



**The Future of Transboundary Water Management—
*Cooperation, Informed Decision-Making,
and Empowering Local Actors***

Prepared by The Horinko Group

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Summit Proceedings



Introduction

The ubiquitous growth of big data has revealed significant implications for better informed water resources decision-making. Constantly improving analytics can provide operational managers and policy-makers with better informed choices. Real time monitoring, early impairment detection, tracking water contaminants and identifying sources, and the impact of drought in arid regions have game-changing value in improving negotiations across state and international boundaries.

At this year's Summit, an impressive lineup of presenters and seasoned capacity builders discussed the informed use of data in addressing key water resource challenges. Focus was placed on how an over-abundance of data can be handled effectively to guide decisions by science and fact, rather than conjecture and politics. Further discussion centered on how to effectively integrate the humanities into policy and water management decisions to fully account for the human dimension in natural systems.

Refer to Appendices for: (A) Participant List, (B) Agenda, and (C) Panel Storyboards.

Background

Diminished freshwater availability and water quality degradation are issues affecting nearly every region of the planet. Inequities are magnified when water sources cross national boundaries, impacting the lives of those less empowered. Globally, countries are struggling to mutually agree on how to manage common water resources. Internationally, conflict in the Middle East could hinge on water supply compromises. Domestically, challenges arise at every

level—national, state and local. This multi-dimensional overlay must be properly addressed in an interconnected manner.

Effective data management can serve to improve the human condition from the conflict-torn Jordan River in the Middle East, to the complicated water rights of the Western United States, to the Mississippi River's cyclic drought and overabundance. Empowering local actors to consider the human dimension in the region and to access and utilize data with purpose and confidence is an important step in positioning farm operators, utility managers and those who govern locally to better self-determine a sustainable path forward.

Welcoming Remarks

Brendan McGinnis, Managing Partner of The Horinko Group, commenced the Summit with introductory remarks. Mr. McGinnis thanked the participants, particularly those traveling afar from the Middle East. He recognized this year's Summit Partners, The Mannie Jackson Center for the Humanities Foundation, the Arava Institute for Environmental Studies, and the National Great Rivers Research and Education Center. Recognition was also extended to the Water Resources Action Project for its longstanding charitable efforts in the promotion of water education programs in the Middle East, and to the law firm of Crowell & Moring for their contribution to the day's events. Mr. McGinnis also extended thanks to the luncheon sponsor, HSW Engineering, and the networking reception sponsor, Booz Allen Hamilton. He then acknowledged the contributions of Summit planning committee members Clive Lipchin and Paul Yarowsky; panel moderators Adam Schempp, Ann Mills, and Clive Lipchin; the plenary session facilitator Bill Kruidenier; and the strong lineup of outstanding panelists.

In his opening remarks, Mr. McGinnis emphasized that the day's participants are involved in solving complex water resources problems, and each one could point to barriers that seemingly confound the best problem-solving intentions. He established the goal of the Summit: to generate a narrative that will reveal new ways of looking at old problems, and more actionably address these complex issues. Since we are currently armed with an over-abundance of data, a shift in focus must occur to utilizing data to empower local actors and policy-makers. He recognized the three panels are geographically expansive: two from United States and one from the Middle East. But all three focus on problem-solving, deconstructing complexities to look at benchmarking opportunities, and attempting to overcome problem-solving gridlock. The anticipation is that this Summit will enable us to develop high impact solutions. He encouraged contribution from each and every participant, and expressed optimism that given the wealth of knowledge and experience brought to the conversation, an actionable narrative we can all rally around will result. He proposed the expectation that a few big ideas today could make an even bigger difference tomorrow. Mr. McGinnis introduced Dr. Dale Chapman as the Kick Off Speaker.

Kick Off Remarks

Dr. Dale Chapman, Chair, National Great Rivers Research and Education Center; President, Lewis and Clark Community College; Secretary/Treasurer of the Mannie Jackson Center for the Humanities Foundation welcomed the attendees and provided context for the role of community colleges as leaders in the broader framework of higher education. He challenged the participants to rethink preconceptions regarding community colleges, and made a case for these institutions as the largest higher education systems in the United States. Dr. Chapman stressed that many community colleges confer baccalaureate degrees and are leaders in applied science, technology and research. Community colleges are not place-bound, but do have expertise in providing a sense of place. He pointed to

the location of Lewis and Clark Community College at the confluence of the Great Rivers in southwestern Illinois. Dr. Chapman then elaborated on the long-term collaboration with the Mannie Jackson Center for the Humanities Foundation. This partnership is enabling a cooperative effort with proven progress in bridging gaps between science and the humanities, and crossing cultural divides. The Mannie Jackson Center has been helpful in bringing the humanities voice into the discussion on international water systems. Dr. Chapman also elaborated on the cooperative effort with the National Great Rivers Research and Education Center, drawing comparisons to Woods Hole Oceanographic Institution or the Scripps Institution of Oceanography, as providing a much-needed center for institutional knowledge on the management of big river systems. Dr. Chapman expressed appreciation and pride in introducing Illinois Congressman Rodney Davis.

