Leveraging Environmental Data to Promote Cooperation Toward Integrated Watershed Management in the Hebron/Besor Watershed

Jennifer Holzer, Tamee Albrecht, Natasha Westheimer and Clive Lipchin

Dr. Clive Lipchin serves as the director of the Center for Transboundary Water Management at the Arava Institute for Environmental Studies; Tamee Albrecht earned an M.Sc. in hydrology from the Colorado School of Mines and currently conducts hydrologic research and GIS analyses at the Arava Institute; Jennifer Holzer holds an MPA in environmental science and policy from Columbia University and is currently researching the food-water-energy nexus at the Arava Institute; Natasha Westheimer works under the Mitigating Transboundary Wastewater Conflict initiative at the Arava Institute and has a BA in international development and conflict management.

Overview

This paper advocates using environmental data as a basis for cross-border entities to work toward integrated watershed management and discusses lessons learned through involving stakeholders in this process. Based on our experience with water and wastewater issues in the Middle East, we have adapted an integrated watershed management approach in response to local challenges such as underdeveloped infrastructure, asymmetric institutional capacities and political conflict. At present, our project work provides decentralized (bottom-up) solutions and, in doing so, develops stakeholder networks that can effect integrated watershed management in the long term. The solution is two-fold — to create a data platform that will serve as an analytical tool to guide water management decisions and, simultaneously, to create a stakeholder forum for cultivating

ongoing cross-border relationships.

To equitably and efficiently manage a transboundary water resource, stakeholders need to be involved from the early stages of the process.[1] Through collecting and presenting scientific data, stakeholders can better understand a complex water management situation in order to inform decision-making and project planning. Furthermore, in stakeholder meetings that aim to address a mutual interest of conflicting parties, science serves as a reliable and less political platform for communication. In educating, engaging and building relationships among these stakeholders based on shared information and goals, parties will create partnerships that can be leveraged for co-decision-making.

The Arava Institute for Environmental Studies, a scientific, nonprofit, academic research institution with a history of successful work across the borders of Palestine, Israel and Jordan, is well positioned to take a leadership role in building sustainable transboundary relationships and conducting high quality scientific research. Within the Arava Institute, the Center for Transboundary Water Management (CTWM), jointly with its Palestinian partner, the House of Water and Environment, is using a series of internationally funded projects[2] to engage, educate and build relationships among students, scientists and decision-makers regarding local and shared water resources. As part of this process, CTWM is conducting research and convening cross-border workshops. Specifically, CTWM is collecting and presenting data on hydrology, water pollution and wastewater throughout the immediate region. It is concurrently convening stakeholder workshops to serve as a forum for sharing scientific research, building relationships and discussing the path to integrated watershed management.

The path to integrated watershed management begins with defining the watershed. A watershed's boundaries are governed by topography and streamflow, rather than political borders. To demonstrate this management framework, this paper refers to CTWM's ongoing work in the Hebron/Besor watershed, a highly polluted transboundary basin. The Hebron/Besor watershed traverses the politically complex areas of the West Bank, Israel, and Gaza. At this time, neither Israeli nor Palestinian scientists nor policy-makers have the tools or platform necessary to manage these transboundary resources effectively, and this fact is exacerbated by political conflict. Our work aims to build such tools and platforms by collecting environmental

[1] Comair et al., 2014. Hydrology of the Jordan River Basin: A GIS-Based System to Better Guide Water Resource Management and Decision Making. *Water Resource Manage* 28:933-946.

[2] International funders include the Osprey Foundation, the USAID Conflict Management and Mitigation office and the JNF Parsons Water Fund.

data, engaging stakeholders and implementing small-scale, off-grid wastewater projects.

This work is conducted in part under the *Mitigating Transboundary Wastewater Conflict* (MTWC) project funded by the United States Agency for International Development (USAID)'s West Bank and Gaza office of Conflict Management and Mitigation (CMM). The CMM office coordinates a reconciliation program for conflict mitigation through cross-border people-to-people engagement.[3] In line with this mission, the ultimate goal of our project is to create a platform for cooperation on water management, in which stakeholders build sustainable relationships and partnerships through a series of stakeholder engagement forums. These forums take the form of workshops, either as trainings, dialogues, field studies or networking events. MTWC programs are based on multi-party recognition and respect; they focus on illustrating mutual interest for collaboration and use scientific information to jointly determine sustainable solutions to water and wastewater issues.

