Streamflow Discharge

Background Information

Data collection is a critical component of most scientific investigations. Water experts calculate the amount of water flowing in a river and analyze stream- flow data to assess water availability, allocate water supplies and document historic high water levels to predict flooding issues.

Streamflow data is collected by many government agencies worldwide, such as the National Hydrological Services, U.S. Geological Survey, navigation groups, irrigation organizations, hydropower operators, and many others. Streamflow (or discharge) data is a measure of water volume (in cubic meters per second or cubic feet per second) passing a given location over a period of time.

To determine streamflow, water managers must know the streambed profile, the height (or stage) of a river, and its velocity. This information tells water managers how much water is flowing in a river at a given time and location. Streamflow information is collected manually or with electronic gages. Electronic gages, typically located near dams or bridges, generally record flows 24 hours a day, 365 days a year. Manual sites are monitored daily, weekly, or monthly as needed, or after large rainfall events. To take a manual reading, a hydrographer wades into the stream or stands on a bridge or cable system, with a current meter and gaging stick, to record velocity and river depth.

Streamflow data is used to develop hydrographs, which show the amount of water flowing or discharged over time at a given location. For example, the average monthly discharge may be plotted at a site over a one-year period (12 monthly readings or data entries) to create the historical hydrograph.

Hydrologists learn about stream fluctuation patterns by monitoring it over many years. For example, depending on the prevailing climate, rivers may have low flows in the fall and winter, increased levels in the spring, and peak flows in early summer. Hydrologists use this data to create computer models to help predict streamflow during and after rainfall, snowmelt, and drought.

Watershed precipitation amounts, and snowpack levels, also help forecast possible streamflow levels. The amount of snowpack in a local mountain range directly affects the amount of water discharged by a river in late spring or summer. Once hydrologists know streamflow patterns, they inform water resource management agencies, city planners, extension agencies, farmers and others of future estimated stream- flow discharges.

Streamflow predictions, even when using scientific methods, might not be fully reliable. Significant changes in a river's watershed, like construction of dams, levees, or water diversions, can cause flows to vary from historical patterns. But, knowing historical patterns can help people predict streamflows and better prepare for possible flood disasters.

Despite how devastating floods can be for human communities, they play a vital role in natural systems. River corridor ecosystems are accustomed to, and in many cases dependent on, variations in streamflow. For example, many fish species depend on floodplains temporarily covered by floodwaters. Wetlands may depend on water circulation and nutrient recycling during floods.

Floods are designated by their probability of occurrence—such as 500-, 100-, or 10-year floods. Past flood records must be studied to make this analysis. A 10-year flood means that in any particular year, there is a 1 in 10 chance of a flood of that magnitude or discharge occurring in a given location (based on historical data). A 100-year flood has a 1 in 100 chance of occurring at a given location in any given year. It's important to note that a 100-year flood can occur two consecutive years at a given location. Hydrologists can only say that, according to historical flood records and other statistical analysis, a flood of a particular magnitude has a given probability of occurring in any particular year.

The concept of a 10-, 100- or 500- year flood is often misunderstood. Many people think that if they have experienced a 500-year flood, it will not occur again for another 499 years. That is not true. A 500-year flood is the discharge of water in a river that has a 1 in 500 chance of happening in any one year. This is based on the laws of probability. For example, the U.S. Geological Survey (USGS) takes annual peak flow discharge values from USGS stream gages and uses a probability model to determine discharge values for a 10-, a 100-, or a 500-year flood. Designations of 10-, 100-, or 500-year floods can be thought of as big, bigger, and biggest floods. Scientists create maps to show the water levels and potential inundated areas of 10-, 100-, and 500-year floods. These are extremely useful for public safety and flood insurance purposes.