ELUCID Middle School Tutorial Worksheet

Your classroom is participating in the Flint River GREEN program this year and you have completed your sampling. Your students are preparing their presentations for the annual summit and want to use ELUCID to explore the Flint River Watershed and learn more about their sampling site. Use ELUCID to answer the questions below.

1. **Name the subwatersheds that are contained within your school district.**

2. **What are the main land uses in your school district? Name at least one suspected pollutant that could be associated with these land uses.**

3. **Are there any wetlands or areas suitable for wetland restoration in your school district? How might these areas influence water quality?**

4. **What subwatershed is your sampling site located in?**

5. **Are there any impairments on the stream you sample?**

6. **Are there any indications that your sampling site may be susceptible to erosion?**

ELUCID Middle School Tutorial Instructions

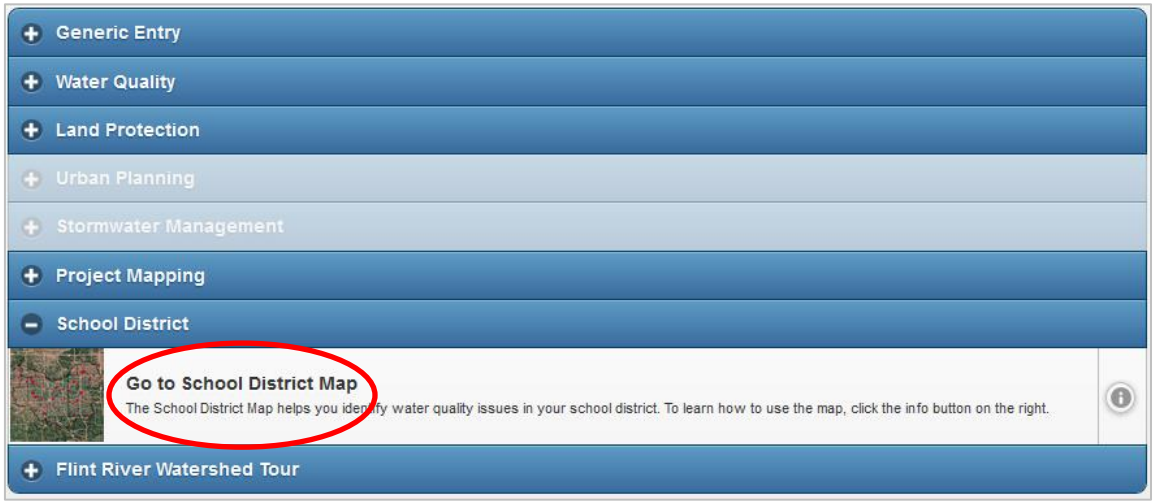
http://elucid.iwr.msu.edu/

Name the subwatersheds that are contained within your school district.

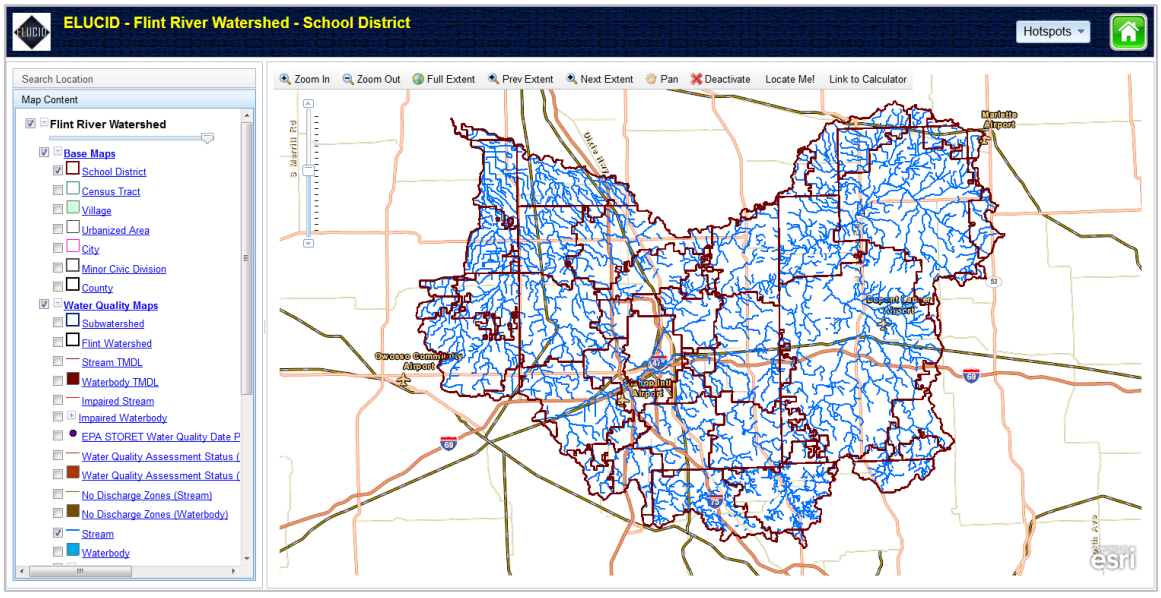
A watershed is an area of land where all of the water within it, both on the land surface and below ground, drains to a common point. For example, the Flint River Watershed drains all of its water to the Shiawassee River which then outlets into the Saginaw River. Watersheds can be divided into smaller subwatersheds. The Flint River Watershed contains 18 subwatersheds.

Step 1: Getting to the map

- On the ELUCID main page, locate the "School District" mapping theme and click on its blue header.
- From the theme's menu, click on "Go to School District Map" beneath the theme's header. You will be directed to the School District Map.



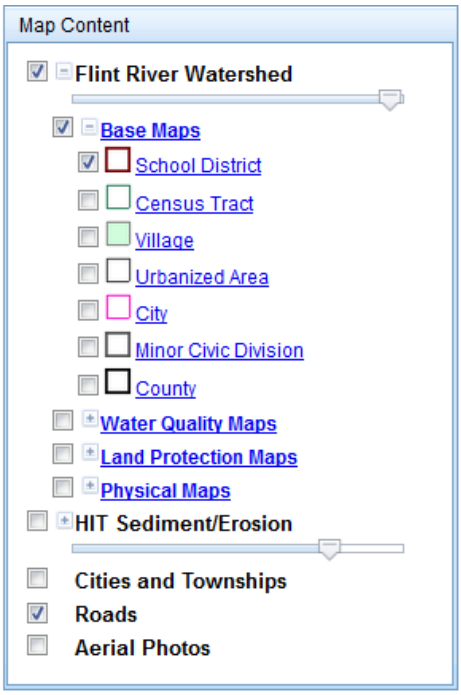
ELUCID Homepage



Default School District Map. The School District theme automatically loads *School Districts, Streams* and *Roads* on the map.

