

POINT AND NON-POINT SOURCE POLLUTION IN THE CHIPPEWA RIVER WATERSHED

INTRODUCTION

Rivers, lakes and wetlands are easily identifiable components of the landscape. Historically, they have been studied as isolated freshwater ecosystems, separate from the landscape around them. Today, we recognize that they are intricately bound to the landscape. Rainwater hitting the ground eventually flows or seeps into a stream, lake, or wetland. This rainwater carries with it the products of the landscape including nutrients, pollution, and sediment.

The Chippewa River, as it flows through Isabella County, is impacted by all of the land surrounding it. Human practices such as agriculture, construction, industry and habitation all produce materials that ultimately can impact the river. In today's lab, we will tour the Chippewa River watershed and observe how human activities on the land influence the quality of the river ecosystem.

OBJECTIVES

In today's lab you will

- identify point and non-point sources of pollution.
- describe the hydrology of the Chippewa River as it flows through Mt. Pleasant
- learn how to test ground water and river water for excess nutrients and hardness.

KEYWORDS

Be able to define the following terms.

riparian	siltation	ground water
aquifer	erosion	hydrology
watershed	surface water	porosity
non-point source pollution	runoff	seepage
point source pollution	water table	

BACKGROUND

"Everybody lives downstream!", is a phrase that is intended to point out the fact that, since the hydrological cycle is a closed loop, no one truly resides at the beginning of the system. Towns situated on rivers are downstream of other towns above them. Even mountainous areas receive their rainfall from water evaporated in the lowlands. The message being sent in this slogan is that whatever is done that affects the water quality at some point in the system will be felt at all other points along the line. Consequently, activities on the land that might not seem to have a direct connection to a water source often have significant impacts on water quality.

There is a simple reason for this relationship. Precipitation falling on the earth's surface, that does not evaporate or become absorbed by the soil, usually drains over the land or through the soil into streams, rivers, lakes, marshes and ultimately the ocean. This water is referred to as **runoff**. The lakes, streams and marshes are considered **surface water**. Some water becomes trapped in underground reservoirs (**aquifers**) and is referred to as **ground water**. The surface of the land that drains to a common point (usually a river or stream) is called a **watershed**. Watersheds can be small, such as the area drained by the ditch running through the old field at Veit's Woods or large such as the area drained by the Mississippi River.

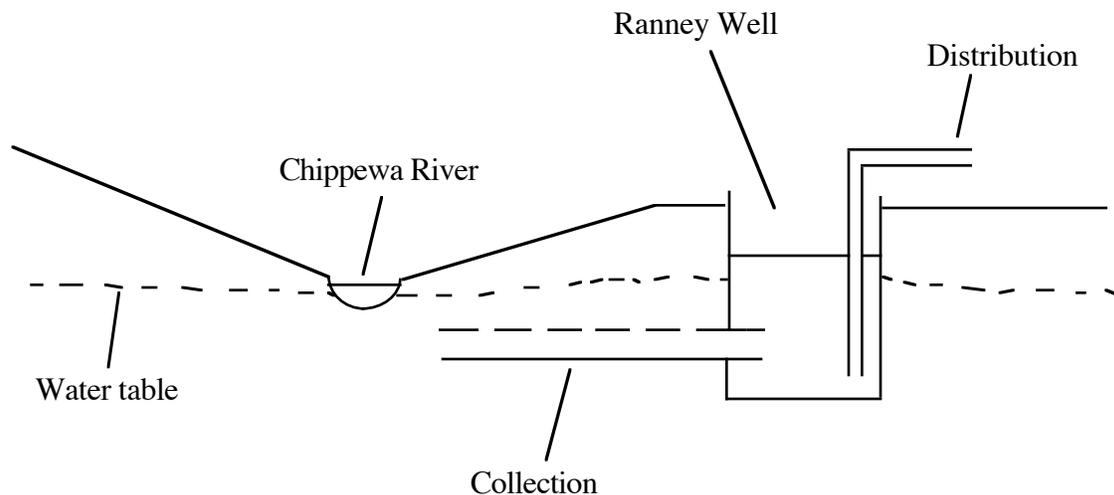
As the water flows over and through the soil it picks up substances, some of which become dissolved in the water and some of which are simply suspended in the water and deposited when it stops. Because of this, any activity or event that exposes the earth to rainwater is contributing to the load of material carried to freshwater systems. This study of the movement of water and its properties is called **hydrology**.

