# The Watershed Story

*Have you ever stood on the banks of a river and wondered -- where did it begin and where is it going? This story is designed to help explain how a stream begins, adapts and changes as it follows a path. The Watershed Story is an imaginary journey down a river to learn about the water in the river and how the surrounding land and human activity can affect the river.*

The water that flows along a river or stream is like a memory of the land through which it flowed. Land that is abused and polluted is reflected in the quality of the water. The land through which streams flow and gather momentum is called the watershed. A watershed is defined as the land area where all of the water above and below the ground drains to a common channel or body of water.

Rivers may begin as headwater streams that flow from hillsides, wetlands, lakes and as melt water from glaciers and snowpack. Some streams are temporary, and can only be seen during times of rain or snowmelt. Other streams are permanent and are fed by groundwater and by rains and runoff from the land. Headwater streams seek lower ground and join other streams to form larger streams that in turn join others, eventually to form one river channel at its mouth. The network of streams forms a branching system like the arteries in your body or the branching of a tree.

At the headwaters of our watersheds, trees, shrubs and other plants shade the water and keep the water temperature cool. As the stream moves along, the water falls over small rocks and glides over riffles, adding oxygen to the water.

Leaves, sticks and other plant debris fall into this stream and provide an important energy source for aquatic insects and other invertebrates. In turn, aquatic insects release nitrogen and phosphorus as they digest the plants and give off waste. Nitrogen and phosphorus are nutrients which when added in the proper amounts help aquatic plants grow and prosper.

As a stream flows down river, it moves over rocks which influence its pH level. pH refers to the acidity of water and is measured on a scale of 0 to 14. If a stream flows and gurgles over gravel and small rocks that rest upon limestone bedrock, this makes the stream more “basic” with a pH of 8. Streams flowing over granite and igneous rocks usually have a neutral or slightly acidic pH of 6-7.

The type of soil in the streambed influences whether sediments will be carried in the stream and cause high turbidity. Turbidity creates a murkiness in the water that blocks sunlight from reaching the bottom. At the headwater of our stream are small rocks paving the bottom and so the water has very little suspended sediment (low turbidity). Down river the water is likely turbid because there are areas of clay and fine-grained soils that are easily suspended in the river.

Rivers naturally get larger and usually get more turbid as they move downstream. A healthy large river, however, still has plenty of stream bank vegetation to cool the water at the edges and to provide fallen woody debris for habitat and food sources for fish, insects and other animals living in the water. The flow rate (or speed) of the water, the temperature, and the turbidity of the river all tend to increase downstream, along with other naturally occurring changes to the chemistry and biology. The challenge most rivers in the world today face is the degree of change being caused by human use of rivers and land through which the rivers run.

How do the dynamics of a river change as the watershed is developed and as the river channel is physically altered? Watersheds--if they are large enough--may have many kinds of human imprints: farming, recreation, cities, suburbs and industries. Let's continue our imaginary journey down river.

There are many farms along the river in this watershed. One farmer spreads manure on farm fields and with the first rain, the manure washes into the river and with it, concentrated levels of nitrates and phosphates. There is also bank erosion along the shoreline where soil washed away from the rain. The water is murkier (more turbid) here from soil erosion. A small lake near the river looks green from too much algal growth, a sign of eutrophication. As the algae and other plants die and decay, small organisms feed upon this decay and demand a lot of oxygen. As a result, dissolved oxygen levels can become very low. This makes life difficult for animals like dragonfly nymphs and turtles.

Farther down the river is a town. If you could look under the streets and buildings of this community, you would see a network of various-sized pipes: sewer lines and storm water lines. The town has a separate sewer system, which means raw sewage is in sanitary lines and is delivered to a wastewater treatment plant. Rainwater and materials from streets flow into separate storm water lines and are discharged to the nearest stream.

When it rains in this town, the water falls on many impervious (hard) surfaces that do not absorb water. In the summer, storms send rain shooting across hot parking lots and the warmed water flows through the storm drains to the river. The storm drains also carry the remains of human activity into the river: excess fertilizer, bacteria from pet wastes, litter, oil and pesticides. The river below town is very turbid, especially when compared to the water up the river. The flow of the river responds quickly during major rains and swells to almost double its volume. In such cases, high bacteria levels, and concentrated nitrates and phosphates are found in the river below this point.

In contrast to the town in our story, many cities and towns have a combined system where sanitary lines and storm water lines flow together into the wastewater treatment plant. With a combined system, during heavy rain events, when the treatment plant cannot handle the combination of sewer inputs and storm line inputs, the system automatically shunts all waste (sewer and storm) past the sewage treatment plant directly to the river.

Our watershed has changed from its headwaters to its mouth, both naturally and in response to human activities and developments. In its headwaters, the stream flow is moderated by vegetation and by a steady source of groundwater. Dissolved oxygen is high and the temperature of the streams does not change much, creating a stable environment for animals. Nutrient levels are tied to natural rhythms and the biological action of the animals living there.

Moving downstream, our river system naturally changes as it gets bigger, deeper and wider. The water chemistry shifts as, among other factors, the vegetation along the banks covers a smaller and smaller percentage of the river's width and as lower elevations bring warmer temperatures. Different communities of insects and animals inhabit the water, reflecting the changes in temperature, depth, flow, and vegetative cover.

In addition to natural changes that come with size, however, our watershed also reflects the many activities of the humans living on the land and using the water. Prone to erratic flow and unnaturally high temperatures due to clearing of land, farm waste, and storm water runoff, the river faces new sets of challenges as nutrient and turbidity levels soar, dissolved oxygen levels dramatically drop, and temperatures become too warm for native fish and insect species.

Preserving a healthy river system, from headwaters to mouth, is the challenge facing the inhabitants of this watershed story. Now that you've heard of one watershed's story, it is time to uncover the mysteries and opportunities waiting for you in your local watershed.