A Science-Based Approach: Using Environmental Data

A science-based approach to integrated watershed management consists of environmental characterization and analysis to inform management decisions. This is especially important in the Hebron/Besor watershed because political tensions may cause parties to question the validity of data as they are reported by other parties. An approach based on scientific observations and monitoring by multiple stakeholders can provide an important foundation for building relationships and trust. The integrated watershed management approach already benefits from a generation of experience around the world, with a recent shift from a "participatory" approach to a "collaborative" approach. This newer, "collaborative" approach refers to a process that is based on mutual learning, exchange and negotiation among actors with diverse interests and concerns, including technical experts and policy-makers.[4] In other words, the expertise of policy-makers and scientists is not necessarily privileged over local stakeholders. In addition, while in the past the watershed management program might have been facilitated by local governments, today a watershed management

[3] United States Agency for International Development, 2012. Bureau for Conflict Management and Mitigation – *Democracy, Conflict and Humanitarian Assistance*. Retrieved from http://www.usaid.gov/who-we-are/organization/bureaus/bureau-democracy-conflict-and-humanitarian-assistance/office on July 1, 2014.

[4] FAO Forestry Paper 150. The new generation of watershed management programs and projects. Food and Agriculture Organization of the UN. Rome, 2006. Retrieved from http://www.fao.org/docrep/009/a0644e/a0644e00.htm on July 7, 2014.

program is more likely to act as facilitator and supporter, with the local government as a stakeholder.[5]

This science-based approach is an iterative process of data collection, centralized data management and data analysis, leading to informed decision making and, ultimately, integrated watershed management practices, as represented in Figure 1. Scenario modeling using computer-based tools such as GIS has been extremely useful in supporting watershed decision-making.[6] Maps and other graphical representations, quantitative results and detailed scenario modeling can help stakeholders to better understand the implications of potential decisions.[7] Research has shown that by including stakeholders early in the modeling process, they are more likely to share their existing knowledge, increase their understanding of the watershed and agree on strategies to address the primary problems in the watershed.[8] The process of watershed research and analysis is a method for identifying cooperative projects as well as constituting a cooperative project itself.

CTWM is using environmental data to guide integrated watershed management in the Hebron/Besor watershed, whose primary stream constitutes one of 15 transboundary streams that flow across both Israel and Palestine.[9] This watershed covers approximately 3,500 square kilometers in and around the population centers of Hebron and Be'er Sheva, making it a key transboundary watershed in the region. The first step in a science-based watershed management approach is comprehensive data collection (Figure 1).

Collecting data throughout the watershed is essential since the watershed is a dynamic system, and understanding the hydrology provides background for understanding all upstream-downstream issues. For our initial characterization of the Hebron/Besor watershed, we collected information about streamflow, climate, soils, lithology, surface water quality, groundwater, population, demographics, land use, wastewater treatment and potential sources of pollution. To best characterize the watershed, both current and historic data were collected whenever available. Since

[5] Ibid.

[6] Carmona et al. 2013. Participatory modeling to support decision making in water management under uncertainty: Two comparative case studies in the Guadiana river basin, Spain. *Journal of Environmental Management*. 128: 400-412.

[7] Ibid.

[8] Ibid.

[9] Tal, A., et al., 2007. Final MERC Report project M23-019. Watershed Modeling: BioMonitoring and Economic Analysis to Determine Optimal Restoration Strategies for Transboundary Streams. Covering the period from September 2004 to December 2007. Unpublished. Arava Institute, WEDO. Submitted to the U.S. Agency for International Development: Bureau for Economic Growth, Agriculture and Trade (Middle Eastern Regional Cooperation).

Figure 1: Integrated watershed management approach.

the Hebron/Besor watershed is a transboundary system, one of the greatest challenges is the availability of and access to scientific information. Data may not exist, and when it does, it is often not readily available to cross border organizations. Another challenge is the lack of a centralized database to facilitate sharing of information, even among institutions operating in the same political jurisdiction. These problems, i.e. a lack of data and fragmented data sources, have been described by many researchers in the region.[10]

Compiling data into a centralized database is the next step. A centralized database is necessary to organize and manage data, integrate data from different sources, provide access to multiple users and adapt dynamically to an expanding database. Our model utilizes a geospatial information system (GIS), which has the unique capability to visualize and contextualize the information spatially. It allows users to integrate hydrologic and socioeconomic data based on shared spatial attributes and conceptualize interactions and patterns that emerge when the information is overlaid on a

[10] Comair et al., 2014. Hydrology of the Jordan River Basin: A GIS-Based System to Better Guide Water Resources Management and Decision Making. *Water Resource Management* 28:933-946.

map. GIS is particularly well-suited for watershed characterization, since the data layers lose context, meaning and impact when divorced from their spatial attributes.[11]

GIS helps visualize the intersection of hydrology, human activity and political borders. Figure 2 shows the watershed boundaries, as delineated based on the topography and streamflow.

