International Watersheds Initiative (IWI)
Multi-board Strategic Workshop

Tuesday, October 24th, 2017 (1:00pm -5:00 pm) at Ottawa, Ontario

The Data Harmonization Task Force (DHTF) – formed under the auspices of an International Watersheds Initiative strategic priority on transboundary hydrographic data harmonization – hosted a one-day workshop in Ottawa with IJC staff and representatives from numerous Boards, spanning the continent. The objectives of the workshop were to:

- Provide background on the multi-year data harmonization project and the DHTF;
- Showcase a new user-friendly website that provides access to harmonized datasets;
- Present case studies of Boards who have utilized harmonized hydrographic data within their basins;
- Provide information about a few new innovative projects that are being developed on top of the DHTF efforts;
- Seek feedback from participants on the hydrographic needs of the Boards, as they relate to Board mandates, and on the accessibility and applicability of current tools provided by the DHTF to meet these needs.

The workshop featured a series of presentations, detailed below, as well as discussion of issues, and potential new areas for using and expanding transboundary geospatial data holdings.

INTRODUCTION

Michael Laitta & Mike Major

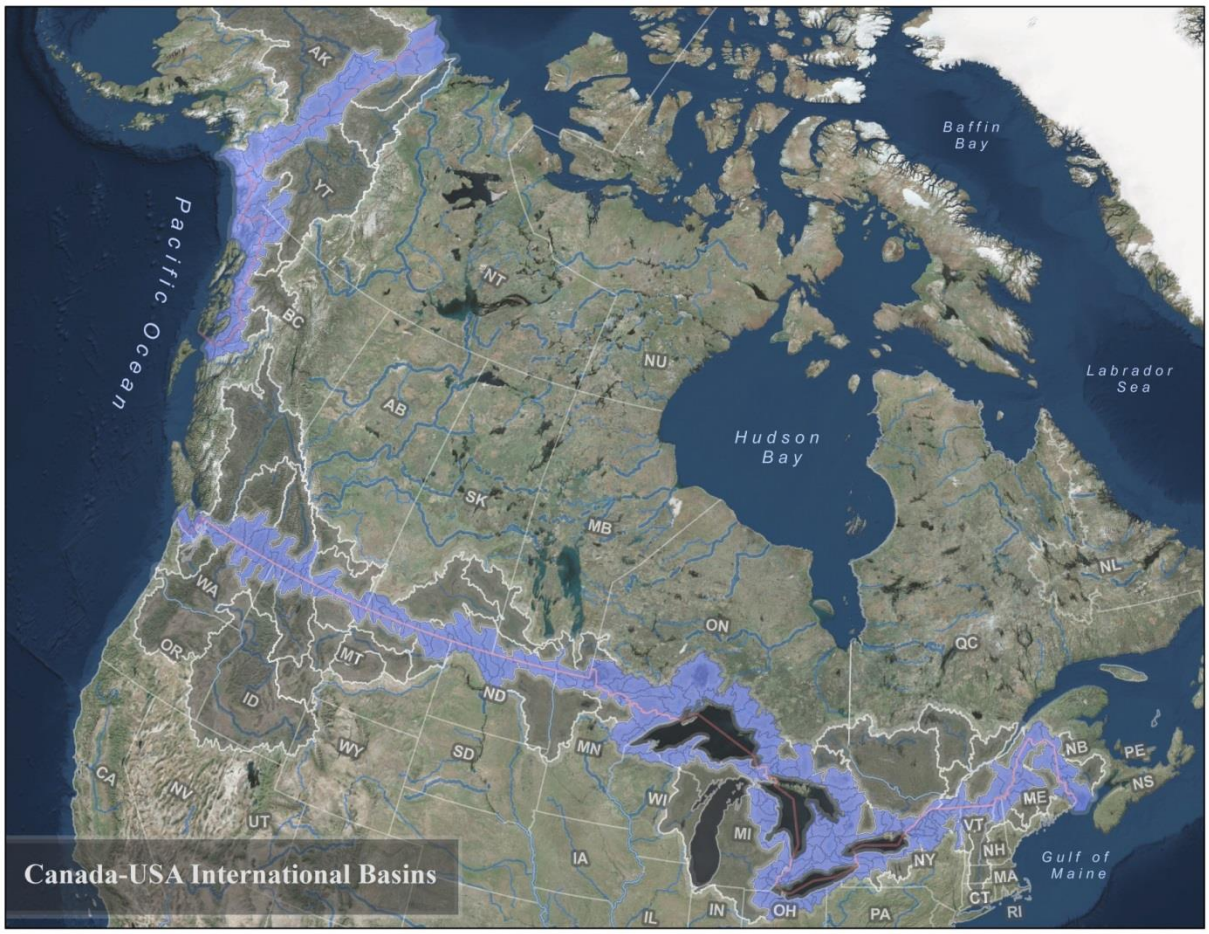
To open the day, DHTF members Michael Laitta (International Joint Commission) and Mike Major (Natural Resources Canada) welcomed participants and focused their remarks on the important continuing collaboration that has made data harmonization possible. The multijurisdictional effort has changed the way Boards and study groups approach issues, and has enabled new opportunities to strategically manage transboundary water resource issues. This long term project has involved federal, state, provincial, and local stakeholders throughout the process, and as the project nears its next phase the DHTF can envision even more ways to enhance decision making with information, and strengthen relationships, particularly with river boards. Mike Major noted that the DHTF would be pleased to offer follow-up calls or technical briefings if requested, for those wishing to delve into any of the workshop content more deeply.

