Chapter 5
Surface Water and Hydrographs

Surface water refers to any water overlying land surface. This can include oceans, rivers, streams, creeks, lakes, ponds, wetlands, and puddles. This even includes sheet flow and runoff associated with heavy rainstorms. Springs are another example of surface water, but the topic of springs will be the focus in a later chapter.

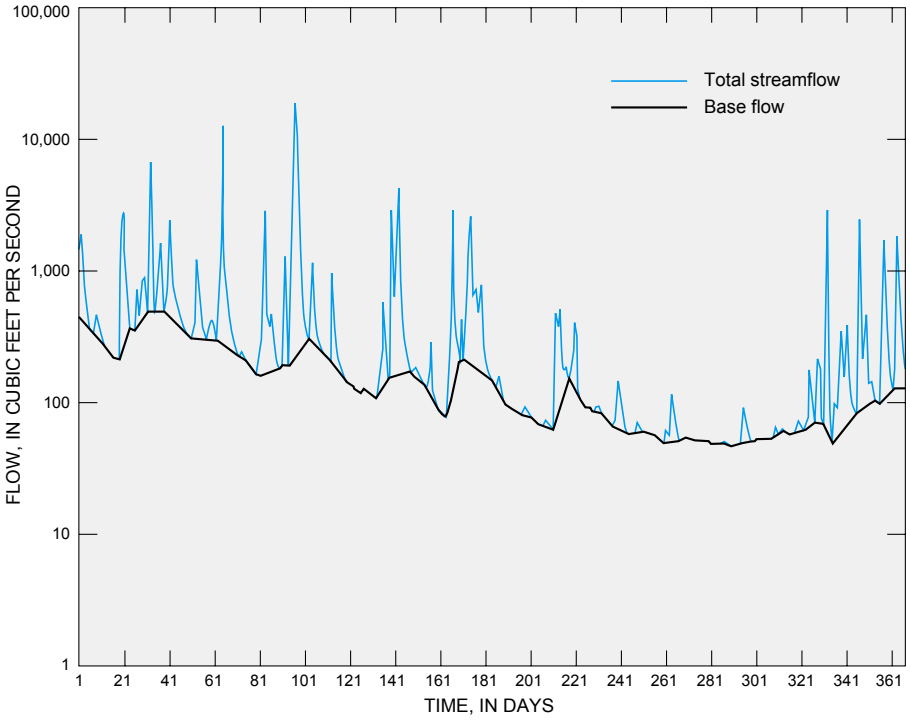
Many people view surface water as a resource separate from ground water. In some situations, this is true, but typically there is a connection between surface water and ground water and they really are part of the same system. Generally, many surface-water bodies are expressions of where the water table intersects the land surface, such as in many of the lakes and streams that occur in the valleys of Nevada. Often, increases and decreases in stage (elevation of water levels) in lakes and streams relates closely to similar changes in the water table. Thus, a lowering of the water table can result in a decline in lake and stream stage, and in some cases, the drying up of these features.

So, how do surface-water bodies form? A simple approach would be to look at the process of Horton overland flow (Horton, 1933; 1940). This process describes three stages where rainfall first infiltrates the land surface. As soils become saturated, the water begins to puddle in depressions. This is followed by puddles becoming filled and overflowing into surface flow. This surface flow will run downhill due to gravity and usually through low areas, such as valleys and channels. The term used for the surface flow of rainfall and/or snowmelt is runoff.

Stella Lake, Great Basin National Park. Photograph by D.A. Beck, USGS.