Step 2: Understanding and using map layers

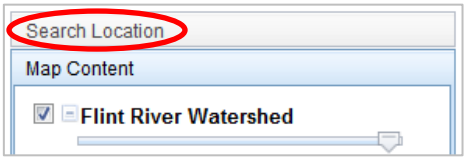
- A map layer is a visual display of geographic information on a map.
- The *School Districts, Stream,* and *Roads* layers are automatically loaded on the School District map.
- The “Map Content” window contains all of the map layers.
- The *Flint River Watershed* layer group contains the majority of map layers and has four subgroups: *Base Maps*, *Water Quality Maps*, *Land Protection Maps*, and *Physical Maps*.
- Layers that are “turned on” and visible on the map have a checked box next to their name. Layers can be turned off by unchecking the box.
- Layer groups can be expanded by clicking on the “+” sign next to their name. They can be collapsed by clicking on the “-“ sign next to their name.
- The slider bars underneath *Flint River Watershed* and *HIT Sediment/Erosion* adjust the layer group’s transparency.

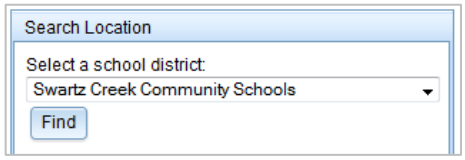


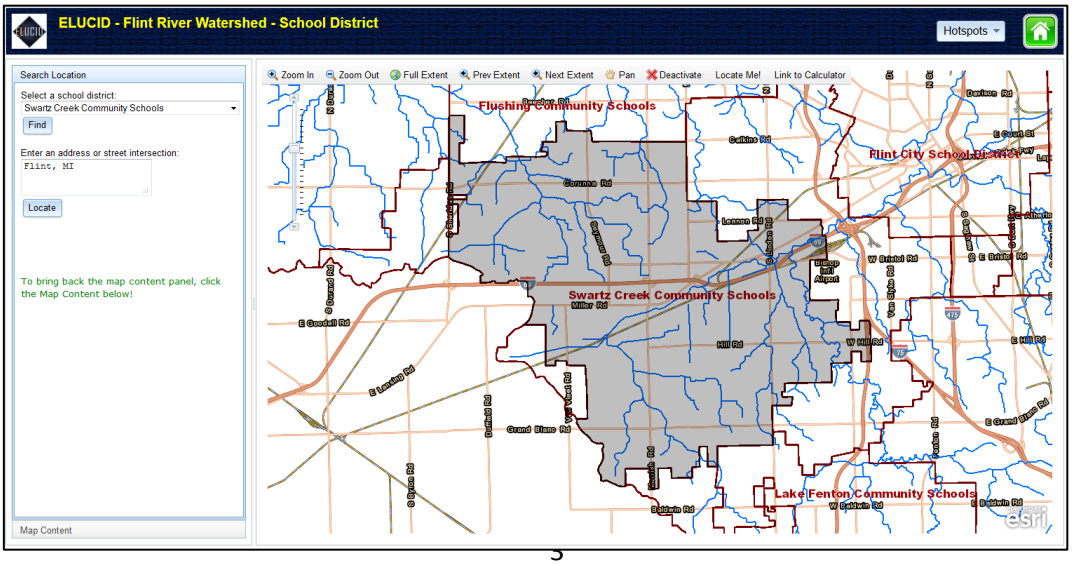
Map Content Window. The *Base Maps* layer group is expanded and the *School District* layer is turned on.

Step 3: Finding your school district

- Click on the “Search Location” tab above “Map Content.” This will open up the “Search Location” window.
- Select your school district using the dropdown menu underneath “Select a school district.”
- Click on the “Find” button.
- The map will zoom in on the school district and shade it in black. Note that it may take a few seconds for the system to locate your school district.



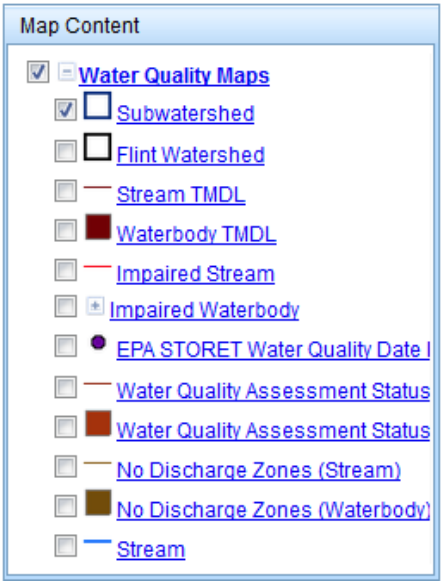


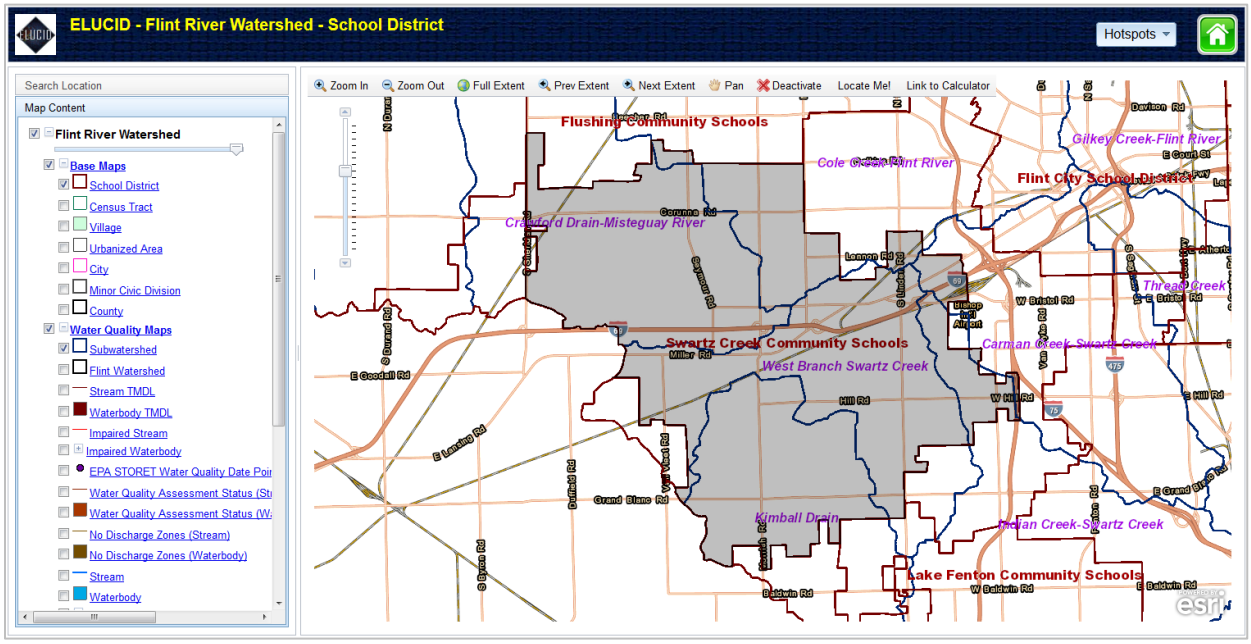


Successfully located school district.