PRESENTATION 1 - Transboundary Hydrographic Data Harmonization Background

Judy Kwan & Pete Steeves

- The DHTF evolved out of the International Watersheds Initiative, as it became clear that a lack of harmonized data was a barrier for understanding and managing shared waters.

- The DHTF focuses on two major geospatial data products: drainage area harmonization and hydrographic harmonization, with a study area comprised of a so-called “swath” of hydrologic units spanning the international border from the Yukon all the way to Maine. The swath is the area featured in purple in the figure below.



- At the inception of the project, datasets along the border were uncoordinated, incomplete, and inconsistent. As a result, rivers or streams might be truncated on one side or the other of the international boundary, the edges of lakes didn’t match up, and data often was collected at different resolutions between the two countries. This made taking a truly transboundary approach to water issues very challenging.
- The first phase of the project involved establishing the harmonized “swath”, data definitions, and processes. This meant matching and reconciling the US 8-digit hydrologic unit with Canadian sub-sub-drainage areas (SSDA) data.
- The second phase was focused on syncing the US National Hydrography Dataset (NHD) with the Canadian National Hydro Network (NHN), which involved edge matching features and crosswalking features and attribution between the two systems. The harmonized hydrographic network can be used both for cartography and for analysis.

For example, the network can be navigated, allowing flow to be traced from a headwater through various channels, and ultimately through the outlet of a basin.

- The third phase of the project is focused on creating new, higher resolution harmonized drainage areas. Previously, the US had higher resolution data that was truncated at the border. Once completed, the harmonized data is continuous within the "swath" hydrologic units.
- Phase IV is focused on assigning hydrographic names and codes to the new Phase III hydrologic units, and is proceeding simultaneously with Phase III. The final two phases started with the Souris in 2011 and have expanded across the swath.

Phase I - Matching and reconciliation of U.S. Watershed Boundary Dataset (WBD) 8-digit hydrologic units with Canada's 4th level Sub-sub-drainage areas (SSDA)

Phase II - Connecting, synchronizing and cross-stepping the U.S. National Hydrography Dataset (NHD) with the Canadian National Hydro Network (NHN)

Phase III - Creating new higher resolution "harmonized" Drainage Areas at the U.S. WBD 10- and 12-digit hydrologic unit level (which will be two new drainage area levels in Canada)

Phase IV - Assigning hydrographic names and codes (attribution) to Phase III new higher resolution drainage areas

- Most critically, this process is about people, not just datasets. To create harmonized drainage areas, the DHTF convened intensive workshops with stakeholders, designed to bring available data to the table for review and to achieve consensus.
- Local knowledge and working collaboratively has been vital to ensuring the output is a model people will accept and use.

