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**Senator George J. Mitchell Center for Environmental and Watershed Research**

*Member of the University of Maine System*

# THE EFFECTS OF THE 2001-2002 DROUGHT ON MAINE DRINKING WATER SUPPLIES

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J. Ziegra

*Water level declines in Adams Pond, supply for Boothbay Region Water District, during the drought of 2001.*

## SUMMARY

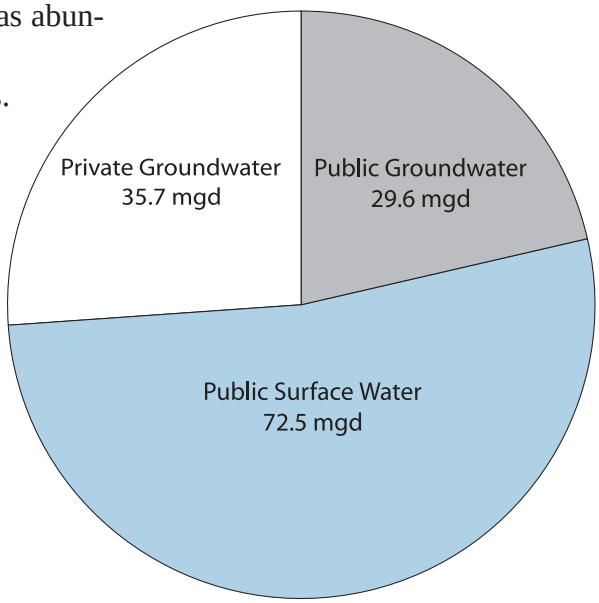
Maine experienced the worst drought in over thirty years during 2001 and 2002. Water in streams, lakes, and groundwater dropped to record-low levels.[1] Thousands of private wells went dry, and many public water systems were forced to implement water use restrictions and tap into back-up supplies. The drought exposed vulnerabilities in the state's public water supply, highlighting a need for water use planning and management even in a "water-rich" state like Maine.

Not all public surface water systems experienced problems, even in areas where the drought was severe. Small, shallow lakes that were already being pumped close to their safe yield were the most vulnerable surface water supplies. These systems were located in the coastal region and other areas where seasonal tourism and residential development increase water demand, suggesting that surface water systems with these characteristics are most likely to be affected by future droughts.[2]

This document highlights the effects of the drought on Maine surface water supplies and discusses ways that managers of vulnerable systems can prepare for future drought and climate variability.

## MAINE'S DRINKING WATER SUPPLY

Thanks to a history of glaciation and a humid climate, Maine has abundant freshwater resources that supply clean drinking water. The majority of Maine residents are served by public water supplies. Rivers, lakes, and ponds supply 75 % of the volume of public water withdrawals, providing drinking water to half a million people (although there are more groundwater systems).

