

Unlocking the Full Potential of Water Data: USGS and the Internet of Water

Peter Colohan • May 2023

OVERVIEW

The [US Geological Survey \(USGS\)](#), a small but vital agency in the [US Department of the Interior](#), is the largest provider of in situ water data in the world. It supports the backbone systems for authoritative water data in the United States. And yet, a far larger portion of the country's core water resources data information is not managed by USGS, hampering its efforts to provide comprehensive water data for the nation. The [Center for Geospatial Solutions \(CGS\)](#) at the Lincoln Institute of Land Policy is working to assist USGS in addressing this gap by developing a widely accessible, comprehensive water data commons and growing the knowledge base upon which USGS assessments can be based. This will result in a more complete picture of water data for all stakeholders.

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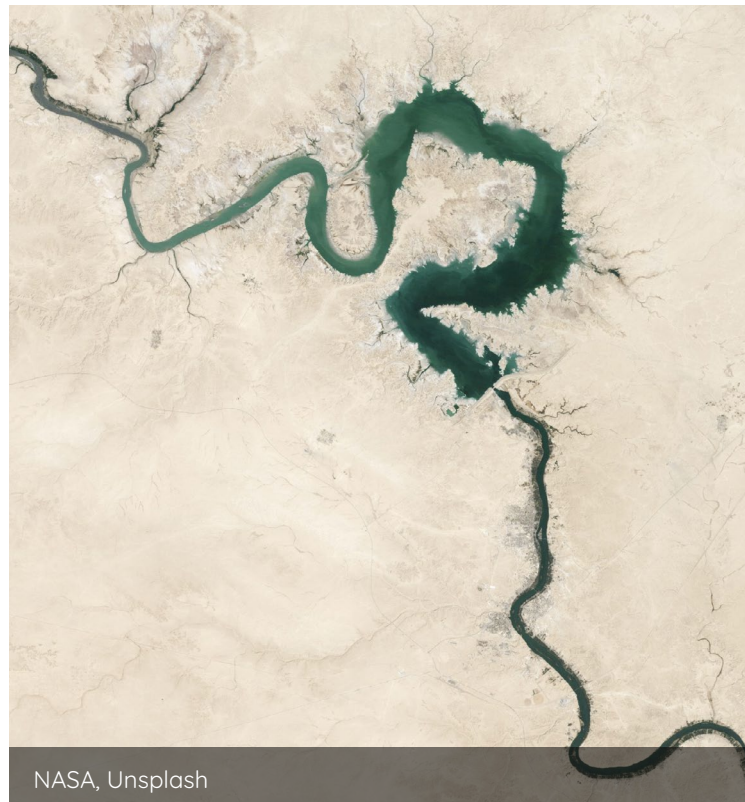
USGS'S NEED FOR A WATER DATA COMMONS

The vast array of non-USGS water data—about watersheds, rivers, aquifers, stream gages and wells, water quality samples and sensors, water rights and diversions, drinking and wastewater services, and more—is notoriously difficult to find. Scattered across multiple platforms managed by states, tribes, and local public sector agencies, as well as in projects managed by the private sector and academia, these non-USGS water data sets greatly exceed the unique holdings of USGS. They are collected for a variety of different purposes, at different scales, with different data standards, and at different levels of data quality. In short, **the**

water data held outside the USGS represents a vast data resource of largely untapped potential.

Why does tapping this potential matter? Simply put, the USGS cannot fully achieve its water mission priorities without greater discovery and access to this wider universe of publicly held water data. Since 2018, the USGS has made important strides in four priority areas:

- [Next Generation Water Observing Systems](#) (NGWOS) will provide high-fidelity, real-time data on water quantity and quality necessary to support modern water prediction and decision support systems for water emergencies and daily water operations.
- [Integrated Water Availability Assessments](#) (IWAAs) are a multi-extent, stakeholder-driven, near real-time census that provides seasonal predictions of water availability for both human and ecological uses at regional and national extents.
- [Integrated Water Prediction](#) (IWP) is an ambitious federal partnership for developing a national, interagency new capacity for water prediction that combines broad aspects of water science into a compelling suite of products that anticipate critical societal water needs across scales from National to local.
- National Water Information System Modernization will enhance the [USGS Water Mission Area's \(WMA\)](#) enterprise water information system of systems that allows for the storage, processing, and approval of many forms of water data. This is how the WMA [communicates its real-time data](#).



