# Understanding Human Impacts on Streams (Ages 15-18)

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People have tried to control rivers and streams for thousands of years. They have been modified more than any other type of ecosystem. Dams are built to capture water for drinking, irrigation, and flood control. Water is pumped for agriculture industry and residential use. Bridges are constructed across rivers. Sand and gravel are excavated from river beds, and all too often trash and other wastes are dumped into rivers. People also use rivers for boating and other recreational activities. Other less obvious activities that can affect river ecosystems include removing nearby trees, over grazing stream banks, and over fertilizing or using too much pesticides on crops or lawns.

To understand if these factors have made a stream "unhealthy," you must look closely at both the stream and its surrounding watershed. People can degrade a stream without even realizing it. The better we understand stream health, the brighter the future for our rivers and streams.

## How Streams Are Classified

A stream or part of a stream can be classified by how often it goes dry and by its tributaries. Classifying a stream allows us to compare it with other streams with simsilar classification.

### Waterflow

One way to classify a stream is by how frequently it flows. A **perennial** stream flows all the time. An **intermittent** stream flows only part of the year. An **ephemeral** (i-**fem**-ər-əl) stream is usually dry. It only flows after a rain or during a very wet season.

### Stream Order

Another classification system is called **stream order** (Figure 1). The order of a stream is determined by looking at a topographic map to see how many tributaries flow into it. A first order stream has no tributaries. When two first order streams come together they make a second order stream. Two second order streams come together, to make a third order stream. If two third order streams come together, they make a fourth order stream and so on.

Stream order increases only when two tributaries of the same order flow together. If the tributaries do not have the same order, stream order does not increase, but keeps the higher of the two orders. For example, if a first order stream flows into a second order stream, it remains a second order stream.

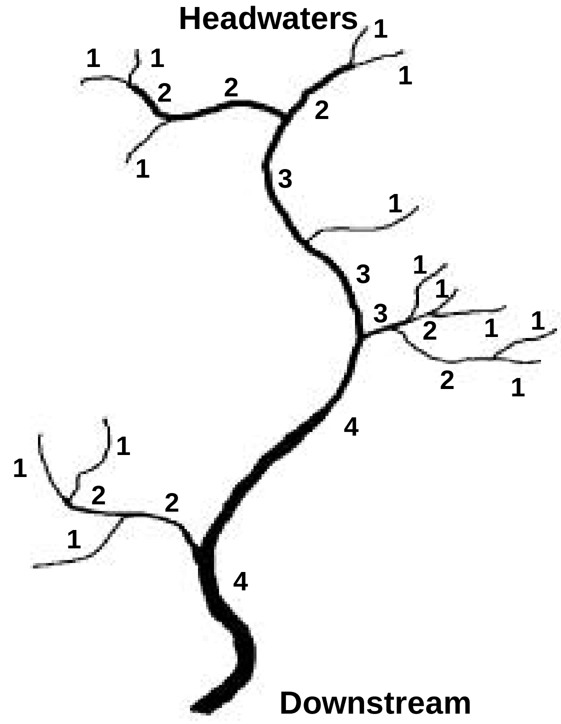


**Figure 1.** Representation of stream network with stream order marked.

## Stream Nutrients

A **nutrient** is an substance that is necessary for life. Three nutrients that are utilized most by aquatic plants are carbon, nitrogen, and phosphorus. Other nutrients needed in smaller amounts are known as micronutrients. These include potassium, sulfur, magnesium, sodium, calcium, iron, manganese, zinc, and copper. Carbon is abundant in streams in the form of organic matter and as a dissolved gas, carbon dioxide. Nitrogen and phosphorus are not as abundant as carbon. They are of concern to biologists because excess amounts can produce excess aquatic plant growth. Too much plant growth is not only unsightly, but can lead to problems, such as depletion of the oxygen in the water and loss of fish. Serious problems like this result when the ecosystem is not in balance.

Limiting amounts of nitrogen or phosphorus is usually what keeps plant growth under control. They are called limiting nutrients. In a stream, the more phosphorus and nitrogen, the faster plants will grow.

Nutrients enter streams in many different ways. When leaves or other organic matter fall or wash into a stream and decompose, nutrients are released. Man-made fertilizers can also runoff from lawns and farms. Other sources include human sewage and animal manures.

## Riparian Areas

The riparian area is the land along the edges of a stream. This area tends to be greener and have a higher soil moisture content than surrounding upland areas. When the riparian area has native grass, brush, or forest cover, water quality and the stream ecosystem is protected.

