



Precipitation & Stream Discharge Resource Brief Annual and Seasonal Trends

Importance

Climate is not just temperature, it also includes precipitation (rain and snow). Ecosystems depend on precipitation and precipitation touches nearly every part of an ecosystem as it moves over and through the land. Eventually gravity pulls that water downward into streams where it is measured as stream flow (discharge).

When the timing and quantity of precipitation or stream discharge changes, it can affect both land and aquatic plants and animals, nutrient cycles, air quality, and more.

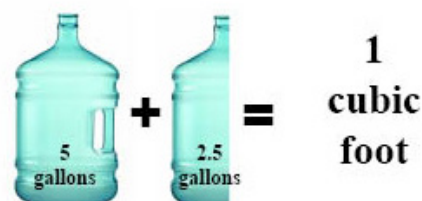
West Virginia, precipitation is historically highest in summer, intermediate in the spring, and lowest in fall and winter (see Figure 1).

In the last 50 years however, MD, VA, and WV have been getting more precipitation in fall. In the last 20 years, DC has had more precipitation in spring.

Precipitation also decreased slightly in the summer months, when it is typically highest. These changes have the effect of leveling out the typical seasonal variations in precipitation.

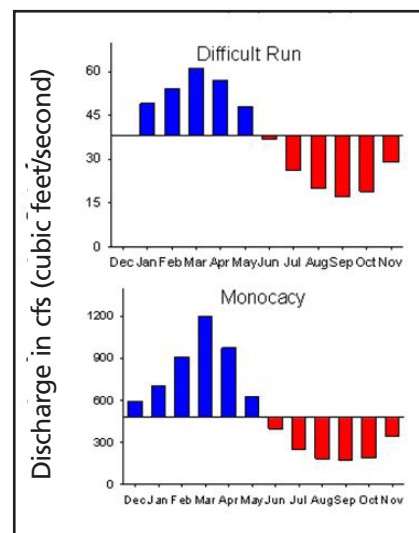
Discharge

Discharge is a measure of the volume of water in a stream passing a particular location at a given point in time. It is measured as cubic feet of water passing a location in one second (cubic feet per second or cfs). A cubic foot is equivalent to 7.48 gallons. Picture a cubic foot of water as roughly equivalent to 1½ 5-gallon water cooler jugs.



In the NCRN, precipitation is the source of water (discharge) in streams. Over the course of a year discharge in the NCRN is generally highest in March and decreases steadily to the lowest levels in September. From there, a gradual increase occurs back to peak discharge levels in March (Figure 2). Strikingly, annual cycles of discharge and precipitation are

Figure 2. Typical patterns of stream discharge for the NCRN are illustrated by data here from Difficult Run (VA) and Monocacy (MD).



Overview

Long-term data on both precipitation (from the National Oceanic and Atmospheric Administration) and discharge (from the US Geological Survey) reveals increases in fall precipitation and fall discharge levels that are exhibited differently in urbanized and rural watersheds.

Precipitation

Precipitation amounts vary by season and can also change over many years. In Maryland, Virginia, the District of Columbia, and

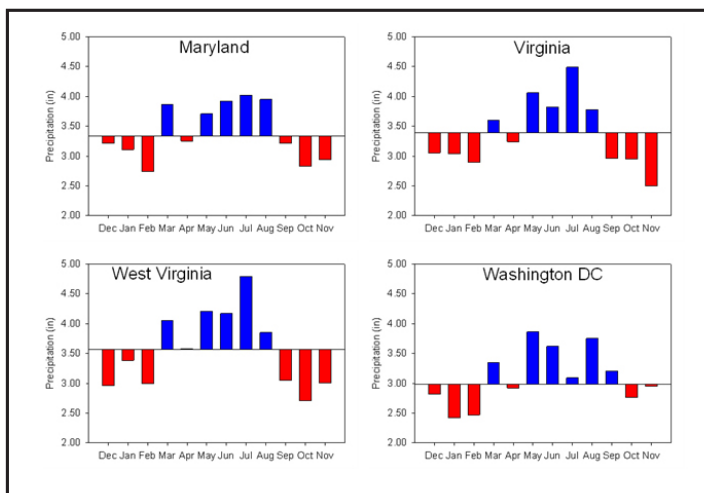


Figure 1. Average Precipitation levels for the NCRN. The horizontal line in each chart shows the average annual precipitation. Red and blue bars represent monthly averages. Data for MD, VA, and WV spans 1895-2009 time period. Data for DC spans 1963-2009.

National Capital Region Network

National Park Service
U.S. Department of the Interior



tion do not match up. This is likely because plants use water in increasing amounts during spring and summer that would otherwise flow into streams.

Discharge levels have been changing over many decades, mainly increasing in the fall months. Increased fall precipitation is raising the year's lowest levels of discharge. There are no changes to the year's highest discharge levels which generally occur in the spring. As a result, typical high flows have not increased, but streams no longer drop as low as they once did in the fall.

