? How?
ENVIRONMENTAL GEOLOGY
LABORATORY EXERCISE 6
SURFACE WATER EROSION AND SURFACE MINE DRAINAGE

SURFACE WATER EROSION

Lake Ontario is a freshwater lake that is large enough to have shoreline erosion problems similar to those found in a coastal (oceanic) environment. Erosion along the shoreline of Lake Ontario is a result of many factors, primarily changes in the water level due to high precipitation and therefore runoff into the lake, storm surges, high winds, and manmade sources. Manmade sources include water seepage from septic systems, pools, storm drains, etc., as well as removal of material for construction purposes. In this exercise, the student will examine the portion of the Lake Ontario shoreline found near Fair Haven, New York.

1. On the graph paper provided, draw a topographic profile of “The Ridge” from the 250’ elevation on the north nearest the “K” in Sterling Creek across the ridge to the 250’ elevation on the south end. Use a 10’ interval for every horizontal line on the graph paper.

2. On the same sheet of graph paper, draw a topographic profile across Sitts Bluff from the Lake Ontario shore nearest the “B” in Bluff to the southern tip where the 250’ elevation intersects the black dashed line. Use the same scale as The Ridge profile.

3. At one time, the topographic profile of Sitts Bluff was probably similar to topographic profile of The Ridge. What happened to the north side of Sitts Bluff?

4. Using a dashed line or a different colored pencil, project on the topographic profile of Sitts Bluff what it will look like in 100 years if it is being eroded at the rate of 5 feet per year.

5. Look at the spacing of the contours of Sitts Bluff nearest Lake Ontario. Name or describe the location of at least three other areas whose north slopes look similar to Sitts Bluff. Would these be favorable places to locate transmission lines for electricity? If so, why? If not, why?

6. Prior to inundation by Lake Ontario, Little Sodus Bay was probably a marsh area similar to what is currently found near Sterling Creek. How many feet would the lake level have to rise before completely inundating The Pond and Sterling Creek marsh?
This exercise will look at the results of underground mining activities which have contaminated the surface waters in the Picher, Oklahoma area. Picher is located in extreme northeast Oklahoma in the Tri-State Mining District of Oklahoma, Kansas and Missouri. The Tri-State Mining District was at one time the world’s leading producer of zinc. The District also produced lead. Zinc was from the mineral sphalerite, ZnS, and lead was from galena, PbS.

The mining of these two ores (an economic deposit of minerals) was from underground mines where the ores were removed from mineralized fractures in limestones. The ores were then transported to the surface where they were crushed and most of the zinc and lead bearing minerals were removed. The excess limestone, containing minerals such as pyrite, FeS, was piled in heaps wherever convenient. Although most of the mines were abandoned by 1958, surface and subsurface waters (groundwater) have been contaminated and are still being contaminated as a result of the chemical reactions taking place within and near these piles of excess rock.

1. What do the half-filled square symbols represent?

2. What is the name of the north-south creek which can be found in the central portion of the map? In which direction is it flowing? How can you tell?

3. What are the numerous circular/elliptical areas of stippled patterns through which this creek flows?

4. What is the name of the creek which flows through sections 21 and 29. It, too, flows through circular stippled areas. In which direction does it flow? Into which creek does it empty?

5. On which creek is the sewage disposal area located?

CONTAMINATION OF THE SURFACE WATERS:

Pyrite within the tailings piles can be chemically broken down by a bacterium called *Thiobacillus ferro-oxidans*. These bacteria only require oxygen and water to begin the breakdown process. One of the by-products of this breakdown process will react with the sphalerite and release zinc into the surface water through infiltration and runoff of precipitation.

Look at the numerous tailings piles. Each contains pyrite and sphalerite. Therefore, each pile has the potential to contaminate surface water as precipitation carries the metals to the creeks. The contamination of the two larger creeks and even the smaller creeks is well documented.