U. S. Congressman Rodney Davis, Representative in Congress for the 13th Congressional District of Illinois thanked Dr. Chapman, Mr. Mannie Jackson and The Horinko Group for the opportunity to attend, and to provide a voice for his diverse fourteen-county district in central and southwestern Illinois that borders the Mississippi and Illinois Rivers. He stressed that in spite of recent perceptions to the contrary, the majority of what Congress does is collaborative. But, he recognized that the Nation has been polarized, even with the advent of the most unprecedented access to information in history of the world. Congressman Davis suggested that the cause of this polarization may be due to individual focus on information and Internet sites that agree with their own assessment on important issues. The proposed solution is for diverse groups to come together to discover where they can agree, not place emphasis on where they disagree. He challenged the participants to focus on the fact that we're not that much different. Congressman Davis reflected on his recent experience visiting the Middle East, a visit he characterized as amazing, and one that reinvigorated his thinking. He was emphatic in his intent on coming to Congress to get things done, and that public works are best spurred by communities coming together to develop a plan. But those locally-developed plans ultimately need funding and organization to be fully actionized. Congressman Davis called for an end to stagnation of progress, and pointed to a need to bring planned regional solutions into national priority. He also noted that public-private partnerships could assist in resolving complex issues. He stressed that there is neither a Republican nor a Democrat solution to fixing complex water problems, but only national and global solutions. He extended thanks to the participants for their efforts, and confirmed that elected officials are profoundly interested in what we all do.

PANEL ONE: Water Diplomacy and Cooperation in the Middle East – Big Data and the Road Ahead

The first panel discussed transboundary water management between Israel and Palestine, a region as hydrologically complex as it is politically challenging. Israeli and Palestinian water experts explored the creation of shared data sets that delineate watersheds by leveraging existing and new technologies. Data analytics are used as a trust-building mechanism for establishing water governance bodies to ensure data are collected scientifically, appropriately, and fairly.

Dr. Clive Lipchin (Moderator), Director of The Center for Transboundary Water Management, Arava Institute for Environmental Studies, restated the panel's purpose and began with a brief review of the geography of the Middle East. Dr. Lipchin pointed out that water management in the region is as much a political issue as it is a technical issue. The mid-1990s Oslo Accords have fragmented the area into multiple jurisdictions, so that even running a pipe for a few meters may involve complicated negotiations. Further, anything that happens on the west bank of the Jordan River affects water quality and quantity in the downstream

communities. Untreated waste from Palestinian communities drains directly into Israeli territory. Multiple political entities further add to the complexity of the situation. Many areas experience a lack of infrastructure. But improvements are evident: 85% of Israeli sewage is treated and used for agriculture, and Israeli technology has resulted in the use of the least amount of fresh water for agriculture worldwide. This has greatly benefitted regional food security. But as a region, improvements cannot be driven from Israel alone.

Dr. Shaddad Attali, Minister at Negotiations Department and Former Head of Palestinian Water Authority, stressed his participation signaled a willingness on the part of the Palestinian people to provide hope. Dr. Attali strongly asserted that water is a basic human need and right. He proposed the issues that surround the provision of water must be addressed by both Palestinians and Israelis. When discussing the treatment of sewage, he expressed his frustration that this situation has not received the attention it deserves at the governmental levels. Dr. Attali proposed the need for a joint (Israel, Jordan, and Palestine) agreement on how to use the Jordan River, and also pointed out that the Dead Sea is suffering from water overuse. He stated that the focus of water sustainability should not just be on the West Bank, but the entire regional aquifer. He proposed that solutions to these problems will not be developed by committees, but only through candid discussions by bringing decision-makers together into one room. The focus of these discussions should not be about refugees or settlements, but simply about water security: the need to improve access to water and sanitation; the need to educate the inhabitants on the nexus between water and food; the need to share data to know how to better manage water systems; and the need to sit at one table and negotiate. But, ultimately the need is to cooperate to transform the region.

Yossi Yaacoby, Director of WaTech Division, Mekorot Water Company, began by providing an excellent description of the role in water management played by Mekorot, the national water company of Israel. He characterized it as a very structured water supply system with its own closed financial cycle. Water in Israel comes at a price, and Mekorot covers those costs without external subsidies. The WaTech Division is responsible for innovation and new technology development. WaTech looks at creating new sources of income, reducing operational and capital costs, improving technological performance, developing human capital, and positioning Mekorot for the future. He pointed to significant progress in desalination and improvements in water quality. Mekorot not only works internally with Israeli companies, but globally in the development of software, data systems, and cybersecurity. One of the goals is to build a bridge between digital solutions and traditional water strategies. They have been able to reduce the amount of energy used as well as to improve water quality through use of data generated by digital solutions. These technological improvements can be easily transported to the other nations, including the United States. Mr. Yaacoby concluded by stating that with water, there are no borders. Technology, cooperation, and coordination will help us to achieve quick wins, while cooperation between governments and private markets will help attain lasting solutions.

Amir Peleg, Founder and CEO, TaKaDu and Chairman, Smart Water Networks Forum, offered his perspective as an entrepreneur, and a self-professed “high-tech geek.” He began by stating that many view water as a non-issue – just turn on the tap and it flows. But now, he pointed out, it is big business. Water is life. It is not trivial to provide clean water to people in their homes. Mr. Peleg challenged everyone to go for 24 hours without domestic water, and observe the immediate change in individual standards of living. He pointed out that there is no shortage of buzzwords surrounding technologies – IoT, Smart City, Cloud Services, Data Analytics, Big Data. But what do they mean? Mr. Peleg proposed that the flow of data equated to an explosion of data, which exposes an absolute need to convert data to usable knowledge. He related his experience with his first customer in the United States, the Knoxville

Utility Board. The Board realized it was collecting large amounts of data without putting it to use. They identified a need for smart software to convert data to a usable form. They then realized the quality of the data being collected was valueless. This led to a revision of their sensor systems so that the information provided was meaningful. It also assisted in better detection of operational issues, such as leaks or bursts and telemetry problems, allowing strategic decisions about where to make capital investments. The power in knowing is that it enables better decisions. Mr. Peleg closed by stating that he never thought he would see a headline linking water and data, but when he did, it was a signal that better data means better service to the water customer.

Moderated Discussion

Panel One continued with a moderated discussion led by Dr. Lipchin as summarized below:

Water isn't free. So how do we use data to get the pricing right for water?