Vegetation in riparian areas slows the velocity of the runoff before it enters a stream, allowing soil particles to settle out and plants to absorb the nutrients. Trees and brush in the riparian areas also hold soil in place and help protect the banks from the force of floodwater. Shade from streamside trees helps keep the water temperature low enough for fish and other desirable aquatic life.

## Watersheds

The water in a stream is affected by what happens on the land that drains to the stream. The land area draining to a stream is known as the **watershed**, or drainage basin, of the stream. The watershed also includes the stream and all of its tributaries. Both the way the land is used and other natural features of the watershed influence the quantity and quality of water in the stream. Which watershed would have more runoff: one with steep slopes and clay soils or one with gentle slopes and sandy soils? Figure 2 shows an example of a watershed.

A watershed is defined as all the land that drains to a point on the landscape. Such a point can be where a tributary joins a stream, or where the stream enters into a larger water body (the mouth of a stream). These points are called **watershed outlets**. The boundaries of a watershed can be defined using a topographic map. The shape of the watersheds will vary from region to region. Some are long and narrow, while others will be more circular. Many Oklahoma watersheds are long and narrow.

Knowing the watershed of your stream allows you to recognize different land uses that might affect the stream's biology, chemistry, or physical attributes. If the stream changes as you follow its course, you can look at the watershed for causes. Also, if people are planning to change the way land is used in the watershed, you might be able to predict how these changes will affect the chemistry, biology, and physical attributes of the stream. For example, how might a stream change if the farm land in its watershed were converted to subdivisions, shopping malls, or parking lots?

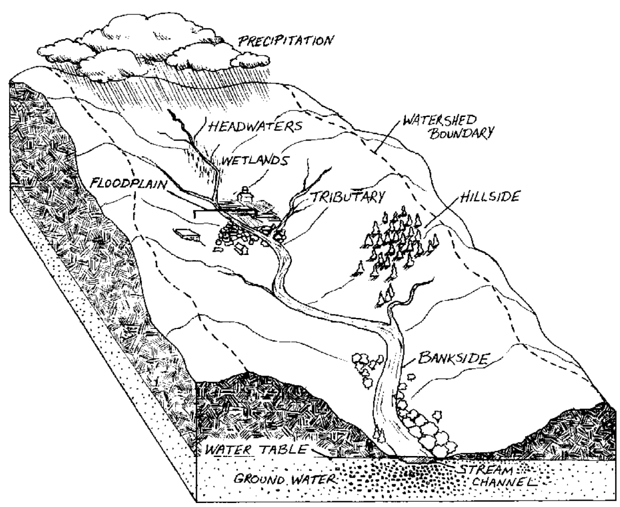


**Figure 2.** Example of a watershed (courtesy Tennessee Valley Authority).

## Topographic Maps

Topographic maps from the U.S. Geological Survey have brown contour lines that represent the elevation of the land surface. The contour interval is indicated at the bottom of your map. For a 20 foot contour interval, every fifth brown line is darker, indicating a 100-foot changes in elevation. A feature such as a road or stream, which crosses contour lines is either increasing or decreasing (moving up or downhill). Contour lines close together indicate a steep slope. Contour lines far apart indicate relatively flat land.

To find the highest point, look for contour lines with elevation numbers. Find the largest number. Then, look to see if there are additional brown lines above it. If so, count them adding the interval for each additional line. The highest elevation number shown maybe 400 feet but the highest point might be 418 feet because it was too difficult to put the elevation number on a small knob, or a peak.

Figures 3 and 4 show a topographic map and how it represents changes in elevation.

## Mapping Watershed Boundaries

1. Lay your topographic map on a firm, flat surface. NOTE: If you do not want to write on your map, you can place a clear plastic sheet over the map and secure it in place with masking tape. You can also laminate your map at a hobby shop or school supply store. This helps keep it dry. If you use acetate you will need a grease pencil or washable marker to trace the watershed.

2. Begin by picking a point on the stream for the watershed outlet. You may want to start with the mouth of a stream or another easily identifiable point near your town, school, place of business, or home. Every place in the watershed eventually drains to this point. Mark this point on the map.