Step 4: Naming the subwatersheds

- Return to the “Map Content” window by clicking on the “Map Content” tab, which is now located at the bottom of the sidebar.
- Find the *Stream* layer underneath “Water Quality Maps.” You will need to scroll down.
- Turn off the *Stream* layer by unchecking the box next to its name.
- Scroll up and check the box next *Subwatershed.*
- The subwatershed boundaries are now displayed in dark blue on the map.
- Subwatershed names are bolded in light purple on the map.





School District Map with subwatershed boundaries turned on.

What are the main land uses in your school district? Name at least one suspected pollutant that could be associated with these land uses.

There are many types of land uses including agricultural, developed or forested. Land uses play an important role in the health of a watershed. Certain land uses may be associated with certain kinds of pollutants. For example, urban and industrial areas like Flint will have different kinds of pollutants compared to rural, agricultural areas like Metamora.

Step 1: Turning on the *Land Uses* layer

- Turn off the *Subwatershed* layer by unchecking the box next to its name.

– Within “Map Content,” scroll down until you see “Physical Maps.”

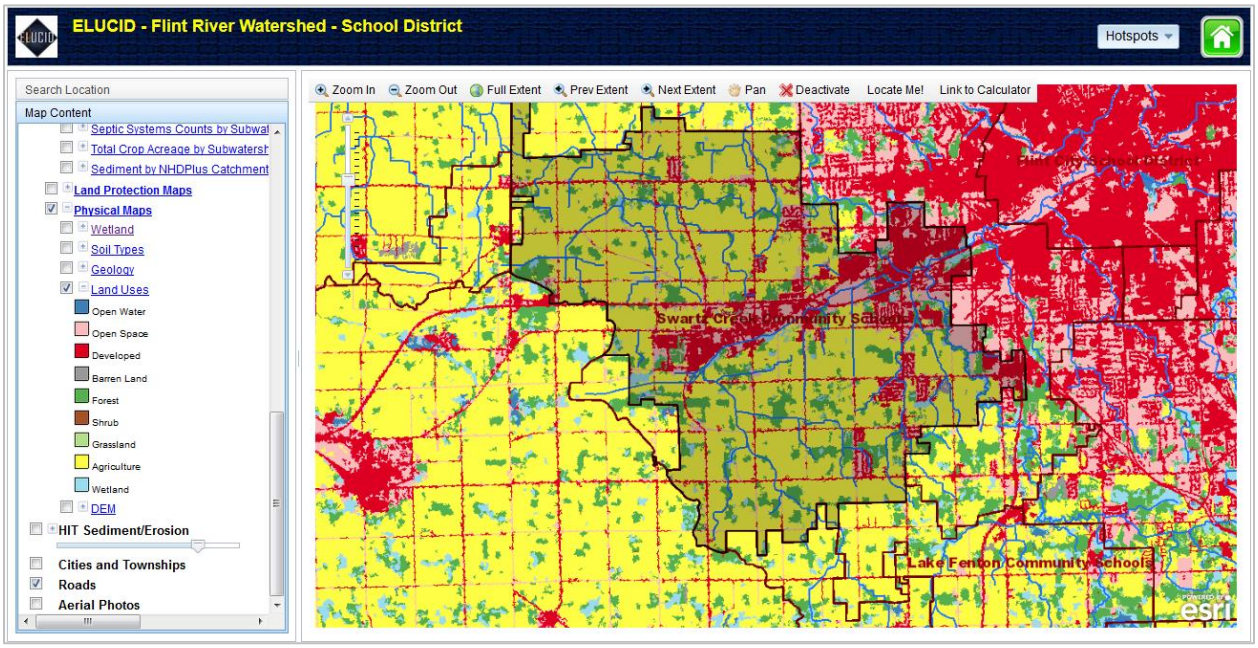
– Click on the “+” sign next to its name to expand this layer group.

– Turn on the *Land Uses* layer.

Step 2: Interpreting the *Land Uses* layer legend

– The legend for this layer is underneath the layer’s name in “Map Content.”

– Note that developed land uses include residential areas, commercial areas, industrial areas, and roads and highways.



Land Uses layer on the map.

Are there wetlands or areas suitable for wetland restoration in your school district? How might these areas influence water quality?

Wetlands are land areas that are saturated with water for the majority of the year. They play an important role for a watershed from a water quality and water quantity standpoint. The majority of wetlands in Michigan have been degraded or destroyed by human activities.