Mr. Yaacoby

- Crisis often spurs the realization of value of water
- Price increase will educate users regarding cost
- Quality of life includes the price of water
- Leadership and governance are part of the journey

Mr. Peleg

- Tier pricing is a good approach: a basic quota for tier one, up to a higher tier for overuse
- Higher the price, the higher user visibility, overuse and water loss cannot be ignored

Dr. Attili

- Water is a basic human right, but one is not paying only for the water, but for the service to deliver water
- Must consider affordability as a humanitarian issue

What are the immediate, implementable practical solutions to transboundary issues?

Dr. Attili

- Focus on a political commitment to reopen the dialogue
- Suggested that the United States could act as a mediator of transboundary water issues, to help negotiate a successful outcome

Mr. Yaacoby

- Treated wastewater is a practical solution
- Reuse of water for agriculture/industrial purposes
- Begin with a joint project for treated water use to show a quick gain

Mr. Peleg

- Value of data technology is zero without right people, organization, and process to use it
- Need local support to craft a workable project to show positive results

Participant Questions

Dr. Lipchin opened the floor for questions from participants:

Q: What is the approach to establishing tiered pricing?

A: The water sector is fragmented on how to implement pricing increases.

Q: Is there an economic incentive for Israelis to address the Palestinian sewage problem?

A: Data collection and use has been problematic; one must determine how much sewage is coming from West Bank Israeli or Palestinian communities. Need a willingness to engage in a joint solution.

Q: Is there a way to build a water community in the US?

A: Because there are so many small water agencies in the U.S, there is inefficiency. Entities could merge into a usable scale and optimal size with local/regional governance as part of the answer.

Q: Have climate change considerations been integrated into the process?

A: Climate change is having an effect, and new masterplans are being developed incorporating technologies such as desalination in extreme parameters of climate change scenarios. A strong suggestion was made to urge the U.S. to change its decision on withdrawing from Paris protocol.

Panel One Closing Remarks

Dr. Lipchin provided final comments, stating that solutions will come through sitting down together and putting technological tools and data to use. Water is not an issue to drive us apart, but an issue that should bring us together to collaborate.

PANEL TWO: *Sustaining Western U. S. Water – How Information and Collaboration Are Improving Water Management*

The panel accounted for current and forecasted water resource challenges facing communities and rural landscapes in the Western United States. The need for interstate cooperation and compromise regarding water resources allocation will become more evident and immediate as water supply and demand imbalances become greater. Effective collaboration and an array of existing and emerging technological, policy and management responses will prove critical for establishing pathways for cooperative water use.

Adam Schempp (Moderator), Director, Western Water Program, Environmental Law Institute, restated the panel’s focus on a variety of issues and innovative approaches for water management in the western United States. Mr. Schempp described the diverse water allocation systems that currently exist for both surface and groundwater across the United States. He explained that prior appropriation is the system used in most western states. Under this system, the first to use the water is always the first in line to receive all the water necessary to meet that original purpose of use in the original place of use; the right holder with the second oldest claim is second in line; the third is third in line; and so forth until all rights are fulfilled or there is no water left in a stream. On the Colorado River, the “Law of the River” is a complex network of compacts, treaties, and agreements. With regard to the federal role in water management, Mr. Schempp noted that the Bureau of Reclamation and Army Corps of Engineers have many reservoirs, commonly with agreements in place for use of that water. He also cited *Winters v. United States*, in which the U. S. Supreme Court ruled that Native American reservations have a reserved right to sufficient access to water to meet the purposes for which they were set aside. This introduction provided basic context for the panel discussion. Mr. Schempp then introduced the Panel presenters.

Shanti Rosset, Colorado River Program Manager, Metropolitan Water District of Southern California, provided an overview of the water system that supplies Southern California. California’s Colorado River Aqueduct was constructed to deliver water to a 5,200-square mile service area with an economic output of \$1trillion dollars and 19 million residents. As such, the Metropolitan Water District is the largest water provider in the world. The aqueduct has been a secure supply for decades, with storage in Lake Powell and Lake Mead providing additional protection for responding to drought conditions. But, 2014 and 2015 were the driest years on record with the lowest allocations from the State Water Project, Metropolitan’s other source of imported supply. Proactive planning, forward-looking management and use of storage in wetter years was how Metropolitan continued to supply its customers even in record dry consecutive years. Then, those two dry years were followed by the wettest year on record in California. Ms. Rosset summarized that ‘unpredictability’ has been the watchword in recent years. She described several programs undertaken by her agency to address specific issues. She highlighted a program to subsidize crop fallowing as providing water supply flexibility, but at the same time retaining the agricultural sector in the community. She also described a twelve-year capital development program involving a series of tunnels to increase water supply reliability. Not only will this protect end-user water supply, it will provide a water source for protected endangered species and biological systems. She also cited a recent lower basin drought contingency plan and new agreements signed with the seven basin states and Mexico.

Dr. Katharine Dahm, P.E., Lead Researcher, Water Resources and Planning Division, Denver Office, U. S. Bureau of Reclamation, described the role and authority of the U. S. Bureau of Reclamation in providing water to the western United States. Reclamation’s goal is to manage, develop and protect water and related resources in an

environmentally and economically sound manner in the interest of the American public. She stated that water levels at Lake Mead are historically low, and there are similar constraints on the diverse dams and reservoirs all across the western United States that Reclamation manages. Dr. Dahm returned to the theme of Reclamation's Congressionally-mandated authority. As an agency, Reclamation has no single organic act, instead there is specific authorization for each project. But in a turning point, the Secure Water Act has provided Reclamation with the authority and ability to collaborate and participate in basin-wide studies. Reclamation has subsequently developed key categories to address collaborative water issues: Supply Augmentation, Demand Management, System Operations, Ecosystem Resiliency, Data and Information. But, Reclamation's authority is limited to surface water, so close coordination with state agencies is important for managing groundwater issues. Dr. Dahm provided some recent highlights in the area of enterprise data management. In an effort to provide more transparency, Reclamation has upgraded publicly accessible systems. Data collected usually looks at infrastructure maintenance and improvement, but Reclamation is now reaching a point of putting data in public hands for general use. She recommended visiting Reclamation's website at: www.water.usbr.gov. Finally, Dr. Dahm encouraged participation in a newly-launched prize competition for public-driven solutions aimed at revolutionizing data visualization for the Colorado River.