It should be apparent that virtually any activity has the potential to introduce foreign substances into the water. Material generated from human activity that is considered harmful in any way is referred to as **pollution**. Material that has an identifiable source such as a spill or leak is referred to as **point source pollution**. Leaky pipes, industrial effluent or chemical waste sites are easy to pinpoint and address. Materials that are washed off roads, parking lots and farmer's fields are much harder to identify and even more difficult to prevent. These materials are referred to as **non-point source pollution**. Non-point source pollution is difficult to

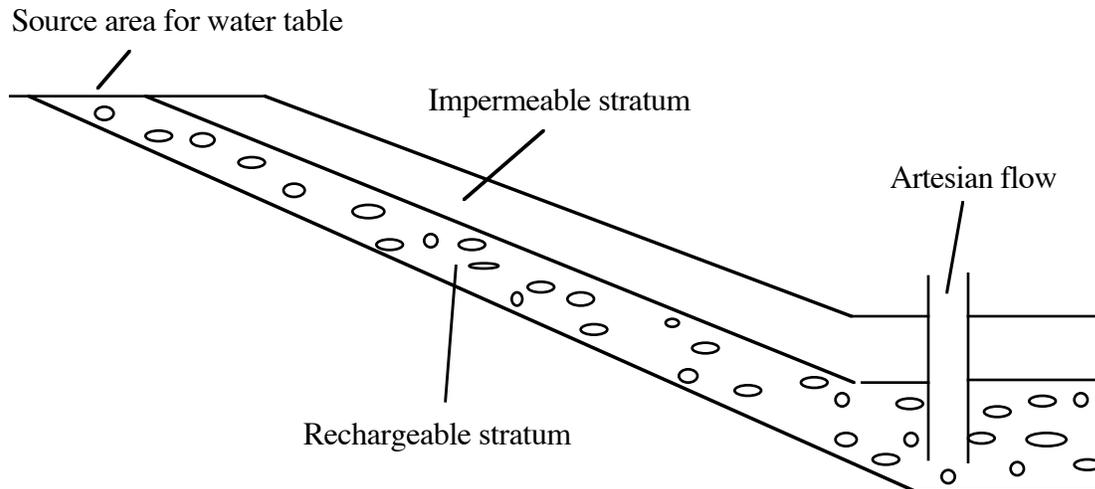
identify and control because of its insidious nature. Unfortunately, the largest majority of pollutants in our water are from non-point sources because the entire watershed is potentially their source.

The Figures 13.1 through 13.2 identify some of the ways in which water is retrieved for use by communities and the ways water is filtered in order to limit the pollutants that might be returned to the water supply. Wells are the most common and one of the most ancient systems by which water is retrieved out of the ground. Different types of rock and soil have different abilities to hold water. This is referred to the **porosity** or **permeability** of the stratum. A well is simply a hole that intrudes into the layer of stratum that is porous enough to hold water. The cavity formed by the well fills with the water that leaks out of the rock or soil. In order for a well to produce water it must intrude to a depth at which the water resides. This level is called the **water table** (Figure 13.1).