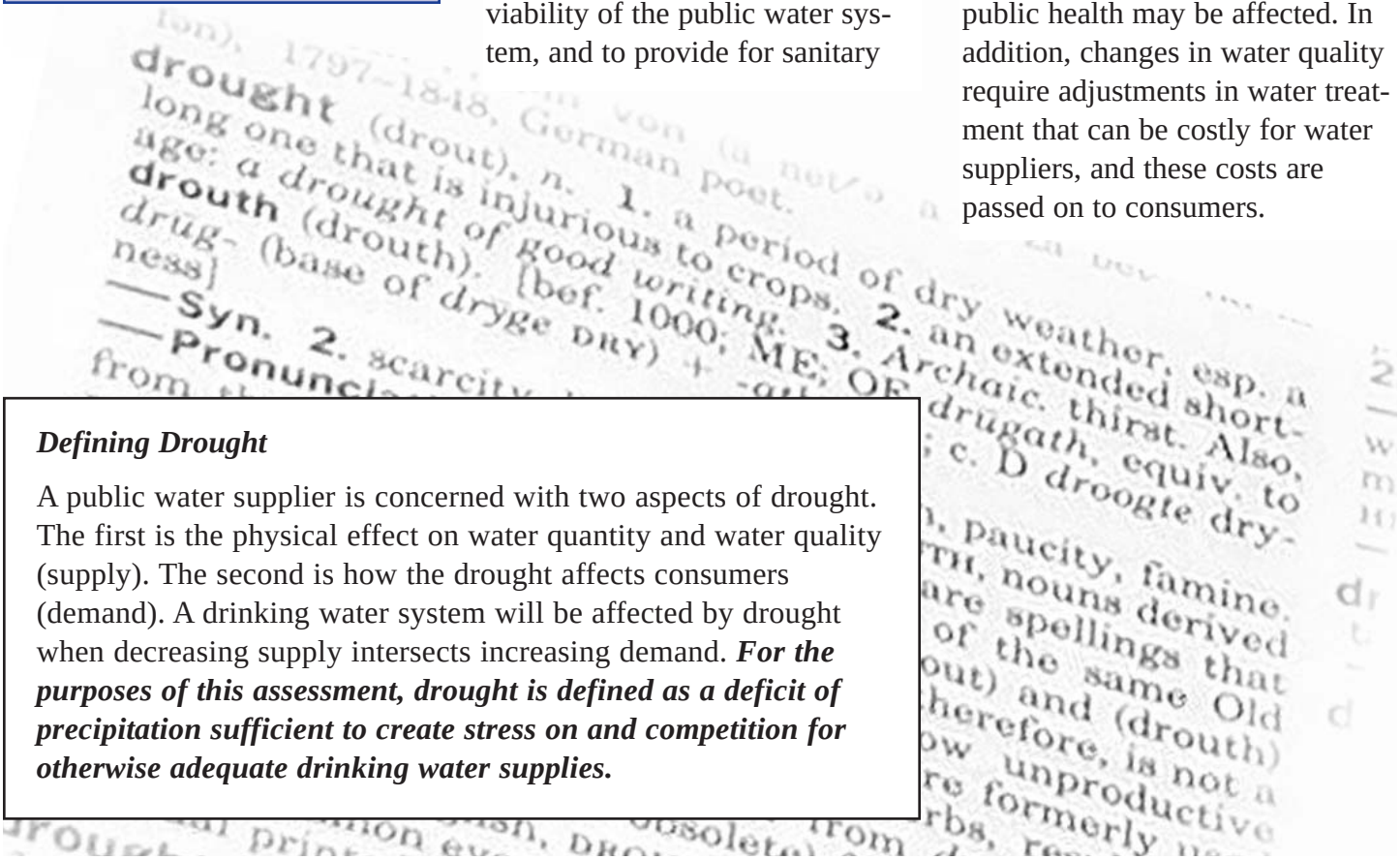



*Drinking water withdrawals, in million gallons per day (mgd).*[3]

Public water systems are governed by the Maine Drinking Water Program, which enforces the Safe Drinking Water Act, and the Maine Public Utilities Commission, which regulates community, non-transient public water systems. These systems are defined as having 15 connections or serving 25 or more people year-round.

## PUBLIC WATER SUPPLY AND DROUGHT

A public water supplier needs adequate volume of water to satisfy customer demand, maintain viability of the public water system, and to provide for sanitary and fire protection needs. Anything that affects water quality is a serious concern because public health may be affected. In addition, changes in water quality require adjustments in water treatment that can be costly for water suppliers, and these costs are passed on to consumers.