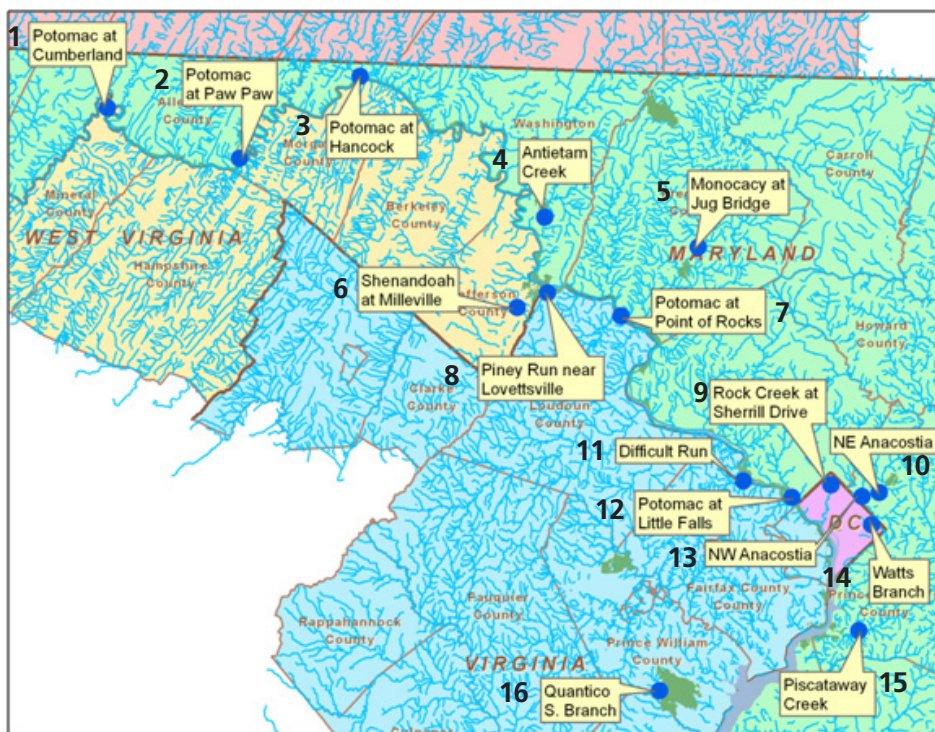
Discharge from a stream is determined by: the amount of precipitation that's fallen, what's on the ground where it's fallen, and human water additions and extractions. Streams in the NCRN are subject to dams, withdrawals for drinking water and discharges from treatment plants, and much of the land around the streams in the NCRN has been urbanized. Water can't soak into the ground where there are buildings, paved lots, or other impervious surfaces. In urbanized areas it travels quickly as surface runoff (rather than slowly as groundwater) and can cause surges or "flashiness" in stream discharge levels.

Stream discharge rates effect the distribution of sediments and nu-

trients in streambeds which in turn influences the distribution of stream dwelling species like crayfish, stoneflies, and dragonflies. Discharge also influences the floodplain habitat for plants and land animals.

The Land Use Factor

Not all streams in a park may respond in the same way to climate change. This is especially true for parks spread out over large areas with a variety of land uses (like the Chesapeake & Ohio Canal National Historical Park and National Capital Parks - East), because land use can dramatically change the behavior of streams despite their similar rainfall patterns and proximity. Several stream gauges in rural areas, where watersheds are largely undeveloped, showed large increases to low flows, with no significant change to higher flows. In more urban areas near Washington, DC, larger amounts of impervious surface effect discharge rates. Urban streams like Rock Creek and Difficult Run show significant increases at high flows, and small decreases in the low flows. And streams on large rivers that are dammed show their own distinct signature—that of no significant changes in discharge.



Locations of Stream Gauges and Corresponding NCRN Parks.

Of the 14 stream discharge gauges used in this analysis, the average data collection period was 75 years. Gauges 8 (Piney Run) and 14 (Watts Branch) had shorter data collection periods and were not used in all analyses.

Antietam NB- 4
Catoctin MP- no suitable gauges
C&O Canal NHP- 1,2,3,7,8,12
George Washington Memorial Pkwy- 11,12
Harpers Ferry NHP- 6
Manassas NBP- no suitable gauges
Monocacy NB- 5
National Capital Parks - East- 10,12,13,14,15
Prince William FP-16
Rock Creek Park- 9
Wolf Trap National Park for the Performing Arts- no suitable gauges

References:

Schmit, J. P. 2011. Annual and seasonal trends in discharge of National Capital Region streams. Natural Resource Technical Report NPS/NCRN/NRTR—2011/488. National Park Service, Fort Collins, Colorado.
 Available online at: http://science.nature.nps.gov/im/units/ncrn/monitoring_water_surface_dynamics.cfm