



Background

- This indicator reflects the renewable freshwater supply in a given basin.¹
- Changes in mean annual runoff are correlated with other hydrologic variables, including mean river discharge, low flows, and high flows.²
- Lower values suggest higher vulnerability relative to other watersheds.

THIS INDICATOR MEASURES ALL WATER DISCHARGED IN SURFACE STREAMS WITHIN A WATERSHED.

Local vs. Cumulative

- Flow-based indicator values depend on where the flow originates.
- The vulnerability assessment tool uses two versions of this indicator:
 - Local (65L): Reflects flow generated within only one 4-digit hydrologic unit code (HUC-4) watershed.
 - Cumulative (65C): Reflects flow generated within a HUC-4 watershed and any upstream watersheds.

Data Sources

Data Source	Description	Spatial Resolution	Temporal Resolution
Coupled Model Intercomparison Project (CMIP-5) output ³	Local runoff within HUC-4 watersheds	HUC-4 watersheds	2035-2064 and 2070-2099

These Indicators Were Used to Assess the Vulnerability of Some of USACE's Eight Business Lines

Indicator	Business Line	Importance Weight (Varies from 1 to 2 for USACE)
65L	Ecosystem Restoration	1.3
	Regulatory	1.3
65C	Regulatory	1.4

Calculation

- Use local runoff values from 47 CMIP-5 climate model traces specific to each future scenario.⁴
 - For indicator 65L, use local runoff values from each model trace.
 - For indicator 65C, use cumulative runoff values from each model trace.
- Calculate the mean annual runoff value for each model trace.
- Calculate the median mean annual runoff value across all model traces to obtain a single indicator value for each HUC-4 watershed.

¹ Milly, P. C., Dunne, K. A., and A. V. Vecchia. 2005. Global Pattern of Trends in Streamflow and Water Availability in a Changing Climate. *Nature*. 438(7066): 347-350.

² Döll, P., and H. M. Schmied. 2012. How is the Impact of Climate Change on River Flow Regimes Related to the Impact on Mean Annual Runoff? A Global-Scale Analysis. *Environmental Research Letters*. 7(1): 014037.

³ CMIP-5 output is available for download online at: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html

⁴ Indicator values were calculated for two scenarios (a wet and a dry future) and two time periods (2035-2064 and 2070-2099).

LOW



LOW INDICATOR VALUE

Rivers may have lower flows in areas with low mean annual runoff.

HIGH INDICATOR VALUE

River discharge may be abundant in areas with high mean annual runoff.

HIGH



Big South Fork National River, TN - Courtesy of NPS

Little Blue River, KS - Courtesy of USGS