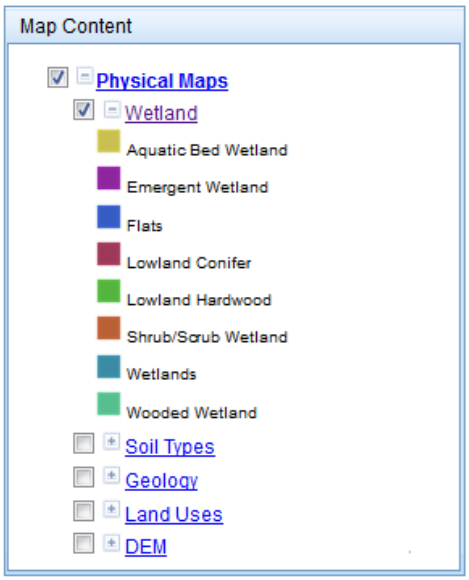
Step 1: Turning on the *Wetlands* layer

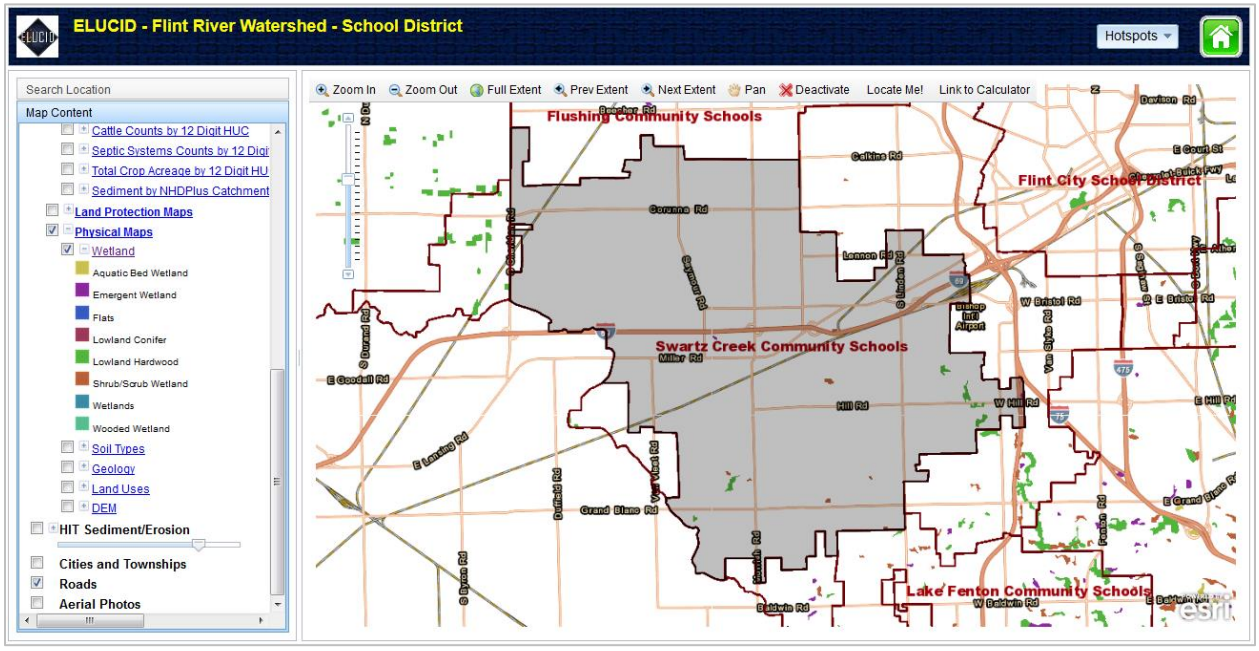
– Turn off the *Land Uses* layer by unchecking the box next to its name.

– Turn on the *Wetland* layer, which is also within “Physical Maps.”

– This layer distinguishes between eight different kinds of wetlands.

– View the legend under “Map Content” to determine what kind of wetlands, if any, are in your school district.





Wetland layer on the map.

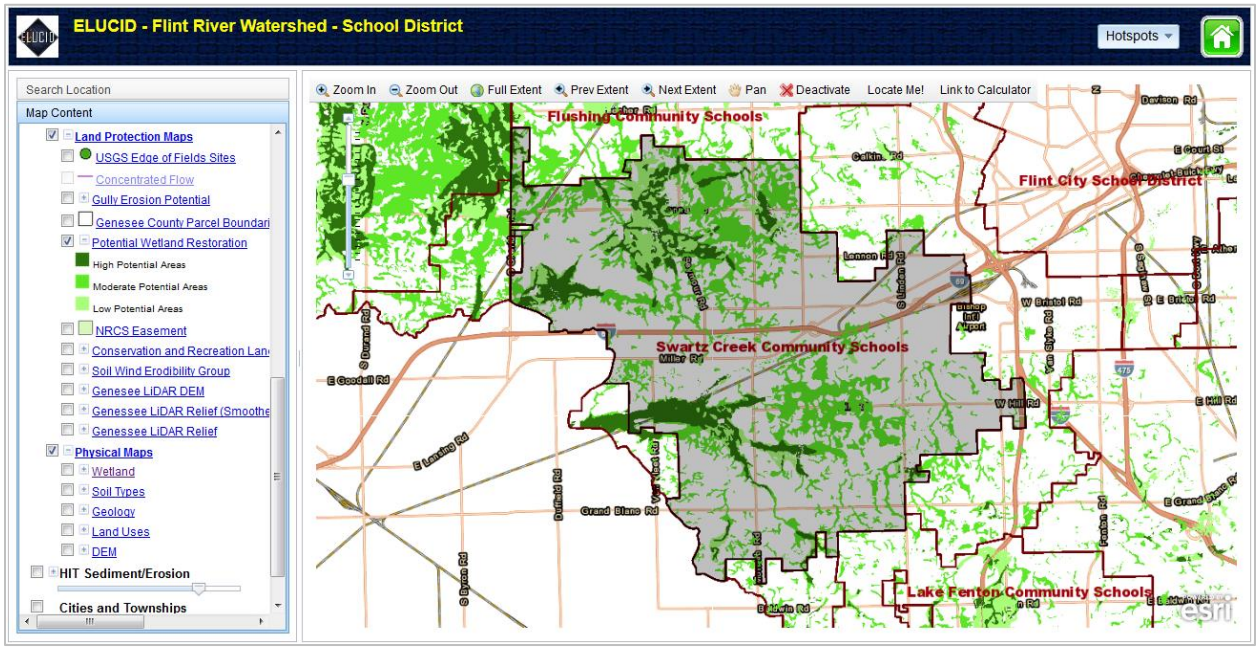
Step 2: Turning on the *Potential Wetlands Restoration* layer

– Turn off the *Wetland* layer by unchecking the box next to its name.

– Scroll up to "Land Protection Maps" and expand it by clicking on the "**+**" sign.

– Turn on the *Potential Wetland Restoration* layer by checking the box next to its name.

– This layer shows areas that either have soils that are usually fully saturated with water (Moderate potential), previously had wetlands on them (low potential), or both (high potential). These conditions are suitable for wetland restoration. The darker the green, the higher the potential to restore a wetland.

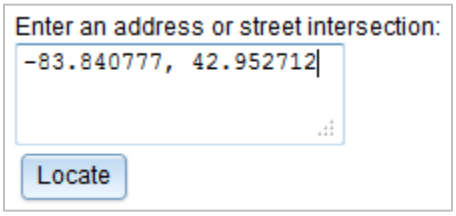


Potential Wetland Restoration layer on the map.

What subwatershed is your sampling site located in?

Step 1: Locating your sampling site

- Turn off the *Potential Wetland Restoration* layer.
- Scroll to the very bottom of “Map Content” and turn on the *Aerial Photos* layer.
- Navigate to the “Search Location” tab.
- In the text box, type in the address of your sampling site. This could be an intersection or an actual street address. You can also use latitude and longitude coordinates, but you must enter the longitude first for the system to accurately locate your sampling site.