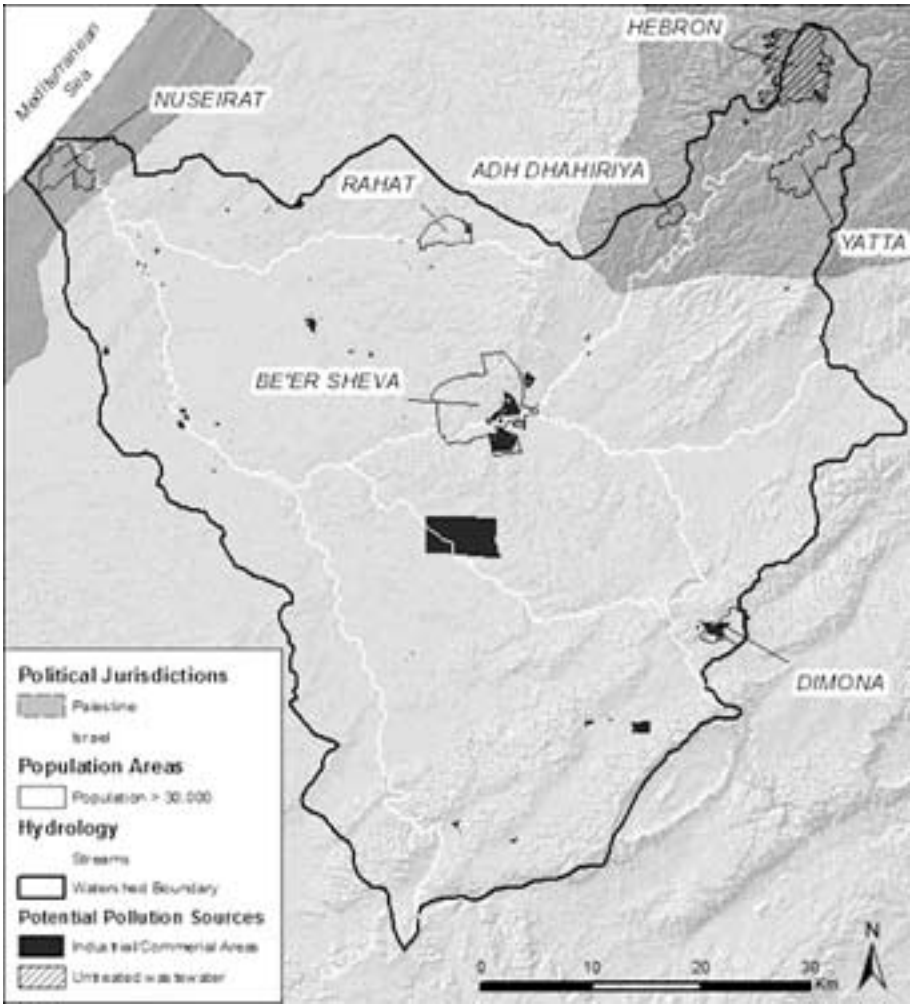

Figure 2: Map of Hebron/Besor watershed.

The headwaters of the watershed are located in areas of higher elevation in the northeast and southeast of the watershed. Streams originating in the headwaters ultimately converge and exit the basin into the Mediterranean Sea. Political jurisdictions subdivide the basin unnaturally; the northeastern

[11] The initial geodatabase for the Hebron/Besor watershed was built in ArcGIS 10.1.

headwaters lie within the West Bank, and all of the streamflow from the basin flows through Gaza before meeting the sea. The proximity of some known and potential sources of pollution adjacent to streams and population areas is also shown in Figure 2. Population areas with more than 30,000 people, such as Be'er Sheva, Hebron, Yatta, An Nuseirat, Rahat, Dimona, Al Bureij and Adh Dhahiriya, are outlined.[12] Untreated wastewater is discharged directly into the Hebron stream headwaters from Hebron and Qiryat Arba. Industrial areas are located in Be'er Sheva, Ramat Hovav (south of Be'er Sheva), Dimona and Hebron. GIS analysis shows the potential impact that upstream activities may have on downstream populations and helps evaluate where water resources are particularly vulnerable to pollution. Further analyses will help to clarify the nature and extent of pollution, and help determine which pollution sources should be further investigated. Once the natural system is fully characterized, GIS can also aid in modeling different management scenarios to inform decision-making. A spatial understanding is crucial because it illustrates that upstream activities cannot be evaluated or managed separately from the downstream, regardless of political borders. Spatial analysis helps better conceptualize the watershed as a whole, and therefore makes a strong case for cross-border management strategies at a watershed scale.