Lee Storey, Water Strategy Specialist and Partner, The Storey Lawyers, proposed a three-part concept of discussing water in terms of access to Wealth, Power, and Life. The sustained drought has made water users uneasy and unwilling to forfeit water rights, because they would be giving up wealth, power, and life. She explained that today, there are more competing interests seeking water allocations, including Native American tribes and environmental groups, and all these voices must be heard. She also identified climate change as a newly-recognized risk that is forcing water users to think strategically about long-term water management goals. Ms. Storey stated that all water users must learn to "adapt and be flexible." Developing partnerships is essential and can be a change-driver. She identified some specific examples: interstate partnerships (with Nevada and California banking of water in Arizona's aquifers), international partnerships (with Mexico, notably Treaty Minute 323, storing water in the United States in Lake Mead) and public/private partnerships (with the City of Phoenix, Gila River Indian Community and Walton Family Foundation, storing water in Lake Mead). In all these cases, compensation was made in exchange for the right to store water in existing facilities for future use. Ms. Storey summarized that ultimately Tribal water rights must be quantified in the Colorado River Basin, and that listening and collaboration is extremely important to resolving water disputes and access to wealth, power, and life.

Moderated Discussion

Panel Two continued with a moderated discussion led by Mr. Schempp as summarized below:

What advances in the collection, processing or conveyance of data do you think would make a big difference in decision-making regarding water?

Dr. Dahm

- Long-term scenario planning with predictive modeling that considers multiple future conditions will make a difference
- Connecting data and geospatial information with individuals to make it accessible to local users

Ms. Rosset

- Use data for risk management, modelling and scenario planning for sensible economic decisions

How can education, outreach and relationship-building be more effectively fostered to address water challenges?

Ms. Rosset

- Move from litigation/acrimony to developing trust/goodwill to work toward win-win solutions
- Drought contingency planning, which requires trust and relationship building

Dr. Dahm

- Federal agency authority to assist stakeholders with providing education for local communities

Ms. Storey

- Suggested a national campaign for water resource public awareness, similar to Keep America Beautiful

In your experience, where has or could investment most significantly and positively affect water management?

Dr. Dahm

- Variety of programs which require a non-federal cost share component
- Linking federal funding with local efforts is one place where having the federal government at the table can make a local project happen

Ms. Storey

- Need for infrastructure improvement with public-private investment as the stimulus

Ms. Rosset

- Investing in both small and large ways to increase reliability and increase conservation
- Use of public funds to encourage change positively effects the way we manage

Participant Questions

Mr. Schempp then opened the floor for questions from participants:

Q: How was a value derived for the payment to a Native American tribe for their water rights?

A: Negotiations were held with tribal councils to forgo rights for a single year. To forgo a use permanently would take an act of Congress. Even though it would appear this is a lesser value than the market would support, there is a huge deviation in market price from one area to another.

Q: How did the Colorado River Basin transition to cooperation from conflict?

A: Compacts provide certainty and a historical baseline. A collective decision was made that we are all in this together, relationships formed realizing collaboration gets us farther than conflict.

Q: How are California's desalination projects progressing?

A: The San Diego (Carlsbad) desalination project is an alternative supply source, but it has not changed demand. Price per acre-foot generated is high, currently this process is cost prohibitive.

Q: What is it going to take to get the Colorado Basin Agreement signed by the State of Arizona for the Drought Contingency Plan?

A: There is an internal conflict between the State of Arizona and their primary water supplier. In a quote from a local legislator, "reverse momentum" is now being evidenced. But, the discussion is not being furthered by debate in the press.

Panel Two Closing Remarks

Mr. Schempp provided closing comments, highlighting the many ways indicated just within the course of the session to approach the challenges faced in western water management: using infrastructure creatively (e.g., banking in Lake Mead and Nevada's groundwater storage in Arizona), leasing programs (e.g., the Bard Fallowing Program), infrastructure development (e.g., the Cal Water Fix), cooperative planning (e.g., the Lower Basin Drought Contingency Plan), legislation to allow things to happen (e.g., the Secure Water Act), usable databases for transparency and communication (e.g., Enterprise Data Management), prompting innovation and public-private partnerships (e.g., the Colorado River Basin Data Visualization Prize Competition), and building trust and relationships (e.g., the Gila River Indian collaboration). Mr. Schempp said that there is no silver bullet; addressing the West's water challenges will require advancements in multiple areas with multiple methods.

PANEL THREE: *Using Data, Law and GeoHumanities to Improve System and Community Resiliency in the Mississippi River Basin*

The panel focused on the nation's most iconic large river system, the Mississippi. The panelists described community and interstate efforts to address key system and community stressors. Opportunities to apply big data techniques and data mining were discussed in a joint effort to better inform watershed-scale environmental, legal, and socio-economic decision-making, while building the adaptive capacity of local actors.