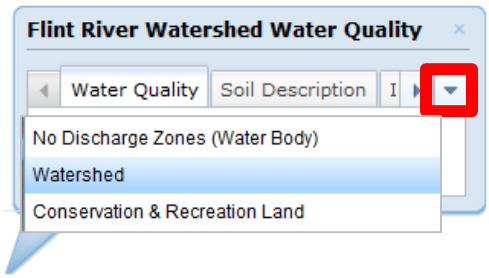


- Hit the “Locate” button.
- Zoom-in on your sampling site by moving the slider bar up at the left-hand side of the map.
- Continue moving the slider bar up until you can clearly see your sampling site.

Located sampling site. The location’s address or coordinates will be displayed in pink. The zoom slider bar is circled in red.

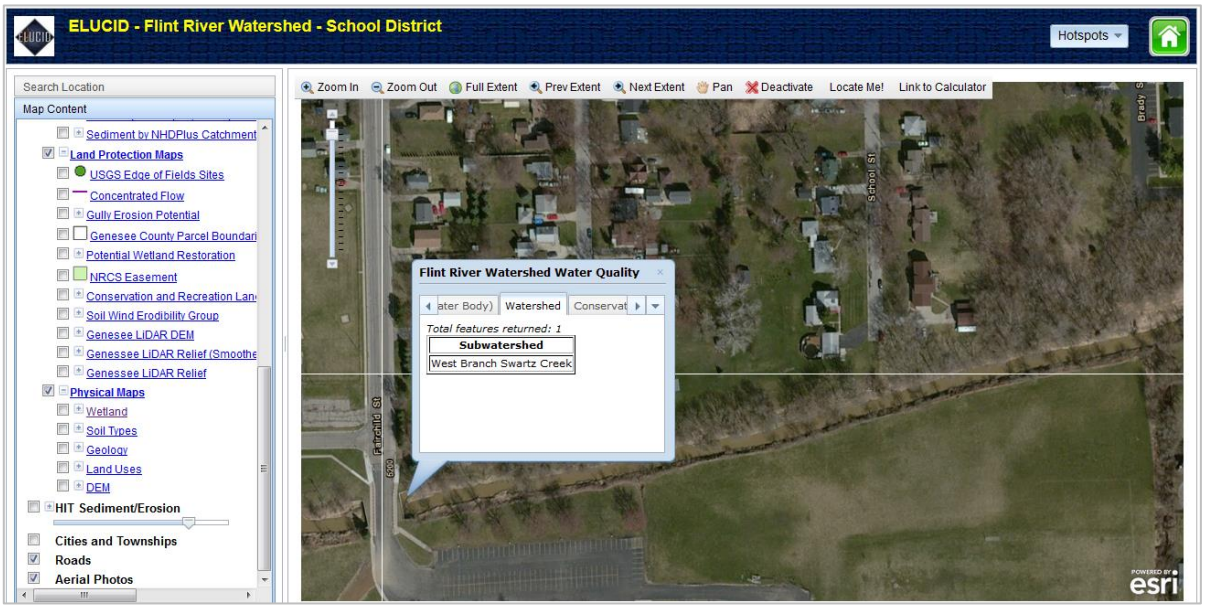
Step 2: Determining your sampling site’s subwatershed

- Click once on the location of your sampling site.
- This will trigger the “Identify” tool to appear. This window displays additional information about certain layers on the map.
- Click on the down arrow within the popup window and select “Watershed.”



- The subwatershed in which your sampling site is located should now appear.

– Close out of the “Identify” tool by clicking on the “X” in the corner.



“Identify” tool open.

Are there any impairments on the stream you sample?

Waters are considered impaired when certain uses of the water are diminished because of poor water quality. For example, high bacteria levels impair a person’s ability to swim in a lake.

Step 1: Identifying an impairment

– Click on the “Map Content” tab at the bottom of the sidebar.

– Scroll to the *Impaired Stream* and *Impaired Waterbody* layers. Turn both of these layers on.

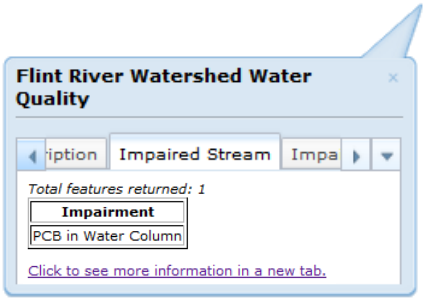
Impaired Stream layer visible on the map (red line along stream).

– A red line running along the stream you sample indicates that there is an impairment. If you sample on a lake, the lake should be shaded in a pink or red color.

– Click on the impairment to trigger the “Identify” tool.

– Use the down arrow to navigate to the “Impaired Stream” tab.

– The tab will now list the source of the impairment(s) for that stream from 2012. It’s possible to have multiple impairments at one location. The latest information is available in Appendix B2 of the Water Quality Pollution Control Report, accessed by clicking on the link at the bottom of the “Impaired Stream” tab.



– You can also navigate to the “Water Quality Assessment Status (Stream)” tab to link to the EPA’s 2010 database.

– Close out of the “Identify” tool by clicking on the “X” in the corner.

– Turn off the *Impaired Stream* and *Impaired Waterbody* layers.

Are there any indications that your sampling site may be susceptible to erosion?

Erosion is the process of water, ice or wind detaching and removing stone or soil particles from the land surface and depositing them somewhere else. Eroding soil can contribute sediment to streams.

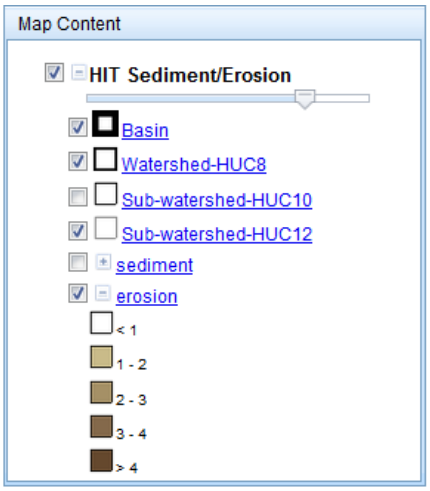
Step 1: Identifying sheet erosion risk

– Scroll down in “Map Content” until you see HIT Sediment/Erosion.

– Expand the HIT Sediment/Erosion layer group by clicking on the “+” sign next to its header.

– Turn on the HIT *erosion* layer. These layers are located towards the bottom of the “Map Content” window, above the “*Cities and Townships*” layer.

– The *erosion* layer displays agricultural areas that may be susceptible to sheet erosion using beige and brown pixels. If you don’t see any of these areas, the HIT model did not predict these areas as high risk spots for sheet erosion or your sampling site is not located on agricultural land.



