

# Riparian Areas, Floods, and Droughts in Arizona

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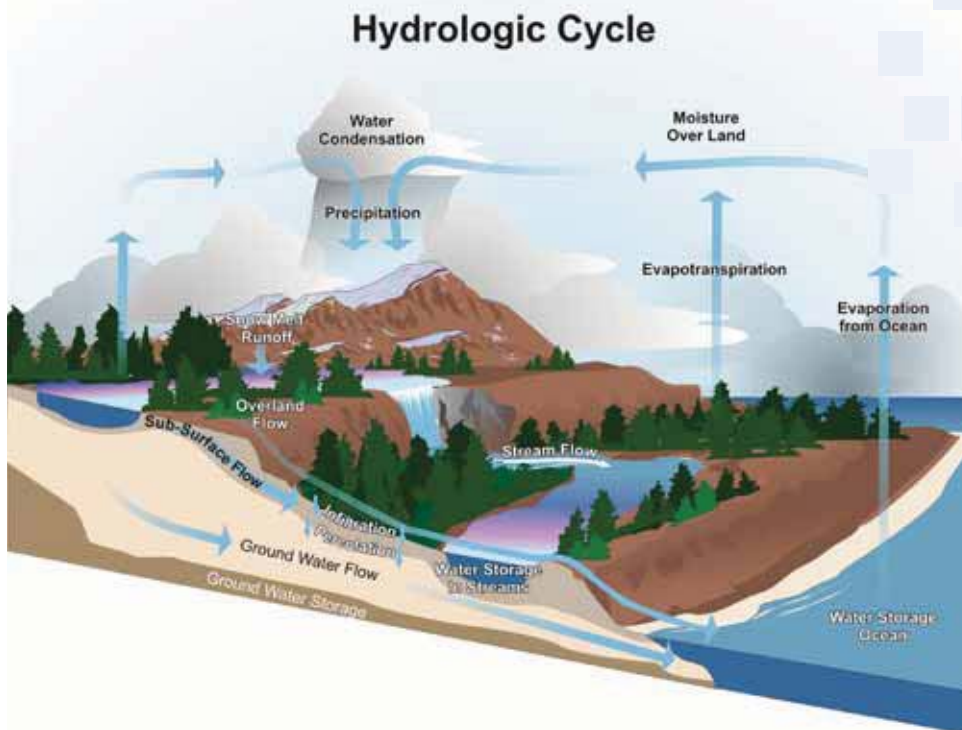


Figure 1. The hydrologic cycle is the movement of water between land, streams, oceans and the atmosphere. This cycle involves many numerous pathways and major storage units such as soils, aquifers, oceans, the atmosphere and plants. Water is not created or destroyed. (Illustration by D. Cantrell).

When you walk along the banks of streams, rivers, lakes or ponds the vegetation is often more dense and different compared to the uplands. These ribbons of green along surface water bodies are called riparian areas. More water is available for vegetation in these areas compared to adjacent uplands, since the groundwater level is much closer to the soil surface and/or because of the proximity to surface water bodies.

Surface water bodies and groundwater are water storage areas frequently displayed in hydrologic cycle drawings as lakes, streams, or aquifers. The hydrologic cycle is the movement of water, as a solid, liquid or vapor, among the atmosphere, the surface of the ground and below the surface (Figure 1). Depending on the climate, particularly the precipitation of the region, the amount and intensity of water movement among the atmosphere, ground surface and below surface will differ. In arid and semi-arid regions, rainfall is the main form of precipitation that characterizes climate.

Precipitation in Arizona is highly variable over space and time, which is characteristic of a dry climate. This high precipitation variability of the region leads to long periods of drought, which may be followed by extreme flooding events. The intervening periods of base flow (the sustained, low flow in a stream that groundwater provides) among flood events in the region occur much more irregularly and typically last longer compared to other regions of the United States (Figure 2). Continual drought can minimize and even completely diminish base flow. These regional floods and droughts can be severe enough to affect the region and its people anywhere from a single

growing season to multiple years or even decades. This characteristic cycle of droughts and extreme floods in Arizona also has a major influence on our state's streams and riparian areas. This fact alone differentiates them from those of other regions of the United States.

Riparian areas are disturbance driven ecosystems. Frequent disturbances, such as floods and droughts, can cause significant changes in vegetation structure and function. Calling these events disturbances gives them a negative connotation that can be misleading. Floods and droughts can cause devastating damage to humans and human infrastructure, but are part of the riparian ecosystems. These disturbances occur frequently enough that riparian ecosystems have adapted to them and tend to recover quickly. In fact, certain vegetation in riparian areas depend on disturbances to regenerate and reproduce.