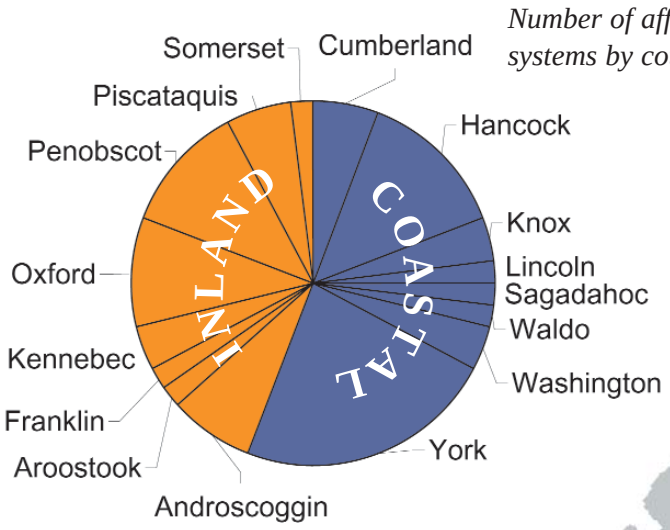



***Defining Drought***

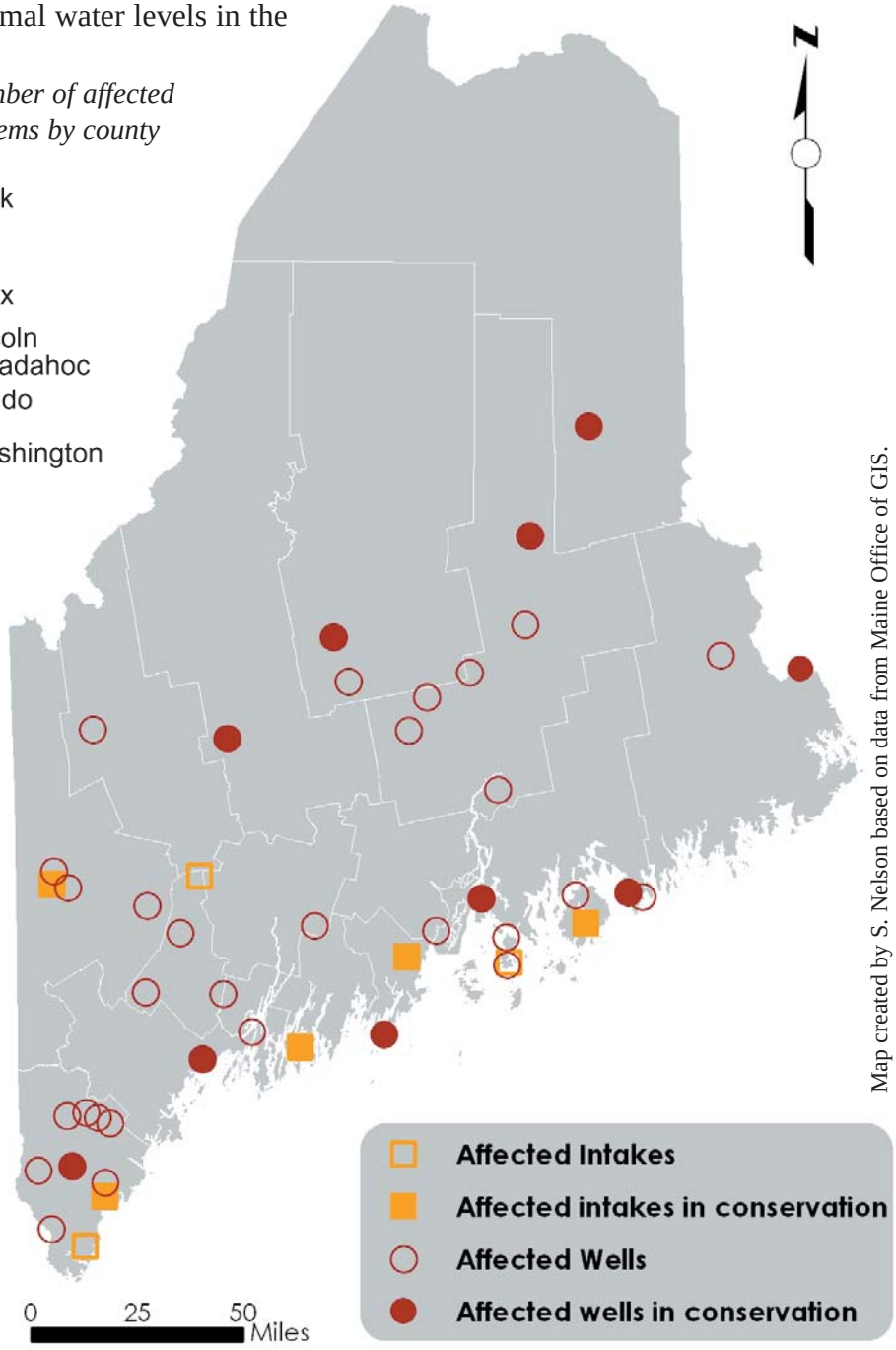
A public water supplier is concerned with two aspects of drought. The first is the physical effect on water quantity and water quality (supply). The second is how the drought affects consumers (demand). A drinking water system will be affected by drought when decreasing supply intersects increasing demand. ***For the purposes of this assessment, drought is defined as a deficit of precipitation sufficient to create stress on and competition for otherwise adequate drinking water supplies.***