6. Besides metal contamination, what other source of pollution is present on this map?
The majority of groundwater contamination problems occur at or near the water table. This exercise will address the problem of groundwater contamination in unconfined aquifers. An unconfined aquifer surrounded by porous rock and soil. A confined aquifer is one that is overlain by porous rock and soil and underlain by a confining bed such as shale.

UNDERGROUND STORAGE TANKS (UST) -- GASOLINE

At most gasoline stations, the gasoline (or fuel oil) is stored in underground storage tanks (UST). The UST are embedded in very coarse gravel and are usually filled from tanker trucks by way of a pipe that has an opening near the storage tanks. The UST are generally covered over with asphalt, but in some cases are covered by soil and vegetation.

The level of the petroleum in the tanks is supposed to be checked on a regular basis. In some cases, it is checked more than once a day but in others it may be checked only once a month. When the level or amount of petroleum product (gasoline) is compared to the amount of product that has been added by refilling or removed by consumption, station managers are able to tell whether or not a tank has developed a leak.

If the tank developed a leak and the amount of product in the tank was only checked once a month, the tank may have been leaking for a month without anyone realizing the problem. As a result of gravity, the gasoline that has leaked from the leaking tank will infiltrate down to the water level (water table). Gasoline is considered to be a non-aqueous phase liquid (NAPL) that is less dense than water and will, therefore, float on the water near the top of the saturated zone in an unconfined aquifer.

Once a leak is discovered, geologists will work to determine the extent of the contamination and will make some type of recommendation for the clean-up of the aquifer. To determine the extent of contamination, monitoring wells are drilled and installed both up-gradient and down-gradient near the leaking tank. A monitoring well is usually 6” in diameter and is made of PVC pipe. The hole into which the pipe is placed is generally drilled to a depth 5’ below the elevation at which water was encountered in that well. The entire length of the hole (from surface to 5’ below the water table) will be cased with the PVC pipe. The bottom 10’ of the PVC pipe has slots cut into the pipe to allow water and gasoline to flow into it. The depth to the water and the thickness of the contaminant can then be measured using a specialized measuring tape.

The monitoring wells can also be used as a part of the clean-up operation. The clean up of gasoline (and most NAPL petroleum products) can involve installing a pump which will pump the product and possibly some water to an above ground holding tank. Once the tank is full, the petroleum will be removed and shipped to a disposal facility. The clean up may also involve the use of activated charcoal-filled drums or a device known as an air stripper. Air strippers are tall circular towers (8-12’ in height) that are filled with many-sided beads that have a diameter of about 1-2”. The water and petroleum product are pumped to the surface, through the carbon drums to remove the heavier petroleum products. The lighter, more volatile products will be mixed with water, pumped past a large blower and to the top of the air stripper tower. The water and light petroleum products will be allowed to infiltrate down through the column of beads where the lighter petroleum products will volatilize and be carried into the atmosphere. (Volatilize means that the product will turn into a vapor.) The cleaner water coming out of the bottom of the stripper will either be pumped back through carbon drums, be released into a sewage line or nearby stream, or will be pumped back into the ground near the contamination site.

In this exercise, you have been provided with a map that shows the location of a gasoline station that contains underground storage tanks for regular, unleaded, and super unleaded gasoline. The map also shows the location of the gasoline islands, the filler pipe heads, the office, the property boundaries, and the location of monitoring wells. The monitoring wells were installed to determine the extent of contamination from a leak that went
undetected for quite some time. Monitoring well #1 was also used to pump the contaminated water to the surface where it was treated.

In Table I, you have been given
1. the monitoring well number,
2. the elevation of the land surface at each monitoring well,
3. the depth to gasoline,
4. the depth to the water.

