

Advisory Board Meeting

February 28, 2019 in Person, Washington D.C.

Board Members Present (8 of 9)

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Around the Room – IoW Priorities

The Board went around the room and named what they hope to discuss during this meeting. Topics named included:

- Are hubs necessary for the IoW if we adopt the internet approach and use catalogs to make data more discoverable? Perhaps there are different types of models that range from an IoW hub to a producer providing metadata on a Google dataset. The end goal should be to type into a search engine the data I am searching for, such as the water temperature at a lake, and discover those data.
- Will the IoW move beyond improving discoverability and accessibility to interoperability? To that end, how can the IoW facilitate the development of standards and data definitions for different types of water data?
- How can the IoW be a resource to state and local governments interested in publishing data? Local and state governments have large amounts of data that we want to unlock.
- How can the IoW clarify its value proposition quickly to different stakeholders in order to secure investment in the medium and long-term?
- Can we develop a clear definition for the IoW and identify clear action points for different entities to become involved?

Update on the IoW

The IoW is in the process of recruiting a data architect and engagement officer. The process of hiring a data architect has revealed the need for two different types of architects: someone who can get in the weeds and solve problems and someone who can interface and communicate technical issues well with decision-makers. The IoW is moving towards collaborating with CUAHSI as a technical lead for the IoW because they already have software developers and architects on staff. The CUAHSI environment would provide a more collaborative space for the IoW data architect.

The IoW will continue searching for someone with a strong water science background that can engage with public water agencies around their technical challenges. The IoW needs to find an individual responsible for ensuring they understand technical standards and data privacy laws that are coming

from the global community that have significant technical and process implications. This person could provide services to public agencies about how to manage their data in a way that is compliant to forthcoming data privacy laws. There was general agreement from the group that there are two types of technical folks and they often have a technical project manager in-house that then contracts with pure technical staff.

The IoW has a strong candidate for their engagement officer with a potential start date of April 1st who would interface with state and local agencies to better understand their needs (above and beyond technical resources). The IoW may also hire someone as a program associate person to help manage day-to-day operations.

The IoW is also seeking to add a few more members to the Advisory Board. There is a need to have NGO representation, as well as someone interested in environmental justice and equity issues. Some suggestions offered included:

- NGO position:
 - Western Landowners Alliance – how to manage working lands with a conservation ethic.
 - Water Data Collaborative – a Pisces funded group working to make citizen science data more discoverable, accessible, and usable
- Environmental Justice and Equity position:
 - Celeste Cantu – comes from a utility background and now works with disadvantaged communities.

Business Model Discussion

Philanthropy has generously provided the start-up funds for the IoW, but there is a clear sense that the IoW needs to expand its business model sooner than later to ensure long-term viability. Potential funding sources include the public sector, private sector, and large NGOs. Additionally, philanthropy may continue funding specific projects and hubs that help them meet their missions, as well as to develop capabilities and prototypes that are generalizable across regions or sectors.

The IoW must clearly identify (1) its value proposition(s), (2) how the value proposition(s) appeal to different funding sources, and (3) potential tradeoffs in funded program activities with respect to the IoW mission.

The IoW is likely to develop a diverse portfolio of funding sources. For instance, the federal government and private industry might not directly fund the IoW, but they could provide in-kind contributions by sharing resources and through collaborative efforts.

The IoW might also develop a cooperative membership dues or some form of a subscription model. The IoW could provide a baseline of free services, but additional services or in-depth engagement could be provided on a fee basis. This is a model used by the Western States Water Council and is being pursued by other data initiatives looking for state agencies to be subscribers.

Another option is for the IoW to provide professional or managed services that monetizes the institutional knowledge created as they work across local, state, and federal agencies. This is a common business model for infrastructure companies that help customers build and maintain their infrastructure. In this example, the IoW could be much cheaper than traditional consultant fees and could lower overall costs for participants. For example, the IoW could work with a company like Azure to create a distribution on cloud services for open data that is cheaper than an individual license. Participants then pay the IoW a fee to cost-share that distribution service. This type of model would also support the IoW efforts for public agencies to institute basic standards and guidelines for information sharing with participants.

There was general agreement and excitement about the IoW becoming a small non-profit that provides ongoing aid to create repeatable structures for data sharing through contracts. This would open up funding to public, private, and NGO sectors. However, the IoW must operate with unquestioned integrity that ensures it will remain a non-profit organization and develops a strong trust with its stakeholder groups. There is such great need by public agencies for help with their data that the IoW should not have difficulty monetizing the knowledge base it develops. There is a clear opportunity to develop professional or managed services for public agencies delivered in a way that are consistent with the IoW mission.