The full achievement of these priorities, however, particularly those related to water availability assessments and water prediction capabilities, is dependent on USGS facilitating greater discovery and access to water data held outside the agency. The agency must rely on engagement with external partners to access and use those data sets. Specifically, USGS needs to:

1. **Find other data and research** - While USGS has some data and models about select watersheds and aquifers, it is unreasonable to assume the agency can comprehensively model more than 3 million miles of catchments

and streams without drawing on external sources. To accurately assess the true state of water resources, USGS must continuously index and discover models and research from public, private, or academic projects about particular watersheds or aquifers.

- 2. Speak a common language** - At present, there are numerous methods, models, formats, and protocols for referencing the Hoover Dam, for example, or the Colorado River. Moreover, there is no consistent national method for resolving conflicting naming conventions and other semantic problems, such as references to the Colorado River of the Western states vs the Colorado River that flows through Texas. Standardized references for commonly monitored water bodies across data sets are critical.

In addressing these two requirements, USGS faces the same reality faced by state and local water resource management agencies: finding best-available water resources data for a given location or environmental feature of interest is a punishing task.

CREATING THE WATER DATA COMMONS: THE INTERNET OF WATER

The solution to this challenge lies in building a sustainable, stakeholder-driven community knowledge network for water resources data that relies on linked data, following the organizational structure of the internet.

In 2017, this idea was infused with new energy at the Aspen Institute Dialog Series on Water Data and formalized in a [report](#) which called for the creation of such a network, along with necessary supporting technologies and thoughtful stakeholder engagement. In 2018, the [Duke University Nicholas Institute for Environment, Energy and Sustainability](#) (Nicholas Institute) incubated the concept by launching the Internet of Water (IoW) Project as part of their Water Policy Program. In 2021, the Nicholas Institute turned to [CGS](#) to operationalize the ambitious technical innovations needed to realize this foundational water data infrastructure and to build a stakeholder network ([the IoW Coalition](#)) to promote the uptake of these technologies. Today, this underlying technology system called [“Geoconnex”](#) is set to make as much water information as discoverable as possible via search applications, without centralizing data governance and storage. Meanwhile, the IoW Coalition is emerging as the community leader for establishing a ubiquitous, nationwide network of public, private, and academic water data users and stakeholders, including key water data leaders from public water agencies.

FROM RESEARCH TO OPERATIONS: SUSTAINING GEOCONNEX FOR WATER DATA

USGS Water Mission Area is undertaking a generational modernization of its water data infrastructure, including a complete overhaul of its data cataloging, dissemination, and display capabilities. This modernization includes the development of a “[National Hydrologic Geospatial Fabric \(NHGF\)](#),” for water information. USGS is also seeking to populate the NHGF with links to all water metadata in the United States, through Geoconnex. As such, Geoconnex solves the problem of water data discovery and the need to speak a common language across water data sources.

Currently, CGS is further developing components of Geoconnex, including a system for resolving persistent identifiers, linkages between and among community data, and providing search and reference data lookup services. These components of Geoconnex are set to be completed as early as December of next year, when USGS researchers will then be able to index and discover models and research from outside the agency . Moreover, USGS will be able to partner with the IOW Coalition, to support a multi-organization water monitoring network of [water data hubs](#), in which all hubs will use Geoconnex to reference common monitored water bodies, and be discoverable through a community monitoring index.

USGS is making great strides in addressing the problem of water data management through its current collaboration with CGS on Geoconnex, which will vastly improve the richness, accuracy, and discoverability of USGS water assessments and predictions. But more is needed. The two organizations are now in dialogue about forming a cooperative agreement to sustain the system over time. With such an agreement in place, Geoconnex will form an integral, foundational element of the water data infrastructure for the nation, creating a sustainable, long-term path for USGS to unlock the full potential of our great trove of water data.

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