Figure 13.1

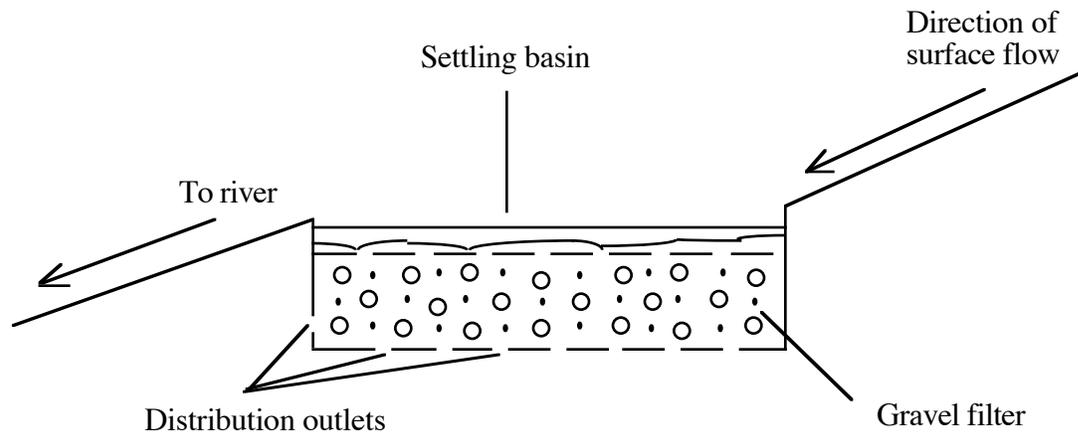


Artesian wells force the water above the water table because of a recharge area that is higher than the site of the well. An impermeable layer of rock over a permeable layer allows water pressure due to gravity to build. It is released when the overlying impermeable layer is penetrated and the water is forced out (Figure 13.2).

Figure 13.2

Abatement is the way in which a problem is resolved. The abatement of non-point source pollution should first attempt to limit the application of substances that might ultimately find their way into the water table. If this is not possible then techniques are used that would limit the amount of material that is on the surface of the ground from entering the water system. This is usually in the form of filtration systems and buffer zones around watercourses. Filtration systems are designed to entrap the water before it enters the river and removes pollutants either through settling of sediments or filtration (Figure 13.3). Finally, and often too late, is removing pollutants from the water supply. This is usually only dealing with drinking water and does not involve the water that is used by the ecosystem.

Figure 13.3



DIRECTIONS

You will be taking a driving tour of the Chippewa River Watershed in the Mt. Pleasant area. There will be some organized stops where you will receive some more detailed information from you instructor. The majority of the sites will be passes from the road (primarily due to traffic and time constraints) and it is each car's responsibility to follow the descriptions of the sites on the "travel log" below. At some sites, you will stop and collect water samples for chemical analysis.

TURN LEFT, ONTO M-20 / HIGH ST.

TURN RIGHT, ONTO ADAMS, TOWARDS FREDDIES (AT ASHCRAFT'S)

TURN RIGHT, ONTO FESSENDEN AVE

TURN RIGHT, ONTO LEATON RD AND STOP IN THE PARKING LOT

Stop #1: Franklin Well

Franklin well is one of the remaining operational wells in Mt. Pleasant. It is about 350 feet deep, where the water is inherited. Currently, we do get water from this well. There are 2 or 3 other wells in the area, but all have the same poor quality water. The color of the water comes from the natural iron in the sandstone. The Chippewa River is directly behind the well. Collect a water sample from the

outflowing well water and from the river itself. Your instructor will show you how to analyze the water for nutrients (phosphorus, nitrate), alkalinity, and hardness.

LEAVE FRANKLIN WELL AREA
TURN LEFT ON FESSENDEN AVE
TURN LEFT ON BRADLEY
TURN RIGHT ON M-20
TURN LEFT ONTO LINCOLN RD

Pass #1: Lincoln Rd.

Pass over the main branch of the Chippewa River. The river should be clear, but dark. Observe the extent of riparian vegetation surrounding the river. How would eliminating that vegetation affect non-point source inputs to the river?

TURN RIGHT ONTO BROOMFIELD

Pass #2: Ranney Well

Ranney Well: the diagram for the well is shown in Figure 13.1. The gray structure is the 2,000,000 gallon reservoir. It is 30 feet deep and 15 feet wide. The brick building is the Ranney Well itself.

Pass #3: Golf course

The golf course on the right side of the road is situated directly on the banks of the Chippewa River. What problems could this pose? Just past the golf course parking lot and before Craig Hill Rd. there is small wetland on the right. How might this abate runoff from the course?

CONTINUE DOWN BROOMFIELD AND FOLLOW BEND IN ROAD TO THE LEFT
TURN RIGHT ONTO BLUEGRASS TO 0.5 MILES FROM THE TURN

Pass #4: Artificial pond

This is a small trout stream and the large culvert is to protect the road from flash floods. There is an artesian well (see Figure 13.2) in the yard of the house. It is hidden by the ornamental water wheel. Notice the color of the pond. What might be a cause? How might the outflowing pond water affect the trout stream?