PRESENTATION 2 - Accessing Transboundary Hydrographic Data
Kimberly Jones

- Kimberly Jones talked about accessing data, and provided a handout with links to important websites (attached).
- The DHTF realized that communicating its results and disseminating data can be challenging. As a result, it created a community on the USGS "Confluence" wiki that is intended for bi-national users. The "Confluence" is intended as a centralized location to provide general information to the public as well as a collaboration space for bi-national users and partners. Access to the collaboration space requires users to request access to the collaboration group. Users can request access to the collaboration site from the DHTF.
- The USGS "Confluence" wiki includes two comprehensive public facing pages that describe the Transboundary Hydrographic Data Harmonization project and outlines instructions on how to access the harmonized data. Find them here: https://my.usgs.gov/confluence/display/USCANHDH

- Within the wiki, the Data and Map Access page is broken down into sections on how to access Hydrologic Units and Hydrography data and leverages, but does not replace the authoritative distribution channels for the datasets.
- The Data and Map Access page includes instructions for downloading data via a Google Earth interactive map, or users have the option to download source data directly.
- Harmonized hydrologic units are available within the U.S. Watershed Boundary Dataset (WBD). A crosswalk table with Canadian codes and names is available on the Data and Map Access page as a resource for users who are interested in these attributes.
- When accessing the Watershed Boundary Dataset (WBD), users will see that it is organized by 2-digit Hydrologic Units; as such, users will probably get far more data than needed, as this dataset represents more than just the swath and includes multiple basins.
- Alternatively, users can open a KMZ file in Google Earth, zoom into an area of interest, and download data via that interface. It's intuitive and doesn't require specialized knowledge. The interface pulls the data from the authoritative source. Instructions on this process are available on the Confluence site.
- With respect to hydrography data, the idea is essentially the same, however this dataset uses four-digit units. This data is also available by eight-digit and from the Canadian NHN data.

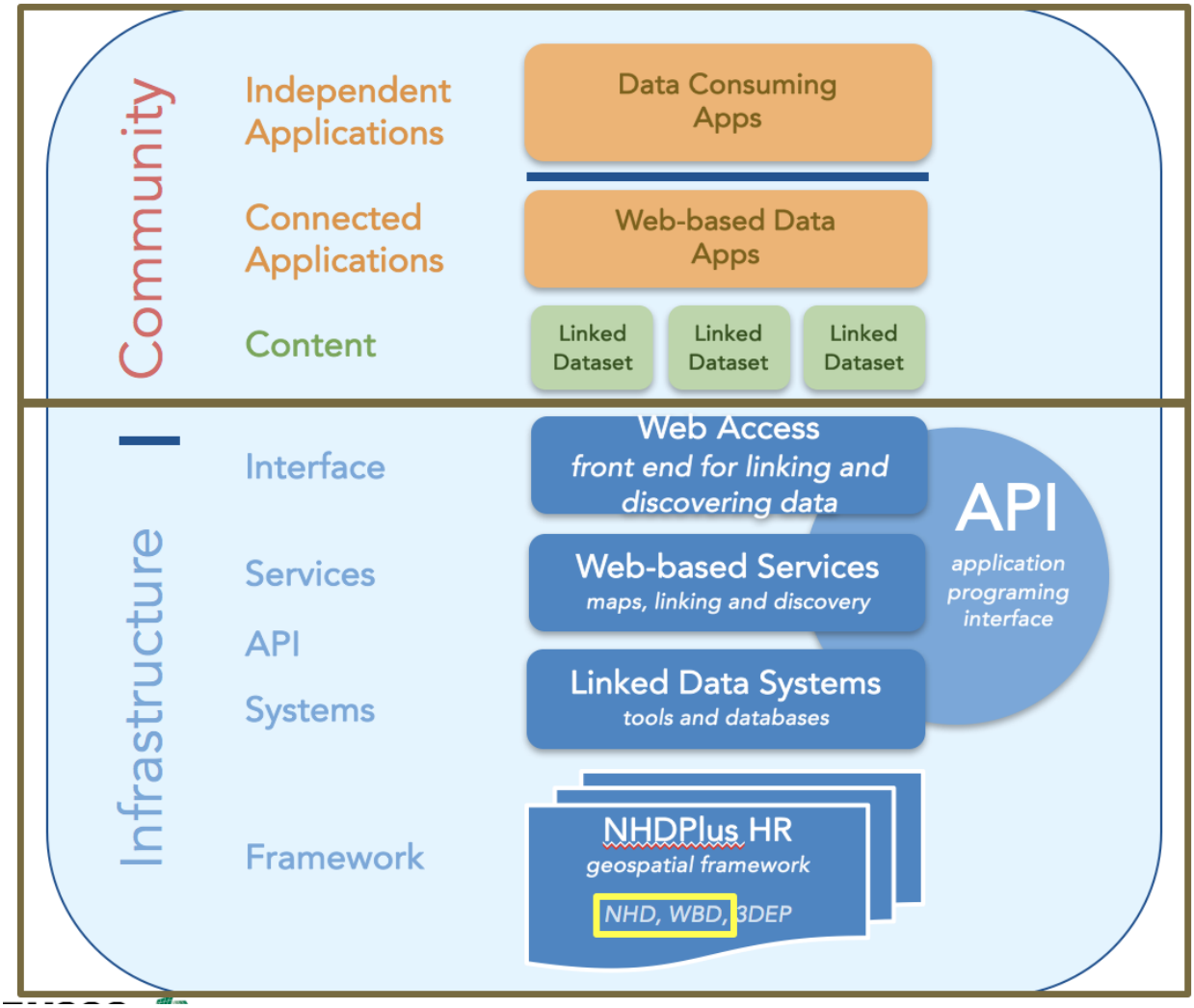
PRESENTATION 3 - IJC Board Case Studies
Michael Laitta