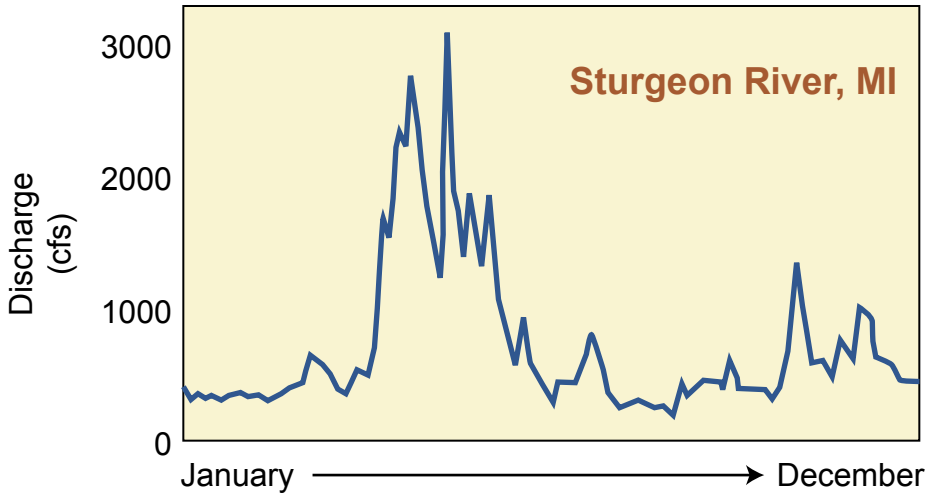
As previously mentioned, some of the water on the surface from rainfall or snowmelt infiltrates into the ground and becomes either soil moisture, held in the pore spaces above the water table, or reaches the water table and becomes ground water. If the water table intersects the land surface along a valley or channel, then the ground water can contribute to the streamflow. This contribution of ground water is called baseflow. Baseflow is what keeps streams flowing during periods in between storm events. So, some of the precipitation contributes directly to streams and lakes as runoff and some of the precipitation flows along a different path and contributes to these surface-water features after traveling through the subsurface (baseflow).

Streamflow and lake levels can be expressed graphically using hydrographs. A hydrograph is a plot of water versus time. For example, a hydrograph, as shown below, can show changes in streamflow versus time. Similarly, hydrographs can be used to show lake levels versus time and ground-water levels versus time. Hydrologists use hydrographs to help understand how lakes, streams, and ground water change with various impacts, such as storm events and droughts. In the hydrograph below, the amount of water from runoff (directly from precipitation and snowmelt) and the amount of water from ground-water discharge to the stream are shown.

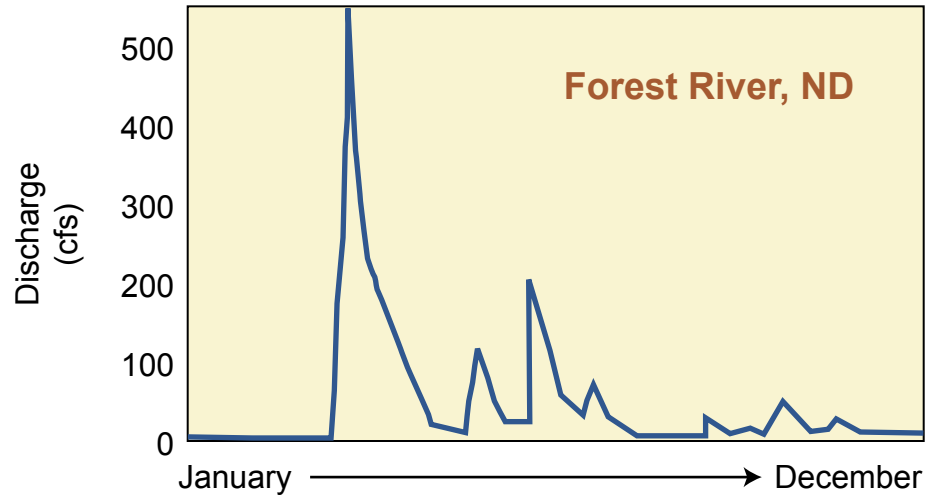


Streamflow hydrograph showing estimated baseflow (Winter and others, 1998).

Hydrographs also are useful for showing how local conditions, such as geology, slopes, vegetation cover, and other factors, affect streamflow following rain and snowmelt events. On the following page are two examples. In the first example (Sturgeon River, Michigan), the peaks in the hydrograph are wide, which indicates that a lot of the water from precipitation and snowmelt goes into the ground and gets released to the stream over time.



Streamflow hydrograph for Sturgeon River, MI (Winter and others, 1998).



Streamflow hydrograph for Forest River, ND (Winter and others, 1998).

The second example (Forest River, North Dakota) is from an area that has very low permeability, so the water from rainfall and snowmelt gets into the stream quickly (does not infiltrate into the ground) and produces narrow peaks in the hydrograph. This is because the land surface is frozen during parts of the year and also because the geology at the surface is mostly clay, which does not allow water to infiltrate readily. The annual snowmelt is very apparent in this hydrograph.

Many other factors affect the shape of hydrographs and hydrologists use hydrographs as a tool to better understand how water moves in particular locations.

Confluence of Baker and Lehman Creeks, Eastern Nevada. Photograph by D.A. Beck, USGS.