This raises several key questions that would benefit from a strongly managed governance committee that lays out transparent charters that provide guidelines on how we transact with certain parties. How can the IoW build the in-house resources and expertise needed to provide those services? How do we provide reasonably priced services to converge to that vision, subsidized by foundations or private entities in the interim? What are the potential impacts of this business model on the IoW mission? Are there conflict of interests or perceptions that could be problematic?

The group noted that there are ample opportunities in the \$80,000 to \$200,000 range from federal programs and agencies to support these types of efforts. State agencies also have this type of funding available. However, reading through budgets to locate these opportunities can be time consuming and challenging.

Strategic Efforts to Meet Recommendations in IoW Report

The Aspen Institute's Internet of Water report is foundational text for the IoW. The Board went through the recommendations listed to identify what progress the IoW has and can make in this first year.

1.1: Articulate a vision of sustainable water resource management and stewardship enabled by open, shared, and integrated public water data.

The IoW has created a vision and mission, as well as a data stories page on their website to continue improving the articulation of those value propositions.

1.2: Initiate an Internet of Water through regional pilots that solve near-term water management problems for key stakeholders through shared and integrated water data.

The IoW is working to develop pilot projects that will begin this year. A discussion of potential pilot projects can be found below.

2.1: Develop water data catalogs that identify all existing public water data maintained by states.

What does “all” mean, and how do we include data collected by federal and/or local public agencies? The Board noted that many states are using Esri’s Open Portal Data Functionality and that provides a mechanism for states to automatically push their data into data.gov. This is a convenient option because state agencies are already using Esri; however, it could lead to a profound dependency on a for-profit company. The other challenge is that most of the data on Esri’s platform is spatial and it may not be conducive to all other forms of data. Other common catalogs used by states include Socrata, CKAN, and DKAN. One of the challenges though is that data not in one of these catalogs they will remain not discoverable. The group decided to leave this discussion for the technical framework committee.

2.2: Develop tools for opening existing, public water data and enable the use of those tools by producers and users.

The IoW is on track to develop tools and resources for opening water data.

2.3: Bind regulation, management practices, permitting, and funding to the provision of open data.

The IoW does not have the capability of accomplishing 2.3 on its own; however, it might work on piloting such changes with federal and state agencies on a voluntary basis. This might be a long-term goal because it does have legal implications and it must provide a clear advantage to local governments to be willing to participate in such a pilot.

3.1: Existing water data hubs should be stabilized and further resourced.

We are still working to define what constitutes a water data hub in the context of IoW.

3.2: A backbone organization should be formed to structure and enable a system of federated data.

The IoW start-up team has been formed to serve as the foundation of the backbone organization.

3.3: The backbone organization should be a non-profit organization but with a cooperative agreement with a federal, non-regulatory agency.

The IoW is currently a project at Duke University, but to have the hiring flexibility of a start-up, it may need to quickly transition into a non-profit organization. As such, it is not clear the IoW can create an MoU until it becomes a non-profit.

3.4: Develop proof-of-concept on integrating data from multiple hubs to advance a water budget.

This is a particularly challenging task that likely cannot be completed within the first two years of the IoW. WaDE is actively working on a low resolution water budget with the Upper Colorado River Basin

states by integrating water supply and water use data. An actual water budget might not be developed in 2019, but progress towards a water budget could be developed by creating a glossary of terms used by states. For instance, each state means something different with the term “water use”. Finding a common definition states can agree with for “water use” alone would enable WaDE to create crosswalks from state data to this common term, which would accelerate progress towards a water budget that would be accepted by those communities. The IoW could play a role by convening and hosting those conversations as a neutral third party. There is also a tremendous need to include water quality in a water budget and the IoW could help lead those conversations as well.

There was general agreement by the board that creating consensus on the term “water use” and a strawman water budget would meet several of the recommendations in the IoW report. It would require developing tools, cataloging data, and developing processes for sharing those data. The Advisory Board noted that the USGS has done tremendous work in developing water budgets, putting tens of millions of dollars towards developing daily HUC12 water budgets. However, the public is not aware of these efforts, and there needs to be a bridge between USGS efforts and end user communities.

The IoW could potentially take the equations developed by the USGS and tag data so that it is discoverable by the IoW in terms of water budget categories. The IoW could focus on developing high-level metadata around datasets for the purpose of creating water budgets as part of its cataloging efforts. The data could also be tagged with FAIR principles to help data producers and hubs understand where there are gaps in open data and what steps or processes could be taken to improve the usability of their data.