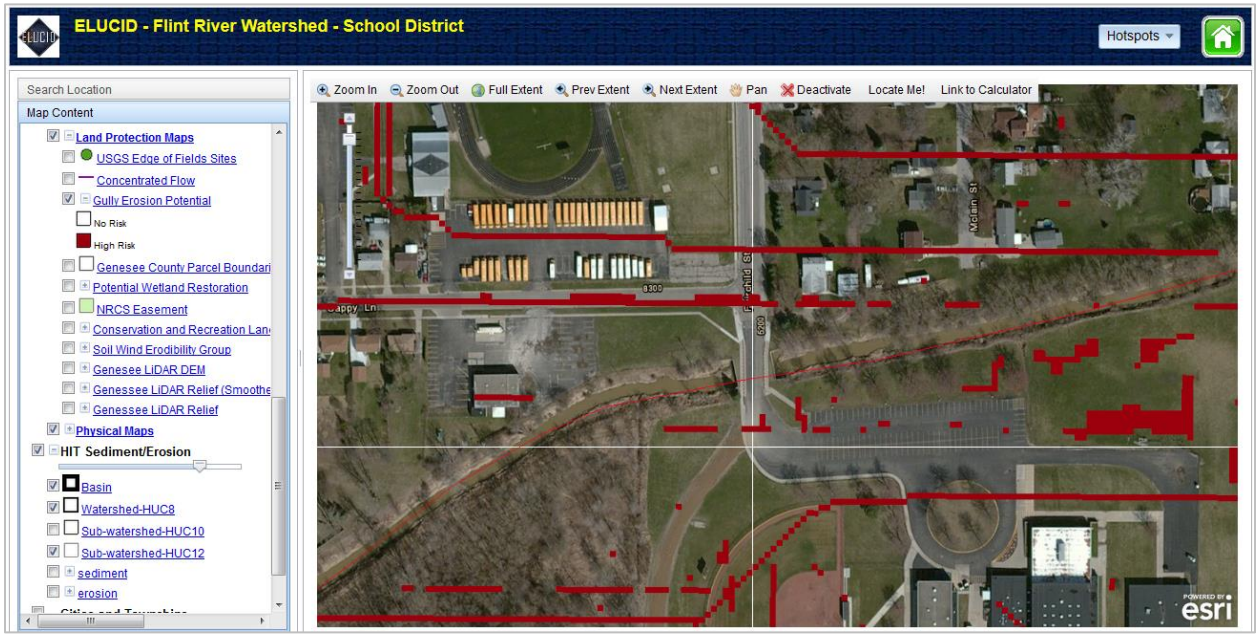
Step 2: Identifying gully erosion risk

– Turn off the HIT *erosion layer.*

– Navigate to “Land Protection Maps” and turn on the *Gully Erosion Potential* layer.

– This layer represents areas at risk for gully erosion using red pixels.

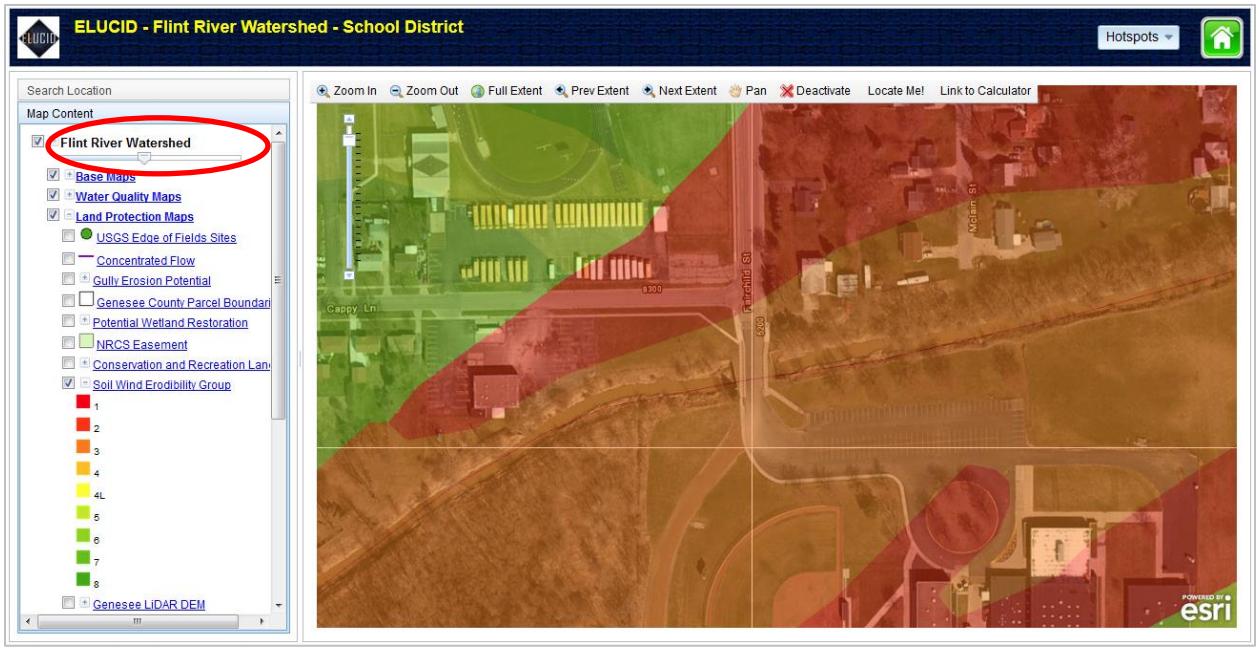
– If your sampling site is in a very developed area, gully erosion may be inaccurately flagged. This layer was developed from the land surface elevation and slope and may incorrectly reflect man-made structures like roads, parking lots, or storm drains. For example, in the figure below, roads were inaccurately categorized as potential gully erosion sites. This layer is more accurate in less developed areas.



Potential Gully Erosion layer visible on the map.

Step 3: Identifying wind erosion risk

- Turn off the *Gully Erosion Potential* layer.
- Turn on the *Soil Wind Erodibility* layer from "Land Protection Maps."
- This layer shows whether the soils at your sampling site are susceptible to wind erosion.
- Areas that are shaded in green are not very susceptible to wind erosion while areas in red and orange are more susceptible.
- You can move the transparency slider underneath the *Flint River Watershed* layer group heading to reduce the opacity of the *Soil Wind Erodibility Group* layer, as depicted below.



Soil Wind Erodibility Group layer visible on the map with some transparency.

Tutorial Appendix: How to take a screenshot of your sampling site

Option 1: Using the “Print” function

- Turn on all desired layers for your screenshot from the “Map Content” sidebar.
- Press the “Print” button from the toolbar located at the top of the map. 

- A new tab will open with an image of your map.
- Right-click to save the image to your computer.
- Note: currently this functionality is only compatible with layers under the *Flint River Watershed* layer group. Unfortunately at this time the *Aerial Photos, Roads, Cities and Townships,* and *HIT Sediment/Erosion* layers will not appear in images produced using the “Print” function.