- Building on having harmonized data, and having tools to efficiently disseminate data, the DHTF realized that board members needed a single, simple, neutral platform to help communicate what that data is telling us.
- Before the data harmonization project there wasn't a place where a board member could consumer, consolidate, and communicate information, but now those dynamics have changed.
- For example, a group used available data to create a new map showing modeled phosphorus loading, which can inform understanding and decision-making.
- Additionally, geospatial narratives, or story maps, can now be developed. These narratives are helpful in communicating water apportionment and water quality issues.
- These tools help to communicate what's happening on the landscape and show work that has been done over the years. For example, a view of IJC involvement in Champlain Richelieu since 1936, with historical references and photos, creates an engaging multimedia representation of what IJC has achieved over the last many years.

- Other examples include the story of what happened during the recent Souris flood with links, photos, videos, and testimonials, showing and describing the impact of the floods in the Souris basin.
- These products are not specifically data harmonization, but are examples of how harmonized and accessible data can be harnessed to enhance communication products and build understanding.
- Boards are invited to join this community and use these tools to explore their issues and tell their stories.

PRESENTATION 4 – Overview of the US National Hydrography Program
Susan Buto & Pete Steeves

- The USGS hydrography program area traditionally has been focused on the National Hydrography Dataset and the Watershed Boundary Dataset. These two datasets – combined with 3DEP elevation are used to build the NHDPlus High Resolution (NHDPlus HR) Geospatial Framework.
- This USGS hydrography program area encompasses both infrastructure and community to build apps based on direct consumption of the data (i.e. you download and use the data), or by accessing the data through web platforms.



- This framework provides a foundation for big data analysis of water information, and is built like a street addressing system used to locate and link data to the network (e.g. from a gauge or geo station).
- The NHDPlus medium resolution framework is in place now, and the DHTF is working on a high resolution version in the NHDPlus HR.
- The NHDPlus HR network is built from higher resolution elevation and hydrography networks and will contain roughly ten times more features than the earlier, medium resolution data. Along with the higher resolution product, the network will include functionality that allows “generalization” or multi-scale representations of the same network. This allows a single framework dataset to be used for both local and national-scale modeling and other applications.
- Two trans-boundary NHDPlus HR pilots are in process; the Rainy River and Lake Champlain/Richelieu.

- There are applications that are being built on NHDPlus like the National Water Model (a US National Oceanic and Atmospheric Administration (NOAA) app) and SPARROW water quality model.
- To illustrate what is possible using the hydrologic framework, the National Water Model allows visualization of near real-time changes in stream flow as weather events move across the landscape and allow for advanced predictions of flood events.
- This data is also useful for time of travel, in the event of a spill, so the movement of contaminants can be predicted as they travel down the network.

