



FEMA



Hydrology

The Study of Water Movement

The United States Geologic Survey (USGS) defines hydrology as the science that encompasses the occurrence, distribution, movement and properties of the waters of the earth and their relationship with the environment within each

phase of the hydrologic cycle. Physical, chemical and biological processes involving water are studied to determine water's various paths, over and beneath the earth's surface. Water resources analysis is beneficial to planners, meteorologists, oceanographers, geologists, chemists, physicists, biologists, economists, political scientists, specialists in applied mathematics, and engineers in several fields.

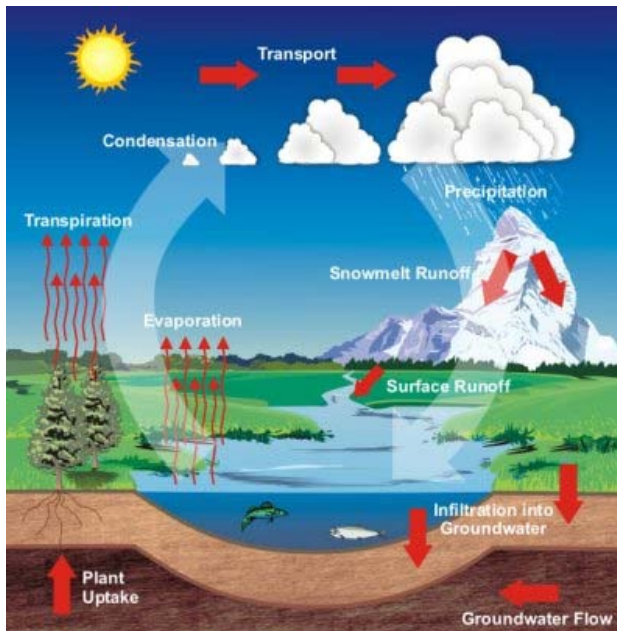


Figure 1: The Hydrologic Cycle

Graphic from National Weather Service

How are hydrology studies used by FEMA?

The Federal Emergency Management Agency (FEMA) prepares Flood Insurance Studies to partner a community's local knowledge with the most up to date technology to model the physical world and identify potential flood hazards within the nation's communities. Identifying the amount of water that falls in a watershed area is the first step in analyzing a community's flood risk.

The analysis is generated and then this information is used to determine the conveyance, or movement, of the storm water through the watershed in a hydraulic analysis. The resultant study results are then mapped and provided to communities as Flood Insurance Rate Maps (FIRMs). FIRMs



What is the Hydrologic Cycle?

The hydrologic cycle, is a continuous process by which water is purified by evaporation and transported from the earth's surface (including the oceans) to the atmosphere and back to the land and oceans.

What is a Watershed?

A watershed is the area of land where all precipitation drains to a common waterway, such as a stream, lake, wetland, or aquifer. A watershed acts similar to a bathtub in collecting the surface and subsurface drainage.

What is the 1-Percent Chance Flooding Event?

The terminology refers to the probability of a storm's occurrence within a calendar year. The 1-percent annual chance event is defined as the storm that has a 1-percent chance of occurring each year.

What is a Special Flood Hazard Area (SFHA)?

The Special Flood Hazard Area (SFHA) is indicated on FIRM panels by a Zone A/AE or Zone V/VE identification. The SFHA indicates the areas within a community that are prone to flooding during the 1-percent-annual-chance storm event.

Figure 2: Water flooding a roadway in Arkansas
Photo used from examiner.com

indicate the extent of flooding expected if a 1-percent-annual-chance event (referred to as the “base flood”) was to occur. Structures within the Special Flood Hazard Area (SFHA) are considered at risk of flooding during the occurrence of the base flood storm event.

The FIRMs indicate existing ground conditions within a community and can be used by local officials, businesses and residents to understand the risk of flooding in their community. More than one-quarter of homes and businesses affected by floods are outside of the Special Flood Hazard Area indicated on the FIRM panels available.

How does development change hydrology?

As climate and physical changes continue to occur due to nature and manmade influences, flood hazard management becomes key in local mitigation strategies to reduce loss of life and property. Each hydrologic analysis performed is a “snapshot” in time as development continues throughout a study’s preparation.

Impacts to stream channels vary at different stages of urbanization. Undeveloped watersheds typically exhibit well-functioning natural systems with little human interaction, development, or pollution. Stream channels are well-vegetated.

Figure 3: Undeveloped Watershed



Graphic by University of Arizona

When rural or undeveloped watershed areas begin to be developed with the addition of some houses and the removal of some of the trees and vegetation, streams are impacted by an increase in storm runoff and erosion. This is because there are fewer plants to slow the overland flow of water. As a result, more water needs to be conveyed by the stream.

Figure 4: Development Begins within a Watershed



Graphic by University of Arizona

As more land is cleared for the construction of houses and subdivisions, more sediment and stormwater is washed into

stream channels. Streams may be diverted to provide a water supply for the increasing population, introducing reservoirs and altering the natural watershed even more. Greater numbers of buildings and parking lots increases the amount of impervious surface, lessening infiltration (water seeping into the ground) and increasing runoff of stormwater to the streams.

Figure 4: Urbanization Begins



Graphic by University of Arizona

The ongoing addition of houses, roads, parking lots, and commercial and industrial buildings represents continued urbanization. This continued development increases the amount of impervious surface within the watershed, further increasing the amount of water that will need to be conveyed by a stream channel. Not only is the amount of water increased, but the water is introduced to the stream channel much quicker than it would have in an undeveloped watershed area. This rush of water increases the erosion along stream channels, near bridges and culverts that have been introduced. Communities may need to increase their maintenance activities near stream crossings to remove the sediment that is transferred so that bridges and culverts perform as designed.

Figure 4: Heavily Urbanized Watershed



Graphic by University of Arizona

Community development decisions alter the calculations as they allow a change to the land use within the watershed. Communities may utilize the analysis performed and detailed on the FIRMs to prepare and plan for hazard mitigation.

What does updated hydrology do for me?

Updated hydrological analysis allows communities to review the flooding hazard potential within their community and determine the effectiveness of local development practices and local mitigation actions. This information may influence future development plans within a community.