Stakeholder engagement is essential throughout the process, but especially in the initial stages of data collection, because a lack of trusting relationships can create barriers to data collection. During the data collection process for the Hebron/Besor watershed, CTWM came to understand that some of the parties who held data sources were unwilling to provide them to a cross border entity, there were no established protocols for data sharing, and that, in some cases, potential data providers were unknown to us. One benefit of stakeholder engagement was demonstrated at a recent meeting under the umbrella of the MTWC project, convened to share information about the Hebron/Besor watershed.[13] By presenting our preliminary data to the group, CTWM researchers were able to initiate conversations with Palestinian researchers who had information or contacts that could help complete the dataset. For example, one researcher might be able to provide details on pollution sources in the Hebron area, and another might be able to provide a professional contact in Gaza with access to local water quality data. We also connected with researchers who are already conducting

[12] Based on data from Israel Central Bureau of Statistics (2011), Palestinian Central Bureau of Statistics (2013), Israel Water Authority (2006-7) and United Nations Relief and Works Agency (2014).

[13] The meeting was co-sponsored by USAID, Arava Institute for Environmental Studies, Ben Gurion University, Water and Environmental Development Organization (WEDO) and the House of Water & Environment.

parallel studies in these locations, but with whom we had not yet established a framework for data sharing.

Stakeholder Engagement: Interest-Based Collaboration

While the relationships formed during meetings are necessary for expanding the watershed data collection and research, these relationships are themselves essential in building capacity toward cooperation of any kind. However, creating forums for stakeholder meetings is fraught with challenges in the context of an entrenched political conflict, from choosing a location and securing participants to developing and presenting the content of presentations and discussions. Here we describe the theory of change for stakeholder engagement used by CTWM; recognizing the need for a science-based approach for integrated watershed management, this section more specifically explains the role of stakeholder engagement in creating partnerships for collaboration.

With cooperation often resting in the hands of a political leadership that lacks the motivation or ability to grapple with such cross border issues, these conflicts cannot be solely the burden of governments. Rather, it should be expanded to civil society, nongovernmental stakeholders, academics and other informal players. However, in watersheds situated within conflict zones, this process is very complex. Fischhendler et al. (2011) describe some challenges of transboundary, governmental cooperation between Israel and Palestine over water management issues. They maintain that some degree of political and economic stability among all players is necessary to allow working relationships to be built. Furthermore, they explain that a cooperative process can only occur when governments are assured that cooperation will be situated within an adaptive framework and that agreements can be adjusted to deal with unexpected events. However, these conditions tend not to be satisfied among countries with conflictual relations.[14] Because this stability does not yet exist in the region, CTWM engages a wide variety of participants in cooperative initiatives. We believe this bottom-up strategy ensures a holistic, comprehensive and sustainable approach to collaboration.[15]

CTWM's theory of change for stakeholder engagement facilitates a process whereby parties collaborate on subjects of mutual interest. By establishing confidence in the meeting content, stakeholders can build

[14] Fischhendler, I., et al. 2011. The Politics of Unilateral Environmentalism: Cooperation and Conflict over Water Management along the Israeli-Palestinian Border. *Global Environmental Politics*. 11:1.

[15] Diamond, L. and Notter, J, 1996. Building Peace and Transforming Conflict: Multi-Track Diplomacy in Practice. *The Institute for Multi-Track Diplomacy*, OP 7.

relationships and trust, creating partnerships that, over time, lead to sustained cooperation (Figure 3). The Arava Institute has developed this process over 10 years of experience as a scientific, cross-border, nongovernmental organization.