Option 2: Using the “PrtScn” button

- Turn on all desired layers for your screenshot from the “Map Content” sidebar.
- Press the “PrtScn” button on your keyboard, typically located in the top right area of your keyboard.
- Open up a program such as Paint or Microsoft Word and press “Ctrl” + “V” to paste the image into the program.
- Save the file to your computer.

Option 3: Using the “Snipping Tool,” Windows Vista and up

- Turn on all desired layers for your screenshot from the “Map Content” sidebar.
- Open up the “Snip Tool” from your computer’s “Accessories” folder.
- The “Snipping Tool” will automatically turn on. Draw a box around the map to take a screenshot of that area.
- Click the “Save” button and save the file to your computer.

Option 4: Macs

- Turn on all desired layers for your screenshot from the “Map Content” sidebar.
- Hit “Command” > “Shift” > “3” on your keyboard to take a screenshot.
- Save the file to your computer

Tutorial Appendix: What is a Watershed?

A watershed is an area of land where all of the water within it, both on the land surface and below ground, drains to a common point. For example, the Flint River Watershed drains all of its water to the Shiawassee River. The Shiawassee River then joins with the Cass and Tittabawassee Rivers to form the Saginaw River, which drains into Saginaw Bay of Lake Huron.

Map Credit: Kmusser

Watersheds can be big or small. Smaller watersheds are always nested within larger watersheds. The Saginaw Bay watershed, Michigan's largest watershed, has an area of approximately 8,700 square miles and contains several watersheds including the Flint, Shiawassee, Cass and Tittabawassee. The Flint River watershed, which is approximately 1,400 square miles in area, can be split up into 18 smaller watersheds called subwatersheds. Those subwatersheds could then be divided further into even smaller watersheds.

You can think of a watershed as being similar to your kitchen sink. When you turn the faucet on, all the water will flow towards and down the drain, just as all the water in a watershed drains to a common point. In the picture of the sink, consider the two sink basins as individual watersheds, separated by a "watershed divide," the metal wall. Since all of the water is falling within the basin on the left, all water will drain within that "watershed." The diagram on the right depicts a three-dimensional drawing of a watershed.

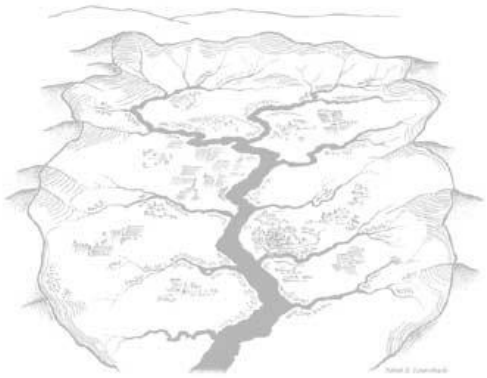


Photo Credit: Grand Valley State University, Annis Water Resources Institute

References

- U.S. Environmental Protection Agency. Saginaw Bay and River. 2013. http://www.epa.gov/glnpo/aoc/saginaw-river/index.html
- U.S. Geological Survey. Water Science School. 2013. http://ga.water.usgs.gov/edu/watershed.html

Tutorial Appendix: What are Land Uses?

There are many different types of land uses including agriculture, industrial areas or residential areas. Different kinds of land uses impact water quality differently. For example, industrial areas and urban areas likely have high amounts of impervious surfaces that prevent water from infiltrating the soil. This may lead to large amounts of stormwater runoff that can carry pollutants to streams and lakes. Agricultural areas may contribute pesticides or nutrients as runoff to waterways. Land cover types in ELUCID are described below.

- **Agriculture –** includes pasture and cultivated crops with vegetation totaling more than 20% of the area. Examples of pasture consist of hay, grasses and legumes, or a variety of each for the purpose of livestock feed, and/or seed and hay production. Examples of cultivated crops can be soybeans, vegetables, and orchards.

- **Barren Land –** areas of exposed rock, clay, and stone; including gravel pits and sand dunes, among other materials; areas typically have lower than 15% vegetative cover.

- **Developed –** includes all types of developed areas: residential, commercial, industrial or transportation areas.

- **Open Space –** lawns, parks, golf courses or other open space in a developed area.

- **Forest –** includes deciduous, evergreen, and mixed with vegetation covering more than 20% of the total area.

- **Grassland/Herbaceous** – areas largely composed of grasses and grass like plants, lichens, and mosses; total vegetative cover is typically over 80%.

- **Open Water –** spaces of open water; typically with lower than 25% vegetation & soil cover.

- **Shrub/Scrub** – areas largely composed of shrubs smaller than 5 meters (around 16 feet) in height; canopies generally more than 20% total vegetation.

- **Wetlands –** Woody wetlands include forest or shrubland vegetation that at times is covered or full of water; vegetative cover totals more than 20% of the area. Emergent herbaceous wetlands contain seasonal vegetative growth that at times is covered or full of water; vegetative cover totals more than 80% of the area.

References

– U.S. Geological Survey. Multi-Resolution Land Characteristics Consortium. National Land Cover Database 2006. Product Legend. March 2013. http://www.mrlc.gov/nlcd06_leg.php

Tutorial Appendix: What is a Wetland?

According to the State of Michigan Department of Natural Resources wetlands are characterized by the presence of water that saturates the soil or covers the land for most or all of the year. The major types of wetlands that occur here in Michigan are marsh, swamp, bog, and vernal pool. You can view wetland data in ELUCID in the following layers: *Wetland* under "Physical Maps" and *Potential Wetland Restoration* under "Land Protection Maps."

Wetlands play a significant part in the water cycle. For example, they help reduce the occurrence of floods by taking in rainwater and snowmelt and slowly release it to nearby lakes and streams, filter harmful substances such as sediments and pesticides from surface water runoff, and assist in resupplying groundwater when connected to an underground aquifer.

A **marsh** type of wetland can hold water ranging from less than an inch to many feet deep. In Michigan, they can be found in low lying areas, near lake shores and river banks. Marshes have been referred to as "flooded grasslands" and contain plants such as cattails, grasses, lily pads, and many more. They provide necessary breeding and feeding ground for many types of fish, birds and waterfowl; as well as many reptile and frog species, and small mammals. Pictured here is Tobico Marsh in the Bay City State Recreation Area.

A **swamp** type of wetland is best described as woodland or shrubland flooded with water. In Michigan, swamps tend to occur near streams or floodplain areas and provide home to trees and shrubs such as red and silver maple, cedar, balsam, and willow. They are also home to a variety of wildflowers, frogs, owls, and other small mammals. Pictured here is the Dead Stream Swamp in the Au Sable State Forest, on northwest side of Houghton Lake, MI.