Using this information, you will need to

1. determine the thickness of the gasoline at each well,
2. determine the elevation of the water table,
3. draw a topographic map (C.I. =1’) of the property,
4. draw a contour map (C.I. =1’) of the water table before pumping,
5. determine the direction of flow before pumping by using flow lines and arrows,
6. draw a contour map showing the extent of gasoline contamination using thickness (C.I.=1’),
7. draw a contour map (C.I.=1’) of the water table during pumping,
8. determine the direction of flow during pumping by using flow lines and arrows.
TABLE 1

<table>
<thead>
<tr>
<th>Monitoring well #</th>
<th>Elevation at surface (ft)</th>
<th>Depth to gasoline (ft)</th>
<th>Depth to water (ft)</th>
<th>Thickness of gasoline (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>(b)</td>
<td>(c)</td>
<td>(c—b)</td>
<td></td>
</tr>
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<td>4.7</td>
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</tr>
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<td>302.3</td>
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<td>4.15</td>
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<td></td>
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<tr>
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<td>301.4</td>
<td>---</td>
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</tr>
<tr>
<td>5</td>
<td>300.8</td>
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<td>---</td>
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<td>303.5</td>
<td>4.3</td>
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<td></td>
</tr>
</tbody>
</table>

H.W. Elevation of water table before pumping (ft) (a-c)

<table>
<thead>
<tr>
<th></th>
<th>Elevation of water table during pumping (ft)</th>
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</thead>
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<td>1</td>
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</tr>
<tr>
<td>2</td>
<td>293.5</td>
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<td>11</td>
<td>298.2</td>
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<tr>
<td>12</td>
<td>299.0</td>
</tr>
</tbody>
</table>

QUESTIONS:
1. Compare the water table contour maps before and during pumping. Is there a difference? What is the difference?
2. What happened to the water flow direction during pumping of monitoring well #1?
3. What is the shape of the water table contours during pumping? This shape is common during pumping and is intentionally created to force the contaminant to flow toward the pumped well.
4. To the north of this property, there is a stream that is basically parallel to the road. The elevation of the water in the stream is the same as the water table in the area. Without pumping, would the gasoline eventually flow into this stream? Why or why not?

CHEMICAL CONTAMINANTS
All too often, a company will dispose of chemicals in such a way that it will be detrimental to the quality of the groundwater. The disposal may involve intentional disposal, a spillage during shipping or unloading of the chemical, or leakage of a storage facility such as an underground storage tank. Chemical contamination of groundwater may not be obvious without extensive (and often expensive) laboratory tests.

To determine if an aquifer has been contaminated, monitoring wells are drilled and installed in the same manner as in Part I of this exercise. Groundwater is removed from the monitoring wells using a special device known as a bailer. A sample of the groundwater is bottled and sent to a laboratory for analysis.

Once contamination of the groundwater has been discovered, removal of the chemical contaminant may be quite difficult. It requires knowledge of the physical characteristics of the chemical and how it will react in the presence of water. Removal also requires knowledge of the local groundwater flow regimes.

In this exercise, you have been provided with a map showing

1. the locations of wells 1-6 and A-F,
2. the location of a major river,
3. the location of a manufacturing company which experienced a leak from an underground storage tank containing a chemical which is toxic in high concentrations.

Wells 1 through 6 are groundwater supply wells for the local municipality. These wells pump water from the aquifer into a storage facility such as a reservoir or water tower, into a treatment plant (usually chlorination and fluoridation), and into homes for drinking water purposes.

Wells A-F are monitoring wells installed to determine the extent of contamination. Samples of the groundwater were taken from each of the monitoring wells and the results are shown in Table 2.

The river flows from the south to the north and is quite contaminated from a lake to the south and from numerous other sources between the lake and this location.

Using the information given, you will need to

1. draw a topographic map of the area (C.I.=1’),
2. determine the elevation of the water table before pumping,
3. draw a water table contour map before pumping (C.I.=1’),
4. draw flow lines and show flow directions with arrows,
5. draw a contour map showing the extent of contamination/concentrations (C.I.=1 ppm),
6. draw a water table contour map during pumping (C.I. = 1’),
7. draw flow lines and show flow directions using arrows.