Ann Mills (Moderator), Senior Fellow, Food Institute, George Washington University and former Deputy Under Secretary for Natural Resources and Environment, U. S. Department of Agriculture, provided context for the panel: that the Mississippi River Basin is the second largest in North America, bordering 10 states and traversing 2,300 miles through the American heartland. The basin reflects a rich heritage of agricultural production, navigation, and recreation. It is ecologically important and provides a globally significant migratory flyway. But, the Basin is facing significant challenges, foremost water quality. The hypoxic zone at the Mississippi delta is the largest ever reported, approximately the size of the State of New Jersey. There are currently shifting federal regulatory and policy problems. To face these problems, Ms. Mills stressed a need to create trust and build common goals. She then proposed the focus of the panel: How do we deploy the expanding sources of data to more effectively empower organizations to make effective decisions? And, how is this information going to be made accessible?

Dr. Steve Sonka, Professor Emeritus, Department of Agricultural and Consumer Economics, University of Illinois, began by pointing out that we are in a time of unprecedented opportunity to use information. He emphasized the primary characteristics of big data: volume, velocity, variety, and analytics. But, will big data have significant influence on human systems like agriculture? How can a large volume of data and analytics be translated into useful products and processes? He associated the use of big data to the game of "Go," a traditional Chinese strategy game more complex than chess. There are an astronomical number of outcomes, but even so, big data has enabled a computer to outplay a human master of the game. Dr. Sonka pointed out that we all have access to big data simply by pulling out a smart phone to decide how to get from the Summit location to the hotel. Data sources today are being used in a similar manner in the agricultural field to decide how and where to effectively spread fertilizer. Sensors placed in river systems are sources of data as well. In the Great Lakes to Gulf project, there are 4,600+ monitoring sites capturing and sending data. In the case of nitrogen fertilizer data alone, collected data have been used to prescribe effective application. Most fertilizer gets applied in the fall, and migrates to the air and water via runoff. But, if you apply nitrogen fertilizer while a crop is still in the growing phase, it is more effective and less environmentally damaging. But, this comes with a risk, because rainfall during the critical application window will preclude fertilizer application. Data can be used to determine the risk and reduce it, and enable nitrogen application more effectively and less harmfully. So far, much of what is being done is with data collected for non-targeted reasons. Dr. Sonka suggested there is a need to look at a business model that will drive data collection with specificity. He concluded by proposing two paths for progress: First, the need to spend time to look at business reasons to capture data; and second, a more aggressive public role in supporting producers evaluate and adopt (or not) digital technologies.

John Ploschnitznig, Director, Modeling and Application Development, Riverside Research, described the goal of applied modelling as creating a capability which leverages space-based collections systems, hyperspectral sensor technology and application to an ultimate end user. He explained a vast network of remote data collection systems, satellites collecting

hyperspectral data on a level that could not be conceived of 20 years ago. Satellite scans on pixel grids with 10 meter square areas translate to 3.38 petabytes of data a day. The way to make this overabundance of information useful is to transpose it via a Bayesian Belief Network into a usable form. Finally, that data must be translated into everyday language so it can create useful and effective change in the field.

Alexandra Campbell-Ferrari, Executive Director, Center for Water Security and Cooperation, challenged participants to think about law as a story, and that legal frameworks taken as a whole (across sectors and jurisdictions) provide context for complex issues. She provided the example of interstate water compacts, and described how those compacts relate a lengthy history. She also proposed that laws themselves are data that reflect our thinking in the past, and in turn, impact how we behave in the future. Law directs and influences our behavior. For instance, she pointed to the Federal laws regarding non-point source pollution. The Clean Water Act (“CWA”) does not specifically address non-point source pollution from agriculture; though the CWA does classify confined animal feeding operations (“CAFOs”) as a point source and does regulate them directly. While the CWA does not set out mandatory water quality standards for farmers, under §319 of the CWA, the federal government can grant money to States to address non-point source pollution. No one should be surprised that there are 50 different approaches to nonpoint source regulation and management: the Federal government indicated in the CWA that the States should handle this. Ms. Campbell-Ferrari further proposed that all laws have unintended consequences. In Iowa, for example, drainage districts were sued by Des Moines Water Works because the extremely high level of nitrates found in the source water being treated for drinking water was costing millions of dollars more than they otherwise would have to spend. But, the law is unequipped to address the impact agricultural production has on the provision of drinking water and the additional cost of providing safe, non-nitrate laced drinking water when agricultural production impacts the water quality of source waters. Within one state, two different and important sectors were in conflict. Tension also exists between upstream and downstream States, and she pointed to the differences in approaches to nutrient management for CAFOs in Wisconsin and Iowa. While “we” know these problems cross sectors, such as agriculture and water supply, and cross State boundaries, the law does not necessarily reflect these interactions. To compensate, we must see law as a planning and monitoring mechanism for ensuring the success of all sectors and jurisdictions are maximized. Ms. Campbell-Ferrari summarized with two primary points: First, law has to be viewed as data, and further viewed as data that provides an indicator of past and future behavior. Second, information about the law needs to be put in a format that is logical and accessible. We need to measure whether laws are achieving the goals, purposes, and objectives laid out in the law.

Dr. Michael Pasquier, Associate Professor of Religious Studies and History, Louisiana State University and Public Humanities Fellow of the Whiting Foundation, began by proposing that methodical, organized data applications like GIS and Google Maps often are seemingly at odds with the human environment. Humanities are not normally neat and tidy. GIS likes certainty, not contingency or variability. GIS can give you spatial representations, but that does not tell the whole story of a messy human environment. Dr. Pasquier furthered the concept that after centuries of human habitation, we are still quarrelling about what the Mississippi River was, is, and will be. He went on to say that history and stories matter, not just in the context of community identity, but also as data about the human condition. Maps, such as the coastal mapping plan will provide, are authoritative and certain, but are missing flesh and blood about the human condition. Dr. Pasquier related meeting a woman in French Settlement, Louisiana, outside of Baton Rouge. Her home was flooded in 2016. There was a diversion canal that caused the flooding, and this had obvious consequences to her life. How can we use this information? At another site, a diversion canal is proposed in the coastal management master plan that simulates a delta. The town of Ironton,

Louisiana, a historically black community, is on the front line of this construction. How do we use data from that community in the decision-making process? By adding information about the human environment to scientific data, you get a convoluted map that changes the best-laid plans for controlling the universe. Dr. Pasquier proposes development of a “deep map” that overlays a physical map with the local stories, community traditions and wisdom that should inform decision making. He further suggested that the business of the humanities is to confound authoritative and ultimate answers. Histories matter, stories matter, and morality matters. It is important to recognize the need to reflect on a moral system that should inform societal decisions. He closed with the proposition that we are better at collecting data on land and water, less so on people.