TURN RIGHT ONTO MERIDIAN

Pass #5: Meridian Rd. development

From the stop sign down to the river is the seepage area through which water flows into the river. Since it is a seepage area, the water table is high. This is an affluent neighborhood and a popular place to live. Most of the houses have septic fields just above the seepage area. How might septic fields influence water quality at this site?

TURN RIGHT INTO MERIDIAN PARK

Stop #2: Meridian Park

Oxbow lakes can be formed from erosion and deposition of sediment by rivers. Observe one that is almost completely formed and one that is just forming. Chippewa River contains a diversity of fishes including hornyhead chubs, rock bass, smallmouth bass, suckers and darters. Drive down to the river and collect a water sample. How do the chemical parameters differ from those of the previous samples?

TURN RIGHT OUT OF THE PARK

Pass #6: North Branch of Chippewa R.

North branch of the Chippewa River goes through agricultural areas prior to this point, picking up silt from erosion and chemicals from farmers' fields. Notice the clarity of the water. How might this influence water quality in the main branch of the Chippewa River?

TURN LEFT ONTO M-20 (CROSS THE CHIPPEWA AGAIN)

TURN RIGHT ONTO VANDECAR (INTO THE AGRICULTURAL AREAS)

STRAIGHT AT THE STOP SIGN AND CROSS PICKARD

STOP AT THE NEXT STOP SIGN (RIVER RD.)

Stop #3: Hogg's Creek Tile Drain

Hogg's Creek tile drain is an outlet for water that has accumulated in ceramic tiles underneath farm fields. Hogg's Creek empties into the North Branch of the

Chippewa River. Whether it has rained or not, water always drains from the fields. What chemicals would you expect to find in Hogg's Creek water?

TURN RIGHT ONTO RIVER ROAD

Pass #7: Engler Farm

Notice the stream that runs through the Old Engler Farm and crosses River Rd. It is usually cloudy with silt. Cattle have trampled stream bank vegetation and have caused increased erosion. Look to the right and notice the North branch of the Chippewa River flowing southeast across a farm field. It has been channelized (straightened and deepened) to limit meandering through the fields. How would channelization affect the movement of water in the stream?

TURN RIGHT ONTO NOTTAWA RD

PULL OFF TO THE SIDE OF THE ROAD JUST PRIOR TO THE BRIDGE.

Stop #4: North Branch of Chippewa River

This is the North Branch of the Chippewa River. Carefully walk down to the river and collect water samples. The channelized North Branch of the Chippewa River may appear yellow from silt and agricultural runoff.

TURN LEFT AT THE STOP SIGN ONTO PICKARD RD

STRAIGHT AT THE STOP SIGN CROSSING MERIDIAN

TURN LEFT AT THE STOP SIGN, ONTO LINCOLN RD

Pass #8: Mission Creek

Few houses in this neighborhood have basements due to a high water table. After passing a barn and subdivision, you will cross Mission Creek. It has been dammed to form a pond. Not long ago, Mission Cr. was cited for excessive pollution from septic fields. Mission Creek empties into the main branch of the Chippewa River. How might the pollution affect downstream communities (Mt. Pleasant, Midland)?