Expanding Engagement to Non-Governmental Organizations

IoW funding currently comes from philanthropic foundations that each bring their own theory of change to the project. The Walton Family Foundation believes markets and the private sector are primary agents of change. The Pisces Foundation believes that citizen science and consent decrees lead to change. Pisces is offering to fund IoW activities but they want us to engage with the Water Data Collaborative (WDC). Pisces wants the IoW to work with the WDC around three activities: (1) make more discoverable/technical, (2) pilots, and (3) develop long-term strategy to build trust in their data. Is this something the IoW should take on?

One Board member noted that some states already engage with the citizen science community. States recognize there is huge potential in the amount of data they are collecting, particularly with water quality, but it is hard to realize that potential. The WDC is working towards enabling citizen science data to be discoverable in the national Water Quality Portal (WQP) by adopting WQX standards. Theoretically, once the data are in the WQP they will be discoverable. The IoW could add value by developing mechanisms to speed up the data life cycle and demonstrate value add of NGO data to public agencies.

In a different example, a company placed sensors into everyone's house following wildfires in California and created an amazing data ecosystem that had an engagement, architect, data management, and analysis component. Perhaps the IoW could instead focus on sensor data, which will become more widespread and the IoW will need to be agile enough to make use of those data. Sensor data are not currently in the WQP portal and there will be a need to develop a process for sensor data to be discoverable, accessible, and usable. The IoW could work on developing standards for different types of sensor data, including standards for publishing and sharing those data. The citizen science community often wants hyper-local data in real time, which is something sensor data can meet better than grab samples.

IoW Candidate Pilots Discussion and Prioritization

The IoW needs to demonstrate the value of making water data more discoverable, accessible, and usable. Pilots will consist of a coalition of people, a defined water problem, public datasets, and the creation of information to address the defined problem for the defined community. The group developed a list of potential pilots:

- Upper Colorado River Basin: Develop a glossary for water use and related definitions for each state and a platform and process for pulling those data into a medium resolution water budget.
- Chesapeake Bay: Explore nutrient trading programs using public data that are verified by public and volunteer monitoring data. This would involve working with wastewater utilities and the data they collect.
- Texas: Pilot the development of services that pull all of the data used by emergency responders into a single platform. There is caution around this approach because of the life and property risk involved. Texas is seeking funding to do this activity already, but perhaps the IoW could help in a year or two if and when they get stuck in the process.
- Texas: Pilot that enables data from groundwater districts is also filled with challenges. Many of the districts are volunteer based and the data are on a pad of paper. There is also huge disparity in the quality of data produced by groundwater conservation districts.
- Groundwater and Surface water interchange: The interface between groundwater and surface water is of interest to Texas because they currently manage these resources differently and that is having repercussions on streams flowing from Texas into New Mexico. Groundwater and surface water interactions are of national issue and local governments are starting to develop odd regulations around land use and groundwater use in fast growing areas. Similar to the discussion of tagging water data for water budgets, the IoW could build tags to pull core surface and groundwater data together that are needed for a variety of groundwater models. There was some concern that this might be too ambitious a goal for IoW, because groundwater and surface water interactions require significant modeling efforts.
- The IoW could identify data gaps and potential sources for collecting those data. The development of a catalog that makes different categories of water data more discoverable would be hugely beneficial to many communities and stakeholders.

- Gold King Mine Spill: The EPA is providing \$2M annually, much of which is going to states and tribes to investing in monitoring activities. However, there is a need for an organization like the loW to put those data to use to better understand the impacts of abandoned mines in watersheds. Can the loW set up real-time notifications when a monitoring station indicates a significant drop in pH or changes in other water quality indicators. This is an opportunity to create a process to share information and data along a river to enable shared situational awareness. This would also require developing tools linking data to a hydrography network. The group thought it made more sense for the loW to be a contractor to a tribe or a state that submits a proposal to EPA.
- EPA: EPA provides eEnterprise grants to states and tribes to improve their data sharing efforts. The EPA can add language that requires grantees to comply with loW principles.

Brainstorm loW Priorities for 2019

The group identified a series of activities the loW should engage with in 2019

(1) Clearly define the loW and provide clear messaging.

The loW needs to develop a brand map with a core messaging platform that anyone can take to their community to articulate what the loW is and why it is important.

(2) Create calls to action for how different communities can engage with the loW. Prior to this, the loW must develop basic terms of service.