3. Arrange your map so the stream is flowing directly toward you. Remember water always flows downhill!

4. Draw a line going uphill from the point you chose by going perpendicular to each contour line.

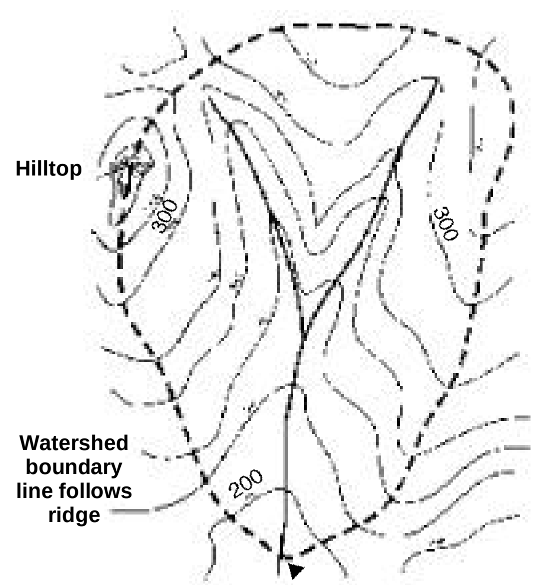


**Figure 3.** Example of a watershed boundary on a topographic map (adapted from U.S. EPA).

5. Work your way to the top of the hill or headwaters of the stream, enclosing all areas that drain toward your point or into streams that drain toward your point.

6. Begin with the left side, trace to the highest point, then start on the right side and do the same. It may help to draw arrows showing what direction the water flows. Remember, any rain that falls outside your boundary drains to a different watershed.

7. Connect the left and right boundaries by following ridge lines. Ask yourself which way the water will flow, in or out of your watershed?

8. When you are finished, the watershed will have one line for its boundary. It may look like a misshapen balloon.

## Stream Hydrology

The study of how water moves and shapes streams is known as **stream hydrology**. Flooding is a natural process that affects all streams. Healthy streams can stand up to most floods without major changes in their banks and streambeds. A healthy stream has areas for flood water to spread out and dissipate some of its destructive energy. These flat areas are known as **floodplains**. When people build roads and homes in or plant crops in floodplains, they risk damage from floods. Less obvious, are the effects of roads, other structures, and land clearing on rivers. If we build a wall to protect a stream bank it is likely the river's energy will cause erosion somewhere else.

The more people living in a stream's watershed, the more roofs, parking lots and other impervious

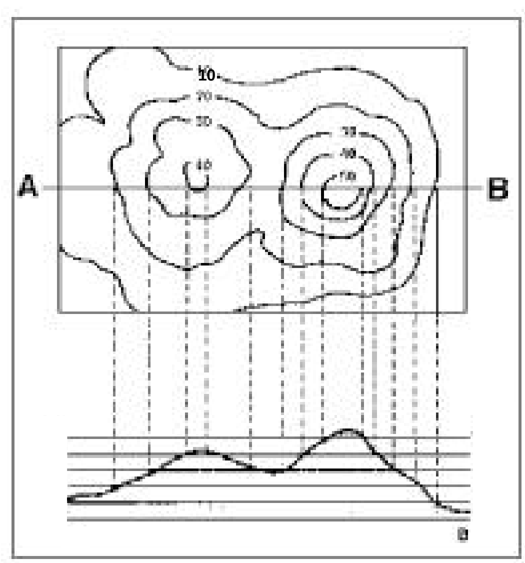


**Figure 4.** Example of the change in elevation represented by a topographic map (adapted from USGS).

surfaces there will be. All rainfall runs off these surfaces. None gets absorbed into the ground. This overloads stream channels with runoff causing bank failure. Sometimes this results in a condition known as **head cutting** (Figure 5). To identify headcutting, look for a "stairstep" appearance in the streambed or a small waterfall. As the streambed erodes, the head cut moves upstream. Head cuts deepen the stream channel, making the banks unstable.

Much harm to streams can be avoided by leaving them in their natural state. Trees and brush growing along streams help hold banks in place. In the past, streams were sometimes straightened to try to reduce flooding. A straightened stream channel does not use its floodplain. It increases the water velocity, causing erosion and floods downstream. We now know that the s-shaped pattern of flow in a winding stream slows down flood water and reduces its destructive power. Figure 6 shows how a straightened stream will naturally regain it's s-shape.