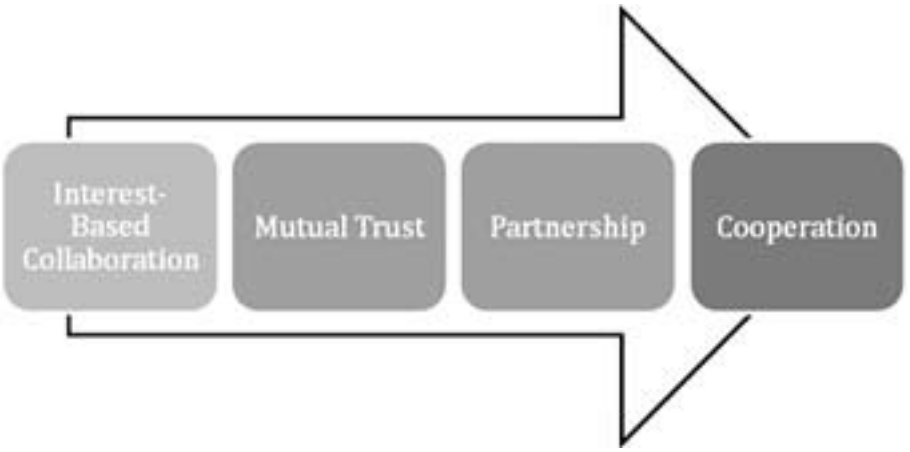

Figure 3: CTWM's theory of change for stakeholder engagement.

Science-based NGOs involved in cross border activities have the unique ability to create a safe platform where both sides of the border can meet; since they are not directly involved in politics and use science as a platform for collaboration, these organizations can avoid some of the more challenging barriers to cooperation.[16] Because watershed-wide stakeholder meetings must be cross-border to be productive, workshop success is contingent upon an NGO's ability to assure potential participants that their attendance will significantly benefit them and their society. As mentioned, CTWM aims to do this by constructing meeting agendas around an environmental challenge of mutual interest to all parties. Through addressing shared interests, stakeholders increase their confidence in the potential for positive outcomes from collaboration.[17] Subjects of mutual interest are more effective when they are linked to science rather than politics, a confidence-building strategy that CTWM has measured in its MTWC project. Confidence that is based in the recognition that all parties are working toward a shared goal, rather than one of self-interest, establishes trust, which is a prerequisite for the partnerships and long-term relationships required for integrated watershed management.[18]

[16] Aburdeineh, I., et al. 2010. The Role of Civil Society in Addressing Transboundary Water Issues in the Israeli-Palestinian Context. *Water Wisdom*, Ch 13.

[17] USAID Office of Conflict Management and Mitigation, 2011. People-to-People Peacebuilding: A Program Guide. *USAID/DCHA/CMM*.

[18] Notter, J. 1995. Trust and Conflict Transformation. *The Institute for Multi Track Diplomacy*, OP 5.

CTWM measures the success of a workshop by its ability to build trust and partnership among participants. At each workshop, participants fill out intake and outtake questionnaires to measure knowledge and perceptions; for example, whether there has been increased understanding of wastewater and water needs or a change in perception of national groups toward one another.

We will discuss two workshops that successfully illustrate CTWM's theory of change. The first of these workshops, held in April 2014, brought fifty students from Israel and Palestine to the Arava Institute for Environmental Studies for training in the theoretical and practical application of decentralized water and energy management solutions; in this case, biogas digesters and grey water recycling systems.[19] Students learned the scientific theory and engineering behind grey water systems and biogas digesters in preparation for building several systems in Bedouin communities in the West Bank. Based on questionnaire results, students from this workshop concluded that while centralized wastewater treatment is an important solution for urban centers, the majority of respondents believe that decentralized systems are among the most beneficial technologies to meet Palestinian wastewater needs.

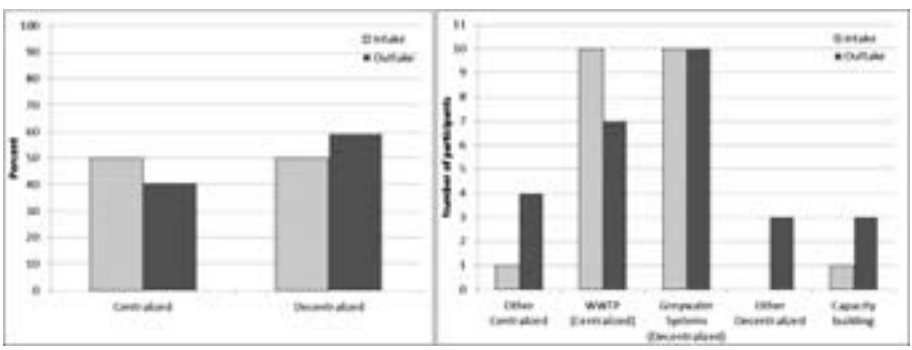

Figure 4: Survey results from student workshops based on fill-in responses to the question "What technologies do you think are the most beneficial to meet Palestinian wastewater needs?" The left graph breaks down responses into centralized (e.g. wastewater treatment plant, desalination plant, etc.) and decentralized (e.g. household greywater systems, small-scale solar, etc.). The right graph breaks down responses further, with the left side representing responses that included centralized solutions, and the right side representing decentralized solutions and "capacity building," i.e. public education campaigns.