How can different entities become involved with the loW? The loW might want to provide specific, tangible action items for different entities. For instance, the loW might provide clear action times to meet different needs of the community such as:

- I have data?
- I need data?
- I need help with my data?
- I want to join the loW?
- I want to connect with others?
- I want to donate?

The loW might want to work with technology companies to develop a user-centered approach to its communication and engagement platform.

The loW could start making “dark data” (data not currently discoverable) discoverable by creating a drop down menu for different types of organizations that provides options of platforms where they can share their data. For instance, a USGS scientist with share their data on ScienceBase, and academic on Hydroshare, the WDC on the Clean Water Hub, an irrigation district on ... Such a tool can be incredibly

helpful; however, the IoW must set up a legal framework prior to advising data producers on how to publish their data into the world.

If this action is taken, the IoW must clearly address the question of liability for data. Does the IoW own any data? What is the liability of exhaust data, for example? What is the liability if a data producer provides bad data? What is IoW's liability if there are incidental findings once an organization chooses to publish their data. These types of disclaimers are also important for data producers. The IoW can and should help data producers create disclaimers for publishing data. Another option is to publish data through a hub or the federal government under their disclaimers.

(3) Begin developing an online water data glossary and an online glossary of terms used by the IoW

The water data glossary will initially provide the various definitions used by different federal and state agencies for each term. The IoW can convene a lot of expertise on different terms and highlight a preferred definition of the IoW. As the IoW and others confer within their communities, perhaps different river basins or aquifers might coalesce around definitions as well.

The IoW also needs to develop a glossary of open data terms. What do we mean when we say “catalog”, “metadata”, and so on. These foundational definitions must be very clear and used consistently throughout the IoW. The group recommended looking at WaMDaM's controlled vocabularies list for data.

(4) Begin developing a resource toolkit

The IoW will begin developing a toolkit of open resources. The toolkit would include the various glossaries, as well as lists of standards and metadata that lead to discoverability. The toolkit would map the tools available for different steps in the process of making data discoverable, accessible, or usable.

(5) Host a workshop around metadata

Metadata dictates how data are exposed to the internet. The IoW could host a workshop on water metadata and data literacy that includes public agencies as well as Microsoft and Google. The workshop may coincide with a meeting on defining water use in the Upper Colorado River Basin.

(6) Begin developing crosswalks between the data inventory and water budget categories

The IoW has begun cataloging the types of water data collected by different federal and state agencies. Perhaps the data could be mapped into the water budget structure and begin developing an index for those datasets to create a catalog for developing a water budget based on the USGS water budget equation. This would essentially map where different data collected by agencies fits into different

components of the water budget. The catalog can also include the indicators of openness and a roadmap of where to find the data and how improve the openness of the data.

This would essentially begin the development of an internal IoW database of data sources. The structure should be flexible and allow for iteration that adapt as we continue developing the catalog and inventory of datasets.

(7) Begin a Consumer Confidence Reports Pilot and one other pilot from the list

Consumer Confidence Reports (CCRs) are generated by drinking water utilities, but they are not required to be submitted to the EPA. The IoW could develop digital services to streamline the process for utilities to create CCRs and pushing the data in those reports into a database. The IOW could build the infrastructure that enables someone to build an app to put those data to use to show the quality of drinking water to end users. These data could also begin to map the fuzzy boundaries of water governance between local, state, and federal agencies. The IoW can help to build a data steward map of who has the legal role, authority, and jurisdiction over different types of water data. This activity is perhaps best suited for as a later pilot, perhaps in 2022.

(8) Advance sensor standards

The USGS has standards for their stream gage sensors and EPA is in the process of standardizing sensor data. CUAHSI has a grant proposal to take the lead on EPA's sensor catalog. The IoW could summarize and synthesize sensor standards and tools that currently exist for different types of water sensor data. There is a challenge to communicating the difference in types of standards and their usability for different data collection methods. The IoW could foster the conversations between sensor companies (such as Xylem) and the federal government (set standards) to resolve the chicken and egg. Federal agencies are waiting to see which standards private companies adopt, while private companies are waiting to adopt the standards set by federal agencies.

(9) Begin facilitating online data services operations and maintenance (O&M) for public agencies

The IoW could work with private industry to create more affordable opportunities for local and state agencies to publish data online. Often Microsoft or Amazon web services will provide free services for a limited amount of time for start-ups. The IoW could also try to broker deals with one of these companies for more affordable web services for IoW hubs or partners.