Moderated Discussion

Panel Three continued with a moderated discussion led by Ms. Mills as summarized below:

When rebuilding resilient communities, what best practices enable inclusion of the human element?

Dr. Pasquier

- Need a cultural change to shift from the mindset regarding the obligatory public meeting
- Interaction not just to check the box, but true listening sessions to understand concerns
- Need to leverage community relationships to gain trust and stakeholder buy-in

How can individual privacy be protected in the collection and distribution of data? And, are smaller farmers at a disadvantage because they do not have the ability to access information?

Mr. Ploschnitznig

- Clearly there are legal implications, but data use is an important consideration
- Is data going to be used to help the local farmer or to regulate them?

Dr. Sonka

- Disadvantage of scale for small farmer
- Distinction between data for farmer’s individual use and decision-making and public use
- Scale differences are not about collection data, but data use

Whose responsibility is it to collect and interpret data so it is useful to the end user? And, who determines the definition of “end user?”

Dr. Sonka

- Need to rely on the private sector for the development of systems
- Must learn how to effectively deploy big data
- Public sector will then come into play as a regulator of proper use

Mr. Ploschnitznig

- Satellites are a new frontier, and now relatively inexpensive to deploy

- Agencies like NASA had provided data for free
- Private sector deployments will now make corporate data use profitable

Ms. Campbell-Ferrari

- Data use is of importance here—need to ensure data is used for the purpose intended
- If information is made public, no question someone will want to use it to litigate/hold actors accountable for their behavior, especially when it impacts someone else

Participant Questions

Ms. Mills then opened the floor for questions from participants:

Q: NASA is becoming better able to process satellite data, now looking at systems to advise users on what can be seen from space and attempting to fine tune data to user needs. The effort requires end user support to ensure accessible data collection sites and to provide feedback on data use.

A: All agreed that this is good news.

Q: How do disadvantaged peoples get a voice in the process, with Flint, Michigan as an example?

A: Some voices are heard. There is increasing awareness that vocal members of the community are not simply pests, but part of a critical mass of outcry that cannot be ignored.

Q: How can innovative financing be used to promote data use?

A: Admittedly we haven't done well at linking funding to use. Over a period of time, market surges and dips can be associated with data-predictable events, translating into economic indicators.

Q: Farm families have an overwhelming amount of information, and make economic decisions daily. Data is so complex and there is so much of it. Need data to be usable in practice. How hard should farmers push to protect the data that is collected? Should it all be private?

A: Not really a big data problem, but a "lots of data" problem. Need to make sure data is communicated so it serves to educate, not confuse. Also, must ensure data is used for the purpose it is intended.

Panel Three Closing Remarks

Ms. Mills then provided closing comments, reflecting on comments from family farmers that clearly brought home the practical perspective. Every human, legal, and data issue explored by the panel is captured by examining the concerns of farmers.

PLENARY SESSION: *Rallying Proof of Concept Initiatives and Key Next Steps*

Dr. William Kruidenier, Associate Director, National Great Rivers Research and Education Center facilitated the concluding plenary session. It was forward-looking, and focused on advancing the panel discussion of regional challenges and solutions. The session involved all Summit participants. There was an effort to identify actions that could propel the Summit's focus on cooperation, better informed decision-making, and building the capacity of local practitioners. An animated discussion centered on the following points and observations:

- There is a business case that surrounds each of these issues. The private sector plays an important role in developing an economic driver for betterments. But one of the key questions that has evolved from today's discussion is, **How do you value the benefits of water without cheapening it with a dollar value?** The focus should be that the cost of water isn't really the water itself, but the infrastructure to deliver the water to users.
- **Facilitating community-backed plans with public-private partnerships.** There has to be a process for community vetting, requesting input for best ideas. Decisions are made at the investment level. Long-term cost assessments made in the public sector have impacts that reach the local level.
- **Recognizing the value of water as a resource.** Israel and Australia have addressed these issues. The solutions are there, other nations have used them, how do we implement those solutions here? What is the tipping point that brings us to the table and causes us to utilize known solutions? We don't agree on valuation here in the United States. We need consensus, and then we need to scale it up. A crisis could serve to bring people together, but we shouldn't wait until there is a crisis.
 - **Inspiration for determining the value of water can be found in the value placed in the energy sector.** Market pricing was one key element, education is another. Everyone needs to be educated on the actual cost of water.
 - **Places where water quality is degraded appear to be related to low socioeconomic conditions.** There is an economic argument that healthy people and healthy communities make for a healthy society.
- **For success, three components are necessary: 1) Market Opportunity; 2) Human Capital; and 3) Money.** If those three components are not there, nothing will change. The value of government leadership is bringing together of all three components.
- **Data must be placed in the right hands for use in a non-regulatory context.** Give private landowners and businesses the tools and power to make informed decisions. There is a notion that water cleanup is regulatory-driven is not necessarily true. It is tempting to think that we can get legislatures to make people do things. We can't sue our way into compliance. In the Chesapeake Bay, the issue was framed locally, a business case was made regarding regional impacts, and the effort was made important to everyone.
- **Reaching the public is important through extension, broad education and explanation.** We need to do a better job of educating, with a clear argument that there

be an expanded role for community colleges.