Interestingly, the majority of respondents indicated that while this was their first cross-border workshop on resource management, the meeting

[19] This workshop was co-sponsored by USAID, the Peres Center for Peace, the Arava Institute for Environmental Studies and the Palestine Wildlife Society.

expanded their understanding of the role that the other party plays in water and energy management. Most of the students are continuing with the project as they move into the construction phase of building off-grid water and energy systems. This demonstrates the impact that interest-based stakeholder engagement workshops have on developing partnerships for cooperative watershed management.

A subsequent workshop, mentioned earlier, brought together scientists and decision-makers to discuss research surrounding the Hebron/Besor watershed. Following research presentations, participants engaged in a dialogue about the necessary steps for mitigating some pressing environmental challenges in the watershed. Questionnaire results showed that more participants strongly agreed that water should be managed regionally after completing the workshop.

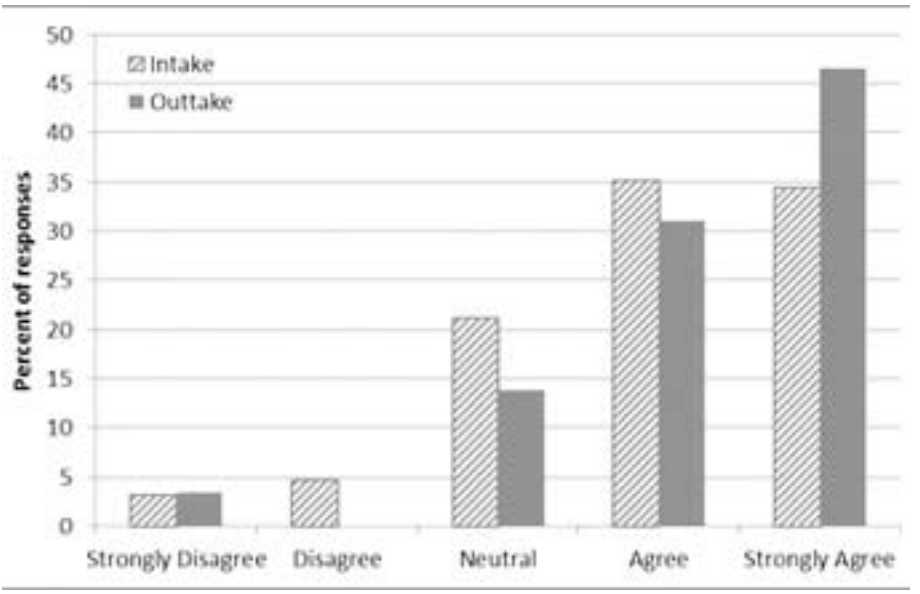

Figure 5: Responses from the workshop held on June 26, 2014 in Beit Jalla. This graph represents combined results from two questions aiming to elicit favorability of conducting water and wastewater management on a watershed scale. The two questions were: "How important are upstream activities to downstream water quality in the watershed?" and "How important is it that water management in your municipality/ town is linked to a regional watershed management strategy?" Responses are shown in percentage of total responses on a scale from strongly disagree to strongly agree.

Participants commented on the need for continued dialogue and cooperation, indicated interest in pursuing partnerships for further collaboration, and recognized the capabilities of the "other" national group in raising public awareness of the watershed's challenges. CTWM attributes

the success of this workshop to a science-based approach that helped to identify key challenges of mutual interest in the watershed based on a trusted common language — environmental monitoring and observation.

Conclusions

Integrated watershed management and stakeholder engagement both assume a long time horizon. These processes should be ongoing, gradual and driven by stakeholder needs and preferences. Scientific research is a necessary foundation for the development of policies that will effectively improve watershed health. Modeling and visualization of the watershed is not only crucial to a scientific understanding, but the process itself sets a precedent for successful cooperation. Importantly, stakeholders address concrete, manageable tasks; for example, stakeholders met to learn about wastewater technologies and to share research specific to pollution in the watershed. Working together to tackle these challenges incrementally can provide confidence in the process and motivation to continue collaboration. While this may be related to politics, stakeholders are not addressing politics head-on, but we believe through fostering these relationships, the stage is set for collaborations to impact policies beyond the scope of this work.