QUESTIONS:

1. Which municipal supply well was most affected by the chemical leakage?
   
   If the EPA specifications specify that water is unsafe to drink if the concentration of this contaminant exceeds 1 ppm, is this well still usable as a drinking water source?

2. Cleaning up these types of spills is very expensive. In your opinion should the manufacturing company or the municipality pay to clean up the drinking water supply? (The manufacturing company has its own source of drinking and industrial water and does not rely on these wells.) Justify your answer.
3. Why would the water from municipal well #1 have a foul taste when the well is being heavily pumped? (Look at the water flow lines during pumping.)

4. How would you solve the foul taste problem? Justify your answer.

5. If no pumping took place, would the contaminant ever reach the other municipal wells? Explain.

6. If heavy pumping of the municipal wells occurs (particularly in the wells closest to the contaminated wells) would contamination of the other municipal wells be possible? Justify your answer.

The state department in charge of monitoring and regulating this clean-up approved a plan to pump the contaminated groundwater from the well and release it directly into the river. This is considered acceptable since EPA guidelines allow a higher concentration of this contaminant in a flowing stream than in groundwater. The flowing stream will dilute the contaminant to lower concentrations.

This type of clean up is called dilution and falls under the belief that “dilution is the solution to pollution.” This procedure is common, but can be environmentally dangerous and detrimental to the flowing stream. Chemicals can enter a stream from numerous sources all along the course of a stream, eventually causing the concentrations of the contaminant to become higher than any single source is putting into the stream. This higher level may not be acceptable according to EPA guidelines.

Dilution of a contaminant may also be detrimental to the ecology of the stream since many contaminants have been found to be toxic to plant and animal life in very low concentrations, less than 1 ppm, or to bioaccumulate.
TABLE 2

<table>
<thead>
<tr>
<th>Well</th>
<th>Elevation at surface (ft)</th>
<th>Depth to Elevation of water before pumping (ft)</th>
<th>Concentration of contaminant (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(a)</td>
<td>(b)</td>
<td>*</td>
</tr>
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<td>3</td>
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* N.D. Not Detected. Assume this means no contamination.
Environmental Impact Statements are a group of separate reports that cover the different ways in which a proposed project may impact the environment. The proposed project may impact the socioeconomic environment, the geologic environment, the biologic environment, or in any other way possible. All possible impacts must be explored before the project can be approved and permitted.

This laboratory exercise will consist of two parts: Part I will be a series of questions that each student will need to answer. In Part II, you will be given a proposal. The class will be divided into groups and each group will need to decide whether the proposal should be allowed, based upon the information covered in this and previous exercises.

The first part of this exercise will consist of questions concerning the impact of any proposed landfill. The student will need to use the NYS Department of Environmental Conservation Report 6NYCRR Part 360 to answer the questions.

For the second part, the instructor will provide a description of the proposed project. The students must develop an environmental impact statement that will be limited to the geologic environment. Each group will also be provided questions that will guide you through the statement. Your decision will need to be written out, but will need to be no longer than one or two paragraphs. The group will also present its findings to the class and will attend a mock public hearing on the project, where questions will be asked about its findings.

ENVIRONMENTAL IMPACT STATEMENTS
6NYCRR PART 360 SOLID WASTE MANAGEMENT FACILITIES
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PART I
QUESTIONS:
SUBPART 360-2
1. What is regulated by this subpart?

2. Under which category would one find the original undeveloped site topography before the excavation or placement of solid waste?

3. What geologic categories must be included in the above in both plan and cross-sectional views?

SECTION 360-2.11 HYDROGEOLOGIC REPORT
4. What is defined by the hydrogeologic report?