- **“What is being done on the data management front that will actually help me make decisions on water resources in my day-to-day operations?”** We must use the data that we collect and translate it into a usable function to answer real life questions like, “How much fertilizer do we put on the field today?” As a practical matter, most individuals simply are not capable of using all this data. We need build capacity from bottom up...through education.
- **We need a unified message.** The solution is us and the problem is us.

Plenary Session Closing Remarks

Dr. Kruidenier acknowledged the vigorous discussion and summarized the session by stating that we have identified opportunities, but the key is to turn those opportunities into actions that will result in transformative cascades. Ultimately, water should not be an issue that divides us, but an issue that unites us in collaborative action.

Networking Reception Greeting

David Chung, Partner in the Environmental and Natural Resources Group of the Law Firm of Crowell & Moring, welcomed the Summit participants to the Networking Reception. He described his practice in agriculture and water sector litigation, but stated he is most encouraged by the shift from litigation to collaboration. He suggested that working together on small scale local projects with visible results provides an excellent alternative to conflict. With collaboration, there is hope of long-standing improvement. He encouraged all participants to turn ideas into actions.

APPENDIX A – Participant List

Jonathan Adelman
Producer, Events Production
American Israel Public Affairs Committee

Alice Alpert
Foreign Affairs Officer
U.S. Department of State

Shaddad Attili
Minister, Negotiations Department; Former
Head of Palestinian Water Authority

Karen Baker
Chief, Environmental Division
U.S. Army Corps of Engineers

Alex Beehler
Fellow
George Washington University

Phil Bradshaw
Former Chair, U.S. Soybean Board

Carly Brody
Technology Board
National Academy of Sciences

Kurt Buchholz
Senior Lead Technical Specialist
Booz Allen Hamilton

Yonatan Bukhdruker
Embassy of Israel
Economic and Trade Mission

Alexandra Campbell-Ferrari
Executive Director, Center for Water
Security and Cooperation

T. R. Carr
Consultant
Novi Analytics

Nichole Carter
Natural Resources Policy Specialist
Congressional Research Service

Joseph Cascio
Faculty
George Washington University

Piers Causton
Senior Lead Technical Specialist
Booz Allen Hamilton

Dale Chapman
President, Lewis and Clark Community
College; Chair, National Great Rivers
Research and Education Center;
Secretary/Treasurer, Mannie Jackson
Center for the Humanities

Isaac Chapman
Program Manager
The Horinko Group

Linda Chapman
Vice President, Academic Affairs
Lewis and Clark Community College

David Chung
Partner
Crowell & Moring LLP

Benjamin Cohen
Impact Associate
Quantified Ventures

Joe Copeland
Military Health
Booz Allen Hamilton

Katharine Dahm
Lead Researcher, Water Resources and
Planning Division, Denver Office, U. S.
Bureau of Reclamation

Shawn Dalton
Principal
Thrive Consulting

U. S. Congressman Rodney Davis
Representative for the 13th Congressional
District, Illinois; Chair, House
Subcommittee on Biotechnology,
Horticulture, and Research

Kevin Donovan
Senior Vice President
Ecology & Environment

Sandra Eberts
Midwest Regions, National Water Quality
U.S. Geological Survey

Elizabeth Eide
National Academy of Sciences

Deohn Ferris
Vice President for Equity, Diversity and
Inclusion, National Audubon Society

Tim Fink
Director of Research and Policy Analysis
Supporters of Agricultural Research

Jordan Fischbach
Co-Director, Water and Climate Resilience
Center, Rand Corporation

Tom Fish
National Director, Cooperative Ecosystem
Studies Units Network

Katie Flahive
Coordinating Committee Co-Chair, Hypoxia
Task Force
U.S. Environmental Protection Agency

Michael Fleischman
Assistant Director, The American Israel
Public Affairs Committee

Biju George
Chief Operating Officer, District of
Columbia Water and Sewer Authority

Ellen Gilinsky
President, Ellen Gilinsky LLC

Meg Gilley
Science Policy Engagement Specialist
COMPASS

Naama Gur-Peleg
Public Relations and Communications
Consultant, TaKaDu

Randy Hayman
Partner, Beveridge & Diamond

Stephanie Henning
Revolution for Sustainable Development,
U.S. Department of State

Carol Henry-Emory
Vice President & Principle Hydrologist,
HSW Engineering

Bridgett Hess
Office of Israel and Palestinian Affairs
U.S. Department of State

Bill Kruidenier
Associate Director, National Great Rivers
Research and Education Center

Ken Krupsky
Vice President, Galil
Jewish National Fund

Dietrick Lawrence
Defense Solutions Directorate
Riverside Research

Ben Lee
President and CEO
NABAS Group

Michael Lesnick
Senior Partner
Meridian Institute

Clive Lipchin
Director, Center for Transboundary Water
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Brendan McGinnis
Managing Partner
The Horinko Group

Patrick McGinnis
Director, Development, Policy & Practice
The Horinko Group

Sean McGinnis
Senior Director
The Horinko Group

Len Miller
Of Counsel
Sullivan & Worcester

Susan Miller
Board Member
Water Resources Action Project

Ann Mills
Senior Fellow, Food Institute, George
Washington University and former Deputy
Under Secretary for Natural Resources and
Environment, U. S. Department of
Agriculture

Alexandra Murdoch
Federal Policy Dretor
Chesapeake Bay Foundation

Nima Pahlevan
Chief Research Scientist
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Administration

Michael Pasquier
Associate Professor of Religious Studies and
History, Louisiana State University; Public
Humanities Fellow, Whiting Foundation

Michael Patella
Senior Advisor on Infrastructure
White House Council on Environmental
Quality

