Precipitation, runoff and runoff ratio maps

These maps show the state-wide variation in precipitation, the amount of that precipitation that ends up as runoff and the ratio between runoff and rainfall, known as the runoff ratio. These parameters reflect natural climate, weather, and landscape variations that occur across the state, and the effects of human alterations.

Precipitation

The State Climatology Office supplied monthly precipitation data by watershed. This data is derived from the Minnesota High Density Network. This network supplies detailed local precipitation data from professional and cooperating volunteer observers across the state. The data is gridded using a geostatistical procedure call kriging, and is then averaged across each watershed.

Runoff

Runoff in this context is the total amount of water discharged from a watershed via a river or stream. Runoff data comes from river gages which record river stage (level), convert stage to discharge, and total the discharge for each year. When a gage is located close to the outlet of a watershed it is a simple process to apply the discharge to the proper watershed. Gages are often not located at the outlet of watersheds however, necessitating some corrections to the discharge data. These corrections include: adjusting watershed area for gages which are some distance upstream or downstream from watershed outlets, subtracting out discharge of nested watersheds from gages on large streams, and averaging data from adjacent watersheds when gages are not available. A record of these corrections is maintained in the supporting data for the maps.

Runoff ratio

Runoff ratio is the runoff for each watershed divided by the precipitation for that watershed. It is the proportion of rainfall that does not infiltrate and is not taken up by evapotranspiration, and thus ends up as runoff. Some of the water which infiltrates emerges as baseflow or through springs and seeps and becomes part of runoff. Runoff ratio is controlled to some extent by natural factors. Soils containing large fractions of clay or silt absorb less water than sandy soils and thus produce higher runoff ratios. Topography has a strong control over runoff ratio. Watersheds with steep slopes tend to shed more water and infiltrate less due to rapid runoff. These areas will have high runoff ratios. Relatively flat areas underlain by coarse sandy soils generally have the lowest runoff ratios as most of the precipitation soaks into the ground. These natural factors affecting the runoff ratio are stable and should not change much over time. Human alteration of the landscape also affects runoff ratio and these changes can be seen in variations in runoff and runoff ratio over time.

Altering the landscape by filling in wetlands, channelizing streams, removing the forest canopy or increasing impervious surfaces will generally increase the runoff ratio by removing landscape features which retain or slow down the movement of rain. Installation of systems such as storm sewers and tile drainage can also increase runoff ratio by intercepting water and routing it to the stream before it infiltrates to the groundwater. Runoff ratio can be decreased by creating water storage, such as reservoirs and wetlands. Planting perennial vegetation and other techniques which slow down the flow of water and increase infiltration will also decrease the runoff ratio.