Large flood events damage vegetation, scour and remove vegetation and sediments, and deposit sediments in the riparian areas. By washing away or throwing down old vegetation, new open sites can re-colonize with younger riparian vegetation. Many riparian plant species are considered pioneering species that first colonize open areas and are short-lived. These species require open spaces to successfully regenerate and maintain their population because they do not grow and compete well under shaded conditions. As a result, floods act as an important regenerative mechanism for riparian areas. Erosion and deposition of sediments by floods redistributes them in the ecosystem. Floodplain soils are replenished in

Verde and Rio Grande Rivers.

Typically, following a flood the stream will have base flow conditions. The newly open sites start re-colonizing with younger riparian vegetation. It is also common to have prolonged drought periods in the arid and semi-arid regions. During these drier periods, the water-width (or wetted-width) of the stream will decrease substantially or completely disappear. It is common in semi-arid and arid regions for many streams to not have flow for a significant part of the year. As a result, riparian vegetation will encroach from the stream banks into the stream channel, but also onto the instream channel bars. Through time you may also see a shift in plant composition, structure and age. If drought persists for an extensively long period and/or is very severe, it can lead to the death of the riparian vegetation.

Drought impacts take several years to affect and change riparian areas, while flood impacts cause immediate changes. Flood and drought events also vary in magnitude, duration, and spatial extent that consequently causes different changes in riparian areas. This increases the variability and unpredictability of the potential changes in stream and riparian areas even more throughout Arizona and other parts of the Southwest.

For semi-arid and arid regions, like Arizona, frequent temporal variation of riparian areas is expected. Through time riparian vegetation will increase (droughts) or decrease (floods or droughts) while also changing in structure, composition and age. A pictorial example of temporal variation of the Verde River in a period of six years can be seen in Figure 3. Knowing the stage of the flood and drought cycle a riparian area is in, will help in understanding the current riparian community and its potential. If the temporal context of change is well understood, serious misjudgments concerning management and restoration of riparian systems may be avoided.

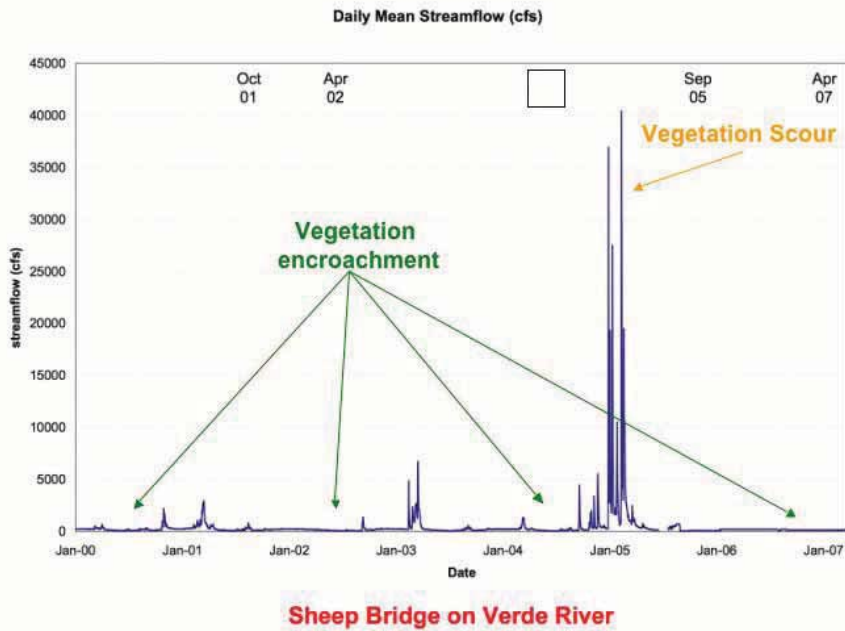


Figure 2. Stream flow conditions from 2001-2007 near Sheep Bridge on the Verde River. Notice the low flows of most years and the flood event in 2005 (graph by M. Crimmins). The dates at the top of the graph indicate when pictures were taken for Figure 3.



October 2001



April 2002



September 2005



April 2007

Figure 3. Photos of the Verde River and its adjacent riparian area from Sheep Bridge (also see Figure 2): a-b) Vegetation encroachment because of low flows (photos by D. Green), c) vegetation is wiped out because of high flood flows in the first half of 2005 (photo by D. Green), and d) vegetation encroachment starts again because of low flows (photo by G. Zaimes).

nutrients by the deposited sediments. In addition, by allowing flooding in small- and medium-sized streams, the amount and downstream speed of water dissipates as it reaches larger rivers where flooding can be more catastrophic. Finally, through flood events, the water table

is recharged and reduces the depth to which riparian vegetation roots must grow to reach water. Researchers have found that groundwater recharge through flood events is extremely important for riparian ecosystems of the Southwest such as those along the San Pedro,

Want to learn more about riparian areas?

CHECK OUT:

1. The educational web-module "Arizona's Riparian Areas" available at <http://ag.arizona.edu/extension/riparian/> and
2. The University of Arizona Cooperative Extension publication "Understanding Arizona's Riparian areas" available at: <http://cals.arizona.edu/pubs/natresources/az1432.pdf>.