A **bog** type of wetland occurs when a built up amount of dead and decomposing vegetation form a mat like cover over a portion of or completely over the surface of old ponds and lakes. The mat like cover is saturated with water and has a spongy consistency that is acidic, and lacks oxygen. Acid tolerant woody plants such as poison sumac and tamarack favor the bog environment, as do some uncommon plant and reptile species, like the pitcher plant and the spotted turtle. A Michigan bog is pictured on the left.

A **vernal pond** type of wetland occurs in the spring from melted water and is typically small in size. Although vernal ponds do not traditionally follow the typical guidelines to be considered a wetland they serve an important role for many species of wildlife. A vernal pond offers a seasonal fish free area for amphibians to lay eggs and allow their young to mature. Pictured to the left is a Michigan vernal pond.

References

- Michigan Department of Natural Resources. Wetlands. 2001-2014. http://www.michigan.gov/dnr/0,4570,7-153-10370_22664-61132--,00.html
- Michigan State University Extension. Michigan Natural Features Inventory. Communities. 2014. http://mnfi.anr.msu.edu/pub/abstracts.cfm#Communities

Tutorial Appendix: What is a Water Impairment?

When waters become polluted, action must be taken to address environmental and health concerns. Certain state and federal government agencies play a role in restoring a polluted waterbody to a healthy state. The Clean Water Act, passed in (1972), is the main law regulating water pollution in the United States. The United States Environmental Protection Agency (EPA) is a federal agency that works with state governments to carry out requirements in the Clean Water Act. One requirement sets limits on pollutant concentrations in waterbodies.

Polluted waters impair uses of a waterbody. For example, high levels of the bacteria *E. coli* indicate that other harmful bacteria are present in the water that may cause illness for swimmers. This impairs a person's ability to safely recreate in the water. Poor water quality or other issues Impairments may also threaten aquatic life. The *Impaired Stream* and *Impaired Waterbody* layers in ELUCID show streams or lakes that the state of Michigan has identified as impaired. You can use the "Identify" tool to determine the cause of a particular impairment. All causes of impairments in ELUCID are described in the table below.

Bacterial Slimes	The presence of certain algae or microbes that form bacterial slimes may negatively affect aquatic life or wildlife.
Mercury in Water Column	Mercury, a heavy metal, is toxic to both humans and wildlife. Mercury emissions from volcanoes, coal-fired power plants and other sources are deposited in water or on land. Fish caught in areas with with high mercury levels may be harmful if consumed.
Other anthropogenic substrate alterations	Human activities like dredging or channel straightening may alter the substrate (stream bottom). Significant alterations could negatively impact aquatic life or wildlife.
Other flow regime alterations	Human activities like dredging, removing riparian vegetation, or channel straightening may alter the flow of water for a stream. Significant alterations could negatively impact aquatic life or wildlife.
PCB in Fish Tissue	Polychlorinated biphenyls (PCBs) are man-made chemicals that were once used in the U.S. to make various commercial and industrial products including plastics, electrical equipment and adhesives. The U.S. banned the use of PCBs in 1979 when it was discovered the chemicals caused cancer in humans and other harmful health defects. People can be exposed to PCBs by eating fish that have accumulated PCBs in their tissue. PCBs may still be present in materials made before 1979 and are easily transported in the environment.
PCB in Water Column	Water samples with high levels of PCBs may be taken into consideration when determining if the fish consumption use of a waterbody is impaired.
Escherichia coli	*Escherichia coli (E. coli)* is used as an indicator for the presence of harmful bacteria in water at a given location and point in time. If *E. coli* levels are high enough, beaches or other swimming areas may be closed to protect swimmers' health.
Temperature	Temperatures may impair warmwater or coldwater fisheries in a waterbody. For example, trout live in cold water streams. If temperatures increase significantly in an area where trout live, this could threaten the trout community.
Phosphorus (Total)	Phosphorus is a nutrient that can cause excessive algae growth and eutrophication in freshwater. Phosphorus is used with biological indicators to determine if negative impacts on aquatic life or wildlife may occur.
Nutrient/Eutrophication Biological Indicators	High concentrations of nutrients or eutrophication may negatively affect aquatic life or wildlife.

References
- Michigan Department of Environmental Quality. Water Quality and Pollution Control in Michigan Sections 303(d), 305(b), and 314 Integrated Draft Report. 2014. https://www.michigan.gov/documents/deq/2014_IR_-_DRAFT_PUBLIC_COMMENT_441454_7.pdf
- U.S. Environmental Protection Agency. Polychlorinated Biphenyls (PCBs). 2013. http://www.epa.gov/epawaste/hazard/tsd/pcbs/about.htm

Tutorial Appendix: What is Erosion?

Erosion happens when the land surface is worn away by forces that detach, remove and deposit the material somewhere else. Eroding forces include water, ice (glaciers) and wind. While erosion is a natural process, human activities can accelerate erosion. There are several types of erosion, but only three are depicted in some capacity in ELUCID. Sheet erosion, gully erosion and wind erosion are discussed below.

Sheet erosion is the uniform removal of a thin layer of soil by water over a large area. This kind of erosion can be difficult to see as no channels form on the land surface. The HIT *erosion* layer in ELUCID represents sheet erosion for agricultural lands. Darker browns indicate more erosion. The HIT *sediment* layer shows areas at risk for sediment loading to streams caused by sheet erosion.

Gully erosion is a severe form of erosion that occurs when accumulated water runoff carves out large channels in the land surface. Gullies can be several feet deep and very wide. ELUCID contains a *Gully Erosion Potential* layer that depicts areas at risk for gully erosion using red pixels.

Wind erosion is caused by strong winds dislodging light soil particles such as silts and clays. Large open areas are more exposed to the wind and thus are more susceptible to wind erosion than areas with trees and dense vegetation. The Dust Bowl of the 1930s is an infamous example of the severity of wind erosion. Soils that are susceptible to wind erosion are classified by the *Soil Wind Erodibility* layer in ELUCID. Soils are assigned a value between 1 and 8. The higher the number, the less susceptible the soils are to erosion. These soils are shaded in green. On the other hand, soils that are susceptible to wind erosion will have a lower value and be shaded in red.

References

- Minnesota Association of Soil and Water Conservation Districts. "Our Soil - A Layer of Life" Study Guide. http://www.maswcd.org/Youth_Education/StudyGuides/Soils_study_guide.htm
- Plant and Soil Sciences eLibrary. Erosion. 2003. http://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1086025423&topicorder=1&maxto=20&minto=1