

Evaluating Drought Vulnerability of Small Community Surface Water Supply Systems in the Midwest

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This study concentrates on the drought vulnerability of small community water supply systems in the Midwest that obtain their water from surface water bodies, such as rivers, streams, natural lakes, and man-made reservoirs. The vast majority of small surface water supplies in the Midwest are located in a relatively narrow band crossing the states of Kansas, Missouri, Iowa, Illinois, Indiana, and Ohio. Much of this report's discussion on drought characteristics focuses on this "southern tier" of Midwestern states. The report does not address communities that obtain their water from the Great Lakes or major rivers where the availability of supply during severe droughts is not in question. The most common small community surface water system obtains its supply from one or two small impounding reservoirs; however, a sizable number of communities obtain their water instead from river withdrawals or from the off-channel storage of water withdrawn from streams and rivers.

Sixty of the 320 small community surface water systems in the Midwest were interviewed for this study. These interviews were used to gather information that could potentially be used to determine the drought vulnerability of their system, including information on the capacities of reservoirs, availability of hydrologic data, recent experiences with drought impacts and related water use restrictions, differences in seasonal water use, and community drought plans. Fewer than half of the interviewed systems that have a reservoir could provide information on their reservoir's capacity. Capacity estimates that were provided were typically neither recent nor based on actual measurements. Few communities were aware of available hydrologic data such as streamflow measurements.

The need for a community to institute voluntary or mandatory water use restrictions was used as a common measure of that community's drought vulnerability. Eighteen of the 60 interviewed communities needed to institute restrictions at least once during the past 20 years. Eight of those systems have since augmented their supplies. Communities most likely to need restrictions were those with off-channel reservoir or low channel dam water supplies. Offchannel reservoir and low channel dam systems also are the least likely to have sufficient data for evaluating adequacy of supply; thus, in general, these system types may be considered to have the highest potential vulnerability to drought conditions.

This report provides information on historical hydrologic droughts in the Midwest, including data on comparative drought streamflows for 27 selected long-term gaging records in the southern tier of Midwestern states where most surface water supplies are located. For longer drought durations (18 months or longer), the 1950s drought is clearly the worst on record for most selected locations. Flow conditions during the drought of record may be considerably lower than other historical droughts. Thus for determining the vulnerability of a system to severe drought, it is very important for that gage's period of record to include either the 1950s or other drought periods comparable in effect to the identified drought of record.

For most states, there is no pre-defined drought threshold that communities are required to surpass in developing their water supply sources. For very small communities, it may not be economically feasible to develop alternative water supplies capable of meeting water use during a drought of record if supplies are adequate during moderate droughts. But for communities where there are no existing alternative supply options, especially for larger communities, it would seem essential that existing resources are capable of meeting water needs during a very severe drought. The past half century has shown that climate is variable; so, even if it has been many decades since the occurrence of some of the worst droughts on record, the likelihood exists that such droughts can occur again and attention should be given toward planning for that eventuality.

To evaluate their vulnerability to severe drought, communities that depend on reservoir supplies need to obtain accurate measurements of the capacities of their reservoirs, if they have not recently been conducted. For Kansas and Missouri reservoir systems, bathymetric (depth) surveys may have already been made through initiatives by the Kansas Biological Survey and Missouri Department of Natural Resources. The Illinois State Water Survey also has conducted measurements for a number of water supply reservoirs in Illinois. A first step for communities with impounding and off-channel reservoirs can be to identify the agencies or consultants that are capable of conducting a bathymetric survey of their reservoir. Capacity estimates not developed from a detailed survey of this type may be substantially inaccurate and particularly may be biased towards overestimating the capacity for small reservoirs. Capacity estimates also should account for the loss of capacity over time as the result of sedimentation.

If hydrologic data and basic physical data such as storage capacity are lacking, it will be difficult for either system managers or experienced professionals to estimate a community system's yield and potential drought impacts, particularly for off-channel reservoir and low channel dam systems that are more likely to be vulnerable to drought. There are several types of data, in addition to the measurement of storage in reservoirs and behind low channel dams, that a community could begin collecting that may be useful for future assessments. Daily records can be kept of: 1) stream withdrawals, including a description of pumping amount and the number of days when water was not withdrawn because water quality was poor or stream levels were too low; 2) drawdown levels for reservoirs and low channel dams in the pools; and 3) precipitation. The first two sets of data could provide information on the relative availability of water, which could then be compared to more complete hydrologic data from regional streams for predicting local conditions during severe drought. Without proactive efforts to keep records of these types, for many communities the only alternative is to wait and see what the next drought brings.