(10) Develop future non-profit 501-3c status for the IoW

Duke University is as flexible as an academic institution can be, but it may not be a sufficiently agile for the IoW in the long-run. The IoW will likely need to become its own entity. Duke could continue providing sub-awards of philanthropic dollars to the IoW through contracts. Eventually, the IoW could begin to contract with Duke for services as it begins to receive its own awards. At the same time, there are benefits to the IoW being at Duke because it is neutral, prestigious, and often seen as a trusted entity.

Two options for IoW's future were discussed in detail. First, the IoW could become a Duke-owned corporation, maintaining clear ties to Duke. The IoW would also be able to benefit from the human resources at Duke in terms of budget and grant management. The Board expressed some concern with this option, particularly if Duke would receive a percentage of the income. Additionally, the university tie can be a hindrance as they are often associated with quick, one-off projects and not the long-term sustained commitment the community desires from the IoW.

Second, the IoW could become a 501-3c non-profit organization. This would require the IoW to raise additional money, perhaps from public agencies, to hire additional human resources, such as a budget or grants manager. The challenge here is that if the IoW starts to pursue public agency dollars, certain representatives of those public agencies may be barred from service on the advisory board. Another option is that the IoW could pursue contracts with federal agencies instead of grants. In general, the Board thought this was a more viable option even if it means losing federal agency representation on the Advisory Board.

11) Engage with stakeholder on priorities

IoW should engage stakeholder groups on this list of priorities.

IoW Hub Definition

The eight definitions for an IoW hub from the last Advisory Board meeting were broken down into four basic components: governance, technical, actions, and coverage. There needs to be a minimum definition for a hub, but then perhaps there will become different classifications of types of hubs in the future.

The definition is important as it shapes how individuals will interact with the IoW down the road. There are three long-term outcomes for how we might engage with water data in the future:

- (A) The user engages with a single catalog of data that takes me to individual websites holding the data.
- (B) The user goes to a specific hub to download groundwater data, another hub to download surface water data, and so on.

- (C) The user searches for data on the IoW and the catalog uses web services to pull data from the USGS, Colorado, and three counties.
- (D) The user searches the internet and discovers the data with the architecture making those data discoverable hidden in the background.

Which definition gets us to option C or D? The technology component is critical and hubs must adopt standards that provide data in a certain format to achieve options C or D. However, this vision might preclude data producers from sharing their data without going through a hub. Options A and B would further the discoverability and accessibility of data. However, options C or D would result in more interoperable and usable data.

There was concern that many data providers don't have the resources or capabilities that USGS, EPA, and states have to create consolidated hubs. Does an individual who creates a structured dataset have to go through a hub or can they share those data online and its discovered through a general internet search? Perhaps one option is to say the IoW is a single entry point to water data, regardless of whether the data are in a hub. Perhaps hubs are scaffolding that figures out how to make water data discoverable and interoperable. The hub network is essentially invisible and the data are discoverable if provided using minimum data, metadata, and exchange standards. Anyone can publish their data using those minimum standards and the data should be discoverable through the internet. Hubs could also provide documentation and the tools required for data providers to share their data on a hub.

IoW Technical Framework Session

Currently, there seems to be four elements for the IoW technical framework: (1) provide resources and tools, (2) endorse the use of open standards and protocols, (3) develop and maintain catalogs, and (4) provide technical support and training.

The purpose of developing catalogs is to identify all the data collected, even if it is not yet discoverable. The end goal is to create a search index for water data to be discoverable through the internet. The exercise of developing a catalog and engaging in pilots can expand community participation and result in unlocking more data.

The group decided there is not a strong need for the IoW to link data across state political boundaries; however, there is a role for the IoW in cross-pollinating and sharing data efforts between states so they can learn from one another. The IoW can provide guidance on the types of standards used by different states, along with the tools and vendors that can help states adopt certain standards. The IoW could help make connections and foster a peer-to-peer learning network.

The IoW can also provide guidance on what financial resources are available for public agencies to update their data infrastructure. For instance, the USGS Water Use Data Research Program provides funds to states to make their water use data more accessible. WaDE has played this role for western states to a degree, though mostly states apply independently.



There is a role for the IoW to work with EPA and CUAHSI on sensor data. IoW could also work with USGS to link state and local data to a geofabric. This would potentially allow someone to pull all the data related to a specific watershed or aquifer onto a single platform (similar to EPA's How's My Waterway). This would provide a clear demonstration of what is possible when data are published following IoW principles. The IoW could foster a community of water experts and developers to create applications for the new data that are exposed.