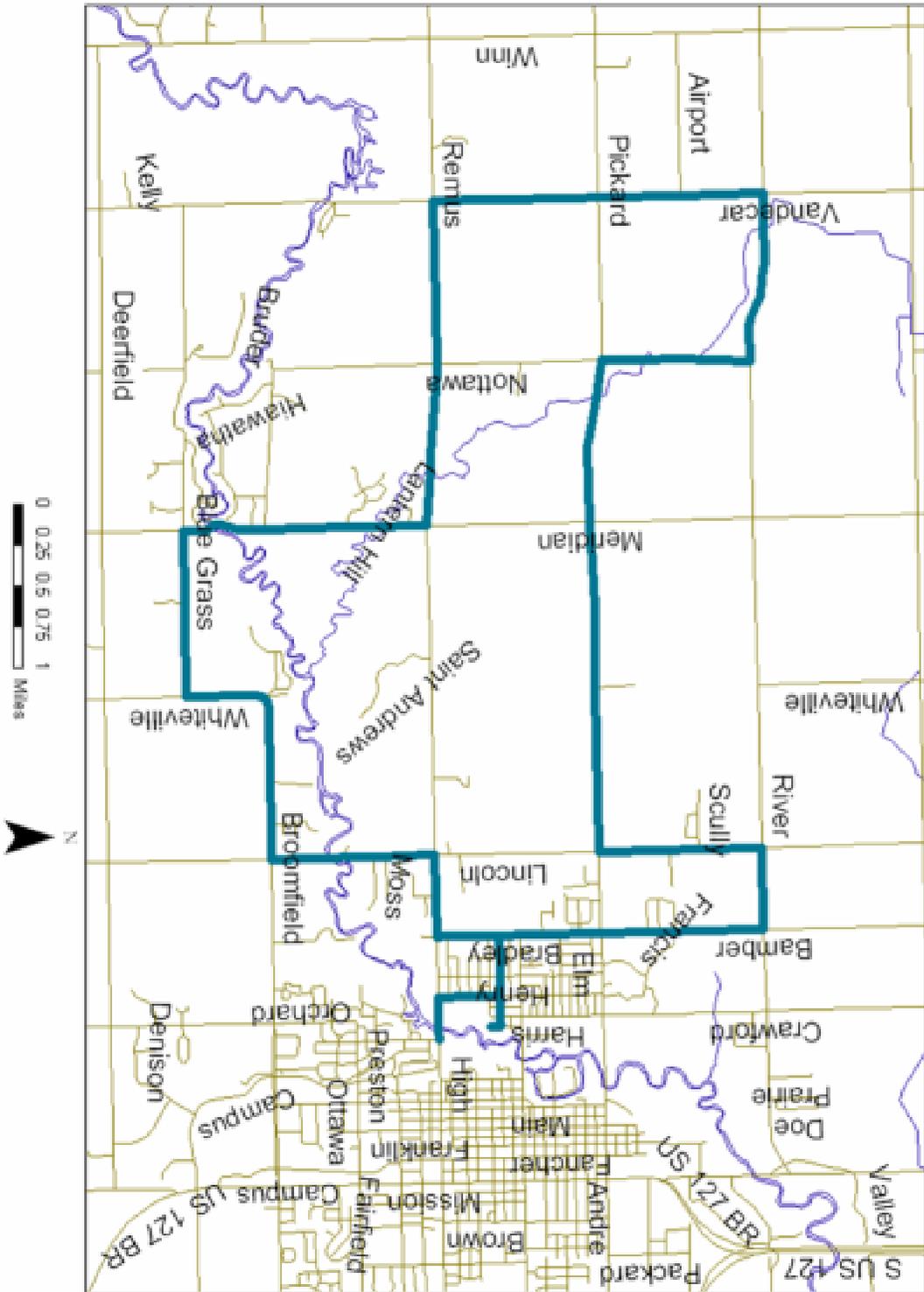
TURN RIGHT AT THE STOP SIGN, ONTO RIVER RD

TURN RIGHT ONTO BAMBER RD

TURN LEFT ONTO M-20

RETURN TO CAMPUS

Point & Non-point Source Pollution in the Chippewa River Watershed



DISCUSSION QUESTIONS

1. What type of non-point source pollution is most problematic for the Chippewa River in Isabella County?
2. What type of non-point source pollution is the easiest to reduce?
3. Identify all point sources of pollution you observed on the tour of the Chippewa River watershed.
4. Did the water quality tests reveal any differences between sites? What may account for these differences?
5. What are some methods farmers can use to minimize runoff from their fields?
6. Consider the range of activities you perform on a daily basis. Which of those activities adversely influences the quality of water in your watershed? What does this mean in terms of water quality on a regional, national, and global scale?

Water Quality Data for Chippewa River Watershed:

Site	Phosphorus	Nitrate	Alkalinity	Hardness
Franklin well				
Mill pond park				
Meridian Park				
North Branch				