## HOW DID THE DROUGHT AFFECT PUBLIC WATER SUPPLIES?

A total of 53 public water supplies were affected by the drought: 45 of approximately 400 community groundwater systems and eight of 68 surface water systems. While more groundwater systems were affected, 70% of surface water systems reported below normal water levels in the summer of 2001.




*Public water supplies affected by the 2001-2002 drought, based on a survey of surface water systems and reports to the Maine Drinking Water Program and Public Utilities Commission. A system was considered affected by the drought if: 1) water quantity was reduced enough for the system to impose voluntary or mandatory conservation; 2) the system manager utilized or explored additional or alternative supplies; and/or 3) the manager expressed concern about the drought's effects on water quantity or quality. Squares represent surface water systems; circles are groundwater systems*



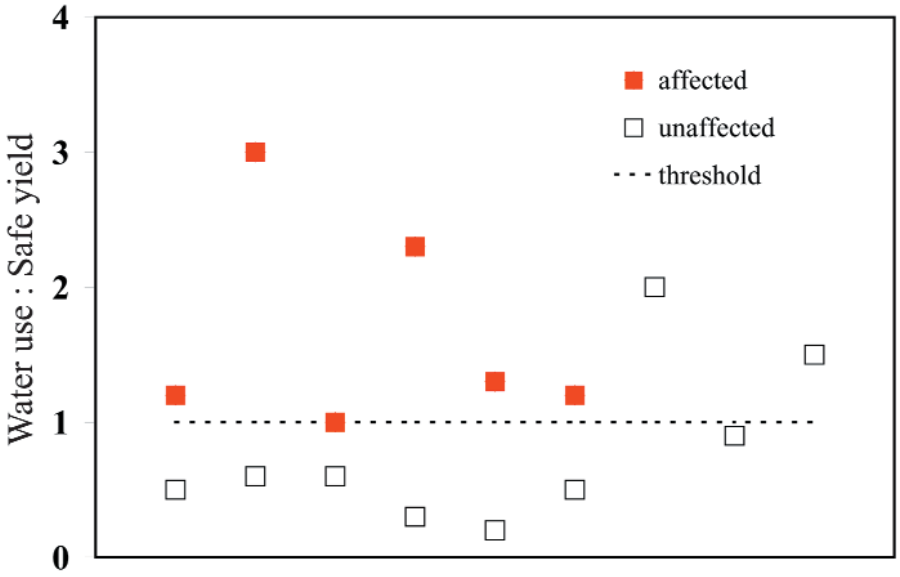

Map created by S. Nelson based on data from Maine Office of GIS.

### THE DROUGHT IN PERSPECTIVE

Although New England is considered to be "water-rich," Maine has experienced several significant drought periods, the most recent in 2001, the driest year since records began in 1895. The severity of the drought varied across the state, with northern Maine experiencing the driest conditions. Lakes, streams, and groundwater were at record low levels.[1]

