Water Supply from NID Reservoirs

This EnviroAtlas national map estimates the millions of gallons of surface water contained in reservoirs listed in the 2009 National Inventory of Dams (NID) summarized by 12-digit hydrologic unit (HUC) for the conterminous U.S.

Why is the amount of water supply from reservoirs important?

Human societies worldwide enjoy the benefits of dams that provide drinking water, electric power, irrigation, flood control, and recreation. In 2015, dams generated 6% of the total U.S. electricity production, and water stored behind dams irrigated about 10% of U.S. cropland. Dams in arid regions in the U.S. have been instrumental in allowing agricultural production and providing residential and industrial water supplies for major population increases in the Southwest.

However, these benefits come at a price, which is the degradation of regional riverine and stream ecosystem quality, function, and services. Post-dam habitat changes are dramatic for aquatic and semiaquatic wildlife: the change from flowing water to still water; reduction in riparian habitats, vegetation, and groundwater recharge; retention of sediment; blockage of fish passage; and downstream changes in seasonality of flood and low flow affecting wildlife feeding and reproduction and native plant succession.[1,2,3] Dams are a major factor in declining native fishery and riparian bird populations.[1,2,3] Physical changes to rivers from damming are more dramatic in the drier regions of the country (the Great Plains and intermountain areas of the West) than in the East and Pacific Northwest where higher rainfall and runoff preserve some of the regulated river's former characteristics.[2]

Water supply storage behind dams balances the variability of seasonal and annual river flow during flood and drought. Dam storage capacity is derived for the NID using regional hydrologic models that relate the mean and variance of annual contributing streamflow to each reservoir's watershed area, precipitation, and temperature.[4] Studies have indicated that peak water storage capacity occurred in the U.S. around 2006 and is now in decline.[5] A major contributing factor to declining storage capacity in reservoirs is the accumulation of sediment.[5] The rate of storage capacity loss for individual reservoirs varies with regional geology, soil type, and the power and sediment carrying capacity of incoming streams.

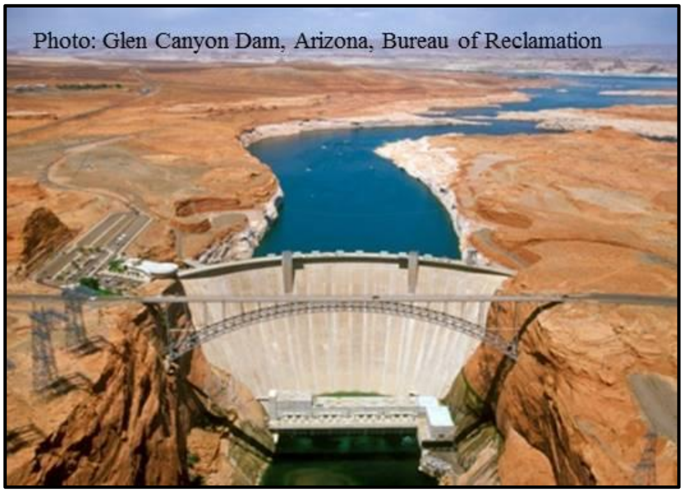
Photo: Glen Canyon Dam, Arizona, Bureau of Reclamation

The gradual loss of storage capacity behind dams increases their vulnerability to the increasing variability of extreme weather (e.g., prolonged drought or extreme wet periods) that is expected with climate change.[5] Recently, an extended period of heavy rain and snowmelt in California following five years of drought contributed to spillway damage and overtopping of the Oroville dam, requiring the evacuation of 188,000 people for several days.

The amount of storage capacity behind dams is also linked to documented recent changes in annual peak runoff. Dam managers depend on gradual snowmelt and adequate storage capacity to extend water storage through peak demand in the summer months. With limited snowpack, early snowmelt, and increased winter and early spring rains becoming more common, water that may have been stored during the summer may be spilled earlier over the dam as excess.[6] Storage capacity is a major factor in balancing water delivery for multiple uses, such as water supply, irrigation, electric power, and flood control, that all have different requirements and responses to variable climatic conditions.[5]

How can I use this information?

