

Geographic Information Systems Analysis of the Surface Drinking Water Provided by Intermittent, Ephemeral and Headwater Streams in the U.S.

Performed by U.S. EPA July, 2009

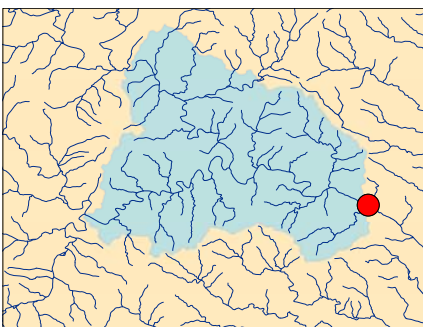
Presented here are results of a series of geographic information systems (GIS) analyses examining the extent of different types of streams in the continental United States, at the national, state and county levels. The objective of this study is to illuminate regional patterns of dependence on intermittent, ephemeral and headwater streams for water to supply public drinking water systems in the United States, using the most recent, valid data available. The analyses are intended to inform interested stakeholders about the distribution of these water features and to assist federal, state, tribal and local governments in planning, prioritization and watershed management efforts. A similar analysis was initially conducted in 2005 and has been updated using improved data and methods in this analysis.

RESULTS

In the continental United States, approximately 117 million people, over one third of the total U.S. population, get some or all of their drinking water from public drinking water systems that rely at least in part on intermittent, ephemeral or headwater streams. This represents 94% of the approximately 124 million people who are served by public drinking water systems included in this analysis. The national map divided by counties reflects major patterns of water resources in the continental U.S. These broad patterns appear to be the result of precipitation levels, the location of regional aquifer systems that provide alternative sources, as well as the salt water gradient along the coast. For example, surface water intakes are largely absent from the land above the Ogallala Aquifer. In the Northeast, where surface water is relatively abundant, and perennial streams are more common, the percentage of intermittent, ephemeral and headwater streams per county is generally lower than that found in the arid west. A more detailed breakdown of the results by state and by county is presented in the attached tables.

In the continental United States, 357,404 total miles of streams provide water for public drinking water systems that use surface water. Of that total, 58% (207,476 miles) are intermittent, ephemeral or headwater streams.

METHODS



The blue shaded area is a Source Protection Area (SPA). Water from streams in the SPA will reach the intake in a 24-hour period. The red dot represents the intake.

This study was accomplished by using a mapping analytical tool (GIS) to overlay public drinking water system data and stream data. The central method for this study was an analysis of the water features (stream type) located in mapped Source Protection Areas (SPAs) across the country. A SPA is the area upstream from a drinking water intake that provides water to a public drinking water system during a 24-hour period. Each public drinking water system serves a specific population, generally based on the primary county served.

This analysis compared the stream length of intermittent, ephemeral, or headwaters to total stream length within all mapped SPAs for each county, state, or the country. Overlapping SPAs were identified and the



overlap area was assigned to only one intake to avoid double-counting stream miles. The total population served is the sum of all populations served by public drinking water systems located in the county, state, or the country, respectively. Populations dependent on intermittent, ephemeral or headwater streams include only populations that are served by systems fed by SPAs containing those stream types.

DATA SOURCES

This analysis was performed using data from the National Hydrography Dataset *Plus* and the Federal Safe Drinking Water Information System, which are described more fully below.

National Hydrography Dataset Plus (NHD*Plus*)

The NHD*Plus* is a comprehensive set of digital spatial data representing the surface water of the United States using common features such as lakes, ponds, streams, rivers, canals and oceans. All streams mapped in the NHD*Plus* are labeled with the hydrographic category of either “intermittent” or “perennial.” Intermittent streams and ephemeral streams are not distinguished from each other in the dataset, but are combined together as “intermittent streams.” The NHD*Plus* defines an intermittent stream as any “stream that contains water for only part of the year, more than just after rainstorms and at snowmelt.” Streams mapped as first order in NHD*Plus* are used as a surrogate for headwater streams both in the dataset and for purposes of this analysis. First order streams are those not joined by any other streams; they are where the rivers begin. The data used in this analysis are the “medium” resolution NHD*Plus* at 1:100,000-scale from the Reach Address Database Version 3.1, which are current as of May 31, 2009. Alaska was excluded from the analysis because their streams are not mapped in NHD*Plus*.

Using these data provides a conservative estimate; the actual percent of intermittent, ephemeral or headwater stream miles is likely higher. This is because many smaller waters are not included in the NHD because they could not be detected on the original aerial photos used to create the dataset. Generally streams less than one mile in length, lakes less than six acres in size, and wetlands less than 24 acres in size are not included at this resolution.

Federal Safe Drinking Water Information System (SDWIS/FED)

The SDWIS/FED data used for this analysis is the EPA’s official record of public drinking water systems. It is comprised of data submitted by the states to the agency. This includes drinking water intake locations, information on the corresponding public drinking water systems, as well as the number of people dependent on each system, although the data provided are sometimes incomplete in one or more of these categories. Using the intake location data, Source Protection Areas were mapped for all intakes located on features in the NHD (completed June, 2009, using 4th quarter 2006 data).

Most public drinking water systems in SDWIS/FED identify a primary county served. Therefore, counties were chosen as the geographic unit used for the analysis. As a result, only those systems that identify a primary county are included in the analysis, although secondary counties may also be served. Consequently, it is possible that counties labeled as having “no data” may actually be receiving their drinking water from a system located in a different county. It is also possible that those counties depend heavily on private surface drinking water systems or use systems reliant on groundwater. In addition, some systems identify a primary city or tribal land served instead of a county. This includes the city of Los Angeles, as well as several entities in Virginia and all of Hawaii. These data gaps resulted in less than two percent of the public drinking water systems with associated SPAs being excluded from the analysis.