PRESENTATION 5 – The HY_Features Standard / Linked Open Data
Mike Major

- Mike Major provided a brief overview of two exploratory projects: 1) a new hydrographic data model, and 2) linked open data. The projects are direct spin-offs from the Data Harmonization Task Force (DHTF) activities and could not have happened without IJC leadership.
- First, current hydrographic models do not leverage emergent technical opportunities to their full potential, and are not built at a continental scale. The idea, then, is simple: there should be one, shared model.
- The Open Geospatial Consortium is developing a new Hydrographic data standard, called Hy_Features.
- This model uses Hydrologic Nexus, Flowpaths, and Catchments, as simple building blocks that – when combined with high performance computing capacity and graph structures, and using high resolution elevation data (as is more and more available through Lidar) – can be turned into powerful tools for water experts.
- On both sides of the border, hydrography has evolved from simple cartographic views, and has added functionality to bridge the gap between what water experts need and what is currently available. More emphasis on web services and computing on the fly will move hydrography in the right direction.
- The new data structure also leverages linked open data. This concept is emerging and more mature in other areas; linked open data allows a user to simply query the web to discover information tied to the stream network. Today access is done via specialized GIS software, mediated through specialists, but what if agencies responsible simply published data to URLs?
- The Ordnance Survey in the UK (data.ordnancesurvey.co.uk) is an example: It is not a GIS application, but rather a web page, that allows a user to click through and navigate to other pieces of data by browsing. It's not ESRI or ArcGIS or a similar commercial GIS platform.

- The single model idea was articulated less than two years ago. Since then, three workshops dedicated to fleshing out the idea have been held. A meeting held in February 2017 in Salt Lake City, UT was where the two-fold strategy of exploring the Hy_Features model and Linked Open Data concept was agreed upon.
- The workplan for the next six months consists of:
    - Completing the documentation of an implementation model
    - Creating a Hy_Features compliant data set for the Champlain/Richelieu watershed
    - Creating the web services
    - Standing-up the IT architecture required to demo a Linked Open Data

QUESTIONS AND COMMENTS FROM THE DAY

- The maps are beautiful and no longer cut off, which is great. Now to what end? The Health Professional's Advisory Board is interested in water quality as it relates to human illness. The Health Professional's Advisory Board is looking at some cities in the Great Lakes basin and the question of the influence of weather patterns on rates of water borne illness. This will help us describe to policy makers what we're talking about.
- This demystifies what's going on. The 2011 Souris flood was an example of how we need to tell the story and visualize it. For the Souris basin we're just initiating the process to update our planned study, which is the bible that dictates how we operate the reservoir system on the Souris. Having a seamless database will support operational planning.
- Useful example from Nevada, where maps can show various reservoirs and their status in real-time. This is a live operational dashboard for the Walker River where you can click through to gauges and get direct links to the real-time information. Gives a sense of where we're going. Is this possible for transboundary areas? Need to understand the level of effort required – would be a desirable tool for many.
- IJC shouldn't just be talking to the Boards, but NGOs as well. In the Red River basin, we have a very active NGO, and the public availability of information will be useful to them, as they have resources to do flood management and preparedness work. COMMENT: NGOs are sometimes engaged in Phase III data workshops.
- The River Forecast Centre in Alberta has just gotten funding to develop an app to use on mobile to play the water management game. They get to tinker with allocating and releasing water to educate the public in the complexity of it. An idea we could leverage.
- We were one of the early recipients of this work and the mindset it created couldn't have been timelier, as it coincided with Minnesota doing a study on the approach to phosphorus in Lake of the Woods. Including both sides of the border in their model was a big change. The great limitation is the lack of real data with which to calibrate models, like real monitoring data, especially on the Canadian side, limits our ability to answer compelling questions.

- IJC is producing excellent information with strong science foundation. This effort is good for communications, and maybe useful for some modellers. All that wealth of information the IJC and many boards create and the studies are really good, but it has to be known and shared. The next step is apps; can't we push information to mobile with GPS, make use of the wealth of data produced by the IJC, that's at a right time and place for the right people? Disseminate the information without them having to go through a portal that they don't know exists. Especially the public. Like hacking events, where they have to come up with apps, etc. in a weekend.
- This information is great for the public to be able to see, but for municipalities, the IJC indicators that we've spent lots of hours coming up with, aren't being used that much. This kind of tool could also provide the monitoring function to show results from phosphorus interventions: are they really doing anything?
- Real-time information is the future. You could find out if something is going on immediately. And go right to the source, rather than go by guess after the fact. It would really tell a tale if we could do that in real-time. If this model could give us the ability to watch the streams as they come down, and all of a sudden one wasn't there; you can find a beaver dam right away, for example.
- In the future environmental indicators or attributes could populate on top of these base maps, showing what's vulnerable in your systems that you need to keep track of. It has an analytic function, socio economic, risk assessment, and more data together that will then point you to where you should do more analysis on your system and do a more detailed look.
- A platform that you can build other risk based information on would be very useful. Especially climate and extreme weather.
- Suppose we link everything, and I look at gauge data in the US and Canada and they're not the same data model, how hard is it for you to analyse that? And use it? The linking is a great tool, but I think there's still that problem of we can link everything but if the data models don't talk across the border the user still has to wade through it.
    - REPLY FROM THE DHTF: this is a fundamental point. Are there other data sets that require harmonization? Yes, like vertical data. Linking data puts pressure on the system and drives toward transboundary harmonization. We shouldn't stop because the challenge is daunting. If there's enough pressure on us mapping agencies we'll be forced to talk to each other.
- It's not sufficient to link data, but we want more uniform data content. Not starting from scratch, a lot of work with international data standards. Like in the groundwater community we've achieved a great level of interoperability and we're not starting from scratch.
- On the flow side we do have the harmonized product with the USGS that's been harmonized. When you want to apply models and do a project, the data you choose is a function of what you want to do. It's impossible to meet all the data needs in advance.