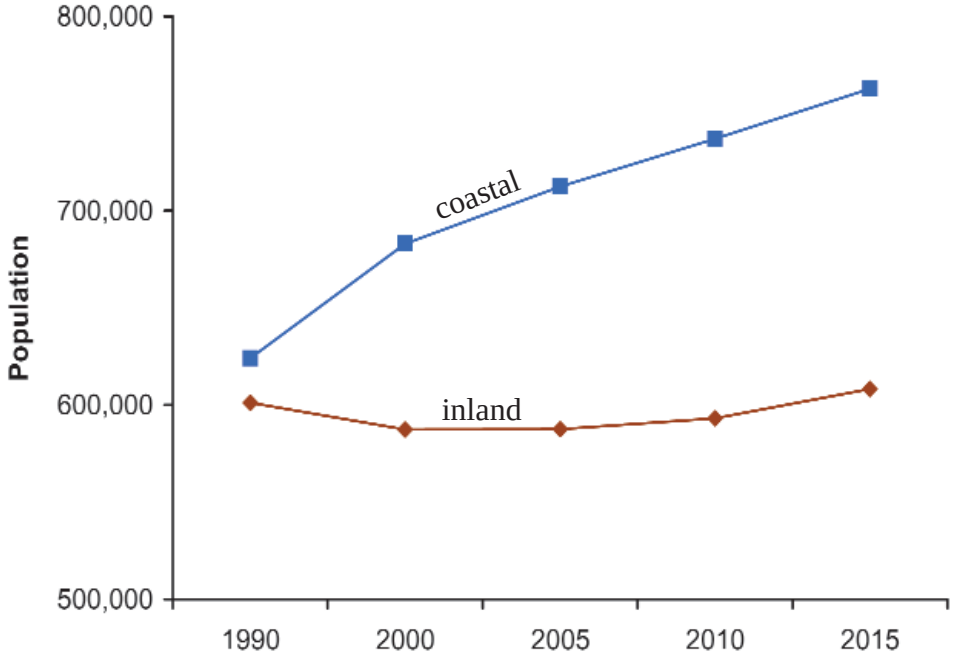
## WHAT DID THE AFFECTED SYSTEMS HAVE IN COMMON?

How a particular water supply responds to drought will depend on its size and watershed characteristics, and the relative contributions of precipitation, surface runoff, and groundwater to the overall water budget. Water levels in 2001 were below normal in the majority of public water supply lakes and streams, in some cases at record low levels. Yet only eight surface water systems were considered "affected," meaning they had problems as a result of decreased water volumes. Climate and hydrologic conditions alone were not enough to drive a system to implement water use restrictions.




*Ratios of water use to safe yield for affected (red) and unaffected (white) surface water supplies. A ratio above the threshold of one suggests vulnerability to drought.*

The response of water supplies is strongly influenced by the timing of drought relative to the seasonal demand patterns of a specific system. A closer look at the affected systems revealed that they operate close to their safe yield during times of high demand, even in a non-drought year. (Safe yield is the maximum quantity of water that can be withdrawn during an extended dry period. The more often a system pumps over the safe yield, the greater the risk of a water shortage.) During the summer of 2001, drought conditions and increased seasonal demand combined to push vulnerable systems "over the edge", forcing them to implement water use restrictions.




*Predicted population increases for coastal (blue) and inland (brown) counties, 1990-2015.*[4]

*Drought conditions were mildest along the coast, yet the majority of public water systems affected by the drought were located in coastal counties. Population increases, tourism, seasonal housing pressure and accompanying land use changes increase the demand for water in coastal areas, where freshwater supplies are limited. Over six million people visit the coast each year, and future population and development increases are predicted to be greater for coastal counties. Conflicts over water use are not likely to subside in the near future.*

## WHAT STEPS CAN MANAGERS TAKE TO PREPARE FOR DROUGHT?

The 2001-2002 drought revealed that small water supplies in populated coastal areas are most at risk for water shortages. Because drought occurs infrequently in Maine, there is little institutional memory among water managers. Lessons learned from dealing with the 2001-02 drought can be used to make recommendations for future drought preparedness.