5. How far downgradient must a survey of public and private water wells be conducted? Upgradient?

6. Why is there a difference in these two survey boundaries?

SUBSECTION (8): MONITORING WELLS AND PIEZOMETERS

(A piezometer is a monitoring device that is installed in a similar fashion to a monitoring well, except it is about 1/2" in diameter. It is used to measure the level of the groundwater.)

7. Should upgradient or downgradient monitoring wells be drilled first? Why?
8. What must the site-specific geology investigation report define?

LANDFILL SITING: 360—2.12, 360—1.14

9. What must the site-specific geology investigation report define?

LANDFILL SITING: 360—2.12, 360—1.14

9. Name the seven areas where landfills are prohibited.

10. Why would landfills not be permitted near airports?

PROBLEM: Onondaga County needs to find a location for a new sanitary landfill.

PROPOSAL: The county wants to expand an existing transfer station to contain the county’s solid waste until a permanent site can be chosen and agreed upon by all parties.

BACKGROUND INFORMATION: Onondaga County Solid Waste Disposal Authority currently transports its solid waste (household garbage, etc.) to the Seneca Meadows Landfill outside of Onondaga County. As of 1 January 1992, Seneca Meadows Landfill will be unable to accept any out of county solid waste. As a result, Onondaga County is currently trying to site a new landfill. New geologic information has caused problems with the selected site and will possibly render it unacceptable. To bridge the gap between the time it will take to secure another landfill site and the 1 January 1992 deadline, the county is entertaining the possibility of upgrading and expanding the existing 7th North Street Landfill in the town of Sauna.

The expansion area will be located as follows:
- bounded to the southwest by 7th North Street,
- bounded to the northeast by the New York State Thruway,
- bounded to the north by Interstate 81,
- bounded to the south by Penn Central Railroad tracks, and
- bounded to the east by U.S. Route 11.

Piezometers located in the northern part of the proposed area show a water table depth of 8’ below the surface. Piezometers located in the southern part of the proposed area show a water table depth of 7’ below the surface.

Data available include:
- topographic maps
- soil survey of Onondaga County*
- bedrock geologic map (in hall near room 363)

Keep in mind when discussing your group’s conclusion that this action will be an interim measure only and will be in operation for no longer than 18 months.

You and your colleagues have been elected to the Solid Waste Management Authority. Your task is to review the available information and make an educated decision on whether the proposed temporary landfill site is geologically acceptable. You must present your decision in a short written report (one or two paragraphs).

Unfortunately, the deadline to close the existing landfill is quickly approaching and your group must reach a consensus on whether or not to expand the existing facility or build a very expensive waste incineration plant. You will have one hour to make a decision. At the end of the hour you will present your findings at a public hearing where you will also be questioned by the people of the county. The following questions will guide you through this process.

1) Locate the proposed landfill site on a topographic map.
2. Using the geologic map in the hall near Rm. 363, determine the bedrock type. ______________________
   What is its age?_______________________ Is it a good rock type on which to build a landfill? Why? What
   factors should be considered? (Before answering, read section on salt in Geology of New York State: A Short
   Account.)

3) Using the Onondaga County Soil Survey Report, determine the soil type at the site. Is it a good soil type for
   the landfill facility? Why? What factors should be considered?

4) Using the topographic map, find and list any surface water located on the site. Where does the creek which
   flows across the site go? Does this creek flow year round? _____ Why is this an important factor in the
   proposed expansion of this site?

5) Measurement of groundwater elevations in monitoring wells from the north side of the site are consistently
   higher than those from the south. In which direction is the groundwater flowing? Is anyone likely to be utilizing
   private wells for domestic purposes in this direction? Justify your answer. How would one be certain whether
   or not private wells existed in this area?

6) Make a table listing the pros and cons of using this site for a temporary landfill. What other information
   would you need before making your decision?

7) Make a table listing the pros and cons of building a waste incineration plant.

8) Assuming continued population growth in this county and increasing resistance to landfill siting, what
    changes in the current disposal practices would you suggest to avert environmental disaster?