You're never going to have all the data you need. Need some way to have the boards define what they have or what they want.

- A link to climate predications and modelling would be useful. Resolution at the watershed level.
- I'm struggling with the Task Force versus an ongoing committee. TF has to come to an end, and it would be nice to put a bow on it and celebrate the success.
- Not sure what we're doing about non-contributing areas in the west. Right now we're using PFRA data from 10 years ago and our mapping agency hasn't picked it up. Non-contributing areas are a challenge.
- In the Souris basin, Non-contributing has two meanings, one is drained wetlands, the other is contributing wetland area depending on the wetness of the basin. You could get either none or significant runoff depending on the wetness of the basin. I'd be interested in knowing "how wet is the basin?".
    - DHTF RESPONSE: in the NHD we're talking about those kinds of issues and network connectivity. Alluvial situations. Seepage, sinkholes, urban areas. Trying to get to the point where the NHD is dynamic wrt to the landscape at any time. Would be a great place to bring in Canadian interests to those discussions. Right now working on a maximally connected network, so you can assume full flow and then pull back to low flow models.
- Do you take into account all the aquifers?
    - DHTF RESPONSE: long term discussion about incorporating groundwater and surface water interactions, like where streams gain or lose in a reach. At this point we're not talking about a three dimensional ground and aquifer model. In the StreamStats program we sort of look at that indirectly.
- We do have cross border aquifer management programs. In terms of harmonization there isn't an effort to make one large model across the border. But we're trying to do the next best thing; we can link where the aquifer is relative to a stream and it might be connected as a first step toward something more detailed.
- Need to be mindful of the fact that we can only do work that governments ask us to do. The reason the boards exist is because the two governments asked us to set up a board or study. We always meant for the Task Force to have an end date. We all need to realize now that the work that we can fund has to support the very important work that the governments have asked us to do, and that future ideas have to fall under the IJC's mission.
- I think a lot of these projects we catalyze a lot of this work and governments see the value and go from there. Looking at the next step, how do we organize ourselves to meet the needs of the boards, would there be a committee that the IJC could be a part of? The governance of the future, how it might look, we'll see. Form follows function.

- What about the analytical tools we need and the ability of boards and the public to understand this detailed data in a manner they can appreciate? Hopefully the Harmonization group doesn't have to do the whole strain of all this, and communication.
- We (NRCan) need to understand the management needs of boards My department is interested in moving away from data holdings to providing services, and independent of the IJC. We've become much more issue driven now. We want to have a role in water management in the future.
- Lidar brings new elements to the table. In Lake Champlain Richelieu it's being used extensively for floodplain mapping etc. Lots of potential there.
- Reality is the boards don't have GIS and analytical capacity. Might exist in some of the agencies, but we don't have it. How do we use some of that plan of study funding to fund longer term communication products that we can use. And maybe we could buy the analytical capacity to get those capabilities and develop tools, and coordinate to make sure we're not duplicating efforts. How do we build on that to turn this data in to information and a service and communications product that people can understand and use?
- Elevation is a big piece and has to come along, crosses boards, and has a direct relationship with water. We've had ad hoc solutions to elevation data. But need a comprehensive and coordinated approach.

TOP BOARD MANAGEMENT ISSUES THAT THIS KIND OF WORK CAN HELP WITH

- Invasive species
- Nutrient management – phosphorous, nitrogen
- Algae blooms
- Flooding and drought, still the core, preparedness and mitigation of both
- Gastrointestinal issues, contamination, waterborne diseases.
- Development in the basin – understanding what development is planned and the impact it will have
- Climate conditions
- Water apportionment
- Groundwater/surface water interface and understanding it