This map allows users to evaluate the amount of water in millions of gallons that is stored in reservoirs across the U.S. summarized by 12-digit HUC. The map provides an indication of the amount of surface water storage available within each HUC for drinking water, power generation, irrigation, flood control, and recreation. This indicator is most useful for drawing attention to regional patterns of water storage within HUCs. The popup that appears when

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clicking on a HUC will reveal the millions of gallons of water storage estimated for that HUC. A companion map, Number of High-Hazard Potential Dams, identifies the number of dams from the NID in each HUC that are classified as having high hazard potential, meaning that a dam failure could cause loss of human lives.

Increasing the transparency and examining the base map gives a view of the drainage network and the locations of potential reservoirs. An area can be more thoroughly investigated by adding data for streams and water bodies (NHDPlus, found under the boundaries icon) to the base map. One may also compare the EnviroAtlas data and base imagery with the interactive map on the NID website for dam locations.

How were the data for this map created?

The data for this map were acquired from the 2009 National Inventory of Dams (NID) maintained by the U.S. Army Corps of Engineers. The NID records maximum storage in acre feet for each dam. These values were converted to millions of gallons (1 acre ft = 325,851 gallons liquid US) and summarized by 12-digit hydrologic unit (HUC) for the entire U.S. The data were summarized by 12-digit HUC boundaries taken from the National Hydrography Dataset Plus (NHDPlus) V2 WBD Snapshot. For more details, see the metadata**.**

What are the limitations of these data?

The mapped information does not represent a complete accounting of all dams within HUCs. It is an inventory of the largest reservoirs that store the greatest volume of water and have the most influence in interrupting the flow of water in rivers and streams within the HUCs. Summarizing and estimating various metrics across HUCs may create misleading results. Dams may be concentrated along a major river or scattered along minor tributaries across a broad rural area in the HUC; the locations of specific dams are not mapped within individual HUCs.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. Summary data on dams for the nation and individual states as well as an interactive map and report may be obtained at the Army Corps of Engineers National Inventory of Dams (NID) website. Non-government users can query the database using the interactive report and map functions.

Where can I get more information?

A selection of resources on dams, dam safety planning, and dam effects on environmental quality is listed below. For additional information on data creation, access the metadata for the data layer from the drop down menu on the interactive map table of contents and click again on metadata at the bottom of the metadata summary page for more details. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

Acknowledgments

Megan Mehaffey, EPA, developed the map. The data fact sheet was created by Sandra Bryce, Innovate!, Inc.

Selected Publications

1. Nilsson, C., and K. Berggren. 2000. Alterations of riparian ecosystems caused by river regulation: Dam operations have caused global-scale ecological changes in riparian ecosystems. *BioScience* 50(9):783–792.

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3. Bunn, S.E., and A.H. Arthington. 2002. Basic principles and ecological consequences of altered flow regimes for aquatic biodiversity. *Environmental Management* 30(4): 492–507.

4. Vogel, R.M., M. Lane, R.S. Ravindiran, and P. Kirshen. 1999. Storage reservoir behavior in the United States. *Journal of Water Resources Planning and Management* 125(5): 245–254.

5. Wisser, D., S. Frolking, S. Hagen, and M.F. P. Bierkens. 2013. Beyond peak reservoir storage? A global estimate of declining water storage capacity in large reservoirs. *Water Resources Research* 49: 5732–5739.

6. Vicuna, S., R. Leonardson, M.W. Hanemann, L.L. Dale, and J.A. Dracup. 2008. Climate change impacts on high elevation hydropower generation in California's Sierra Nevada. *Climate Change* 87 (Supplement 1): S123–S137.

Power, M.E., W.E. Dietrich, and J.C. Finlay. 1996. Dams and downstream aquatic biodiversity: Potential food web consequences of hydrologic and geomorphic change. *Ecosystem Management* 20(6): 887–895.

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