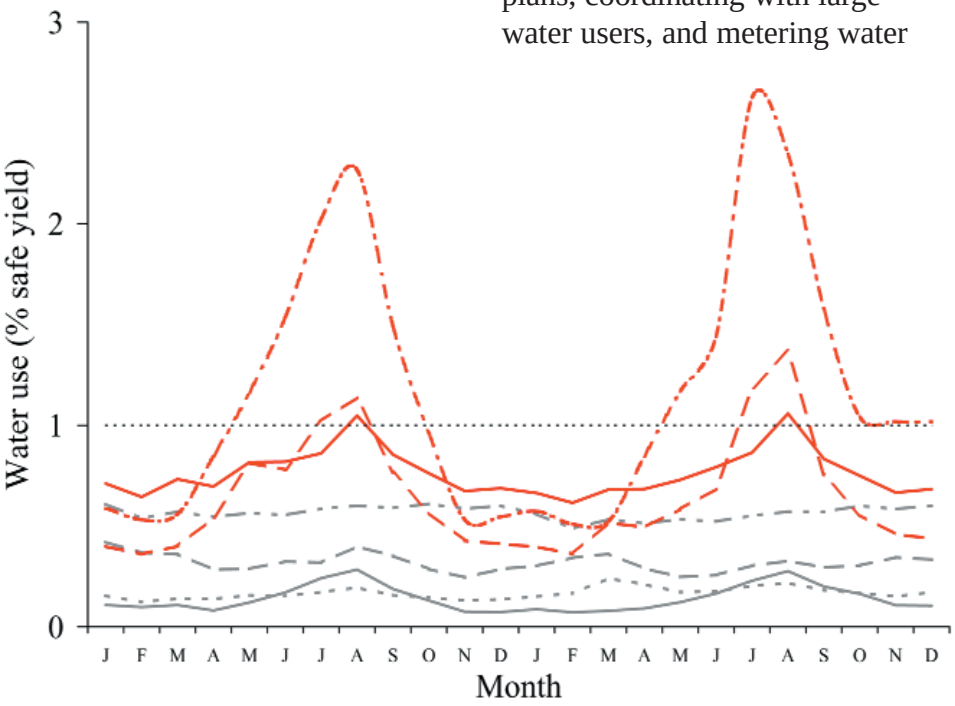
### *1. Enforcing Water Use Restrictions*

Four surface water systems implemented voluntary conservation measures and one system imposed mandatory restrictions in 2001. The most common strategy was to target the large users of water while asking all customers for voluntary conservation via newspapers or direct mailings. This approach was successful for all of the systems except one. Most managers cited good cooperation with towns and customers in reducing water demand. Cooperation coupled with the end of the summer tourist season (not the end of the drought) eased the pressure on systems so they could avoid mandatory restrictions.

*Successful water conservation efforts involve everyone in a community, from seasonal visitors to summer homeowners to local businesses. Regular communication with water users develops relationships that will prove beneficial for public water system managers in the event of a drought.*

### *2. Securing back-up supplies*

Minimizing system leaks, developing watershed management plans, coordinating with large water users, and metering water usage are all important conservation tools. Yet balancing supply and demand with back-up sources remains the best insurance against drought problems. *Surface water systems affected by the 2001-2002 drought were more reliant on supplemental or alternative water supplies.* With increases in seasonal demand related to residential and tourism development growth, managers will look farther afield for additional supplies at the same time that environmental or health regulations limit the availability of suitable water sources.[5]




*Monthly water usage as a percentage of safe yield for affected (red) and unaffected (gray) surface water supplies, 2001-2002. Water use above the threshold is a characteristic of drought-affected systems.*

### *3. Monitoring*

The point when managers implemented conservation measures in 2001 might coincide with parameters which could serve as threshold or action levels when planning for drought. Dry conditions (as measured by precipitation, water levels, streamflows, and drought indices) had been building for five or more months before water restrictions were implemented, and yet the worst of the drought did not occur until later.

The affected systems implemented conservation when water withdrawals approached or reached the estimated safe yield. Monthly water usage as a percentage of safe yield can be used to predict whether or not a system has reached a point of intersecting supply and demand and will begin to experience drought stress. *In general, systems that were affected by the drought were withdrawing volumes close to or exceeding their safe yield prior to the drought.*

## PREDICTING WATER SHORTAGES DURING FUTURE DROUGHTS

The 2001-2002 drought revealed that conflicts over water use are likely to be greatest in areas served by small surface water systems where seasonal demand exceeds available supply. Water systems in coastal Maine, where predicted increases in residential development and tourism will raise the demand for water, are most likely to encounter difficulties in the uncertain climate of the future.

Preserving the integrity of ecosystems that supply drinking water will help to protect public water systems from the effects of a variable climate. Current efforts in source water protection, such as acquiring and protecting undeveloped land in the watershed, improving security, and enhancing system flexibility, recognize that drinking water supplies are parts of larger watersheds. Future water use management that views drinking water supplies as aquatic ecosystems requires integration with other environmental and planning strategies.

C. Schmitt

*A dock extends on dry ground in Ambejejus Lake during the drought of 2001.*

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### ADDITIONAL INFORMATION


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