**Figure 5.** Headcutting results from erosion at an abrupt change in elevation.

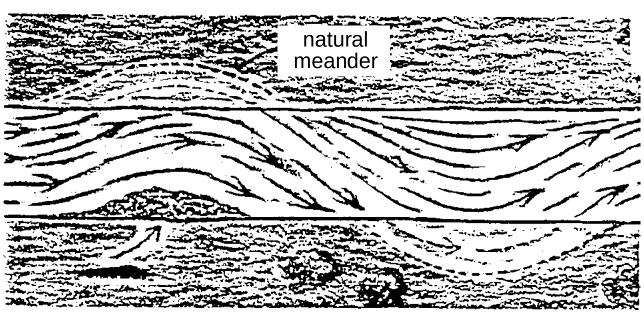


**Figure 6.** An example of a channelized stream and its natural meander.

## Summary

To make good decisions concerning streams, you must understand the stream, its riparian area, and its watershed You need to be able to classify a stream to compare it to similar streams. The amount of nutrients it receives is important because excess nutrients can lead to algae blooms and oxygen depletion. Knowing the sources of the nutrients allows you to develop effective management practices. You need to know the watershed boundaries to determine what land uses will affect your stream and what kind of changes to expect.

Streams always compensate for human activities, but recovery from damage can be very slow. Predicting how a stream will react to human activities is not an easy task, but it is an important one. If we understand the strengths and weaknesses of streams, we will be able to make intelligent decisions that are best for us and the stream.

## Sources for topographic maps:

Topographic maps may be purchased on-line at the US Geological Survey web site. (http://www.usgs.gov) You may also contact your local Natural Resource Conservation Service (NRCS) or the Conservation District Office for maps. Some of sources may need to special-order your maps.

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**Requirements for State Fair Exhibit for Understanding Human Impacts on Streams (15-18)**

The report should describe two different streams, including the land use, possible nutrient sources, and graphs showing the numbers and kinds of organisms in each environment. Use Report Form (Lit #25). Differences, similarities and possible influences should be discussed. The report should also compare and contrast the different points within a stream (high points vs. low points). Photos of habitat and preserved specimens of aquatic organisms collected should be included. Members entering this project for the second or third year should compare changes over time in the same body of water and include photos from previous years.

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OSU
OKLAHOMA COOPERATIVE EXTENSION SERVICE

# Report Form
# Understanding Human Impacts on Streams
# (Ages 15-18)

4-H YOUTH DEVELOPMENT

**No. 25**

Name:_______________________ County________________________

*Safety: Always go with someone when you are around water. Never go to a stream alone. When testing a stream or lake, do not attempt to take any measurements unless it is safe to do so. Do not sample in fast-moving or deep water. Wear the appropriate clothing for the site (old tennis shoes, long pants). If the stream or lake is on private property, be sure to get permission before going to the site.*

Select two different streams you wish to investigate. A written report and photos of the areas should show the differences and similarities you find. The report should answer the following questions and be two to four pages double spaced, not including item #10 and other additional attachments. In addition to the written report, include (in this order): photographs of habitats, graphs, map(s) showing stream order, stream sketches or photographs showing adjacent land uses, interview, and optional maps or photographs. Put your report in a folder with brads or in a three-ring binder to prevent any pages from getting lost.

1. What are the locations of the streams you are sampling? (Include a map for each stream that would allow someone else to find them.)

2. What are the dates of observations for each stream?

3. What is the order of the streams you are studying? (Mark this on the map as shown in figure 1, located in Lit # 24.)

4. Describe how the areas around the streams are being used (percentage of cropland, residential,forest, pastures, or other).

5. Describe the characteristics of each stream. Include banks, bottom, water appearance, plant and animal life, ratio of width to depth, percentage shaded by trees.

6. What are some possible nutrient sources for the stream? Is there evidence of excess nutrients?

7. Collect some stream water from a high and low point in the watershed. Does the water differ in color, clarity, smell or other factors? How could observed land use practices or natural factors explain the differences? Show the sampling points on your map.

8. Do you think that your stream handles floods well or not? Look for the presence or absence of flood plains, begetative cover, and signs of erosion. Briefly explain your answer.

9. Include graphs showing numbers and kinds of organsims collected in each environment, using techniques learned in previous years. Mark collection sites on map and discuss what you found in terms of watershed activities.

10. Interview an adult who knows the history of the stream you are investigating. On a separate sheet of paper, list some of your questions with the answers. You may also include old and current photos of the stream, showing how the stream has changed. Label the photos and write a short description of the characteristic(s) that are important and describe how they have changed. Also, write a short paragraph telling what you learned from the interview. (Limit to two pages)

Optional: Draw the watershed boundary for one or both of the streams. Start at any point that you think is appropriate.

**2nd and 3rd year project** (members completing this project report form for the 2nd and 3rd year)

Write a description of the similarities and differences you found this year to other years. (not to exceed one page)