Amir Peleg
Founder and CEO, TaKaDu and Chairman,
Smart Water Networks Forum

John Peukert
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U. S. Army Corps of Engineers

William Piermattei
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Ed Pinero
Director of Water Programs, U.S. Business
Council for Sustainable Development

Layne Piper
Project Associate
Environmental Council of the States

Beth Pitrolo
Senior Advisor, Permitting & Compliance
The Horinko Group

John Ploschnitznig
Director, Modeling and Application
Development, Riverside Research

Cameron Prell
Partner
Co2Efficient

Alan Roberson
Executive Director, Association of State
Drinking Water Administrators

Shanti Rosset
Colorado River Program Manager,
Metropolitan Water District of Southern
California

Will Rowe
Distinguished Technical Specialist
Booz Allen Hamilton

Amy Saltzman
Program Officer
Walton Family Foundation

Mitchell Schaben
Political Affairs Consultant
Schaben Consulting, LLC

Adam Schempp
Director, Western Water Program,
Environmental Law Institute

David Schultz
Reporter
Bloomberg BNA

Sara Schwartz
Master of Water Resources Science and
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Britt Sheinbaum
Graduate Fellow
Oregon State University

Morgan Snyder
Program Officer
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Agricultural and Consumer Economics,
University of Illinois

Lee Storey
Water Strategy Specialist and Partner, The
Storey Lawyers

Holly Sullivan
Project Management Consultant
Tel Aviv University

Maureen Sullivan
Director of Environmental Management
Office of the Assistant Secretary of Defense
(Energy, Installations and Environment)

Zaheer Tajani
Associate
Beverage & Diamond

Steve Via
Director of Federal Relations
American Water Works Association

Sarah Walen
Senior Mediator
Meridian Institute

Dick Warner
Senior Scientist
National Great Rivers Research and
Education Center

Ken Watson
President
HSW Engineering

Julie Weisman
Environmental Attorney
Carter, Ledyard & Milburn LLP

Jordyn White
Statistician
National Academy of Sciences

Ruth Wieder
Strategic Illustrator
Arlosoul

J. P. Woodley, Jr.
Principal
Advantus Strategies

Jen Worth
Economic Development
American Association of Community
Colleges

Yossi Yaacoby
Director of WaTech Division, Mekorot
Water Company

Paul Yarowsky
Associate Professor
University of Maryland

Julie Ziino
Executive Assistant, North Atlantic
Division, U.S. Army Corps of Engineers

APPENDIX B – Final Agenda

Registration **8:15 – 9:00am**

Welcoming and Objectives **9:00 – 9:10am**

Brendan McGinnis
Managing Partner, The Horinko Group

Kick-Off Remarks **9:10 – 9:30am**

Dale Chapman
Chair, National Great Rivers Research and Education Center
President, Lewis & Clark Community College

U.S. Congressman Rodney Davis (Illinois-District 13)
Chair, Subcommittee on Biotechnology, Horticulture, and Research
House Committee on Agriculture

Panel One **9:30 – 10:45am**

Water Diplomacy and Cooperation in the Middle East – Big Data and the Road Ahead

Clive Lipchin (Moderator)
Director, Center for Transboundary Water Management, Arava Institute for Environmental Studies

Shaddad Attili
Minister at Negotiations Department and former Head of Palestinian Water Authority

Yossi Yaacoby
Director of WaTech Division, Mekorot Water Company

Amir Peleg
Founder & CEO, TaKaDu and Chairman, Smart Water Networks Forum

Break **10:45 – 11:00am**

Panel Two **11:00am – 12:15pm**

Sustaining Western U.S. Water – How Information and Collaboration Are Improving Water Management

Adam Schempp (Moderator)
Director, Western Water Program, Environmental Law Institute

Shanti Rosset

Colorado River Program Manager, Metropolitan Water District of Southern California

Katharine Dahm, P.E

Lead Research, Water Resources and Planning Division, Denver Office, U.S. Bureau of Reclamation

Lee Storey

Water Strategy Specialist and Partner, The Storey Lawyers

Networking Luncheon

12:15 – 1:30pm

Panel Three

1:30 – 2:45pm

Using Data, Law and GeoHumanities to Improve System and Community Resiliency in the Mississippi River Basin

Ann Mills (Moderator)

Senior Fellow, Food Institute, George Washington University and former Deputy Under Secretary for Natural Resources and Environment, U.S. Department of Agriculture

Steve Sonka

Professor Emeritus, Department of Agriculture and Consumer Economics, University of Illinois

John Ploschnitznig

Director, Modeling and Application Development, Riverside Research

Alexandra Campbell-Ferrari

Executive Director, Center for Water Security and Cooperation

Michael Pasquier

Associate Professor of Religious Studies and History, Louisiana State University

Plenary Session

2:45 – 4:00pm

Rallying Proof of Concept Initiatives and Key Next Steps

William Kruidenier (Facilitator)

Associate Director, National Great Rivers Research and Education Center

Networking Reception

4:00 – 6:00pm

Reception Greeting

David Chung

Partner, Environment & Natural Resources Group, Crowell & Moring

APPENDIX C – Panel Storyboards

In addition to the written record of the Summit proceedings, a strategic digital illustrator used a tablet to visually capture each of the panel presentations as “storyboards.” The end product are graphic recordings providing a map or tool for understanding the story behind the content of the discussions and a foundation for follow-up from the Summit. The illustrations were developed in partnership with Arlosoul and the Mannie Jackson Center for the Humanities.

Panel One Storyboard

To download the full-size Panel One Storyboard, [Click Here](#).

Panel Two Storyboard

To download the full-size Panel Two Storyboard, [Click Here](#).

Panel Three Storyboard

To download the full-size Panel Three Storyboard, [Click Here](#).